Why liquidity matters to the export decision of the firm

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Abstract

Under financial constraints, exporting may have less to do with productivity and more to do with financial resources. The established relationship between exporting and productivity would differ when examined through the lens of the working capital needs of the firm. I approach the hypothesis that working capital matters in the firm's exporting decision in two ways: first, by articulating a dynamic working capital model of the firm that incorporates the firm's export decision. Secondly, by testing the hypothesis empirically using a unique firm level dataset from Bangladesh, where issues of financial constraints are particularly acute. The model shows that productivity determines export status of the firm as long as it is not under financial constraints. However, under financial constraints, export status is less dependent on productivity and more dependent on the availability of working capital. Empirical results support the model's prediction. The relationship between exporting time and the need for greater liquidity is also borne out empirically as shown by a positive and significant correlation between the amount of working capital and the distance of export destination. An important policy implication from the analysis is that short term liquidity is critical in allowing productive firms to export and that access to finance may prevent the benefits of trade liberalization within a country to be fully realized.

1 Introduction

The growth of exports is a key priority for many developing countries as a means to access foreign earnings and to stimulate economic growth[1]. Yet, among developing countries, access to external finance is a major problem. The World Bank Investment Climate Surveys, covering more than 26,000 firms across 53 developing countries, find that the cost and access to finance is considered by firms to be the top 5 problems they face (Hallward-Driemeier and Smith (2005)). An important question to ask is how do financial constraints affect the export decision of the firm. This questions is particularly relevant in light of the recent financial crisis, where the freeze on credit coincided with a drop in world exports of more than 30 percent[2] that cannot be entirely explained by the drop in aggregate demand.

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[1] See Roberts and Tybout (1997)Roberts and Tybout (1997)

[2] Quarterly trade data from WTO, compiled from data sourced from IMF, International Financial Statistics; Eurostat, Comext Database; National statistics; Global Trade Atlas.

To understand how financial constraints affect export status, the first step is to ask what are the financing needs of an exporting firm. Take for example, a firm owner who has to decide between selling to domestic or foreign markets. She/he would face export specific costs such as the costs of licensing or getting entry to markets.[3] However, beyond these additional costs, the owner also faces a significant difference in timing between domestic sales and foreign sales. I show that in the case of Bangladesh, exporting to Hamburg can take up to 39 days. With domestic sales, goods would be delivered faster and the payment for the goods received within a shorter time. With foreign sales, although the goods will fetch a higher price, the goods will take longer to deliver and the payment will be received with a longer delay. I also show that most firms receive payment only after their goods have been delivered. The decision to export involves the owner asking themselves whether they would be able to remain liquid during the period before payment is received. Operating liquidity in financial metric terms is working capital. As such, to address how financial constraints affect the export decision of the firm, it is necessary to understand how working capital affect the export decision of the firm.

This paper makes two contributions to this question. First, I articulate a dynamic working capital model of the firm's export decision. Second, I test the empirical predictions of the model using a unique panel dataset of Bangladeshi firms and find robust evidence that financial constraints provide a significant barrier to exports.

The theoretical model builds upon the dynamic working capital model of the firm Chan (2008) and extends it to the export decision of the firm. To my knowledge, there are no existing trade models that have formalized the role of working capital in exporting decisions.

Working capital underlies two fundamental concepts in trade: costs to entry and the role of distance in determining trade volumes. The extra working capital demands from exporting over domestic sales due to shipping time, formalizes the concept of sunk cost or the cost of entry which many trade models are premised upon (see Alessandria and Choi (2007); Arping and Diaw (2008); Das et al. (2007); Bernard et al. (2006); Bernard and Jensen (2004)). Furthermore, as the amount of working capital directly reflects transportation time, the greater the distance, the greater the working capital demands in exporting. Therefore, the model also speaks to the area of trade research on how distance determines trade volumes as well as on how time can act as a trade barrier (see Hummels (2001); Clark et al. (2004); Islam et al. (2005) for research in this area).

The main theoretical result is that the export decision of the firm is determined by both productivity and working capital and their relative importance depends on whether the firm is financially constrained or not. The model shows that exporting depends primarily on productivity *if the firm is not financially constrained.* When firms are financially constrained, however, a lack of working capital can severely restrict a firm's willingness and ability to engage in exports. The implication is that among the population of firms, there will exist low productivity firms that never export regardless of their cash positions, and cash-poor firms that do not export regardless of their productivity levels.

To assess the importance of this mechanism, I use a unique firm-level dataset which allows two key aspects of the model to be examined: a) a direct test of the interaction between financial constraints, working capital and productivity in determining the export status of the firm, and b) the relationship between working capital and the export distance that underlies the rationale behind the theoretical model. The 2002 Bangladesh Investment Climate Survey is one of the few panel datasets available that contain firm level financial information, their access to credit and detail information on exports. The empirical results provide support for the

[3]Costs to exporting also include shipping and transportation, custom duties and many more. These are discussed in Hummels (1999).

model's predictions that the affects of working capital and productivity will differ between financially constrained and unconstrained firms. Specifically, for financially constrained firms, productivity matters less than for unconstrained firms while working capital matters much more. The correlation between working capital and export distance is shown empirically to be positive and significant, lending support for the working capital model of the firm's export decision.

The paper is structured as follows: the next section discusses the relevant literature for both theoretical firm models and empirical work in the area of export and finance[4], Section 3 motivates the need for the working capital model of export decision by taking a preliminary look at the data to examine the distribution of productivity between exporting and non-exporting firms and also to look at the additional working capital demands that exporting imposes, Section 4 develops the working capital model of the firm's export decision, Section 5 examines the empirical results and then the conclusion.

2 Relevant Literature

The role of firm productivity as a determining factor for the export status of the firm has been researched extensively both theoretically through the heterogeneous firm models of Melitz (2003); Bernard et al. (2003) and empirically in the work of Pavcnik (2002); Bernard et al. (2003); Bernard and Jensen (2004). It is, however, ambiguous as to whether the existence of financial constraints changes the relationship between productivity and exporting.

The literature on the interaction of trade and financial factors has existed for some time Kletzer and Bardhan (1987), but the emphasis has been on incorporating finance into the theory of comparative advantage to explain trade patterns across countries. Only more recently has the new trade literature begun to consider the role of finance in heterogeneous firm models (see Manova (2006, 2008); Chaney (2005); Suwantaradon (2008)). Existing models of exporting decisions such as Manova (2006); Chaney (2005); Suwantaradon (2008) assume a set percentage of borrowing and do not account for the accumulation of internal finance that affect financial constraints and reduce the demand for borrowing. Their models assume that all firms are affected by financial constraints, due to the set borrowing requirement, and therefore financial constraints will *always* influence exporting decisions, regardless of differences in internal financing between firms. This is a restrictive assumption as it is important to take into account of both good financial health, when firms do not require to borrow, and when firms are financially constrained so as to accurately capture the impact of financial constraints on the distribution of firms in the aggregate.

