Firms in International Trade

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Abstract

Firms play a critical role in the global economy. In this chapter we survey the behavior of firms in the international economy, both in theory and in the data. We first summarize recent theoretical developments on the micro-foundations of firm behavior in an international context, focusing on how firms select into exporting, and how firms respond to international shocks. Next, we turn to a "real world", empirically focused view of exporting, beginning with the growth dynamics of firms expanding to global markets, and then the critical financing decisions made when engaging in international commerce. We conclude with directions for future research.

Introduction

The last twenty years has witnessed a substantial expansion in research studying firms in the global economy. In contrast with the classic literature, where the pattern and implications of international trade were driven primarily by country-specific differences in productivity or endowments or both, the literature on firms in trade studies how firms, and in particular self-selection of the most productive firms, shape the landscape of international trade and investment. These firms in international trade tend to be large, and are responsible for decisions that create linkages between countries and across major sectors of the world economy.

One need look no further that some of the most well-known businesses to understand the importance of firms in shaping world trade flows. For example, Boeing, the largest exporter in the US, exported $29 billion in 2009, or approximately 1.8% of *total* exports from the US.[1] This number is more impressive when we consider that there are approximately 1.28 million exporters in the US (BLS, 2011). Another firm, Fontera—a large dairy producer and New Zealand's largest company—is responsible for 20% of its home country's total merchandise exports.[2] There are many more such examples. In fact, Bernard, Jenson Redding and Schott (2007) document that while exporting firms in the US are a minority of manufacturing firms, not all exporters are the same and a very small share of exporting firms (11%) account for a very large share of exporting revenues (92%). Clearly, big firms play a large role in exports from the US and other developed economies in a wide range of industries.

The role of firms in shaping trade flows is not limited to developed countries. The World Bank *Exporter Dynamics Database* reports basic statistics on firm-level export flows from 70 exporting countries, almost all developing or least developed. Using this database, one can evaluate the size of the average exporter compared with the

[1] http://www.slate.com/articles/business/exports/2010/11/the_boeing_co.html
[2] http://www.nzdairycareers.co.nz/?page=Dairy_Industry&subpage=Dairy_Facts

median exporter. The statistics are striking, and show how country-level exports tend to be dominated by a few, very large firms. Precisely, for the median exporter-year observation in the sample, the ratio of average firm-level exporter revenue to median exporter revenue is 55.1. This ratio is greater than 1 even when we look at a much more disaggregated unit of observation.[3] Thus, for many developing countries, trade flows are primarily composed of trade from relatively few large firms.

These anecdotes and facts show that the largest exporters dominate trade flows, and, consequently, researchers have provided a large number of new theories to explain the presence of large firms, their evolution, and how they operate. In this chapter, we review the role of firms in international trade, from the economic theory that explains the links between trade costs and self-selection into exporting, to the real-world practice of exporting, including how firms evolve in the global economy and how firms finance their export operations. In the first section, we outline a basic framework to model exporting decisions of firms, and focus on how trade costs and trade policy affect these decisions. In the second section, we take an empirical view of how exporting evolves over time, and how this may influence future firm performance. In the third section, we focus on how firms finance their exporting operations, and how credit constraints can alter the pattern of trade. Finally, we conclude with ideas for future directions in the literature.

1 Modeling Firms in Trade

1.1 Framework

To study the role of firms in trade, it is important to emphasize the key components of the optimization problem of a firm reaching a new market within a general environment. To this end, we start from the optimization problem for consumers in

[3] When the unit of observation is exporter-importer-year, the median ratio is 5.8. Finally, at the exporter-importer-industry-year level, the ratio is 2.8.

the export market. In this market, each consumer earns utility from a general utility function,

(1) $$U = U(Q(q_1, \dots, q_m), q_1, \dots, q_m, x_0)$$

where the consumer enjoys consumption over *m+1* goods, q_j is the consumption of (potentially) differentiated good *j,* and x_0 is consumption of an outside good. Consumption of the *m* differentiated goods is aggregated into utility units through two basic components. In the first, $Q(q_1, \dots, q_m)$ maps consumption into an consumption index (which may simply be aggregate quantity) that is additively separable in its components, and the separate entries of $q_1, \dots, q_m$ are additively separable components of utility where there is no direct substitution. A key issue that we discuss below is whether exporting firms are big – with substantial market power – or small, having market power only in their own variety. Technically speaking, we will be choosing the part of the consumer's problem the firm takes as an "aggregate" term, beyond its control, as opposed to a measure over which it has control.

While the notation above may seem cumbersome at first, it nests a wide class of utility functions that yield a number of common demand functions used by researchers to study the behavior of firms. For example, the most common framework to model firms in trade (à la Krugman, 1980) utilizes a constant elasticity of substitution (CES) utility function that yields constant elasticity demand. In this case, *U* and *Q*, are defined as follows:

$$U = Q^{\frac{\sigma}{\sigma-1}}$$

$$Q = \sum_{j=1}^{m} q_j^{\frac{\sigma-1}{\sigma}}$$

Here, there is no outside good, and consumers only earn utility in the differentiated sector, with σ representing the elasticity of substitution across varieties. For the case of pure quadratic utility, as would be typical in Cournot competition, *U* and *Q* are defined according to:

$$U = x_0 + \theta Q - \eta Q^2$$

$$Q = \sum_{j=1}^{m} q_j$$

In this case, the outside good x_0 would typically be used to pin down the marginal utility of income to unity, yielding a pure linear demand curve. Further, θ and η are parameters that govern the substitution between the outside good and Q. Finally, for "continuum quadratic" preferences, which will be used extensively below, utility is defined according to:

$$U = x_0 + \theta Q - \eta Q^2 - \gamma \sum_{j=1}^{m} q_j^2$$

$$Q = \sum_{j=1}^{m} q_j$$

Again, in this case, x_0 would typically be used to pin down the marginal utility of income, and θ and η are defined as before. The term γ determines the substitution of individual varieties with the numeraire, and hence, governs the "love of variety" within this utility function.

For modeling firms in international trade, the question is whether firms are "big" or "small", which precisely, determines whether they account for their effects on "economic aggregates". Do firms have enough purchasing power to affect the wage? Do firms take into account the direct effect of their output choices on the incentives for other firms (à la Cournot)? Or do firms act as small, either taking price as given, or only having control over a "monopoly" market for their own variety?

Despite the analytical complications from doing so, the early literature on firms in trade focused on oligopoly as the main framework to model strategic decisions. Within the above framework, firms would internalize the effect of their production decisions on the aggregate index Q. For example, Brander and Krugman (1983) and Brander and Spencer (1985) each evaluate the effects of trade costs (the former) and subsidies (the latter) on the strategic behavior of firms in an oligopoly framework. Eaton and Grossman (1986) determine the optimal tariff in a conjectural variations model, focusing on the how the nature of competition

determines this optimal policy. While enlightening for policy discussions over tariffs and subsidies, the literature on strategic trade suffers from an analytical complexity that severely limits its ability to appropriately represent firms in international trade. That is, firm-heterogeneity in productivity, one of the hallmarks of recently empirical work in trade, is very difficult to model in an environment with large firms that have market power within and across varieties.[4] Indeed, this also makes difficult the analysis of self-selection into exporting by productivity, which is at the center of positive and normative questions at the intersection of trade policy and theory of the firm.

Starting with the seminal work of Krugman (1979, 1980), a significant majority of empirically-focused work on international trade stems from the assumption of monopolistic competition, which assumes that firms have market power in their own varieties but do not account for the effects of their decisions on economic aggregates (price index, wage, marginal utility of income, etc.). Within the framework described above, this assumes that the quantity index Q is held fixed when the firm is determining output, and that if not already pinned down by an outside good, the marginal utility of income is also held fixed. Thus, firms may have market power in their own variety, but take as given the aggregate quantity (or price) index when making these decisions. While this assumption may seem restrictive, making it allows researchers to then appeal to probability distributions to describe the mix of firms, and elegantly evaluate how policy and geography affect the mix of firms serving a given market. We now outline a basic framework of firms and trade that summarizes this literature, and the role of trade costs and trade policy in guiding the landscape of international commerce.

1.2 Exporting and Monopolistic Competition

[4] Recent research is allowing for a more general treatment of market power with firm heterogeneity by assuming that the most productive firms enter the market first. See Atkeson and Burstein (2008), Eaton, Kortum, and Sotelo (2015), and Gaubert and Itskhoki (2015).

In serving an export market, we assume that firms choose quantities to maximize profits. To reach the destination market, firms must first build their product at a cost c per unit, and may pay a host of costs related to trade and trade policy. Specifically, there are four costs of trade that may affect the decision to sell abroad. The first is the **melting iceberg** trade cost, $\tau > 1$, which is precisely the number of units of a good that a firm must produce for one unit to reach the destination market. There are a number of ways to interpret this trade cost. Explicitly, there is a possibility that goods are stolen or damaged en route, and thus to fill a customer's order there is an expectation that more goods are sent than is required. In reality, many firms do not send extra goods, but instead insure against this probability, and hence, τ may also be interpreted in this way. Another interpretation of the iceberg cost is in the compounded costs of financing that occur over time as a good is shipped from one location to the next, or the compounded risk from shipping (Schimdt-Eisenlohr (2013), see section three).

