Credit Constraints, Technology Choice and Exports - A Firm Level Study for Latin American Countries

By

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Abstract

This paper introduces technology choice and credit access constraints in Melitz (2003) model under a dynamic setting to explain the factors that limit the prospects of a firm from availing trade liberalization benefits. Two such constraints which are specifically relevant in a developing country context are firm's access to credit and frontier level technology. The theoretical model confirms that firms face varying levels of credit constraints depending on their initial productivity and small firms are more constrained compared to large firms. Thus credit constrained firms operating below the production frontier may never be able to cross the minimum productivity threshold required to enter and sustain in a foreign market. The empirical evidence of the model is derived by analyzing the firm level data for five Latin American countries. The empirical findings indicate that firms are constrained both in technology adoption and the extensive margin of trade The study is significant as it focuses on firm level constraints which impact a country's participation in international trade by analyzing both theoretically and empirically the impact of credit constraints on the extensive and intensive margins of trade. An important policy implication of this study, for increasing exports, could be the diversion of public resources from subsidizing production to extending credits to prospective exporters which will ultimately result in directing resources towards more productive sectors of the economy.

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Introduction

The use of firm level data in recent research on trade theory has opened up new areas in international economics. The variation in productivity across firms and their decision to produce either for domestic or foreign markets is the focus of the new trade theory. Studies on inter-firm data and industry level exports identify some unique features. According to Bernard *et.al.* (2007), in the year 2000, only 4% of the 5.5 million firms operating in the U.S were exporting enterprises and the top 10% of these exporting firms accounted for 96% of the U.S.' total exports by value. Also studies such as by Clerides *et.al*. (1998) show that exporters have a higher productivity than non-exporters.

However, neither classic or new trade theories could completely provide an explanation of the fact that exporting firms comprise of only a very few highly productive manufacturers. In light of the fact that firms of varying levels of productivity do exist, Melitz (2003) constructed a model in which only a few highly productive firms are engaged in export. The underlying idea in Melitz (2003) is that trade liberalization diverts factors of production towards the most productive firms in the market, that is the exporters who on the basis of their high productivity are able to make sufficient profits to cover the fixed costs required for foreign market operations.

The dynamic industry-trade model by Melitz (2003) with heterogeneous firms under monopolistic competition assumes identical fixed costs in the production function. In this model firms use the same production technology but are heterogeneous in terms of their productivity levels supported through an exogenous distribution. The variation in productivity levels across firms arises only from the differences in the marginal costs and this determines the firm's production decision; either to produce for domestic market only or to produce also for the

foreign market or to exit the industry. Besides, Melitz' model assumes no credit constraints as firms can freely make investment decisions of their choice.

The above two assumptions in the Melitz model regarding identical firm technology and zero credit constraints are not supported by the realities on the ground in developing countries. As such, trade liberalization per se may not result in diversion of resources towards the most productive enterprises. Even before the recent trade theories, neoclassical and endogenous growth theories assume that access to the latest technology automatically follows from openness to trade and foreign investment, and access is equivalent to effective use. However, empirical studies show that in practice the acquisition, diffusion and improvement of world production frontier level technologies requires conscious decisions by the firms.

In this context access to financial credit and technological growth are topics of interest. Access to financial credit is significant for firms especially in developing countries where equity markets are underdeveloped. The information asymmetries and contract enforcement problems make external credit an imperfect substitute for firm's retained earnings and invalidate the separation between financing and investment choices implied by the Modigliani-Miller (1958) theorem. Firms with limited or no access to credit therefore cannot undertake potentially profitable projects without incurring the extra cost of capital. Thus acquiring new technology by firms is also adversely affected due to the fact that firms cannot make an unconstrained investment decision.

There is widespread agreement on the importance of technological progress for economic growth. Technological change increases the productivity of land, labor and capital, reducing costs of production and improving the quality of outputs. The ability to be internationally competitive also depends on having up-to-date technology. Although most developing countries

have undertaken fast and deep trade liberalization since the early 1990s, technological progress has become vital for their competitiveness and economic viability. It is a considered opinion that promotion of technological change will most effectively contribute to reaping the benefits of globalization if it forms part of a broader strategy which is aimed at developing productive capacities (UNCTAD,2007).

Developing strategies to adopt latest and more efficient technologies requires an enterprise to make significant investment decisions. Nevertheless, deciding to make the initial and ongoing investments is contingent on the organization's perception that the future benefits will outweigh the costs involved.

The solution to firm's profit maximization problem subject to technology choices based on credit constraints is used to arrive at the optimal investment decision in a dynamic two period setting. A firm's production technology choice in a particular industry can affect its decision to enter the foreign market or to increase the volume of its export goods that is the extent of extensive and intensive margins of trade respectively. The research methodology of this paper is to introduce technology choice and credit constraints simultaneously into the Melitz (2003) model in a dynamic setting. The Melitz (2003) model identifies two categories of fixed costs borne by exporting firms. First is the market entry cost which determines firm's productivity, and for this study I take this component as the production technology cost. The second fixed cost is accrued for establishing a foreign market network and obtaining information. This model takes into account both these fixed costs to identify the investment decision of the firm.

This paper follows the Schmidt (2010) setup of introducing technology choice in the firm's demand and profit functions. So firms can opt between low, intermediate and high levels of technology. This decision is constrained on the availability of a firm's own retained earnings

and/or availability of external credit. The presence of credit constraints limit a firm's technology choice and its opportunities relating to intensive (trade deepening) or extensive (trade expansion) margins of trade.

The research done in this study is significant at two levels. First, at the firm level, arriving at the optimal investment decision is critical for a profit maximizing firm. A firm having already invested in a specific technology knows its productivity and profits and using this model can calculate the optimal investments to be made to upgrade its technology of production. Second, at the policy level, marginal firms can be identified which if supplied with requisite credit can cross the productivity threshold and enter foreign markets. The basic challenge for this approach is on account of dynamic setting of the model as the firm's investment decision and expected profits relate to different time periods.