Existing models also assume that allocation of credit is perfectly aligned to productivity. This assumption drives the result of these models: exports with financial constraints simply raises the productivity cutoff across all firms. Existing models assume no time difference between inputs and revenues and as such, the financing of the inputs responds directly to the input choice. This, coupled with the assumption that credit is perfectly aligned with productivity, drives the existing models' result.[5] However, existing literature has shown that the allocation of credit does not correspond perfectly to productivity (see Hsieh and Klenow (2009); Banerjee and Duflo (2005)). The assumption of direct correspondence is thus too strong as it does not allow for the existence of distortions in the allocation of credit. The assumptions made by existing theoretical models,

[4]The literature on the area of trade credit , such as Fisman and Love (2003); Fisman (2001); Fisman and Love (2004); Fisman and Raturi (2004); Burkart and Ellingsen (2004) reviewed in Chan (2008).

[5]The working capital model differs from the existing models in that the firm's maximization problem at time t is bounded by predetermined internal revenues- that is, revenue is a state variable. Even if credit is perfectly aligned to productivity in the working capital model, this would not detract from the predictions that are driven uniquely by the timing difference between inputs and receipt of revenues.

static borrowing demand and direct correspondence between allocation of credit and productivity, lead to essentially the same result as predicted by Melitz (2003) with the caveat that financial distortion raises the productivity cut off level across all firms.

The empirical literature using micro level data on the relationship between exporting and finance is limited due to both the availability of firm level datasets as well as the topic being an emerging area of research. Of note, one of the few studies is Greenaway et al. (2007) that uses a large UK panel dataset. They show that financial health of firms positively affect export decisions. Another more recent study, Berman and Hericourt (2009) uses cross section of firm level data across 9 developing countries and they find that access to finance is important to the firm's decision to enter exports. Furthermore, they find that financial constraints create a disconnection between firms' productivity and their export status: productivity is only a significant determinant of the export decision if the firm has a sufficient access to external finance. While the existing empirical work show that there are significant relationships between exporting and financial factors, neither studies relate these empirical findings to a model that explains the underlying economic relationships that drive these results.

3 Why might working capital restrictions affect exporting decisions?

The Bangladesh Investment Climate Assessment 2002 surveyed 990 firms and collected annual recall data for 2000 and 2001 for key variables, except for access to finance questions that are only reported for 2002. A total of six manufacturing industries are represented: Garments, Textiles, Food, Leather, Electronics and Chemicals. The distribution of firms within each of these industries is representative of the composition of the Bangladeshi economy, with 57 percent of the observations in the garments and textiles industry. The dataset contains financial information that allows working capital to be measured at the firm level. Working capital is defined in the data as the sum of inventories, accounts receivable and cash on hand.[6] Working capital can be though of as current assets or the liquidity of the firm. A unique characteristic of the dataset is that it contains country destinations of exports. This allows us to look at whether the distance to country destinations is correlated with working capital at the firm level.

There are three major observations from the data that indicate working capital is particularly important for exporting. First, there are substantial additional costs to exporting in the form of custom duties and procedures. Table 1 shows that average official costs are 84,935 takas (approximately $1,456 USD) and average unofficial costs total 32,895 takas (approximately $564 USD). In light of the average value of exports is only 139,981 takas (approximately $2,399 USD), total custom costs are a substantial cost to firms in Bangladesh. In addition to these costs, exporting firms also hire clearance agents to help get them through customs -around 90% of exporting firms use a clearance agent at an average cost of 0.82% of the value of the freight. These costs plus the time delays in customs would require the firm to have adequate working capital in order to just get their goods through customs.

Second, exporters do not get paid until their goods are delivered to the export destination for a much larger proportion of their sales than non-exporters. Table 2 shows that on average, 89 percent of the sales for exports is paid upon delivery (median is 100 percent) compared to 65.74 percent for non-exporting firms (median 75 percent).[7] Therefore, exporters would require to cover a greater percentage of their costs with

[6] Working capital is measured according to the accounting definition: current assets (inventories, accounts receivable, cash and short term credit) minus current liabilities (accounts payable and any short term debt). Note that working capital data is only reported for 2002

[7] A proportion of sales is also bought on credit, and here, non-exporting firms appear to extend more credit than exporting firms. Extending credit to customers would further delay the receipt of revenues from when the cost of production was incurred. On average,

Table 1: Costs to Customs

2002 Bangladesh ICA	Mean	Standard Deviation
Average days to clear customs	8.87	10.69
Maximum number of days to clear customs	14.10	13.76
Official costs (takas)	84935	440869
(USD)	1456	7556
Unofficial costs (takas)	32895	221242
(USD)	564	3792
Value of exports (takas)	139981	321491
(USD)	2399	5510
Percent that use clearing agent	89	
Cost of agent as % of the value of freight	0.8132	3.109

Source: Bangladesh 2002 Investment Climate Assessment Survey, World Bank
Note: The exchange rate in 2002 average is 0.017137961 takas=1 USD

Table 2: Timing of payment for sales

Mean	% of Sales paid before delivery	% Sales paid at delivery	% Sales bought on credit	Number of Obs
Non-Exporting Firms	5.57	65.74	28.43	561
Exporting Firms	2.87	89.42	7.66	421
Total	4.41	75.89	19.53	982

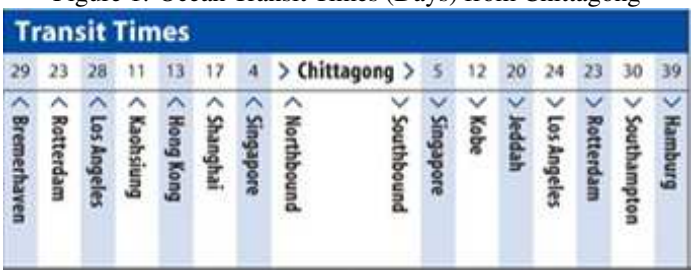
Source: Bangladesh 2002 Investment Climate Assessment Survey, World Bank

their own working capital than non-exporters. Furthermore, the longer the time period is between production and delivery, the greater the amount of working capital is required.