Exporting firms may also be subject to a **per-unit** or **specific** cost, s. This cost is also related to distance, and can be easily interpreted as the physical cost of moving the good, whether due to weight or weight over a distance.[5] Further, some trade policy measures are assessed per unit (as opposed to as a percentage of value). In recent work, using Norwegian firm-level data, Irarrazabal, Moxnes, and Opromolla (2014) estimate that specific trade costs are 14% the median price of traded goods.

There are also are **fixed costs of export**, F_x, which do not depend on output. These costs tend to be interpreted as organizational, logistical, or other administrative costs involved in shipping the good from the plant to the customer in another market. Often, these costs are referred to as "red tape" and many occur at the port of entry. Indeed, in a recent survey by the OECD-WTO (2015), countries were almost twice as likely to report trying to improve general border procedures, and

[5] For example, fuel costs are technically the cost of energy required to move a specific mass over a distance.

30% more likely to report trying to improve transport infrastructure in an effort to facilitate more trade than reducing explicit policy costs and fees.[6]

A final cost related to international trade is the **import tariff**, which is typically ad-valorem and assessed on the value of the good when it arrives at the destination. To model the tariff, it is typically assumed that if the consumer pays a price p, the firm receives a price p/t, where t is the tariff factor (one plus the ad valorem tariff). This particular valuation method is called "Cost of Insurance and Freight", or CIF, and it will form the basis for our treatment of trade costs in the model that follows.[7]

Having defined the costs of exporting, we now move to defining the objective function of the firm in serving a foreign market. Above, we defined products by j, and below, we assume that firms each produce one product. Thus, the profit function of an arbitrary firm i selling to an export market is written as:

(2) $$\Pi_i = \frac{1}{t}p(q_i)q_i - \tau c_i q_i - sq_i - F_x$$

In the profit function, we note that the only heterogeneity across firms are in the marginal cost of firm i, c_i, and in the firm's output choices (which are, of course, a function of c_i in equilibrium). This marginal cost is inversely proportional to firm-level productivity, and in extended models, can be a function of factor and input prices.[8] In the literature, it is common to assume that transport costs and fixed costs are homogenous across all firms, though in reality firms may face heterogeneous trade costs exogenously or endogenously (section three will discuss ways in which costs may be endogenous through trade finance).

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[6] See Figure 2.17 in https://www.wto.org/english/res_e/booksp_e/aid4trade15_e.pdf

[7] An alternate method, "Free On Board" or FOB, is used by a handful of countries, and levies the duty on the value of the good net of the cost of insurance and freight. Johnson (1966) discusses the way in which CIF valuation naturally discriminates against exporters from distant countries compared with FOB valuation.

[8] For this manuscript, we abstract from wage and other input prices. However, all results in this manuscript follow when assuming that costs are in labor units, and that the costs include a scalar for the wage.

Firms, as mentioned above, maximize profits by choosing quantities. Suppressing *i's* for the remainder of the manuscript – understanding that c defines a given firm producing a particular product – the maximization problem yields optimal pricing for the export market,

$$p(q) = \frac{\varepsilon(q)}{\varepsilon(q)-1}(\tau c + s)t \tag{3}$$

where $\varepsilon(q) = -\frac{dp}{dq}\frac{q}{p}$ is the elasticity of demand in absolute terms. Depending on the assumption over the utility function, this elasticity may be constant (CES, as in Krugman, 1980; and Melitz, 2003), variable and falling in output (Melitz and Ottaviano, 2008), or may have some other properties (see Mrázová and Neary, 2015, for a general treatment of the convexity of demand and selection into exporting).

Of note, the price derived in (**3**) is the consumer price, and this price can be broken up into three terms: the mark-up $\left(\frac{\varepsilon(q)}{\varepsilon(q)-1}\right)$, marginal costs $(\tau c + s)$, and the tariff adjustment factor, t. However, note that the tariff factor does not affect the price that the producer receives, $\frac{p(q)}{t}$, unless it affects the mark-up. This will have an important effect on the response of firms to a given set of international shocks, since the effect of the shocks will depend on the pricing conduct and market power of each firm, as embodied in the mark-up.

Implicitly, using the particular functional form of $p(q)$, equation (**3**) pins down the value of q as a function of marginal costs and tariffs. The firm then solves for the profits of serving the export market and decides whether or not to enter. We now move to this basic entry decision, focusing on the role of trade costs and trade policy in the decision to export.

1.3 Selection into Exporting

The first decision a firm must make is whether to enter an export market or remain domestic. As specified in (**2**), the firm balances variable profits against a fixed cost of exporting when making this decision.[9] Below, we describe this selection process using a variety of assumptions over the revenue function; we refer to this decision to enter the export market as the extensive margin of trade as explained in section two.

CES Demand

The canonical model of exporting with heterogeneous firms, as developed in Melitz (2003), uses a constant-elasticity demand function to model consumers. In this framework, the elasticity of demand is constant and equal to σ, and hence, using (**3**) consumer prices are equal to

(4) $$p(q) = \frac{\sigma}{\sigma-1}(\tau c + s)t$$

Plugging into the revenue function, we find that profits are equal to:

(5) $$\Pi = At^{-\sigma}(\tau c + s)^{1-\sigma} - F_x$$

where A is function of aggregate variables and parameters, and below, will be representative of a demand shifter in the export market. The firm chooses to enter the market in d if the profits from doing so are greater than zero. In this case, variable profits are always positive due to the CES assumption (discussed below), so the question of selection boils down to whether these variable profits are greater than the fixed cost of exporting, F_x. Intuitively, this occurs if production costs are sufficiently low:

(6) $$c < \frac{1}{\tau}\left(\frac{A}{F_x t^{\sigma}}\right)^{\frac{1}{\sigma-1}} - \frac{s}{\tau}$$

[9] A separate literature has developed that allows for variable profits in multiple markets to be linked through the cost function, thereby making the entry decision more complicated. See Ahn and McQuoid (2013); Spearot (2012); Blum, Claro, and Horstmann, (2013); McQuoid and Rubini (2014); Soderbery, (2014), and Spearot (2015). Mora (2016) allows for markets to be linked through a financial constraint.

Note that in (**6**), different from Melitz (2003), we have included ad-valorem tariffs as well as per-unit transport costs. Indeed, with the addition of per unit costs, it is clear that if per-unit costs are sufficiently high, there exists no positive range of production costs, *c*, such that trade occurs. That is, there are "trade zeros" through endogenous firm selection. Though different from the treatment of trade zeroes in Helpman, Melitz, and Rubinstein (2008), where trade zeros occur because of a bounded distribution of productivity (firms can only be so good), this result highlights how natural forces of geography and trade costs can limit trade not only by firms, but also trade between countries.

For clarity, we now simplify the model to that in the original Melitz (2003) framework, where there are no tariffs, *t*, and no per-unit transport costs, *s*. In this case, exporting occurs if:

(7) $$c < \frac{1}{\tau}\left(\frac{A}{F_x}\right)^{\frac{1}{\sigma-1}}$$

In (**7**), we find a number of intuitive relationships between trade costs and selection into exporting. Both the fixed costs of exporting, and the iceberg transport cost, when larger, reduce the range of marginal costs such that exporting occurs. That is, with higher trade costs, to successfully export a firm must be even more productive. Importantly, this equation also makes clear that destination market factors, such as the demand shifter A, affect the incentives to export and the role of trade costs. Indeed, a more distant market can support more exporting if the market size is large enough to compensate for the additional costs of trade. Empirically this is an important issue to consider since it suggests a necessary empirical strategy that requires destination market effects, potentially by industry.

Non-CES Demand

CES demand holds special properties that, while making analysis tractable, are empirically implausible. In particular, under the assumption of monopolistic competition, demand is always positive, regardless of the price, and demand

asymptotes to infinite values when prices are low enough. Ironically, baked into the CES framework – which usually requires that firms be small – is the possibility that a firm is extremely large as it gets very productive. To move away from the possibility of "super firms" within a model of monopolistic competition, researchers have explored the use of other utility functions that may be less tractable but better match the data in this and other dimensions. The two most commonly used non-CES preferences are Translog and Continuum Quadratic.[10]

For the following section, we focus on continuum quadratic, and in particular, an extended version of Melitz and Ottaviano (2008). Precisely, continuum quadratic preferences yield a (linear) inverse demand function, represented by $p(q) = A(Q) - bq$, where *A(Q)* is an aggregate term that is decreasing in quantity sold to consumers in that market by all firms. However, as motivated above, to keep firms small, we assume firms take A as given. With this linear demand function, and the assumption of small firms, the profit maximizing producer price from (**3**) is simplified as:

(8) $$\frac{p(q)}{t} = \frac{A+(\tau c+s)t}{2bt}$$

Here, we find a number of interesting differences between linear and CES demands in terms of the effects of trade costs and trade policy. Most importantly, we find that producer prices are not proportional to marginal costs, either firm-level production costs or the costs related to transportation. This results from the variable elasticity of demand under the assumption of linear demand, and in particular, that absolute elasticities fall with lower costs (higher output).