The findings of the theoretical model are tested through an empirical estimation process. The data used for this are from the World Bank's Enterprise Survey database which is relevant regarding the variables in the model. I use panel data for 1501 firms from Latin America (Argentina, Brazil, Columbia, Chile, Mexico and Venezuela). The econometric results suggest that credit availability is significant for the decision to export, but is not significant in determining the volume of the exports. Another result indicates that a firm's decision to invest in capital goods such as plant , machinery and equipment depends on its access to credit. Finally total factor productivity (TFP) is dependent on firm's credit access ease.

The setup of the paper is as follows. Following the literature review, the theoretical model is explained. followed by empirical analysis of the hypotheses based on theoretical part of the paper. I use panel data from the Enterprise Survey of the World Bank for the empirical section. The last section presents the results and some concluding thoughts.

Literature Review

Do all firms trade? No. Based on this oft asked question whether all firms trade and the response based on trade data evidence, the Melitz (2003) model provides an extension of Krugman (1980) that incorporates firm level productivity differences. In Melitz model, the demand side is a CES utility function meant to incorporate the differentiated consumption from among the substitutable varieties of a product. The supply side of the economy is characterized by monopolistic competition and firm productivity is random. Firms face a constant marginal cost and a fixed overhead production cost in terms of a single input (labor) which is treated as the numeraire. Prior to entry, firms face productivity uncertainty. A firm has to pay a fixed cost of entry and only then can it obtain its productivity draw from a known distribution. After observing its productivity the firm decides whether to produce or exit the market.

The monopolistic competition model presented in Melitz (2003) does not incorporate a firm's choice of appropriate technology as it assumes the existence of a single production technology common to all firms. Nevertheless, the Melitz model provides an innovative element to allow for the firm heterogeneity through the idiosyncratic productivity of every firm, supported through an exogenous productivity distribution. It is this concept of heterogeneity in the idiosyncratic productivity borrowed from Melitz (2003) that is the fundamental element in subsequent modeling for the choice between alternative production technologies

Several theoretical extensions have been introduced into the pioneering work of Melitz (2003). Notable in this context are those by Bustos (2005) and Schmidt (2010). The technology extensions introduced by Bustos (2005) and Schmidt (2010) share the Melitz (2003) result, that opening up of the economy reallocates resources towards firms with higher idiosyncratic productivity, forcing those with low productivity levels to exit. Bustos (2005) introduced

technology choice in a trade model with heterogeneous firms. In her setup, firms with higher productivity earn higher revenues and are the only ones to find it feasible to pay higher fixed costs relating to production and exports. The model is used to study the impact of regional free trade agreements on firm's productivity through technology upgrading financed by increased revenues. The Bustos (2005) paper differs from earlier work, such as that of Bernard *et.al.* (2007) who consider productivity as residual in the production function.

Schmidt (2010) incorporates this concept into a model of monopolistic competition with firms that are heterogeneous in their idiosyncratic productivities by developing an extension of the Melitz model. In her model, she departs from Melitz's assumption of a single, common to all firms, production technology and allows firms to choose between three alternative technologies. The most basic technology (L) is analogous to the firm's own technological frontier. The other two technologies go beyond the firm's own technological frontier. Firms deciding to upgrade technology may aim at technology from the countries within the world technological frontier (technology M), or from the world leaders in R&D (technology H). The choice between the three alternative technologies, through its impact on productivity, affects the firm's exporting behavior: the higher the firm's technological status, the more aggressive the market strategy it is likely to undergo. The technology choice model by Schmidt (2010) is then used to study the role of human capital in identifying the barriers to technology adoption by the technology lagging economies.

The related strand of literature in the context of credit constraints and firm's progression in domestic or foreign markets as detailed in Melitz' model is the one that points towards the adverse impact of financial frictions on growth. From the several available studies, I refer to

Rajan and Zingales (1998) who shows that industrial sectors dependent on external finance grow faster in financially developed countries.

The literature on the link between credit constraints and trade has been steadily growing. Manova (2008) shows that there is a negative effect of credit constraints on the intensive margin of trade at the industry/country level. Thus firms belonging to sectors that depend on outside financing and having less collateral are the most affected. Later, Manova (2010) paper shows that credit constraints have a negative impact on both the intensive and extensive margins of trade and thereby explain zero bilateral exports. Analysis of French firm level data by Mayneris (2010) shows that financial constraints have a negative impact on firm's probability to become an exporter but do not affect the quantities exported by the firm.

The liquidity constraints added by Chaney (2005) are linked with productivity heterogeneity as less productive firms, due to these constraints, are unable to enter export markets. Besides these findings, there is a considerable literature which provides evidence of liquidity constraints, establishing correlation between a firm's financial condition and its investment decisions. Some notable works in this regard are Stein and Froot (1998) and Holmstrom and Tirole (1997). In terms of trade, some theoretical work such as Becker and Greenberg (2005) shows that financial development becomes a source of comparative advantage in the presence of credit constraints. The work of Chaney (2005) and Manova (2008) differs as the latter also models sectoral-variation in external finance dependence to distinguish between extensive and intensive margin of trade. In both these works, credit constraints in firms export related decision making have been studied in a static setting. Credit constraints faced by firms are mainly either due to the non-availability or incompleteness of financial markets.