Last, delivery times are longer for exporters than non- exporters. Turnover time differs from industry to industry. It ranges from a month in garments to 4 months for shrimp farming (Arnold (2004)). For firms that export, clearing customs, transiting to overseas destination and clearing foreign customs all add to the amount of time firms have to wait before receiving payment for their goods. The time to clear domestic customs is on average around 9 days, with a maximum of 14 according to the 2002 Bangladesh ICA (see Table 1) For transiting time, Bangladesh exports are shipped using international shipping lines that run on regular schedules. The time in transit consists of: overland to port, a feeder journey from Chittagong or Dhaka to Singapore to meet up with the international shipping line, and then the destination port to customer location. According to Arnold (2004) , the greatest delays are caused in the exchange from feeder to mainline vessel as schedules may not synchronized and containers may wait in the transshipment port for several days. His estimate of ocean transit times from Bangladesh, using a variety of shipping companies, is between 25-35 days. Figure 1 shows the transit times for APL shipping (the world's sixth largest container transportation and shipping company) which corroborates the Arnold (2004) estimate. Without even counting for time needed to clear foreign customs and inland delivery, selling to European markets from Bangladesh can add an extra month to the product cycle. Considering that production of garments only requires about a month to process, exporting essentially would double the amount of working capital required.

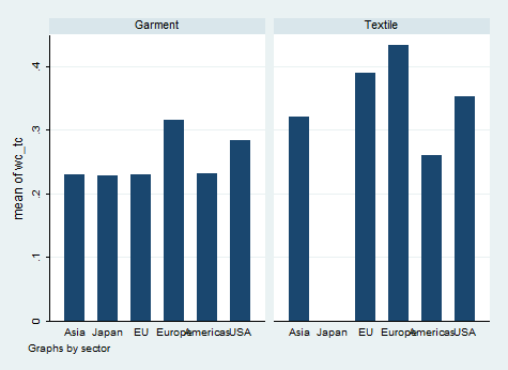
amongst those that do extend credit to customers, 43.77 days of credit is extended with a median of 30 days. This is funded mainly from retained earnings (median of 60%, with the rest from micro lenders or informal lenders). This implies that those firms that extend credit to their customers are doing so because they have enough cash or access to finance. They charge their customers extra for the credit for the delay in the receipt of payment and the delay is not crucial for completing the exchange. Unlike the delays caused by shipping across large geographical distances which are unavoidable and crucial to completing the transaction between the exporter and the customer.

Figure 1: Ocean Transit Times (Days) from Chittagong



Source: APL Limited (American President Lines Ltd.) at http://www.apl.com/services/documents/sells_mkt_ia_chtct2.pdf

Figure 2: Export Destination and Working Capital



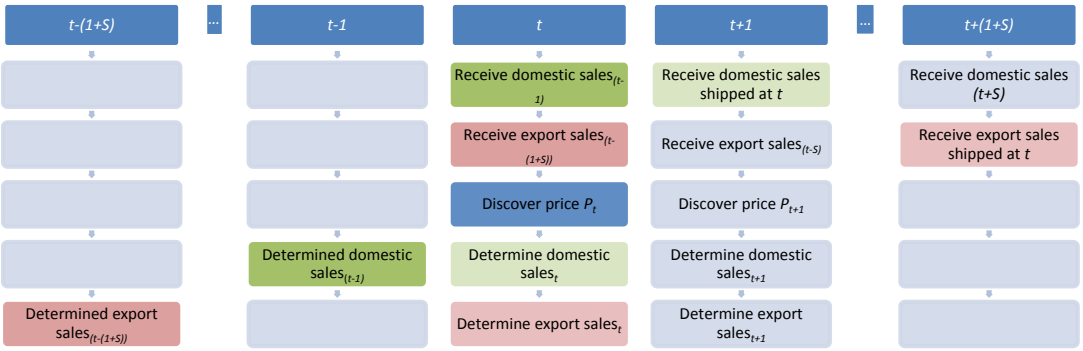
Source: Bangladesh 2002 Investment Climate Assessment Survey, World Bank
Notes: Average of the percentage of working capital to total costs (sum of total wage cost, raw material cost, energy costs and other costs). Other sectors and regions drop due to lack of observations.

Among exporting firms, Figure 2 shows that the amount of working capital is increasing with the distance of export destination. This relationship is particularly stark with Europe and the EU - destinations that have the longest shipping transit times from Bangladesh. This suggests that if firms require additional working capital the longer the transit time or the greater the distance of the export destination.

4 A Model of Export Decision with Working Capital

The previous section motivates the importance of working capital in the firm's export decision. This section presents a dynamic model of the firm's export decision that allows for differences in liquidity to affect export decisions. The purpose of articulating an export model where working capital is required for production is to show how productivity and cash interact to jointly determine export status of the firm, and as a result, the presence of financial constraints distorts the selection of the most productive firms into exports through the time demand for liquidity required for exporting. The interaction is highly intuitive: the firm exports if it has met both productivity and cash requirements for exporting. This implies that among the population of firms, there will exist low productivity firms that never export regardless of their cash positions, and likewise, cash poor firms that do not export regardless of their productivity levels. The interaction of productivity and cash as necessary conditions to enter exports would give rise to lower correspondence between productivity and export status of the firm than the correspondence predicted by earlier models.

Figure 3: Time line for Production and Receipt of Revenue



Note: Price P_t represents both domestic price P^D and foreign price P^F.

Take a representative firm within an industry with the production function $F(K_t, L_t)$. At each period, the firm chooses inputs in labor and capital as well as the percentage of output, ψ, to sell to international markets[8] to maximize all future stream of profits. Capital takes one period to install. Labor is inelastically supplied. Productivity, A_i, is exogenously given and differs across firms. Firms know their productivity level and makes production decisions based on the uncertainty of output and prices in the domestic and foreign markets.[9]

The firm also has access to financial services where it can borrow or save, b, at interest rate r.[10] The standard assumptions apply where wages, w, the price of capital, p^k, and the interest rate, r are assumed to be exogenous and non time varying. The discount factor given by $\beta = \frac{1}{(1+r)}$ and the depreciation rate of capital given by δ. Entry to export markets requires a fixed cost, f , each period, which can be viewed as a license, permit or agent's fee to export.

To incorporate the need for working capital, time delays between production and receipt of revenue are introduced. The time delays are as follows: selling to domestic markets requires one period to receive the revenue and selling to international markets requires S periods in addition to the one period delay that is normally incurred through domestic sales. That is, exporting requires additional time for products to be shipped and received overseas over that of domestic sales. Figure 3 shows the timing of production and receipt of revenue. At each period, the firm receives the revenue from past sales: past sales includes any domestic sales from period $(t-1)$ and any export sales from period $(t-(1+S))$. At each period, the firm also decides on production to be sold domestically and/or exported - the revenue from which will be received either at the next period $(t+1)$ or at $t+(1+S)$ periods later. All costs of production are incurred at the time of production, regardless of whether products are going to export or domestic markets, but the production choice affects the transitional equation at the present period and at $(1+S)$ period when export revenues arrive.