Plugging (8) into the revenue function, profits under linear demand with fixed exporting costs are written as:

(9) $$\Pi = \frac{(A-(\tau c+s)t)^2}{4bt} - F_x$$

[10] Feenstra (2014) outlines a firm heterogeneity model using a general form of homothetic preferences with variable elasticities. Bertoletti, Etro, Simonovska (2016) discuss the gains from trade in a utility function with indirect additivity. Rodriguez-Lopez (2011) develops a firm-heterogeneity model using a translog expenditure function.

where it is clear where linear demands become intractable with fixed exporting costs. While it is true that lower costs increase the probability of exporting, the functional form of this cutoff is far less tractable than with CES. Precisely, firms export if costs meet the following condition:

(10) $$c < \frac{1}{\tau t}\left(A - 2\sqrt{btF_x}\right) - \frac{s}{\tau}$$

Like in CES, if the per-unit costs of transportation s are too high, no firm will be of sufficient productivity to export. However, unlike CES, even when per-unit costs of transportation are zero, it is still possible that no firm will export. Specifically, setting s equal to zero in (**10**), we have:

(11) $$c < \frac{1}{\tau t}\left(A - 2\sqrt{btF_x}\right)$$

Intuitively, since monopolists never produce beyond the point of unit elasticity, revenues are bounded under linear demand. Thus, if the fixed costs of export are too high, no firm with a positive marginal cost can enter the export market.

Given these properties, the literature rarely uses fixed exporting costs with linear demands. Instead, the literature focuses on selection through the iceberg cost (Melitz and Ottaviano, 2008), or the tariff (Spearot, 2013), where the selection condition is simply $c < \frac{A}{\tau t}$. Additionally, selection in the linear model is also proportional to demand levels and trade costs, like in CES. So, while the linear model is slightly more restrictive in terms of the types of transport costs that are used, the model is similar in the use of ad-valorem trade costs, and ultimately facilitates an elegant analysis of trade when mark-ups may vary.

1.4 Firm-level trade

The role of trade costs does not end at the decision to export or not. In particular, there are a variety of variable trade costs that can affect the intensity at which firms trade; we refer to increases in average exports by firms as the intensive margin of

trade in section two. Next, we briefly examine these incentives within the CES and linear demand models.

CES Demand

In the CES model, firm-level trade revenues, conditional on trading, are easily derived as:

(12) $$v = \sigma A t^{-\sigma}(\tau c + s)^{1-\sigma}$$

To evaluate the role of market and trade costs shocks on this value, we log-differentiate (**12**) with respect to A, and all trade cost and trade policy parameters.

(13) $$\hat{v} = \hat{A} - \sigma\hat{t} - (\sigma - 1)\frac{\tau c}{(\tau c + s)}\hat{\tau} - (\sigma - 1)\frac{s}{(\tau c + s)}\hat{s}$$

Here, "hats" refer to percentage changes in the variable. Equation (**13**) makes clear that, under the assumption of CES demand, firm-level trade revenues change proportionally with demand shifters and tariffs, and proportionally to other changes in trade costs scaled by their cost share. Unfortunately, iceberg and per-unit trade costs are typically not measured separately (if at all), so determining the cost share of different types of trade costs would prove a difficult endeavor. However, as described above, one could argue that the former is related to insurance and value and the latter to weight, which would give a sense of their costs shares.

Typically, the literature uses the iceberg cost interchangeably as both a "distance" and "trade policy" parameter. Equation (**13**) makes clear that this interpretation is not correct for two reasons. First, even if there are no per-unit transport costs, the elasticity of firm-level trade to tariffs is larger than the elasticity to trade costs. This is because the tariff reduces revenues directly, and through the optimal choice of quantity.[11] For iceberg costs, the only effect on revenue is through the optimal choice of quantity. Second, with non-zero per-unit trade costs, it is clear that any

[11] To see this in (**12**), note that the effect through the optimal choice of quantity is simply through the revenue function $-(\sigma - 1)$. With the extra cost of tariffs for the firm, we reduce this exponent by one to $-\sigma$.

elasticity to distance is contaminated if the share of ad-valorem costs is not appropriately measured.

Non-CES Demand

The analysis of demand and trade shocks under the assumption of linear demand is more complicated. First, note that firm-level trade revenues are derived as:

(14) $$v = \frac{A^2 - t^2(\tau c + s)^2}{4bt}$$

Log differentiating (**14**) with respect to A, and all trade cost and trade policy parameters yields a reasonably complicated function related to parameters, trade cost shocks and the latter's respective share of marginal costs. However, as shown in Spearot (2013), this effect of trade shocks can be simplified as follows:

(15) $$\hat{v} = \frac{A^2}{2btv}\left(\hat{A} - \hat{t} - \frac{\tau c}{(\tau c + s)}\hat{\tau} - \frac{s}{(\tau c + s)}\hat{s}\right) + \hat{t}$$

Finally, noting that the *highest* value of revenues that a firm can earn with linear demands is $v_{max} = \frac{A^2}{4bt}$, (**15**) can be further simplified to:

(16) $$\hat{v} = 2\frac{v_{max}}{v}\left(\hat{A} - \hat{t} - \frac{\tau c}{(\tau c + s)}\hat{\tau} - \frac{s}{(\tau c + s)}\hat{s}\right) + \hat{t}$$

Equation (**16**) makes clear the effect of trade costs, trade policy, and demand shocks in an environment with demand that is more inelastic for higher quantities. Within the parentheses in equation (**16**), the effects of trade cost and policy shocks are similar to CES. However, all trade shocks must be weighted by firm-level export revenues, v, and it is predicted that a given set of shocks will be less pronounced in percentage terms on firm-level trade when the firm is larger (more productive).

1.5 Aggregating firm-level trade

A crucial component of firms in trade, and a major innovation in the analysis of world trade flows, is aggregating the decisions of firms into country-level trade flows. Starting with Helpman, Melitz and Yeaple (2004) and Chaney (2008), the

most common method of aggregating firms is to use the Pareto distribution to represent heterogeneity in the costs of production. The use of the Pareto distribution is empirically supported in a wide number of studies (Eaton, Kortum and Kramarz, 2011; Di Giovanni, Levchenko, Rancier, 2011), though recent research has extended analysis to include a log-normal productivity distribution (Head, Mayer, and Thoenig, 2014; Fernandes, Klenow, Meleshchuk, Pierola, and Rodríguez-Clare, 2015).

For this chapter, we move forward with the Pareto assumption due to its ease of use and reasonably strong support in the data. Precisely, we assume that in the exporting country, N firms, some of whom will fail immediately upon entry, have paid a fixed cost of entry and are potential exporters. After paying their entry costs, these N firms draw a random value of marginal costs, c, from the following distribution:

(17) $$G(c) = \Pr(C < c) = \left(\frac{c}{c_m}\right)^k$$

where, c_m is the maximum value of costs in this distribution, and k is the distribution's shape parameter. After firms draw their value of marginal costs, they make decisions regarding which markets to serve, and how much to sell to each market.

Assuming that c_m is nonbinding (above the cutoff values for exporting), aggregate exports assuming CES preferences is derived using the following,

(18) $$V = N \int_0^{c^*} \sigma A t^{-\sigma} (\tau c)^{1-\sigma} g(c) dc$$

where $c^* \equiv \frac{1}{\tau}\left(\frac{A}{F_x t^\sigma}\right)^{\frac{1}{\sigma-1}}$ is the cost cutoff for exporting in CES. Imposing the Pareto distribution from (**17**) and integrating, we have:

(19) $$V = N A^{\frac{k}{\sigma-1}} t^{-k\frac{\sigma}{\sigma-1}} \tau^{-k} K_{ces}$$

where K_{ces} is a constant of model parameters. In (**19**), we again see a distinct difference between the effects of tariffs and the effects of iceberg costs. First, the

effects of tariffs are more pronounced, and also a function of the shape parameter of exporters, and the destination market demand elasticity. In contrast, the elasticity of trade to iceberg costs is simply the shape parameter of the exporter.

For linear demand, the elasticity of demand is endogenous. However, using a similar procedure for linear demands, we can show that under the Pareto assumption the aggregate value of trade has a similar form:

(20) $$V = NA^{k+2}t^{-(k+1)}\tau^{-k}K_{lin}$$

where K_{lin} is a function of model parameters related to the linear case. In (**20**), we see how the firm-level trade aggregates to observed bilateral trade value under two common modeling assumptions. On its face, the relationship between trade costs and tariffs and aggregate trade value are observationally equivalent between the two models. That is, in each model, trade costs are raised to the shape parameter, and tariffs are raised to the power of a tariff elasticity. However, the interpretation of the tariff elasticity itself derives from different micro-foundations.[12]

As a final note on both the simplicity and limitations for the canonical firm heterogeneity models, we can solve for the average exporter trade flow, *conditional on success to that market.* This statistic is crucial since it represents the average firm size of the set of surviving firms, which is the set of firms that comprise reported trade data. Within the CES model of exporting, average export revenue, conditional on exporting, is written as:

(21) $$E[v|v > 0] = \frac{\sigma k}{k-(\sigma-1)}F_x$$

In (**21**), we have a stark relationship between key parameters of the model and the average size of an exporter in the export market. Indeed, within the CES context, the only two places that could yield within-market variation in average export size are the elasticity of substitution, and the fixed cost of exporting. Fernandes, Klenow,

[12] Indeed, in terms of the direct effect of tariffs on the value of trade, the tariff elasticity under CES, $k\frac{\sigma}{\sigma-1}$, could be more responsive to firm heterogeneinty, k, in highly differentiated goods ($1 < \sigma < 2$), when compared with the tariff elasticity under linear demand, $k + 1$.