Model

Consider two symmetric countries, home *h* and foreign *f*. The symmetry is assumed to ensure that wages being the numeraire are the same in both countries, that is the marginal cost incurred by the firms in the same industry is same. I study the production technology and investment decisions of firms in country *h*, conditioned on a firm's decision to produce either for home market only, or both the home and foreign markets (exports) or to increase the volume of its exports. Following the Schmidt (2010) extension to the Melitz (2003) model, I introduce a technology choice among three alternatives, *L* (primitive), *M* (intermediate), and *H* (latest). The second extension is made according to Manova (2008) through the introduction of credit constraints on a firm's decision to innovate as I do away with the assumption that there exist perfect financial markets to finance the technology upgrade and foreign market costs of exporters.

The research methodology for this study involves developing a theoretical model indicating inter-temporal firm choices. Firms make their investment decision in time t_0 based on their production decision in time t_1.In the model, consumer preferences are based on the Dixit-Stiglitz (1977) model with a constant elasticity of substitution (CES) utility function for the heterogeneous good. Similar to Melitz (2003), I use one factor of production, *i.e.*, labor. To incorporate different technology choices I use Schmidt's (2010) three tier model where the top level has the highest initial fixed cost but the lowest marginal cost of production. Based on a firm's initial technology type, associated productivity, fixed and marginal costs of production, I work out the profits in each period. The choice of technology is exercised by the firm in the time t_0. The retained earnings and the available external credit determine the firm's investment decision and hence its profits in time t_1. The model calculates the investment decision made by

firm and hence pins down the credit requirements in that regard. Firm's productivity and therefore its feasibility to produce either for the domestic market only or both domestic and foreign markets is thus dependent on the underlying technology of production.

Taking the technology part first, consider two time periods, t_0 and t_1. The firm's productivity φ_t^T is indexed over time *t* to indicate the time period and the superscript *T* refers to the technology of production. A firm in time t_0 draws an initial productivity φ_0^T from a distribution $g(\varphi_0^T)$ with support $[0, \infty]$. The firm then makes its technology innovation decision in the same period based on its production decision for time t_1. Of the possible situations in period 0, my concern for this study is limited to the following two cases:

a) a firm with technology *L* finds its productivity is just sufficient to survive in the domestic market and it decides to enhance its productivity by investing in technological innovation, and hence trading. This relates to the extensive margin of trade.

b) a firm's technology is *M* and its productivity is such that it can undertake some export activity which can be further enhanced, both in terms of quantities and destinations, by switching to technology *H*. This relates to the intensive margin of trade.

I assume that a firm can commit its pre-innovation profits and the balance of investment is financed through external credits. The cost of technology upgrade is incurred in time t_0 and productivity enhancement is achieved in time t_1.

Model Setup

The basic framework in terms of demand, production and firm investment decision is as follows.

Demand

As in Dixit-Stiglitz (1977) the demand side is represented by a representative consumer with CES preferences. The good q is produced over a continuum with total available varieties N, indexed over ω, and I have the following utility function:

$$U = \left[\int_0^N q(\omega)^\rho d\omega\right]^{\frac{1}{\rho}} \quad 1)$$

The varieties of good q are substitutes but they are not perfect substitutes, implying $0< \rho< 1$ and the elasticity of substitution σ between any two goods is given by $\sigma = 1/(\rho - 1)>1$.

Technology and Production

The firms are heterogeneous as in Melitz (2003) and they produce substitutable varieties of good q and the market is monopolistically competitive. I use the Schmidt (2010) setup to determine firm's profitability for the home or foreign market. The choice between the three technology types allows study of the impact of technology choice on the extensive and intensive margin of trades and specifically, the intermediate technology choice is incorporated to explain the intensive margin of trade. The available empirical evidence regarding the impact of financial constraints on the intensive margin of trade is mixed.

The firm technology options $T=L$, M and H have increasing fixed costs and decreasing marginal costs across these choices . A firm starting with technology L in time t_0 may decide to acquire technology M or H. As M or H has a higher fixed cost so the firm faces an investment decision then and will benefit from a low marginal cost of production in time t_1. The same analogy stands for a switch from technology M to technology H. Under monopolistic competition each firm faces a residual demand curve and thus charges a markup above the marginal cost of production. I assume that wages remain the same for all technology types and

are normalized to one. Even otherwise with low technology a firm will employ low paid less skilled labor who have low productivity causing a higher marginal cost of production.

As in Bustos (2005), firms with technology *T* produce with constant marginal cost $(1/\varphi^T)$ and multiples of fixed cost *f*. The fixed cost multiple is η_T such that for the three technology options $\eta_H > \eta_M > \eta_L = 1$. The total cost (TC) under each technology irrespective of time period is as follows:

$$TC_T = \eta_T f + \frac{q}{\varphi^T} \quad 2)$$

Firm Entry and Exit Decision

In order to enter an industry a firm has to incur a technology-specific sunk cost first. The firm knows its productivity level only thereafter. As in the Melitz (2003) model, until its productivity is drawn the firm is not aware whether it will remain in the market or will be forced to exit. The fixed cost component for acquiring technology *H* is the highest and lowest for technology *L*. As firms do not know their productivity unless they incur the fixed cost of entering the market, a rational firm initially acquires the technology with the lowest fixed cost so that it incurs minimum losses in case it is forced to exit. As per the study of Aw et al. (2007), the firm's productivity is positively related to its technology except that the gains in productivity with more expensive technologies are diminishing in nature. In every period there is a probability δ that the firm is hit by a bad shock and is forced to exit. I assume that with technology option the productivity level $\hat{\varphi}^L$ crosses the threshold level, defined as the zero cutoff productivity level by Melitz (2003), and which is required to make non-negative profits in the home market. For the three technology types the corresponding firm productivity follows the increasing order $\varphi^H > \varphi^M > \varphi^L$ and $\tilde{\varphi}^T$ represents the mean productivity of the group of firms using technology *T*.