At each period, the firm discovers the prices for output; the domestic price, P_t^D and the foreign price, P_t^F. Both prices are stochastic over time. For simplicity, the present value of the foreign price is assumed to be always greater than domestic price so that there is an incentive for firms to enter exports, $\beta^S P^F - P^D > 0$.[11]

[8] Likewise, $(1-\psi)$ percent is sold to domestic markets

[9] This departs from current literature where firms only realize their productivity after paying a fixed cost Melitz (2003); Manova (2006); Suwantaradon (2008). The rationale is that firms are privy to more information about their own operations and how productive they are more so than knowing the price conditions on foreign markets.

[10] Note, this follows the international finance literature in that b represent bond holdings and positive implies savings and negative implies borrowing.

[11] Relaxing this assumption will simply allow more instances where firms will choose not to export because it isn't as profitable. The objective of this paper is to highlight how financial constraints affect export behavior, and thus it is important for firms to have an incentive to export in the first place.

The availability of export markets can be thought of as an additional mechanism to transfer resources over time: domestic sales get P^D and returns are delivered at time $t+1$ while international sales get P_t^F but incurs a fixed cost and returns are delivered at time $t+1+S$.[12] Intuitively, the extra time required for exports costs the firm the discount rate β^S on revenue which is increasing with time S. The delays imply that at each period, the firm has a stock of wealth made up of revenues that are due from past production and any bond holdings from last period. This stock of wealth is the firm's working capital, X_t:

$$X_t = (1-\psi_{t-1})P_{t-1}^D AF(K_{t-1},L_{t-1}) + \psi_{t-(1+S)}P_{t-(1+S)}^F AF(K_{t-(1+S)},L_{t-(1+S)}) + (1+r)b_{t-1}$$

The cash the firm has at any particular point will not include *all* export sales pending from all previous periods but only the export sales due at that period. The revenue for export sales is only realized as cash at the period the firm receives it. Working capital is liquidity, and pending payments that are not received cannot be used to pay for inputs.[13]

The firm chooses labor, investment and percentage of production to export according to how much working capital it has. Therefore, the firm's budget constraint is given by:

$$wL_t + p^k\left(K_t - (1-\delta)K_{t-1}\right) + \{f_t|\psi_t > 0\} + b_t = X_t$$

Financial constraints are introduced as a limit on how much the firm can borrow at any particular time. The firm is restricted to borrow only up to a percentage, φ, of it's total wealth: $b_t \geq -\varphi X_t$.[14]

Define π^D as the current value profit from only domestic sales; $\pi^D = \beta P^D A_i F(K,L) - C(K,L,K_{-1})$. Likewise, define π^E as the current value profit from sales where exports are non-zero;

$\pi^E = \left((1-\psi)\beta P^D + \psi\beta^{1+S}P^F\right)AF(K,L) - C(K,L,K_{-1}) - f$. Variable costs are denoted by $C(K,L,K_{-1}) = wL + p^k(K-(1-\delta)K_{-1})$. The dynamic maximization problem of the firm can be described by the value function defined below:

$$\begin{aligned} V(X,K_{-1}) = \max_{\psi=0,\psi>0}\Bigg\{ & \max_{L,K}\pi^D + \beta E\left[V\left(X',K\right)\right] + \nu\left[(1+\varphi)X - C(K,L,K_{-1})\right] \\ & s.t.\, X' = P^D A_i F(K,L) + \psi_{-s}P_{-s}^F A_i F(K_{-s},L_{-s}) + (1+r)\left[X - C(K,L,K_{-1})\right], \\ & \max_{L,K,\psi}\pi^E + \beta E\left[V\left(X',K\right)\right] + \nu\left[(1+\varphi)X - C(K,L,K_{-1}) - f\right] \\ & s.t.\, X' = (1-\psi)P^D A_i F(K,L) + \psi_{-s}P_{-s}^F A_i F(K_{-s},L_{-s}) + (1+r)\left[X - C(K,L,K_{-1}) - f\right] \Bigg\} \end{aligned}$$

Following Bond and Van Reenen (2007), the borrowing constraint for domestic, $(1+\varphi)X - C(K,L,K_{-1}) \geq$

[12] The firm also has available bonds, that earns interest, r, that is received also at $t+1$. It is implicitly assumed that the rate of return from domestic production is greater than the interest rate - or else there is no incentive to produce. In other words, P^D is bounded from below such that there is always an incentive to produce.

[13] It is possible that pending payments could be used as collateral to borrow more, but this scenario will be left for further research. The focus of this paper is to look at cash strap firms in developing countries where any kind of credit is difficult to obtain even on cash collateral.

[14] This setup differs from the existing literature in three ways: 1) borrowing is endogenously chosen, 1) the probability of exiting export markets is not assumed a priori, 2) the amount the firm produces for domestic and international markets is chosen endogenously by the firm in response to relative prices and 3)the time required to trade and the resulting liquidity requirements are modeled explicitly. I take out the assumption of monopolistic competition, where exporting firms can influence price levels, and substitute this with financial constraints as this may be a more realistic assumption for firms in developing countries.

0 and for exports, $(1+\varphi)X - C(K,L,K_{-1}) - f \geq 0$, is embedded in the value function where ν denotes the shadow value of loosening borrowing constraint.

The firm's maximization problem involves 2 steps due to discontinuity introduced by the fixed cost of exporting. First, given the cash available and output prices, the firm determines the output levels that will maximize profits under domestic sales as well as for export sales. Under export sales, the firm also determines the optimal amount to export if exporting. Second, the firm then chooses between the two profits to determine whether to export.

4.1 Domestic Sales

The firm's dynamic problem in the domestic sales case reduces to only two possible solutions, as established in Chan (2008); the firm is either not financially constrained, in which case it produces at the optimal, or it is constrained, in which case, it produces as much as it can given cash on hand. The first order conditions are repeated below:

Unconstrained:

$$\beta P^D F_L(K,L) = w \tag{1}$$

$$\beta P^D F_K(K,L) = p^k . \frac{(r+\delta)}{(1+r)} \tag{2}$$

L^{D*} and K^{D*} is the solution to the firm's maximization problem if and only if:
Equation (1) and (2) hold and $(1+\varphi)X - wL^{D*} - p^k(K^{D*} - (1-\delta)K_{-1}) > 0$.
Otherwise, the solution is given by Equations (3) and (4) below:

Constrained:

$$\frac{\beta P^D F_L(K,L)}{w} = \frac{\beta P^D F_K(K,L)}{p^k} + \frac{(1-\delta)}{(1+r)} \tag{3}$$

$$X = \frac{1}{(1+\varphi)} \left[wL + p^k(K - (1-\delta)K_{-1}) \right] \tag{4}$$

Let $V^{*D}(A_i)$ denote the value of the value function of optimal domestic profits as a function of A and let $X^{D*}(A_i)$ denote the minimum cash requirement for unconstrained profits to occur. Note that both profits and cash requirements are increasing with technology, A. Let $V^{\overline{D}}(A_i, X_i)$ denote the value of the value function where profits are at constrained optimal (where $X_i < X^{D*}(A_i)$). It is necessarily so that constrained optimal profits is lower than unconstrained profits: $V^{*D}(A_i) > V^{\overline{D}}(A_i, X_i)$.