Meleshchuk, Pierola, and Rodríguez-Clare (2015) use this stark result to motivate using a log-normal distribution of productivity to bring in endogenous effects of distance and market size to better match the model to data.

Within the linear model, average export revenue, conditional on exporting, is:

(22) $$E[v|v > 0] = \frac{A^2}{2bt(k+2)}$$

In contrast with the CES case in (**21**), we see in (**22**) a bit more destination market influence in terms of the average size of the exporter. However, after controlling for tariffs and destination market fixed effects, all remaining variation is captured by the exporter's shape parameter. Put differently, there is no bilateral variation in this statistic as is possible in the CES case.

1.6 Exporting and Investment

The canonical model of selection into exporting can be extended in a variety of directions, and much of the next two sections summarize theory and empirical work that extends the basic model to capture export dynamics and the role of finance in export decisions. However, before moving to these issues of trade "in practice", we summarize basic theory that links trade and firm-level investment decisions.

From a neoclassical perspective, the incentives to invest are larger when market-size increases. In the traditional firm-heterogeneity context, this has been studied through two primary mechanisms: quality and productivity investment. In Verhoogen (2008), firms invest in higher levels of quality, where reaching a higher quality level requires a fixed cost of investment. Similarly, Bustos (2011) examines productivity investment, where a higher productivity requires a fixed cost of investment. Interestingly, these two problems in their most basic form are isomorphic when using a CES revenue function, where higher productivity firms invest, whether for productivity or quality. Further, when trade costs fall, investment increases by adding less-productive firms that previously did not find

investment profitable. As derived generally in Mrázová and Neary (2015), this results from super-modularity between productivity (or quality) with the costs of reaching the foreign market.

Arkolakis (2010) presents another extension to the canonical firm-heterogeneity framework, in this case through investment in marketing expenditure. In his model, firms invest in marketing subject to a convex marketing cost, where marketing is more costly as you reach more consumers. Similar to Verhoogen (2008) and Bustos (2011), reduced costs of trade increase investment in marketing, which increases trade through a "new consumers" margin of trade. However, different from the canonical model, the elasticity to trade costs is higher for small firms as on the margin it is less costly for these firms to reach new consumers in response to a trade shock. Interestingly, this response to trade costs is qualitatively similar to the non-CES model as described in 1.4.

Another form of investment and self-selection is the investment in becoming an importer. Similar to investing in productivity, becoming an importer is optimal if it reduces costs or increases competition amongst suppliers. Thus, if firms can overcome the fixed cost of becoming an importer, firms make this investment. This process is modeled in Amiti, Itskhoki, and Konnings (2014), who develop a model to study exchange rate pass-through in an environment where firms can select into exporting and importing. Interestingly, in their model, self-selection into importing and exporting can mute the effects of exchange rate shocks. For example, an exchange rate appreciation in the country in question will have counteracting effects on the import and export sides of the business.

Finally, non-CES models have been used to a lesser degree to study the impact of investment on exporting and firm performance. Again, as characterized generally in Mrázová and Neary (2015), the typical selection patterns found in the CES-based literature – that high productivity firms engage in investment – do not necessarily follow to an environment with non-constant elasticities since it becomes possible

that the profit function is no longer supermodular in productivity and costs of trade. Two recent examples are Rodriguez-Lopez (2014) and Spearot (2015). In the former, the investment is in offshoring in a model based on a translog expenditure function. In the latter, firms invest in capital within a linear demand framework. In both cases, there is an inverse-U relationship between productivity and the probability of investment. The intuition is that under common, non-CES demand systems, revenues will be bounded or the absolute elasticity decreases in quantity such that on the margin investment is not profitable for large firms.

The discussion of firm heterogeneity and investment naturally follows to issues of exporter growth and dynamics. As exporting is a particularly costly endeavor, it is not a stretch to suggest that the decision to export is only the beginning of a complex set of decisions that requires excellent management to ensure success. To this end, we now discuss export dynamics, and in particular, how exporters grow or fail after reaching beyond their domestic borders.

2 - Firms and Export dynamics

As described in section one, at the heart of the literature on firms in international trade is selection between exporters and non-exporters. Indeed, much of this literature is influenced by seminal empirical studies finding key differences between exporters and non-exporters within the same industry. These differences are emphasized in Bernard, Jenson, Redding, and Schott (2007), where the authors identify two robust stylized facts about U.S. firms and exporting. First, exporting is rare, where only 4% of U.S. firms export, and within tradable sectors like manufacturing, only 18% of firms export. Second, exporting firms differ substantially from non-exporting firms, where exporters are larger, more productive, pay higher wages, and are more skill and capital intensive. For other studies identifying differences between non-exporters and exporters, and even differences within exporting firms, see Eaton, Kortum, and Kramarz (2011) using data from France; Mayer, and Ottaviano (2008) using data from various EU

countries; Casas, Díez, and González (2015) using data from Colombia; and Clerides, Lach, and Tybout (1998) using data from Colombia, Mexico, and Morocco. The key finding in all of these studies is that firm productivity is correlated with exporting; in all sectors, the most productive firms are more likely to export.[13]

2.1 Self-Selection vs. Learning-by-Exporting

The studies above make clear that exporters are different than non-exporters, yet many studies do not explain the mechanism behind this finding. For instance, did the difference in firm characteristics exist before exporting, perhaps due to intrinsic characteristics of the firm, or do they result from the exporting decision itself? In the first case, the difference in firm characteristics exists whether or not firms export and the difference shows up only because the more productive firms find it profitable to export; the literature refers to this explanation as "self-selection". This self-selection of exporters was central to the theoretical mechanisms presented in section one of this chapter. In the second case, there are none or fewer differences between firms before exporting occurs, and the difference shows up because the act of exporting helps exporters learn new, more efficient production techniques. Naturally, the literature refers to this explanation as "learning-by-exporting." The distinction between these two different mechanisms is important as identifying any causal relationship will lead to very different policy recommendations. For a summary of the findings in the papers discussed here, see Table 1.

One of the first studies to test for evidence of learning-by-exporting is Bernard and Jensen (1999).[14] The authors, using U.S. data, find that there are differences between exporters and non-exporters and the differences preceded the act of exporting:

[13] While most papers, using various measurements of firm productivity, find evidence that only the most productive firms export, the most common measurement of productivity, TFP, is calculated by estimating the production function. Ghandi, Navarro, and Rivers (2011) argue that estimating the production function suffers from bias, and find that correcting for the bias, in the case of Colombia and Chile, results in smaller productivity differences in most cases and no differences in others.

[14] For a thorough summary of the learning-by-exporting vs. self-selection empirical literature covering 33 countries see Wagner (2007).

firms that will export, compared with those that will not, already are larger in terms of employment and shipments, pay higher wages, and have higher productivity. Additionally, the differences in productivity and wage growth remain unchanged after exporting. To measure productivity, the authors calculate total factor productivity (TFP) using the residual of an estimated Cobb-Douglas production function. They then regress various performance measures on changes in export status with some controls for initial firm characteristics. While productivity does not grow, they do find evidence that firm survival increases with exporting. Clerides, Lach, and Tybout (1998) find similar results using a very different empirical strategy, where they evaluate for firms in Colombia, Mexico, and Morocco whether productivity trajectories improve after exporting. The authors develop a model with endogenous and exogenous explanations for exporting status and productivity; marginal cost is endogenous because the exporting decision may affect marginal cost, and demand shifters (foreign income, exchange rates, prices of other products) are exogenous to the firm. To test for evidence of learning-by-exporting the authors simultaneously estimate an autoregressive cost function and the choice to participate in exporting. They find that cost and productivity trajectories do not change after firms enter foreign markets and conclude that the positive association between exporting and productivity is purely driven by self-selection of more productive firms into exporting.[15]

While most studies find no evidence of learning-by-exporting, some find mixed evidence and others find evidence in special cases. Aw, Chung, and Roberts (2000), using a methodology similar to that of Bernard and Jensen (1999), find mixed evidence of learning-by-exporting: In Korea, TFP does not increase when firms export, but it does in Taiwan. The authors restrict the data to five industries that have high export participation rates and compare the productivity of similar plants that differ in export status. They conclude that the evidence supports neither the learning-by-exporting hypothesis nor the self-selection hypothesis. Casas, Díez, and

[15] For other papers that test for and don't find evidence of learning-by-exporting see Isgut (2001) using data from Colombia and Bernard and Jensen (2004) using U.S. data.