Equilibrium of the Model (Closed and Open Economy

Firms' profits and productivity associated with technologies *L* and *M* are depicted in the figure 1 below. The intercepts give the fixed costs associated with each technology and the fixed costs of exporting $f_{x.}$ Technology *L* (the most primitive one) has a fixed cost of f and Zero-Cutoff Productivity $\hat{\varphi}^L$so any firm with productivity below this is forced to exit. For the marginal firm the productivity cutoff condition is $\pi_h(\hat{\varphi}_0^L) = 0.$ The technology *L* is the same as the one assumed in Melitz (2003) model. For technology *L* the mean productivity is $\tilde{\varphi}^L$.

In the case of technology *M*, if the firm produces for the home market alone the fixed cost is $\eta_1 f$ and if it produces for the foreign market the total fixed cost is $\eta_1 f + f_x$ as shown in the figure 1. $\hat{\varphi}^M$ is the zero cutoff productivity level for technology *M*. For the marginal firm switching from optimal productivity $\tilde{\varphi}^L$ under technology *L*, the following condition holds:

$$\pi_h\left(\varphi^{M(h)}\right) = \pi_h(\tilde{\varphi}^L) \tag{3}$$

Insert Figure1. around here

At this level of productivity when the firm switches from technology *L* to technology *M* and produces for the home country, it can profitably cover the higher fixed cost $\eta_1 f$ and earn higher profits. If the firm decides to produce for the foreign market also it will meet the condition:

$$\pi_{h+f}\left(\varphi^{M(h+f)}\right) = \pi_h(\tilde{\varphi}^L) \tag{4}$$

That is a firm whose productivity with technology *L* permits it to opt for an investment decision $I(\phi_0^L)$ will acquire technology *M*. Similar equilibrium conditions exist for switching from technology *M* to technology *H* .The above equations can be solved to find the equilibrium productivity levels for each case.

Technology Choice and Investment Decision by Firm with technology L

I assume that a firm with technology *L* has productivity that is just feasible for producing for *h*, i.e., the home market only. In t_0 the firm maximizes the following profit function:

$$\pi_h\left(\varphi_0^L\right) = p_h\left(\varphi_0^L\right) q_h\left(\varphi_0^L\right) - \frac{q_h\left(\varphi_0^L\right)}{\varphi_0^L} - f \qquad 5)$$

Where p_h is the price of product in home market set as a markup over marginal cost. Also q_h is the quantity produced for the home market. Now let the firm decide to upgrade either to technology *M* or *H,* which implies an investment decision to be financed by external credit $C(.)$ measured in terms of the numeraire. In t_1 firm has to pay back $R(.)\,C(.)$ where$R(.) \geq 1$ being the principal plus interest rate charged by the creditor. Both the quantity of the credit available and the rate of interest charged by the financial institutions are a function of several factors including productivity contingent on technology in t_0, availability of collateral, profits earned in the last fiscal year, a firm's affiliation with a domestic or foreign business group and firm's profits in the next period t_1 to be earned from the investment. Due to information asymmetries the opportunity cost of external financing is greater than internal financing which is normalized to one. As the firm by adopting improved technology will produce for both the home and foreign markets so it earns positive profits from both in t_1. However, the firm has to pay the additional trade costs which includes the fixed cost $f_x > 0$, so assuming variable iceberg costs (Samuelson), $\tau > 1$ units of product need to be shipped for 1 unit to arrive at destination and the cost of credit. The firm therefore maximizes the following:

$$\Pi(\varphi_1^{M/H}) = \pi'_f(\varphi_1^{M/H}) + \pi'_h(\varphi_1^{M/H}) - R(.)C(.) \qquad 6)$$

where $\acute{\pi}_f(\varphi_1^{M/H})$ and $\acute{\pi}_h(\varphi_1^{M/H})$ are the present values of firm profits from foreign and home markets with technology *M* or H in t_1 ($\acute{\pi} = (\frac{1}{\delta})\pi$ that is discounted future profit). To find the optimal investment, I apply the first order condition on the above equation with respect to $C(.)$

$$\delta\{\Pi(\varphi_1^{\frac{M}{H}})\}/\delta\{C(.)\} = \delta\acute{\pi}_f(\varphi_1^{M/H})/\delta\{C(.)\}+\delta\acute{\pi}_h(\varphi_1^{M/H})/\delta\{C(.)\} - \delta[R(.)\,C(.)]\,/\delta\{C(.)\} = 0 \quad 7)$$

Simply, this asserts that in t_0 the optimal investment should be such that an equilibrium in t_1 firm's marginal rate of return from the investment is equal to the marginal cost of the credit.

If the firm produces for both the home and foreign markets then the profits are given as:

$$\pi_h(\varphi_1^M) + \pi_f(\varphi_1^M) = \frac{(1+\tau^{1-\sigma})}{\rho}\, E(P\rho)^{\sigma-1}(\varphi_1^M)^{\sigma-1} - \eta_M f - f_x \quad 8)$$

According to Mayneris (2011) the relationship between the two period productivities and the investment is given by:

$$\varphi_1^{M/H} = [C(\varphi_0^L,.)]^{\alpha}\varphi_0^L \quad 9)$$

where $0 < \propto < 1$. The investment done here is to acquire a higher level of technology *M* or *H* to enhance the firm's productivity. Using the relation above, the optimal investment for this case is given as follows (for derivations please see Appendix):

$$C(\varphi_0^L,.) = (E\alpha)^{\frac{1}{\beta}}\left[\frac{\sigma-1}{\sigma}\right]^{\frac{\sigma}{\beta}}[P\varphi_0^L]^{\frac{\sigma-1}{\beta}}\left[\frac{\delta}{1+\tau^{1-\sigma}}\right]^{\frac{1}{\beta}}\left[\frac{1}{R(\varphi_0^L,.)}\right]^{\frac{1}{\beta}} \quad 10)$$

where $\beta = 1 - \alpha(\sigma - 1)$.