4.2 Export Sales

The firm's dynamic problem in the export sales case can also be similarly reduced to two scenarios. Let Σ denote the expected sum of all future shadow values up till the period export revenue is received; $\Sigma = E[\nu_{S-1}(1+\varphi)] + ...E[\nu'(1+\varphi)]$. This can be interpreted as the opportunity cost of liquidity due to exporting. The first order conditions under export sales are given by:

$$(5)\qquad \frac{\partial V}{\partial L}: \qquad \left(\left((1-\psi)P^D+\psi\beta^S P^F\right)\beta AF_L - w\right)\left(1+E\left[\frac{\partial V'}{\partial X'}\right]\right) = \nu w + \psi\beta^{1+S}P^F AF_L.\Sigma$$

$$\frac{\partial V}{\partial K}: \qquad \left(\left((1-\psi)P^D+\psi\beta^S P^F\right)\beta AF_K - \beta(r+\delta)p^k\right)\left(1+E\left[\frac{\partial V'}{\partial X'}\right]\right)$$

$$(6)\qquad = \nu p^k + \varphi\beta\nu'(1-\delta)p^k + \psi\beta^{1+S}P^F AF_K\Sigma$$

$$(7)\qquad \frac{\partial V}{\partial \psi}: \qquad \left(\left(-\beta P^D+\beta^{1+S}P^F\right)AF(K,L) + \beta E\left[\frac{\partial V'}{\partial X'}\frac{\partial X'}{\partial \psi}\right] + \beta^{1+S}E\left[\frac{\partial V^{(1+S)}}{\partial X^{(1+S)}}\frac{\partial X^{(1+S)}}{\partial R^F}\frac{\partial R^F}{\partial \psi}\right]$$

$$either \qquad \nu \neq 0 \Rightarrow (1+\varphi)X - C(K,L,K_{-1}) - f = 0,$$

$$or \qquad \nu = 0 \Rightarrow (1+\varphi)X - C(K,L,K_{-1}) - f > 0$$

Identical to the case of optimization of domestic sales, the choice of labor and capital is governed by their respective marginal cost when unconstrained and governed by the binding budget constraint when constrained. Unlike the case of domestic optimization, optimizing export sales involves taking into consideration of the additional future periods until export sales revenue are received.

The first order condition for exports dynamically captures the timing differences between domestic sales and export sales and also show why this matters under financial constraints. One way to see this, is by simplifying the first order condition by substituting in $\frac{\partial X'}{\partial \psi} = -P^D AF(K,L)$ and $\frac{\partial X^{(1+S)}}{\partial R^F}\frac{\partial R^F}{\partial \psi} = P^F AF(K,L)$ into the first order condition for ψ, Equation (7). This yields:

$$(8)\qquad \frac{\partial V}{\partial \psi} = A\beta F(K,L)\left[\left(\beta^S P^F - P^D\right) - E\left[\frac{\partial V'}{\partial X'}\right]P^D + \beta^S E\left[\frac{\partial V^{(1+S)}}{\partial X^{(1+S)}}\right]P^F\right]$$

The entire term in the square brackets can be interpreted as the net price of exporting which has two components: i) the difference in price between exporting and domestic, given by $\left(\beta^S P^F - P^D\right)$, and ii) the value of the timing of the different revenue streams, given by $-E\left[\frac{\partial V'}{\partial X'}\right]P^D + \beta^S E\left[\frac{\partial V^{(1+S)}}{\partial X^{(1+S)}}\right]P^F$. An increase in the percentage of exports will increase export revenue via the $+\beta^S E\left[\frac{\partial V^{(1+S)}}{\partial X^{(1+S)}}\right]P^F$ term at time $(1+S)$ while a decrease in the marginal domestic revenue, via the $-E\left[\frac{\partial V'}{\partial X'}\right]P^D$ term at the next period. Each of these revenue streams are weighted by the corresponding value of cash at that point: $\frac{\partial V'}{\partial X'}$, the expected change in the value function due to additional cash at the next period and $\frac{\partial V^{(1+S)}}{\partial X^{(1+S)}}$, the expected change in the value function due to additional cash at time exports arrive, $(1+S)$. The second component, $-E\left[\frac{\partial V'}{\partial X'}\right]P^D + \beta^S E\left[\frac{\partial V^{(1+S)}}{\partial X^{(1+S)}}\right]P^F$, is only relevant when financial constraints are binding as that is the only time when additional liquidity brings value to the value function.[15]

The additional time dimension of the export sales maximization problem makes the solution less tractable than the domestic case. However, the export maximizing solution can be characterized similarly as domestic sales into unconstrained and constrained scenarios:

Unconstrained

If constraints are never binding during the S periods it takes for international sales to be received, i.e. $\nu = \nu' = ...\nu^S = 0$, then:

[15] Cash, X, in of itself does not contribute to the value function but only when financial constraints bind.

$$\frac{\partial V}{\partial \psi} = A\beta F(K,L)\left(\beta^S P^F - P^D\right) \qquad \psi = 1$$

$$\begin{aligned} \psi\beta^{1+S}P^F AF_L &= w \\ \psi\beta^{1+S}P^F AF_K &= p^k.\frac{(r+\delta)}{(1+r)} \end{aligned}$$

Constrained

$$\left(\beta^S P^F - P^D\right)\left(1 + E\left[\frac{\partial V'}{\partial X'}\right]\right) = \beta^S P^F \Sigma \tag{9}$$

$$wL + p^k(K - (1-\delta)K_{-1}) + f = (1+\varphi)X \tag{10}$$

$$\frac{\left(\left((1-\psi)P^D + \psi\beta^S P^F\right)\beta AF_L - w\right)}{\left(\left((1-\psi)P^D + \psi\beta^S P^F\right)\beta AF_K - \beta(r+\delta)p^k\right)} = \frac{\nu w + \psi\beta^{1+S}P^F AF_L\Sigma}{\nu p^k + \varphi\beta\nu'(1-\delta)p^k + \psi\beta^{1+S}P^F AF_K\Sigma} \tag{11}$$

Equation 9 comes from a derivation of the first order condition from exports, given by:

$$\frac{\partial V}{\partial \psi} = A\beta F(K,L)\left(\left(\beta^S P^F - P^D\right)\left(1 + E\left[\frac{\partial V'}{\partial X'}\right]\right) - \beta^S P^F \Sigma\right) \tag{12}$$

[16]

Thus the solution to the export maximization problem is as such:

- If there are no binding future constraints for all future periods up to $(1+S)$, i.e.$\Sigma = 0$, then the marginal value of increasing export sales is strictly positive. Exports in this case will be the maximum amount possible which is 100 percent; $\psi = 1$.
- If there are binding future constraints in the period up to $(1+S)$, the extent that financial constraints are binding during that time will determine the amount of exports. The choice of ψ affects the size of Σ, the shadow values ν and ν' as well as $E\left[\frac{\partial V'}{\partial X'}\right]$. The choice of labor, capital and export percentage will be determined where all three equations are satisfied. Exports in this case can take on values between 0 and 100 percent due liquidity constraints.