González (2015) find weak evidence of learning-by-exporting. Firms that become exporters ("Entrants") experience an increase in TFP; evidence of learning, however, disappears once the authors control for firm size. Other studies find stronger evidence of learning-by-exporting in transitional and in least developed economies. De Loecker (2007), using data from Slovenia and matched sampling techniques, finds that exporters become more productive after exporting and the effect is stronger for those firms exporting to high-income regions. He argues that firms in economies in transition, such as Slovenia, have the most to learn from exporting. Van Biesebroeck (2005), using data from several least developed countries in Africa and three different econometric methodologies, finds that the productivity advantage increases for firms after exporting. Van Biesebroeck argues that he finds evidence of learn-by-exporting, unlike others, because he looks at small domestic economies with poorly functioning credit markets.

Table 1: Summary of Learning-By-Exporting Literature

Paper	LBE?	Data
Bernard and Jensen (1999)	No	United States
Clerides, Lach, and Tybout (1998)	No	Colombia, Mexico, and Morrocco
Isgut (2001)	No	Colombia
Bernard and Jensen (2004)	No	United States
Aw, Chung, and Roberts (2000)	No	Korea
Aw, Chung, and Roberts (2000)	Yes	Taiwan
Casas, Díez, and González (2015)	Weak	Colombia
Van Biesebroeck (2005)	Yes	Burundi, Cameroon, Cote d'Ivoire, Ethiopia, Ghana, Kenya, Tanzania, Zambia, and Zimbabwe
De Loecker (2007)	Yes	Slovenia

2.2 Aggregate Productivity Improvements

Even if exporting does not lead to improvements in productivity at the firm level, it is nevertheless possible that exporting leads to productivity improvements at the sector level. Here, it is important to note the role of import competition in driving self-selection. That is, in isolation, lower tariffs in an export market reduce the average productivity of firms that can reach the market (since it is now easier to profitably sell in that market). However, during liberalization episodes that involve cutting tariffs globally, the surge in imports and higher wages due to increased export demand leads a market with lower domestic margins, and consequently, drives out the least productive firms. That is, trade liberalization increases average productivity through self-selection. Aw, Chung, and Roberts (2000), Pavcnik (2002), and Bernard and Jensen (2004) all find evidence that productivity indeed rises at the industry level after trade liberalization as the least productive firms exit the market and resources are reallocated to more productive firms. Clerides, Lach, and Tybout (1998) argue that firms may not exclusively benefit from exporting; that is, firms may learn-from-exporting, but domestic-only firms are not excluded from the cost reductions. Thus, they not only find, as mentioned above, no evidence of learning-by-exporting, but they also find that increases in export activity decrease average variable costs within a region.

2.3 The Intensive Margin vs. the Extensive Margin of Trade

While productivity differences may explain why few firms export and why few exporters dominate export value, it does not fully explain the export dynamics observed in the data. For example, is export growth lead by the intensive margin as exports per firm increase or is export growth lead by the extensive margin as the number of firms exporting increases? As shown in section one of this chapter, changes in trade costs most clearly impact the extensive margins of trade when using the Pareto distribution to represent firm heterogeneity. In the model, fixed export costs determine whether or not a firm exports, and trade variable costs

(tariffs/transportation costs) affect prices and, thus, sales abroad. However, since lower variable trade costs and lower fixed export costs draw in firms on the margin to export, the impact of these changes on exports per firm at the country level is ambiguous and export growth is driven exclusively by the new exporters.[16] This finding contrasts with previous models, where trade liberalization would only affect the intensive margin (that is, through the production choices of a fixed number of exporters).

Recent empirical work has identified several important facts about the intensive margin, in contrast with our theoretical model above. First, the already mentioned work by Fernandes, Klenow, Meleshchuk, Pierola, and Rodríguez-Clare (2015) use data from the World Bank covering 50 developing countries to evaluate trade growth on the intensive and extensive margin. They develop a Melitz-style model of exporting but with a log-normal distribution of productivity, and they, estimating the model using maximum likelihood, find that half of the variation in exports occurs along the intensive margin. Second, Lawless (2010) uses U.S. Census Bureau data and finds that distance—in contrast with other gravity variables such as language, internal geography, and import cost barriers—lowers the intensive margin. Finally, Das, Roberts, and Tybout (2007) using Colombian data find that in sectors with heterogeneous firms, where firms clustered far from the export entry margin, reductions in trade costs, enhanced export promotion, and moderate depreciation of the exporting country's exchange rate all result in increases of the intensive margin. While these empirical findings make the argument that the intensive margin should not be ignored, the evidence nonetheless implies that the extensive margin explains most of the export dynamics seen in the data. A key reason is the importance of new exporters on future export growth; Eaton, Eslava, Kugler and Tybout (2007) find, for example, that new exporters contribute little to overall revenues when entering the export market, but will account for almost half of total export growth within a decade. In addition to Eaton, Eslava, Kugler and

[16] See section one for a discussion of the determinants of average export flows.

Tybout (2007), Mayer and Ottaviano (2008) and Bernard, Jenson, Redding, and Schott (2007) also argue that the extensive margin is much more important. Mayer and Ottaviano (2008) find empirical evidence that suggests distance and other trade barriers correlated with distance reduce the number of exporters, but not average exports per firm. Bernard, Jenson, Redding, and Schott (2007) find evidence for the importance of the extensive margin using US data; they argue that economies of scale and sunk costs may lead firms to expand the number of products/destinations.

The relative importance of the extensive and intensive margin of trade is the focus of several theoretical models. Here, we focus on two: Helpman, Melitz, and Rubinstein (2008) and Das, Roberts, and Tybout (2007). Helpman, Melitz, and Rubinstein (2008) develop a model that decomposes trade flows into the intensive and extensive margin of trade, including the possibility of zero trade flows. They argue that standard gravity regressions only capture the intensive margin of trade and fail to take into account selection. Using a first stage probit to begin their two-stage estimation procedure (the first equation is selection into trade and the second a trade flow equation), they find that the probability of exporting behaves in a similar way as does export volume in standard gravity estimates and the extensive margin may explain higher trade volumes when barriers are lowered. In an alternative model for the margins of trade, Das, Roberts, and Tybout (2007) estimate their model using Bayesian Monte Carlo Markov chain estimators and firm-level data on three Colombian manufacturing industries: basic chemicals, leather products, and knitted fabrics. In contrast with their findings for the intensive margin, the extensive margin is likely to increase when many firms are clustered near their export entry threshold, and either expectations about future market conditions improve or firms experience favorable shifts in exchange rate. The effect is muted, as mentioned above, if firms are far from the entry threshold and most of the adjustments will take place through the intensive margin. Finally, the authors find that export promotion policies that subsidize exporter variable costs will have a larger impact on export sales than policies subsidizing fixed exporter costs. The

authors argue that the latter policy is likely to bring in firms on the export entry margin that will likely have relatively low export sales.

In section three we discuss how financial constraints also affect the intensive and extensive margin of trade. Since that requires a more extensive explanation and since financial constraints introduce additional issues, we save that discussion until the next section. Here, we end the firms and export dynamics discussion by summarizing the literature seeking to understand why firms start small when they first export and then grow, and the literature focusing on firms that fail at exporting.

2.4 Why Firms Start Small

There is another strand of the literature that focuses on firm dynamics but does not make a clear distinction between the number of exporters (the extensive margin) and export value per firm (the intensive margin). This literature focuses on the finding that exporters tend to start small, in terms of sales, when entering the export market and then, conditional on surviving, increase sales. These firms, as mentioned above, play an important role in future export growth. Studies seeking to reconcile these facts incorporate elements of both the extensive and intensive margins of trade. In general, these papers argue that firms learn about the success of their product only after exporting a small amount, and those firms finding that they are not competitive abroad exit the export market (the extensive margin) and successful exporters then subsequently increase export sales (intensive margin) and may even increase the number of products or destinations (the extensive margin). Albonoz, Calvo Pardo, Corcos, and Ornelas (2012) refer to this as "sequential exporting." In their model, export profitability is uncertain, but correlated over time and across destinations. Their model may explain why some new exporters give up shortly after entry, despite having paid high fixed export costs, and others increase sales and expand to other destinations. Their model also rationalizes why firms may start in smaller markets first, only expanding to larger markets after realizing export quality. They find evidence to support their mechanisms using data from

Argentina. Conditional on survival, export growth will be higher after the first year than in subsequent years (23 percentage points higher), new exporters are more likely to enter other markets than continuous exporters (4.8 percentage points), and new exporters are more likely to exit the export market than continuous exporters (29 percentage points).

There are several other models that explain some of these new exporter facts. In recent work, Eaton, Eslava, Jinkins, Krizan, and Tybout (2015) develop a search and learning model where success in exporting reveals information about demand for a product, and a successful exporter will subsequently search for more buyers. The study uses method of simulated moments to replicate key patterns in Colombian customs data and calculate the effect of trade costs and learning effects on exporter behavior. The authors quantify the role of several frictions, and find that for new exporters the cost for finding one client in the U.S. every two years is $1,405 and the cost rises to $51,471 to find one in one year. Once a client is found, the costs for finding another one drop to $106 and $3,898, respectively. On average, only one out of five potential foreign clients a firm meets will result in a successful partnership. In another example, Rauch and Watson (2003) focus more on importers in developed countries trying to identify firms in developing countries able to supply large orders. In their purely theoretical paper, firms in developed countries will start with small orders under uncertainty to learn information about the supplier's capabilities, and exports sales grow for successful partnerships.