To ensure that the investment function does not explode I assume that $\beta \neq 0$.

Several intuitive explanations are due at this point. The firm's investment decision is endogenously determined in the model. The credit used is a decreasing function of its price so the higher is the price of credit, the higher will be the level of credit constraint faced by the firm in its pursuit of upgrading technology. Investment is positively related to firm productivity so more productive firms invest more than others.

Empirical Implementation

In this section I study the effect of credit availability on margins of trade, firm's decision to invest in plant and machinery and significance of credit as a determinant of firm's TFP. Considering the fixed costs as shown in (5) and (8) above , the firm may face credit constrain in either market entry or export decision or both. The following hypotheses are outlined for testing:

i. Extensive Margin of Trade: Credit availability increases the likelihood of export by a firm.
ii. Intensive Margin of Trade: The volume of exports by a firm is more likely to increase with the availability of credit.
iii. The likelihood of firm to invest in capital goods (plant, machinery and equipment) increases with the availability of credit.
iv. The likelihood of firm to export increases with its investment in capital goods.

Data

The dataset used for this research is from the World Bank Enterprise Surveys for Latin American countries. The survey was conducted twice; in the years 2006 and 2010 for Argentina, Bolivia, Colombia, Peru, Mexico and Venezuela. The survey was conducted to identify the technological, contractual and financial constraints faced by firms. The survey contains detailed quantitative and qualitative questions about firm's access to finance, production, innovation, labor

employment and business related infrastructure and market information. The main piece of survey information used in this paper relates to credit access, exports as a percentage of sales and introduction of new production processes or products.

Sample Selection

The industry selection in the dataset is broad based and the firm selection is random to ensure that they are true representatives of the population. The degree of heterogeneity in the sample reduces as the firms share the following: they are small or medium in size, privately owned urban-based and relate to manufacturing sector. However, to account for time invariant firm specific unobservable characteristics, dummy variables are used in the model. The descriptive statistics of the firms are given in table 1.

Insert table 1 around here.

Variables of Interest

Dependent Variable

To investigate the effect of credit availability on export and investment made by the firm, three dependent variables have been defined. The first dependent variable is ***Export*** which is defined equal to 1 if the firm undertakes direct exports and zero otherwise. ***ExportShare*** is the second dependent variable which is the logarithm of the direct exports share of total sales of a exporting firm. The third dependent variable is ***Invest*** which is defined equal to 1 if firm invests in plant, machinery and equipment, and zero otherwise

Insert Table 2 about here

Credit Availability Variable

The variable central to this study is ***Credit*** which equals 1 if firm ***i*** has an available outside line of credit from private commercial bank or a financial institution and zero otherwise.

Insert figure 2 around here

To control for several firm characteristics I use the logarithm of the number of the production and support labor employees. Besides, firm's affiliation with a business group or foreign shares is depicted by variable ***Conglo***.

Dummy Variables

To capture the effect of unobservable characteristics, dummy variables based on firm's location (6 countries) and its industry (19 categories) have been used.

Empirical Methodology

The theoretical model studied in this paper suggests that credit constraints negatively affect a firm's investment decision to acquire new technology and pay off the fixed costs of entering a foreign market.

Hypothesis (i) deals with a binary discrete choice which depends on whether the firm is exporting or not. I use the following probit model to test the probability of export by firm i :

$$prob(Export = 1) = prob\ (\alpha + \beta Credit_i + \kappa Z_i + \mu_i > 0) = \Phi(\alpha + \beta Credit_i + \kappa Z_i) \qquad 11)$$

where in equation (11), Z are the control variables. The error term μ_i has standard normal distribution and it constitutes the unobserved firm attributes and other unaccounted factors that may influence the dependent variable. The expected sign of the *Credit* coefficient is positive, that is $\beta > 0$.

For hypothesis (ii), the dependent variable in the model given in (11) is replaced with logarithm of direct export share in total sales as follows:

$$ExportShare = \alpha + \xi Credit_i + \kappa Z_i + \varepsilon_i \qquad 12)$$

As only exporting firms are being considered, so the export share is always greater than zero. The expected direction of the ***Credit***' coefficient based on the available literature is ambiguous as this parameter determines the significance of fixed or marginal costs in trade.

For hypothesis (iii), I regress the reported access to credit on firm's decision to invest in plant, machinery and equipment, using the following probit model:

$$prob(Invest = 1) = prob\ (\alpha + \beta Credit_i + \kappa Z_i + \mu_i > 0) \quad 13)$$

where in the above equation μ_i is normally distributed random error term.

Hypothesis (iv) tests that the likelihood of export increases with the firm's investment in capital goods.

Instruments and Exogeneity Test

Building a causal relation between firm's export and credit availability or firm's investment in technology and credit availability is likely to suffer from endogeneity. The credit availability variable is suspected of being endogenously determined. For the first situation, two plausible scenarios for this are described as follows. First, the firms with high productivity and large export shares earn higher profits and are more likely to have an easy access to supply of credit. Second, firm-reported problematic access to finance may be due to inefficient firms shifting the blame for their inefficiency to the financial market imperfection (Beck *et al*., 2005).

For hypothesis (i) where a probit model estimation has been used, exogeneity of the suspected endogenous variable *Credit* is tested using the Smith-Blundell (1986) test of exogeneity. The null hypothesis can be rejected at 5% significance level thereby implying that the regressor cannot be taken as exogenous. In the next section, I turn towards an instrument variable (IV) approach, and perform the Durbin-Wu-Hausman test of endogeneity. Under the IV approach, the null hypothesis can be rejected for the pooled case at 5% but cannot be rejected for

the panel case. For hypothesis (ii), the Durbin-Wu-Hausman test of endogeneity is performed, and again the null hypothesis is rejected, which implies that the *Credit* variable is endogenous. However, if we perform the Davidson-Mackinnon 1993 test of exogeneity following the IV/2SLS regression for the panel data the null hypothesis cannot be rejected.