Let $V^{*E}(A_i)$ denote the value of the value function of optimal domestic profits as a function of firm specific technology A_i and let $X^{E*}(A_i)$ denote the minimum cash requirement for unconstrained profits to occur. Additionally, let $V^{\overline{E}}(A_i, X_i)$ denote the value of the value function where profits are at constrained optimal (where $X_i < X^{E*}(A_i)$). It is necessarily so that constrained optimal profits are lower than unconstrained profits: $V^{*E}(A_i) > V^{\overline{E}}(A_i, X_i)$

The cash requirement, $X^{E*}(A_i)$, to satisfy $\Sigma = 0$ can be calculated by iterating backwards the budget constraint from the period when export revenue is received. At that period, cash on hand must be greater than expected cost. ie $X_{t+s} > \frac{1}{(1+\varphi)}E_t[Cost_{t+s}]$ for constraints to not bind. Likewise for the period before that, and so on and so forth. The minimum cash required for constraints to not bind for each period thus can be given as: [17]

[16]This utilizes a backward iteration of $\frac{\partial V}{\partial X} = E\left[\frac{\partial V'}{\partial X'}\right] + \nu(1+\varphi)$ that allows us to summarize the change in the value function at time $(1+S)$ in terms of the history of shadow values leading up to it: $E\left[\frac{\partial V^{1+S}}{\partial X^{1+S}}\right] = E\left[\frac{\partial V'}{\partial X'}\right] - \Sigma$.

[17]The cash threshold is defined for where the firm also expects to export in the future. An alternative scenario is that, due to

Let C^F denotes the cost to produce optimally at foreign prices.

$$
\begin{aligned}
X^{E*}(A_i) &= C^F + f - \beta^{1+S} P_t^F A_i F(K,L) \\
&\quad + E_t\left[C^F + f\right]\left(\sum_{s=1}^{S} \beta^s\right) \\
&\quad + E_t\left[C^F + f\right]\frac{1}{(1+\varphi)}\beta^{1+S} - \omega \qquad (13) \\
\textit{Given}: &\quad \omega = \beta^S P_{-1}^F A_i F_{-1} + \beta^{S-1} P_{-2}^F A_i F_{-2} + \ldots + P_{-(1+S)}^F A_i F_{-(1+S)}
\end{aligned}
$$

The characteristics of the cash threshold as defined by Equation 13 is intuitive as all costs enter positively; an increase in production costs and fixed costs will raise the cash threshold. Revenues enter negatively; if foreign price, P^F, increases, the amount of cash required to export will decline. ω denotes the current value of foreign sales revenue that is going to be delivered in the future, between $t = 0$ and $t = (1+S)$, from past production. If the firm has never exported before then $\omega = 0$. If the firm has exported before (and the greater the value of ω is), the lower the initial amount of cash required to export. This captures how firms are more likely to export, if they have exported before. The motivation here, however is not a learning story as is often forwarded by existing trade story (ie Clerides et al. (1998)), but one of liquidity and the timing of when cash arrives - firms that have exported before will have more liquidity to export in the present period.

The cash requirements also show that in addition to the fixed cost f required to export, the firm requires additional liquidity to cover the longer delays in exporting. The term $E_t\left[C^F + f\right]\left(\sum_{s=1}^{S} \beta^s\right)$ is the cost of production for exporting sales during the interim. The greater the distance, S, the greater the cash required for the firm to not run into binding liquidity constraints. Thus it captures the role of distance in exporting and relates this to the liquidity demands. The borrowing allowance φ also affects the cash threshold: if it decreases, the threshold also increases as firms cannot rely on external borrowing to finance production but need to finance internally.

The cash threshold is an increasing function of firm productivity A_i as cost of production, C, increases with inputs L and K which themselves are increasing functions of productivity. Intuitively, greater productivity increases the level that optimal scale of production is reached.

4.3 Exporting Decision

The exporting decision rests on choosing between domestic sales or export sales depending on which value stream is greater. The value streams depend on the state variables A_i and X_i.[18]

First, looking at technology A_i, let's assume that the firm's cash level X_i is greater than the minimum cash requirement to export, $X^{E*}(A_i)$. The firm picks the maximum of the two unconstrained optimal value streams: $V^{*D}(A_i)$ or $V^{*E}(A_i)$. As cash is not a binding constraint both at the present time period and in the future, the firm need only compare current profits: $\pi^{D*} = \beta P^D A_i Q^{D*} - C^{D*}$ to $\pi^{E*} = \beta^{1+S} P^F A_i Q^{E*} - C^{E*} - f$. The

higher than mean expected price realizations, the firm is able to export once but expects to return to domestic sales only as prices return to expected mean. In this scenario, the cash threshold , $X_{FD}^{E*}(A_i)$, will be lower. $X_{FD}^{E*}(A_i) = C^F + f - \beta^{1+S} P_t^F A_i F(K,L) - E_t\left[\beta P_{t+1}^D A_i F(K,L) - C^D\right]\left(\sum_{s=1}^{S} \beta^s\right) + E_t\left[C^D\right]\frac{1}{(1+\varphi)}\beta^{1+S} - \omega$

Price expectations are iid such that: $E_t\left[P_{t+1}\right] = E_t\left[P_{t+2}\right] = \ldots = E_t\left[P_{t+T}\right]$. Expected costs at time t are the same: $E_t\left[C_{t+1}^F\right] = E_t\left[C_{t+2}^F\right] = \ldots = E_t\left[C_{t+T}^F\right]$ where C^F denotes the cost to produce optimally at foreign prices and $C^D$the cost at domestic prices.