Finally, Morales, Sheu, and Zahler (2014) use the idea of "extended gravity" to explain why firms often export to markets that are similar to markets already served. In this model, bilateral trade liberalization not only increases exports to the partner's market but also to other similar markets. The argument is that entry costs to other similar markets are lower after entering one of the markets, so that trade liberalization with one country can have an impact on other similar markets (even without trade liberalization in those other markets) through "extended gravity." The authors use matched firm-level data from Chile in the chemicals sector to measure

the importance of gravity and extended gravity, and find that firms are more likely to export to countries that border, or are in the same continent as, a previous trading partner. The authors estimate that for Chilean firms, (1) market entry costs are lowered by $22,930 when new markets border existing markets; (2) market entry costs for entering a similar country in South America is between $16,350 and $18,970; and (3) market entry costs outside of South America are between $94,860 and $101,990.

2.5 Export Survival

While most of the learning literature focuses on the dynamics of successful, new exporters, a strand of the literature focuses on the fact that most new exporters do not export beyond one year.[17] This "export survival" literature attempts to understand what makes an exporter successful, and what happens to the firm when they are not. This question is important since, as mentioned above, several papers find that the costs of entering export markets are quite high and export growth is lead by the extensive margin. Additionally, first-time exporters, which tend to export small amounts the first time they export, likely experience a negative profit relative to market entry costs, and this loss in turn may affect domestic performance. Mora (2016), for example, finds that financially constrained unsuccessful exporters are more likely to go out of business and experience lower domestic revenue and revenue growth when compared with successful exporters and firms that never tried exporting. The firm-level literature finds that exporting to closer markets improves export survival (Esteve-Pérez, Mánez-Castillejo, Rochina-Barrachina, and Sanchis-Llopis, 2007) and export success increases with the number of exporters, suggesting within sector externalities (Cadot, Iacovone, Pierola, and Rauch, 2013 and Stirbat, Record, and Nghardsaysone, 2013).

[17] Here we focus on firm-level studies but there are studies that look at survival of country level export product lines and destinations.

As just mentioned, financial constraints are one of the determinants of an exporter's success and, therefore, play a significant role in shaping the overall international trade flows. In the next section we look precisely at how financial factors affect the exporters' performance and how exporters manage to finance their operations.

3 - International Trade and Finance

Traditionally, the international economics literature has focused on the role of physical capital in determining the patterns of trade. In contrast, the role of financial capital has been mostly overlooked. Still, the workhorse trade models, including those mentioned in section one (Melitz 2003, Bernard et al 2003), focused on the decisions made by individual firms to participate in international markets, and provided the setting to incorporate financial elements into the firm's decision-making analysis. Why is this analysis relevant? There are a number reasons why firms engaged in international trade deserve to be analyzed through a different lens from the typical (domestic) corporate finance considerations. Firms in international trade face situations where the time between the shipment of the product and its payment is significantly longer that for firms operating in the domestic market, creating special working capital needs.[18] Additionally, in the case of a contract breach—either the importing firm not paying for the delivered goods or the exporter not sending the goods according to the specifications agreed upon—there is an increase in risk due to the potential litigation in foreign jurisdiction.

The literature can be (broadly) broken into two parts. First, there are studies evaluating the characteristics that determine a firm's export outcome at the country, sectoral, and firm level. That is, this branch of the literature studies the features of a country's financial system, or a sector's external funding requirements, or even firm-specific characteristics that shape the observed patterns of trade. Second,

[18] Foley and Manova (2015) report that international shipping and delivery typically takes 60 days longer than domestic transactions. This paper also provides an excellent survey on the recent literature intersecting corporate finance and international trade and investment.

another branch of the literature focuses directly on the financing of specific trade flows, the so-called trade finance and trade credit.[19] This literature looks at the determinants of how *a given trade flow* is, in one-way or another, financed. Moreover, both approaches pay special attention to the effect financial crises have on international trade. We describe these different analyses next.

3.1 Financial Considerations Shaping International Trade

There are several ways by which finance can affect the resulting patterns of trade. For instance, the overall development of the financial system, a source of financial capital, establishes cross-country differences enabling firms from certain countries to have an advantage. Similarly, since some sectors have stronger needs for external funding, countries with more developed financial systems facilitate access to capital and, thus, enhances the ability to enter external markets for certain sectors. Further, a firm's financial health also affects access to both capital and international markets. The literature studies the interaction between finance and trade at all of these different levels. We describe the main findings below and summarize the main factors considered by the literature in Table 2.

One group of papers studies the link between the development level of a country's financial system, the different sectoral external financial needs, and the resulting group of firms that enter international markets.[20] Beck (2002) considers a model with two sectors, a homogeneous good and a differentiated good (with economies of

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[19] Typically, the term international trade finance refers to the set of contracts by which exporter and importer agree on the specific terms and conditions regulating their transaction. Still, sometimes the term trade finance is reserved for the financing of a transaction via the intermediation of a bank, while trade credit refers to the financing of one firm by the other. While it lies beyond the scope of this article to provide a detailed description, there is an abundant literature on trade credit including Petersen and Rajan (1997) and Burkart and Ellingsen (2004), Love, Preve, and Sarria-Allende (2007), Klapper, Laeven, and Rajan (2012), to mention just a few.

[20] A country's level of financial development is usually proxied by variables such as credit to the private sector as a share of GDP, the value of the capital (equity) markets as a share of GDP, or the ratio of the financial system liabilities to GDP. Further, specifying that a sector's financial vulnerability is usually measured by external funding needs and tangible assets, following Rajan and Zingales (1998) and Claessens and Laeven (2003), respectively.

scale). The model also includes a loan market with both asymmetric information and search costs. Critically, firms located in a more financially developed economy face lower search costs, implying greater capital access. Thus, the model predicts that these financially developed economies have a comparative advantage in the differentiated-good industry. Beck (2003) uses data for 56 countries and 36 industries and finds evidence that more financially developed countries export relatively more in financially dependent industries. Manova (2008) provides additional evidence, supporting these results. Using data for 91 countries and the 1980-1997 period, she finds that opening equity markets to foreign capital increases exports, especially in sectors with higher external financing needs.

Manova (2013) also studies how financial frictions affect aggregate trade flows but incorporates elements of the current workhorse (Melitz) trade model. The paper specifically presents a multi-country, multi-sector model, with heterogeneous firms in terms of productivity, heterogeneous sectors in terms of external financing needs and collateralizable assets, and heterogeneous countries in terms of the probability of contract enforcement.[21] In this setup, depending on the firm's need of external funding, credit constraints can increase the exporter's productivity cutoff or even reduce exports below their first best. She then applies the model to a large dataset of 107 countries and 27 sectors spanning from 1985 to 1995, and finds that around 20-25% of the total effect of credit constraints on trade is due to decreased output, one third of the remaining (pure trade) effect is due to decreased entry into the export market, and the remaining two thirds are due to decreased export sales. Further, countries that are relatively more financially developed have less acute credit constraints—therefore, they export more in sectors with higher external financing needs, export to more countries, and export more products.

[21] In most models, there is a clear (often one-to-one) correspondence between a firm's productivity and export performance with its ability to obtain external capital. This link becomes imperfect in Chaney (forthcoming) where firms draw productivity levels and liquidity levels. Since export costs are financed through domestic sales and the liquidity endowment, some productive firms may not export if they drew a low liquidity level while some low productive firms may export if they receive a high liquidity draw.

Another group of papers focuses on how firm-level financial considerations affect a firm's involvement in the export market. Greenaway et al (2007) examine whether a firm's financial health affects its export market participation, where financial health is measured as either a firm's liquidity (the ratio of current assets minus current liabilities over total assets) or leverage (the ratio of short-term debt to current assets). The paper uses data on UK manufacturing firms for 1992-2003 and finds that exporters present better financial health than non-exporters.[22] However, these differences are essentially driven by continuous exporters. New exporters actually present poorer financial health, possibly due to the sunk costs incurred to start exporting. Further, in a similar fashion to the discussion on self-election vs. learning-by-doing of section two, the paper also finds no evidence that firms with better ex-ante financial health are more likely to start exporting, and strong evidence that participation in export markets improves firms' ex-post financial health.[23] The authors thus conclude that financial health can be seen as an outcome rather than a determinant of export entry.

Minetti and Zhu (2011) also study the link between a firm's financial condition and its exports. But instead of relying on financial statements, they obtain a (binary) measure of the firm's credit rationing directly from its responses to a survey of Italian manufacturing firms. The data on this survey combined with Italian banking regulation allows the authors to follow an instrumental variables approach to tackle potential endogeneity issues. The paper finds that credit rationing affects both the extensive and intensive margins: the probability of exporting is 39% lower for credit rationed firms and rationing reduces exports by more than 38%. Further,

[22] Several other papers also find that exporters present better financial health than nonexporters. For example, Muûls (2015) finds that among Belgian firms, credit ratings are correlated with exporter (and importer) status and exported (and imported) values. Berman and Héricourt (2010) use firm-level data from 9 emerging economies and also find that financial health correlates with export status, but it does not increase the probability of remaining an exporter nor the size of exports. Moreover, the paper also finds that productivity only matters for the exporting decision if the firm has sufficient external financing.