For hypothesis (iii), the chance of reverse causality is very much plausible. A firm investing in capital goods is more likely to have access of external finance from banks etc. compared with one which does not purchase these items.

Instrumental Variables Approach

As the regression results for hypothesis (i) and (ii) are not reliable at 5% significance level, the 2SLS approach is adopted in this section. To overcome this potential endogeneity some exogenous instruments are required. One of the instruments selected for this is based on the relationship and trust between the enterprise and the financial institution and is ***OverDraft*** which equals 1 if a firm enjoys an overdraft facility and zero otherwise. The second instrument is ***ExtFin*** which is a indicative of the financing of the fixed assets of the firm by the banks and financial institutions and equals 1 if the bank or financial institution has financed the purchase of the fixed assets of the firm and zero otherwise. For hypothesis (iii) besides ***OverDraft,*** another instrument used is ***FinInd*** which indicates if the enterprise got its financial statements audited independently or otherwise.

As I have two instruments for one endogenous variable, I can check for the over-identification restrictions using Sargan's test. The test statistics indicate that null hypothesis cannot be rejected indicating that the instrument variables are uncorrelated to the residuals and are valid by this criterion.

Credit Situation in Latin America

A country specific brief on credit availability for firms for the Latin America is given in this section. Besides other sources, this section is primarily based on the contents of Galindo et. al., (2003).

Argentina*:* At the turn of the century, credit constraints faced by firms is a high profile issue as the cost is high and availability is limited. All this is in the backdrop to the fact that the financial markets are underdeveloped not just in comparison with developed OECD countries but also the neighboring emerging economies such as Chile (Caballero 2000). Due to the limited options presented by capital markets, bank credits are crucial for the firms.

Colombia*:* The financial reforms in 1990s decreased the liquidity and the debt requirements, but credit constraints faced by firms increased in 1990s. Only firms belonging to conglomerates and multinationals have been found to less constrained (Arbelaez and Echavarria 2002).

Mexico*:* A significant feature of Mexico is the existence of an internal capital market within each business group in which affiliate firms despite being rationed out from the external capital markets can still have access to financing through the use of cross financing (Castaneda 2002).

Table 3 and 4 around here.

Comparing tables 3 and 4, it can be concluded that number of firms reporting high interest rates as a reason for not applying for credit, is rising in Argentina and falling in Peru from 2006 to 2010.Moreover, the tables show that many Mexican firms do not have a bank account of their own, which confirms the presence of some informal channel of financing.

Table 5 around here

Regression Results

The regression results for the probit model to test hypothesis (i) are given in table 6 below. The column(1) and (2) coefficients indicate the marginal values for the pooled and panel probit models. The impact of credit availability on firm's decision to export is significant.

Table 6 around here

As these models do not take into account the unobservable factors and the endogeneity of the credit variable, the results are suggestive of nothing more than a correlation between credit availability and exports. In the remaining analysis, I try to deal with this weakness step by step. The problem of credit endogeneity is addressed by employing an instrumental variable (IV) two-stage least-squares (2SLS) procedure. The IV model is estimated with a full set of industry and city dummies to capture the country-industry fixed effects and the results are shown in column (3). Finally I use IV estimation for panel regression for fixed effects (columns 4). The problem of firm time invariant unobserved effects can be partially addressed by performing a random effects (RE) model on the panel of firms assuming that the firm specific error term , is uncorrelated with the included variables. However, as explained in Arulampalam (1996) the RE probit coefficients could be misleading as the covariance matrix of standard errors could be biased. Also as the appropriateness of RE estimators is not established by Hausman specification test and therefore I do not report them.

For hypothesis (ii) which tests for the intensive margin of trade, I consider the dependent variable as the logarithm of share of direct exports in the total sales of the firm. This dependent variable is regressed against the same explanatory and control variables as in the hypothesis (i). In table 7 the results are for fixed effects model under OLS and 2SLS respectively. In all the three models, the credit variable has a negative coefficient, although it is significant only in

column (2) for the IV 2SLS model. The negative relation indicates that credit availability in the economy causes diversion of resources towards more productive but financially vulnerable sectors and thus intensive margin of trade gets shallow. It can be concluded that once firms have incurred the fixed costs of production and for entering the foreign markets, they are not credit constrained to increase the volume of their exports..

Table 7 around here

The hypothesis (iii) is to test the significance of credit in firm's investment decision on plant, machinery and equipment procurement. The results are shown in table 8. Irrespective of the model, credit is always highly significant in firm's investment decision. The results in columns (3) and (4) control for endogeneity and fixed effects with standard errors clustered on the type of industry. The coefficient of the credit variable indicates its significance in investments made by the firm.

Table 8 around here.

The last hypothesis tests how investment in capital goods is likely to affect the export decision of the firm. The results shown in table 9 indicate that controlling for endogeneity through instrumental variables, investment is positive and significant for pooled and panel estimates. Thus the main theoretical finding that investment in plant, machinery and equipment is vital for the foreign market participation is upheld.

Table 9 around here.

Total Factor Productivity and Credit Availability

The concluding empirical analysis for this paper involves estimation of firm's TFP using Olley and Pakes (1996) method which controls for simultaneity and selectivity biases. The TFP so estimated is regressed on the credit availability and it transpires that productivity of the firms

with credit availability is 52% higher when endogeneity is controlled using the instruments identified earlier.