[18] Recall that all firms are assumed to face the same prices, wages and interest rates.

productivity threshold, $\bar{A}$, is defined where $\pi^{D*} = \pi^{E*}$:

$$\bar{A} = \frac{C^{E*} - C^{D*} + f}{\beta^{1+S} P^F Q^{E*} - \beta P^D Q^{D*}}$$

The productivity threshold exhibits some intuitive characteristics in terms of it's parameters. An increase in the foreign price P^F or a decrease in the domestic price, P^D, lowers the threshold as this causes exporting to be more profitable relative to domestic sales. Likewise, an increase in the fixed cost, f, raises the productivity bar for firms to be profitable exporting over domestic sales. An increase in the delay, S, such as through shipping distance, increases the threshold through the discount rate.

The productivity threshold is important in that it defines the minimum technology level required for the firm to be profitable in exporting. It would not be profitable for a firm with technology below the threshold to export, regardless of it's cash position. This threshold holds even under financial constraints as a firm that is not profitable exporting without constraints, will not be profitable exporting *with* constraints.

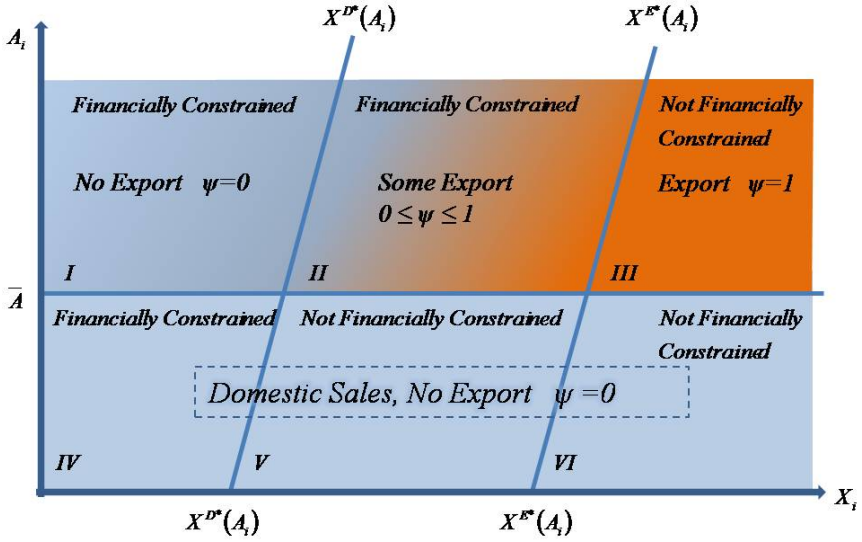
However, productivity alone does not determine whether the firm exports. While the productivity threshold separates firms with the ability to export from those that cannot, whether the firm has the means to do so will depend on the level of cash, X_i. Clearly, if the firm meets both productivity and cash requirements, $A_i > \bar{A}$ and $X_i > X^{E*}(A_i)$, the firm will export. Also, if the firm does not meet productivity requirements, $A_i < \bar{A}$, then the firm will not export regardless of the cash position, X_i. Therefore, out of the set of solutions dependent on the state variables A_i and X_i, the situation where the firm meets productivity requirements, $A_i > \bar{A}$, but does not have the cash, $X_i < X^{E*}(A_i)$, is the only combination left to fully map out the solution.

Previously, in the sections on domestic sales and export sales, the minimum cash levels required for unconstrained optimal were defined as $X^{D*}(A_i)$ and $X^{E*}(A_i)$ respectively. If the firm has cash levels below the minimum domestic "unconstrained optimal", that is $X_i < X^{D*}(A_i)$, then the firm would necessarily not choose to export as the value of exporting is lower than domestic sales, $V^{\overline{D}}(A_i, X_i) > V^{\overline{E}}(A_i, X_i)$. This will hold regardless of productivity levels, A_i. Intuitively, if the firm cannot afford to produce at optimal for domestic markets, it would not produce for export markets where there are even greater demands on liquidity due to fixed cost of exporting and the longer delays in the receipt of revenues, even if $A_i > \bar{A}$.

Take the situation when the firm's cash level is above the minimum domestic unconstrained optimal but below the minimum export unconstrained optimal, that is $X^{D*}(A_i) < X_i < X^{E*}(A_i)$ and $A_i > \bar{A}$. In this case, the firm has more than enough liquidity to sell at domestic optimal, but not enough to sell at the export unconstrained optimal. The firm needs to compare between unconstrained optimal domestic sales, $V^{D*}(A_i, X_i)$, with constrained export sales, $V^{\overline{E}}(A_i, X_i)$, where export percent is less than 100 percent. This situation gives rise to two interesting outcomes: either a) the firm chooses to export, but it will export at less than 100 percent which is unusual to observe when there is a fixed cost to export, or b) the firm chooses to sell to domestic markets even though it meets productivity requirements.

The export decision mapped accordingly to the interaction between the two state variables A_i and X_i can be summarized by Figure 4. All firms below the productivity threshold needed to be profitable in export sales do not export regardless of cash levels; that is, if $A_i < \overline{A}$, then exports will equal zero, $\psi = 0$, for all values of X_i (Areas IV, V and VI in Figure 4). All firms that above the productivity threshold, and are not financially constrained to export, will export 100 percent; that is, if $A_i > \bar{A}$ and $X_i > X^{E*}(A_i)$, then exports will equal one, $\psi = 1$ (Area III in Figure 4). Area I in Figure 4 demarcate values of cash that constrain firms from producing at domestic unconstrained optimal levels and thus will not export despite productivity levels that are above the threshold; if $A_i > \bar{A}$ and $X_i < X^{D*}(A_i)$, then exports will equal zero, $\psi = 0$. Area II demarcate values

Figure 4: Summary of Model Results



Note: FC -Financially constrained, NFC - Not financially constrained.

of cash that constrain firms from producing at unconstrained export optimum, but allow the firm to produce at unconstrained domestic optimum. Here, export able firms will choose to mix export sales with some domestic sales depending on the level of cash on hand; that is, if $A_i > \bar{A}$ and $X^{D*} < X_i < X^{E*}(A_i)$, then export values will take on values between zero and one, $0 \leq \psi \leq 1$. Within Area II, cash is the greater driver of the export status of the firm. For example, take two firms with the same cash level X_i where $X^{D*} < X_i < X^{E*}(A_i)$ and both has productivity levels higher than the threshold. The firm that has lower A_i would have a higher likelihood of exporting as it has lower liquidity requirements to export. (See cash threshold requirements Equation 13 that the higher the A_i the greater the the cash is required to produced at unconstrained optimal)

The results of the working capital model with exports is unique in that it captures the tension between time and payoff that arises under financial constraints. The firm faces a tradeoff between getting a higher price but waiting longer, or getting a lower price but getting it sooner in its decision between exporting and domestic sales when financial constraints are present. Under severe financial constraints, such as in Area I in Figure 4, firms choose to sell to domestic sales as liquidity constraints demands that payoffs be received sooner - *eventhough* the option of selling at a higher price is available. Under severe financial constraints, firms cannot afford to wait the longer time it takes to export. As financial constraints become less restrictive, such as in Area II in Figure 4, the firm will mix both domestic and export sales to maximize payoff and the timing of when revenue is received to ensure adequate working capital for future production.