[23] This is in contrast to Bellone et al (2010) who, using data on French firms, find that firms enjoying better financial health are more likely to become exporters.

while credit rationing affects domestic sales, this effect is significantly smaller than that of foreign sales. Finally, the negative effect on exports is particularly important in sectors with high external financial dependence and firms that export mostly in high-tech sectors.

Finally, Manova and Yu (2016) show how credit constraints affect a firm's export mode, using firm-level data of Chinese manufacturers for 2000-2006. Central to their analysis, there are three types of export modes in China: ordinary trade, import-and-assembly processing trade (where the processing firm sources and pays for imported inputs), and pure-assembly processing trade (where the processing firm receives foreign inputs for free). While profitability increases from pure assembly to processing with imports to ordinary trade, more profitable trade regimes require more working capital. The paper finds that financially healthier firms conduct more ordinary trade relative to processing trade and more import-and-assembly relative to pure assembly, and that financial health improvements are followed by reallocations towards more profitable modes. The impact of firm and sector financial health and vulnerability is bigger in Chinese provinces with weaker financial systems. Further, the paper also finds that the role of firm financial health as a determinant of the export mode choice is independent from that of firm size, age, productivity, ownership structure, production technology, and tariffs on imported inputs; and its effect is economically large relative to that of firm productivity.

3.2 International Trade Finance

Since shipping goods internationally takes significant time, exporters and importers must agree not only on the price and quantity of a transaction but also on who will finance the lag between production and delivery. Indeed, the firm that finances the transaction will bear the risk. These considerations translate into, essentially, three alternative contractual setups: an open account system where the exporter provides the financing (and bears the risk) by shipping the goods and waiting for the

importer to receive them and only then gets paid; a cash-in-advance system where the importer provides the financing (and bears the risk) by paying to the exporter upfront; and a letter-of-credit system where the parties are financed by their respective banks.[24] According to a report by the IMF (2009), the open account system is the most commonly used, and comprises 42% of transactions, while the bank financing and the cash in advance systems amount to 36% and 22%, respectively. There are a handful of recent papers that study how exporter and importer choose a specific type of contract to execute their transaction.

Schmidt-Eisenlohr (2013) presents a model where exporter and importer play a one-shot game in order to select the transaction's payment choice. The model's solution indicates that the party from the country with the lower financing costs and weaker contract enforcement should finance the transaction. Thus, the model predicts that trade is affected by the financial and legal conditions in both countries. The model also implies that trade finance costs are proportional to the value of the exported goods, similar to the iceberg cost mentioned in section one. When both parties are located in countries with weak contractual enforcement, bank financing is optimal since it resolves the commitment issues on both sides. Several of the model's predictions are validated using a dataset the covers 150 countries between 1980 and 2004. In particular, gravity equations show that two countries trade less with each other if their financing costs are higher and this effect is larger the greater the distance (proxy for time to ship) between both countries. The regressions also indicate that importer financing matters as much as exporter financing for international trade.

[24] Banking finance actually includes other products such as documentary collections, pre-export finance, and supply chain finance. A report from the BIS (2014) describes these alternative methods. The same report estimates that trade finance directly supports about one-third of global trade, around 6.5-8 trillion dollars per year, with letters of credit covering about one-sixth of total trade. Figure 1 presents a schematic representation of the workings of a letter of credit system, taken from Ahn (2015).

Antràs and Foley (2015) present another model on the financing conditions under which international trade takes place. The paper uses detailed data on a US-based food exporter to identify three stylized facts: (i) most trade is financed by either the exporter or importer (so bank financing is seldom used), (ii) exports to countries with weak contractual enforcement are more likely to be financed through cash-in-advance, but (iii) these kinds of transactions become less likely as the exporter has repeated interactions with a given importer. The authors motivate their trade finance model by appealing to cross-country differences in contractual enforcement. The static version of the model predicts that open accounts or cash-in-advance are used (over letters of credit) as long as the banks from the importer's country can pursue claims against importers more proficiently than exporters. Additionally, the theory also predicts that the effect of the contractual environment on the financing choice is stronger the further away the importer is from the exporter. The dynamic version of the model considers that a fraction of importers are not trustworthy and that, when hit by a liquidity shock, do not honor their contracts. In this setup, the exporter learns about the importer's type and, through repeated interactions, offers post-shipment financing terms. When taking these predictions to the data, multinomial logit regressions indicate that cash-in-advance and letters of credit are most frequently used with customers located in countries with relatively weak contractual enforcement measures. The effect of weak enforcement is strengthened when interacted with distance, implying that the effect of any contractual enforcement weakness is reduced for importers in close proximity to the exporter. Further, the inclusion of importer fixed effects shows that as the relationship develops, it becomes more likely the firms will move to have open account terms. This last result has important implications for policy since it implies that developing a trading relationship can become a source of capital for firms located in countries with weak contractual environments.

Other papers focus directly on trade finance provided by banks. For instance, Ahn (2011) develops a model to explain the usage of letters of credit. In the model, firms require capital from banks to finance operations. Banks cannot observe the firms'

type but can invest in acquiring information about the transaction to be financed. Critically, repayment depends not only on the bank's customer but also in the counterparty. That is, an exporter's bank needs to acquire information about the importer being financed and an importer's bank needs to acquire information about the exporter. Further, since international trade is costlier than domestic trade, the volume of international transactions will be smaller than domestic transactions, making banks, in turn, less willing to invest in getting information for cross-borders transactions. This makes international transactions loans riskier than domestic ones. Moreover, in the case of a financial crisis, banks become relatively more uncertain about international financing loans precisely due to their relatively smaller amount of information, increasing the exporter/importer financing costs relative to domestic transactions—resulting in international transactions falling more sharply than domestic ones.

Niepmann and Schmidt-Eisenlohr (2014) provide empirical evidence on the role of letters of credit for exporting. The paper uses data on US banks' trade finance claims by destination country at the quarterly level for a 15-year period. These claims are mostly letters of credit in support of US exports and account roughly 20% of total exports. With these data they estimate time-varying trade finance supply shocks; since importers cannot change banks easily, a change in the supply of letters of credit will end up affecting trade. The paper's baseline result is that a one standard deviation negative shock to the country-level supply of trade finance leads to an average 1.5 percentage points decrease in exports growth. This finding results from employing a methodology that identifies the causal effect of access to trade finance.[25] Therefore, the paper identifies a new (risk) channel by which financial factors affect trade, separate from the working capital channel. Moreover, given the degree of high concentration in the business, a shock to a sole large bank can affect US aggregate exports growth and, since banks specialize in certain markets, a shock

[25] The identifying assumption to provide a causal link between letters of credit supply shocks and export growth is that there are no time-varying unobserved country specific factors correlated with both export growth and supply shocks. The authors argue that this condition holds in the data.

to a given bank will have heterogeneous effects across destination countries. Further, shocks to the supply of letters of credit are stronger in the case of smaller and poorer destination countries with fewer active US banks and in the moments of financial distress.[26]

3.3 International Trade during Financial Crises

The literature on trade finance has also been focused on the dynamics of international trade during financial crises. This has been particularly important in light of the Great Trade Collapse (GTC) that took place during the 2008-2009 global financial crisis when the fall in international trade far exceeded that of economic output. Broadly put, papers that study the GTC can be grouped into two categories. A first group explains the GTC essentially as the result of demand shocks and compositional effects. Another group of papers emphasizes instead the role of financial factors, such as reduced access to capital. The general consensus is that the demand and compositional issues played a primary role, while the trade finance considerations had a secondary but still sizeable effect.[27] For example, Bems et al (2012) survey the literature on the causes of the GTC in the 2008-2009 global recession and argue that the collapse in aggregate expenditure was the main driver of the GTC.[28] Specifically, during the recession there were large declines in spending on final goods (as opposed to services), and, in particular, on durable goods. Therefore, since the declines in expenditure were largest in the most traded sectors, these changes were transmitted forcefully through the border. The paper also points out that financial shocks played a secondary role in explaining the decline in trade while trade policies (protectionism) played no significant role.

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[26] Del Prete and Federico (2014) use matched bank-firm data for the case of Italy during 2007-2010. They are able to distinguish between types of loans and find that trade is affected by changes in the supply of general loans but not as much by constraints in trade finance loans.

[27] Moreover, there is evidence that trade credit was relatively more resilient than bank credit during the GTC (Malouche 2009, Coulibaly et al 2013).

[28] Additionally, Bems et al (2010) find that almost 60% of the decline in trade in 55 countries can be explained by the actual changes in demand in those countries.