Conclusion

The selection of the firms in export market depends on their exogenously determined productivity according to the Melitz (2003) model. However, it is also very important to examine the underlying assumptions of this extremely popular model to determine the actual selection of the firms in export market specially in a developing country context. Firms need to finance two different types of fixed costs for entering and surviving in the foreign market; fixed cost to meet the costs related to entering the market (capital goods investment) and the costs needed to establish a foreign market network and information gathering etc. The premise for research in this paper was to determine if the availability of credit is significant for the firms to undertake direct exports (to meet both of the above mentioned costs) and for investing in plant machinery and equipment (to upgrade technology of production which has impact on firm's productivity).

The theoretical and empirical results indicate that firms require credit either to undertake innovation in their production process, or to introduce significantly improved new products or to meet the fixed cost of entering the foreign market. The empirical findings for firms in Latin America further indicate that firms are credit constrained only to the extent of its impact on the extensive margin of trade. That is firms need finance beyond their retained earnings to meet the fixed cost requirements for exporting. The incompleteness or imperfection of financial markets in developing countries limits the investment decision of firms and hence their prospects of competing in the export market. Extending credit to firms for introducing innovations or

establishing foreign market network can feasibly replace the trade related subsidies to existing exporters.

The recent trade theories have the potential to explain the gap in the theoretical benefits of free trade and the actual observed ones. Generally, trade discussions focus on barriers and restrictions affecting cross-country trade patterns. However, there are significant firm-level constraints which ultimately determine the pattern of a country's exports and the direction of trade. Thus even in cross country trade the winners and losers are decided at the level of the firms and therefore the focus of the policy should be the same level.

Appendix

Firm pricing rule in home market: $p_h = 1/\rho\varphi$

Firm pricing rule in foreign market: $p_f = \tau/\rho\varphi$

Firm profits from home market: $\pi_h(\varphi_1^T) = \left(\frac{E}{\sigma}\right)(P\rho\varphi)^{(\sigma-1)} - f$ (from Melitz (2003))

Firm profits from home and foreign markets:

$$\pi_h(\varphi_1^T) + \pi_f(\varphi_1^T) = (1+\tau^{1-\sigma})\left(\frac{R}{\sigma}\right)(P\rho\varphi)^{(\sigma-1)} - \eta f - f_x$$

E=aggregate expenditure and P= aggregate price

Now we have $\varphi_1 = [C(\varphi_0,.)]^{\alpha}\varphi_0$ so

$\delta\{\Pi(\varphi_1^{\frac{M}{H}})\}/\delta\{C(\varphi_0^L,.)\} = \delta\pi_f(\varphi_1^{M/H})/\delta\{C(\varphi_0^L,.)\}+\delta\pi_h(\varphi_1^{M/H})/\delta\{C(\varphi_0^L)\} - \delta[R(\varphi_0^L)C(\varphi_0^L)]/$

$\delta\{C(\varphi_0^L,.)\} = 0$

$$E[\frac{P\varphi_0}{\tau}]^{\sigma-1}\alpha[(\sigma-1)/\sigma]^{1-\sigma}[I\varphi_0]^{-\beta} = p_I E(\varphi_0)$$

$$C(\varphi_0^T,.) = (E\alpha)^{\frac{1}{\beta}}\left[\frac{\sigma-1}{\sigma}\right]^{\frac{\sigma}{\beta}}[P\varphi_0^T]^{\frac{\sigma-1}{\beta}}\left[\frac{1}{1+\tau^{1-\sigma}}\right]^{\frac{1}{\beta}}\left[\frac{1}{E(\varphi_0^T)}\right]^{\frac{1}{\beta}}$$

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Table 1: Countries and Share in Sample

Country	Freq.	Percent
Argentina	594	29.2
Bolivia	132	6.49
Chile	388	19.08
Colombia	368	18.09
Mexico	314	15.44
Peru	238	11.70
Total	2034	100

Table 2 Firm-Industry Statistics

Industry	**No of Firms.**	**Percent**
Food	502	24.68
Textiles	236	11.6
Garments	334	16.32
Chemicals	350	17.21
Plastics & rubber	46	2.26
Non metallic products	62	3.05
Basic metals	6	0.29
Fabricated Metal products	126	6.19
Machinery and equipment	174	8.55
Electronics	50	2.46
Others	148	7.28
Total	**2034**	**100**

Table 3: Average Interest Rates

Country	Interest Rates	
	2006	**2010**
Argentina	7.63	9
Bolivia	3.57	0.86
Chile	5.25	3.25
Colombia	7.25	3
Mexico	7	4.5
Peru	4.5	3

Source: tradingeconomics.com

Table 4: Reasons Firms Did not Apply for Credit

Country	No Need / Sufficient Capital	Application Procedure Complex	High Interest		Collateral Required	Total Firms Reporting
			2006	2010		
Argentina	218	45	44	62	29	460
Bolivia	129	10	14	9	16	204
Chile	162	14	0	8	3	225
Colombia	126	7	8	11	6	203
Mexico	228	18	17	13	14	315
Peru	69	6	11	8	6	110

Source: Enterprise Surveys World bank

Table 5: Firm Financial Characteristics

Country	Total Reporting Firms	Firms Bank A/c	Firms with OD	Firms with Credit	Firms Credit from Comm Bank	Firms Credit State Owned Bank	Firms Credit from Other Sources
Argentina	786	775	591	389	313	68	8
Bolivia	358	341	172	195	175	3	17
Chile	550	535	479	420	409	9	2
Colombia	554	548	500	410	386	7	17
Mexico	420	255	90	141	137	1	3
Peru	334	316	239	260	254	0	6

Source: Enterprise Surveys World bank

Table 6: Regression Results for Hypothesis (i)

VARIABLES/Model	Probit	XTProbit	IVREG	XTIVFE
Credit	0.056*	0.077**	0.273***	0.192*
	(0.032)	(0.027)	(0.055)	(0.105)
Skilled Labor (prod)	0.054***	0.050***	0.050***	0.010
	(0.012)	(0.011)	(0.010)	(0.014)
Support Staff	0.067***	0.086***	0.057***	0.019
	(0.014)	(0.013)	(0.017)	(0.022)
Conglo	0.043	0.057*	0.064*	0.013
	(0.037)	(0.033)	(0.036)	(0.038)
Observations	1733	1733	1733	1733
R-squared	0.193	-	0.205	0.012
Country /Ind FE	Yes	No	Yes	Yes
Sargan Stat (P-val)			0.514	0.15

*Significance at 10% ,**Significance at 5%, *** Significance at 1%

Table 7 : Regression Results Hypothesis (ii): Intensive Margin

VARIABLES/MODEL	XTREG OLS	IVREG IV/2SLS	XTIVREG
Credit	-0.008	-1.807**	-0.420
	(0.100)	(0.422)	(0.28)
Skilled Labor	0.155***	0.183**	-0.0019
	(0.039)	(0.061)	(0.098)
Support Labor	0.088 *	-0.058	-0.067
	(0.049)	(0.105)	(0.161)
Conglo	0.032	-0.054	-0.208*
	(0.103)	(0.120)	(0.070)
City/Ind FE	No	Yes	Yes
Observations	591	591	591
R-squared	0.05	0.08	0.056
Sargan Stat (P-val)		0.674	0.464

* Significance at 10%, **Significance at 5%, and *** Significance at 1%

Table 8: Regression Results (iii)

	Pooled Probit (1)	Panel Probit (2)	IV with Dummies (3)	XTIV with FE (4)
Credit	0.110***	0.190***	0.353***	0.685***
	(0.032)	(0.024)	(0.129)	(0.224)
Skilled Labor	0.044***	0.024	0.037***	0.031
	(0.012)	(0.011)	(0.014)	(0.022)
Support Labor	0.060***	0.078	0.037*	0.016
	(0.015)	(0.012)	(0.014)	(0.039)
Conglo	0.063	0.027	0.065	0.018
	(0.042)	(0.034)	(0.043)	(0.059)
FE	Yes	No	Yes	Yes
R-squared	0.15		0.148	0.16
Observations	1933	1933	1933	1933
Sargan Stat (P)			0.18	0.334

* Significance at 10%, **Significance at 5%, and *** Significance at 1%

Table 9: Regression Results (iv)

MODEL	Pooled IV/2SLS	Panel XTIV
INVEST	0.0543***	0.144**
	(-0.0172)	(-0.0645)
LABEMP	0.0789***	-0.0749
	(-0.0179)	(-0.0664)
CONGLO	0.0942***	-0.0401
	(-0.0365)	(-0.0553)
Observations	1,253	788
R-squared	0.043	0.281
Sargan Test Stat.	0.646	0.152

* Significance at 10%, **Significance at 5%, and *** Significance at 1%

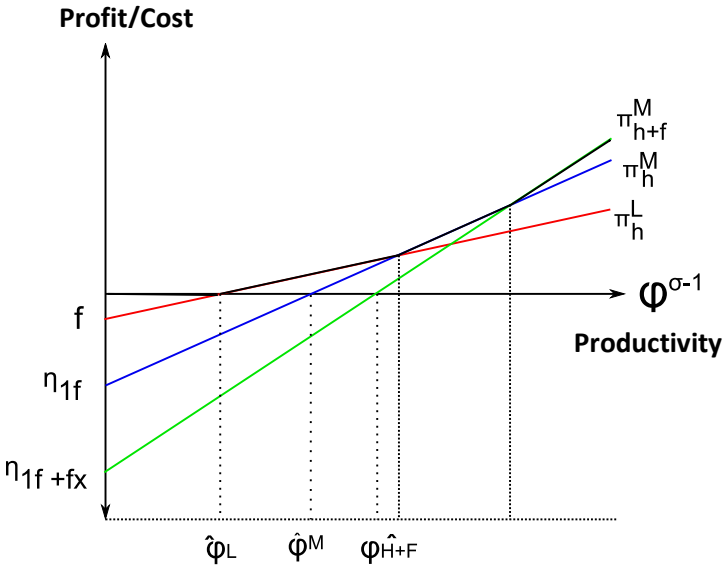

Figure1. Profits and Productivity Levels for Firm

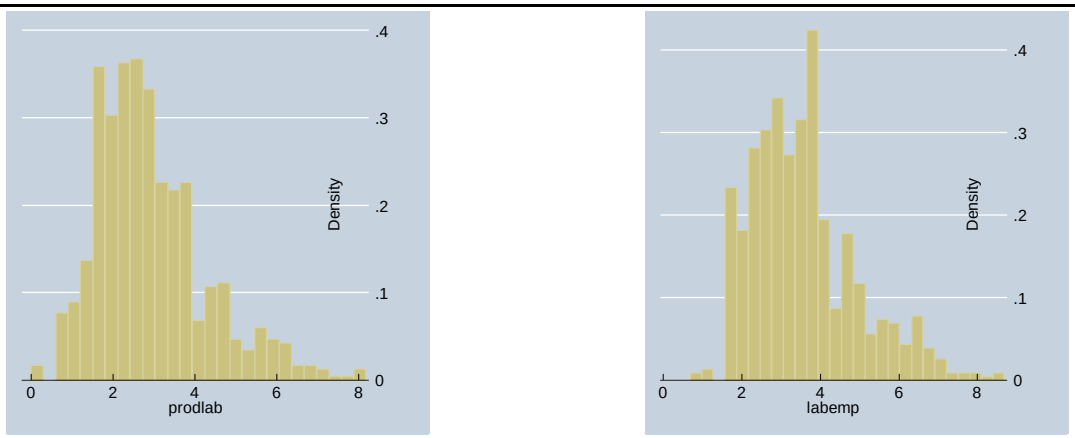

Figure 2: Histograms for Control Variables (a) Skilled Labor (b) Total Employees