Also among the group of papers emphasizing the demand and compositional effects, Eaton et al (2016) develop a multi-country, multi-sector, Ricardian general equilibrium model to interpret international trade data. They apply their setup to data on 21 countries to extract the time series from the different shocks. The paper finds that a shift in final spending away from manufactured durable goods, mostly due to a decline in investment efficiency, accounts for most of the observed decline in the trade to GDP ratio.[29]

Behrens et al (2013) look at the effects on the 2008-2009 crisis on the performance of Belgian firms. They find that most of the collapse in trade took place at the intensive margin. Moreover, they also find that the main driver was the fall in the demand for tradables while finance and involvement in global value chains played a minor role. In fact, they claim that had foreign growth rates during the crisis been the same as those before the crisis, Belgian exports would have fallen by about 54% less than what they actually fell, something quantitatively close to that reported by Eaton et al. (2011).

Brincogne et al (2012) study the effects of the GTC on French firms. They match export data with firm-level credit constraints and find that most of the trade collapse is explained by demand and product characteristics. For large firms, the trade collapse was mostly at the intensive margin while, for small exporters, the effects were mostly at the extensive margin. The additional financial constraints imposed by the financial crisis exacerbated the difficulties for financially constrained firms (especially in sectors with high external financial needs), but this effect was quantitatively quite small in the aggregate since only a small number of firms were affected and their number did not increase significantly during the crisis.

Among the second group of papers, exploring the role of financial factors, the analysis often relies on studying the relationships between exporting firms and the

[29] Levchenko et al (2010) also argue that most of the trade drop can be explained by demand and compositional effects while Alessandria (2010) study the role of inventory adjustments.

banks funding them. For instance, Amiti and Weinstein (2011) use matched bank-firm data from Japan for the 1987-1999 and 2008-2009 periods. In the paper, each firm is matched with one bank that clears most of its transactions. They find that if a bank has a negative shock to its market-to-book value, the firm's exports fall relatively more than its domestic sales. Moreover, this reaction is stronger during periods of crisis.

Similarly, Paravisini et al (2015) study the effects of credit supply shocks on the exports of Peruvian firms during the 2008-2009 crisis. They use matched bank-firm data and exploit the fact that there was a capital outflow from Peru during the crisis, which affected banks differently depending on their pre-crisis reliance on foreign funding. The paper finds that, within the same product and destination, the credit shocks affected the intensive margin of exports, while they have no effect on the entry and exit firms.[30]

Ahn, Amiti, and Weinstein (2011) also highlight the role of financial factors in the GTC. The paper shows that export prices increased relative to domestic manufacturing prices across several developed countries—this can indicate that exports face a larger supply shock than domestic sales. The authors also find that import and export prices of goods shipped by sea, which are more likely to be affected by trade finance, rose disproportionately more than those shipped by air or land.

Chor and Manova (2012) use detailed monthly data on US imports to study how the tightening of credit conditions affected trade during the recent financial crisis. They show the importance of this channel by exploiting the variations in the cost of capital (proxied by interbank interest rates) across countries and over time. The paper finds that exports from countries with higher interbank rates were systematically lower during the crisis. Further, the paper also shows that this effect

[30] Ahn (2015) also finds that bank liquidity shocks during the 2008-2009 crisis affects the imports to Colombia using letters of credit.

was particularly acute for the exports from sectors with higher external financing needs, less collateralizable assets, and limited trade credit.

Finally, Berman et al (2013) document how the fall in trade caused by a financial crisis is amplified by the time-to-ship goods between the exporter and the importer. In their model, a financial crisis increases the probability of default of the importer and this effect is amplified by the time-to-ship. Specifically, the time-to-ship increases the elasticity of exported volume to the expected cost of default. In this way, for a higher probability of default, exporters react by increasing exporting prices and reducing exporting volumes and values—and this reaction is stronger the longer the time-to-ship. This precise pattern is found when looking at data on French exporters for 1995-2005 and also when analyzing an aggregate panel of 185 exporting countries and 69 importing countries from 1950 to 2009.

4 - Conclusion and Directions for Future Research

Our understanding of firms in international trade has expanded greatly over the last twenty years. However, there is much to be done to further our understanding of how firms, and in particularly big firms, operate in the global economy. Below, we address a few areas that could be the next frontier of research in this area.

Although many of our anecdotes and empirical analyses have clearly pointed to the critical role of big firms in international trade, the ability of the theory to capture the full extent observed in the empirics is still limited. For example, a large share of empirical models are motivated under the assumption of monopolistic competition, where as, in reality, models of empirical industrial organization are likely more appropriate. Indeed, the entry of firms into new markets is not smooth – a small tariff change will likely not affect firm behavior much, though a large trade agreement or devaluation could have large effects on market entry. Atkeson and Burstein (2008), Eaton, Kortum, and Sotelo (2015), and Gaubert and Itskhoki

(2015) pioneered early work studying the impact of shocks on discrete entry decisions, where potentially large firms enter based on an ordering of productivity. Continuing this line of research to study all aspects of firm decisions in response to international shocks will greatly enhance our understanding of firms in international commerce.

We also studied various elements of firm dynamics, many of which have not been settled by empirical work, and future work would benefit from an introduction of elements recently identified in international trade. For example, the debate between learning-by-exporting and self-selection would benefit from studying the increasingly important role of imported intermediates in international trade. Vertical specialization may allow firms to produce items more efficiently and may allow firms to produce items that would not have been possible without an expansion of global supply chains. Likewise, since vertical specialization may increase the activity of firms in the global economy, it may affect the extensive margin as more firms export, and may affect the intensive margin as firms are able to export more. Thus, understanding the firm decision to import intermediates and to specialize in various parts of the global supply chain may provide insight in the discussion of learning-by-exporting vs self-selection and of the extensive vs intensive margin of trade. Another potential direction of future research in understanding firm dynamics is the role of uncertainty in limiting exports. For example, Handley and Limao (2015) find that firm behavior changes significantly in the presence of policy uncertainty and firms may choose to delay entering a foreign market until conditions improve. Likewise, firms in developing countries that tend to have higher export failure rates may also delay entering markets. In fact, it may be that uncertainty limits the activity of firms abroad more so than other trade costs, and policymakers should spend resources not just in order to increase market access, but also to lower uncertainty (for example, helping potential exporters find partners abroad) or lowering fixed costs associated with exporting.

Finally, there are several directions in which the literature on trade and finance can move forward. First, the trade finance theory could greatly improve by incorporating new layers of heterogeneity. Specifically, allowing for the optimal financing choice to depend on, for example, the product being traded could shed new light into the analysis—as the characteristics of the goods (as shown in another chapter of this Handbook) affect the mode in which they are transported, it is reasonable to think that it also affects the payment choices, thus potentially creating a link between trade finance and mode of transportation. Moreover, the literature could also incorporate elements usually considered in open economy macro like exchange rate variations and expectations, which surely play a significant role in determining if a given transaction will be profitable. Further, the choice of the currency in which the transaction will take place also appears as extremely relevant and still there is very little known about it. [31] Last but not least, probably the most important need of this literature is the procurement of datasets on the different payment choices to identify new stylized facts and to test future theories.

[31] Casas, Díez, Gopinath, and Gourinchas (2016) show the importance of currency invoicing in the reaction of trade flows to exchange rate variations.

Table 2: Main Financial Variables Affecting Trade

Country-level variables	– Credit to the private sector to GDP ratio – Value of listed shares to GDP ratio – Financial sector liquid liabilities to GDP ratio – Indices of contract enforcement and expropriation risk
Sector-level variables	– External financing dependence – Asset tangibility ratio – Inventories to sales ratio – R&D to sales ratio
Firm-level variables	– Leverage ratio – Liquidity ratio – Credit rationing

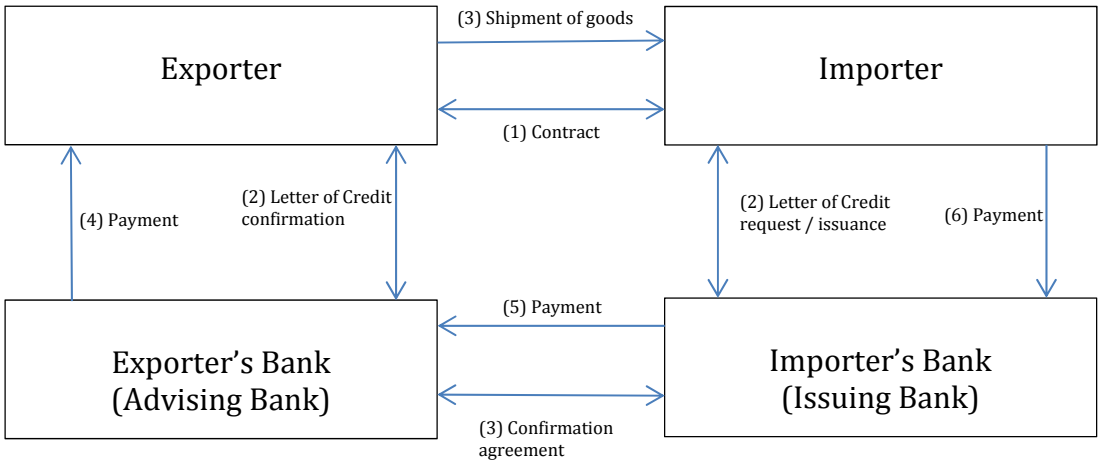

Figure 1: Letter of Credit System (Ahn, 2015)

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