The decision to export under financial constraint is analogous to a decision in investing in an illiquid investment. This occurs as liquidity becomes important when firms are financially constrained. When liquidity is important, firms would not strictly specialize in domestic or exports so as to not put all their liquidity in one longer term illiquid investment. Instead, they would choose to spread the 'liquidity investment' over both domestic and export sales.

The working capital model with exports is essentially a model of liquidity for the firm, that draws parallels with models of liquidity in the household savings literature (ie. Deaton (1991)). Additionally, the working capital model provides an alternative explanation to recent trade research that attribute the negative correlation of domestic sales with exports to decreasing returns to sales Nguyen and Schaur (2010) and Ruhl and Willis

(2008) .

The results of the export working capital model of the firm shows that the export decision of the firm is determined by both productivity and working capital. The model exhibits the characteristic results of Melitz (2003) in heterogeneous firm models of export, where exporting depends on productivity but also highlights the fact that this only occurs if the firm is not financially constrained. The working capital model shows that under financial constraints, the lack of working capital can yield different export outcomes even if the firm is productive enough to export. Liquidity constraints can constrain export potential firms to not export and/or export less than 100 percent. Therefore, the correspondence between productivity and exporting is much weaker

5 Empirics

This section examine empirical evidence in support of the model. First some stylized facts are presented: 1) the most productive firms do not necessarily self select into exporting and there does not appear to be a productivity cut-off above which all firms export, 2) significant differences exist in physical and working capital between exporters and non- exporters even within the same industry and 3) access to finance differs significantly between exporters and non-exporters and credit does not appear to be allocated according to productivity.

The Bangladeshi dataset allows two key aspects of the model to be empirically tested: a) whether the export status of the firm is determined by both productivity and working capital and that their effects depends on whether the financial constraints are present, and b) whether there is a relationship between working capital and the export distance.

5.1 Stylized Facts

5.1.1 Productivity of exporters and non-exporters in the data: Self selection not evident.

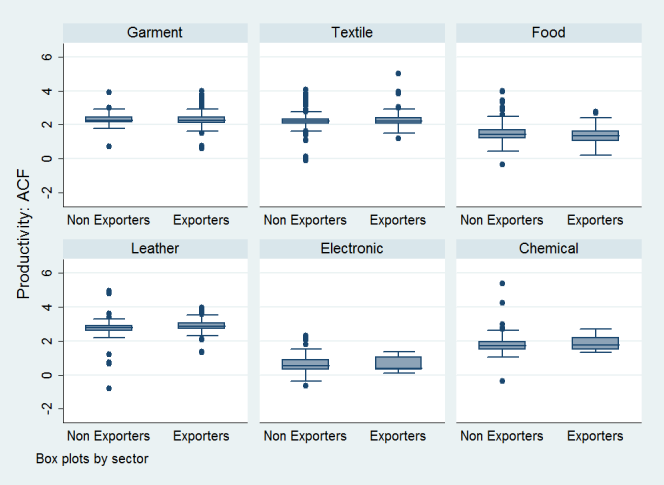
Productivity is measured as total factor productivity estimated according to Ackerberg et al. (2006) as the method allows for more generally plausible assumptions as to the dynamic data generating process of the inputs used to estimate the production function. [19] A possible caveat to estimated productivity is that estimates of the production function with a large proportion of financially constrained firms could potentially underestimate factor coefficients as firms are not operating at optimal scale. This potentially could bias the size of the TFP estimate but not the distribution of tfp overall. However, the consequences of estimating production functions with firms operating sub-optimally is not clear and is left as possible future research.

The dominant trade theory at the firm level (Melitz (2003); Bernard et al. (2003)) predicts that, within each industry, the firms at the upper distribution of productivity above a certain cut off will export while those that are below will produce only for the domestic market. Trade liberalization induces a self-selection of the most productive firms into exports. However, this self selection is not evident in the data and it does not appear that export firms are necessarily the most productive. Figure 5 on the next page shows the distribution of productivity for exporters and non exporters in each industry.[20] If there is evidence of self selection, the

[19] TFP was also calculated using OLS, RE, FE and using the Levinsohn and Petrin (2003) method. The OLS estimate suffer from endogeneity issues and both fixed effects and random effects estimates relies on strong assumptions on ω_{it} and has not worked well in practice. The LP estimates relies strictly on specific assumptions on the data generating process of the inputs to production that may not hold generally (see Ackerberg et al. (2006)) and is prone to suffer collinearity. See Appendix A.1 on page 27

[20] Furthermore, Table 12 in Appendix A.2 shows that the median productivity level do not substantially differ between exporters and non-exporters and, in fact, shows that mean productivity is higher for domestic firms than for exporting firms in all sectors except for

Figure 5: Distribution of Productivity and Export Status



Source: Bangladesh 2002 ICA, World Bank. Productivity as measured by estimated total factor productivity using Ackerberg et al. (2006). See A.1 on page 27 For table of inter quartile range

productivity levels of exporting firms would be within a range that is distinctively higher than the range of non exporting firms. However, the productivity range of exporters overlap non-exporters in each industry. The distortion to self selection due to financial constraints as articulated by the working capital model (see Figure 4) in fact provides an explanation to the non correspondence seen in in the date (Figure 5).

5.1.2 Differences between Exporting and Non-Exporting Firms: Working Capital, Physical Capital and Size.

Table 3 examines firm characteristics that differentiate exporters and non-exporters. Along with the established differences in size and age[21], the difference in means between exporting and non-exporting firms in output, physical capital and working capital are also examined. Two main patterns emerge: First, the direction of the differences between exporting and non-exporting firms are not the same across all sectors. Exporting firms are on average older than non exporting firms except for Electronics and Chemicals sector. The same reversal of the difference is seen in output, physical capital, physical capital per worker and working capital per worker.[22] This suggests that between industries, age and physical capital may have different effects in determining whether a firm exports. Secondly, working capital and labor are the only two variables where exporters consistently have a higher mean than non-exporters across all sectors. The significance of the differences are even sharper when samples are taken according to productivity cutoffs and the direction of the differences remain unchanged.

Leather and Chemical.

[21] Differences in firm size and age has been shown to be persistent in different empirical studies both of the US and in developing countries (Bernard and Jensen (2004); **?**).

[22] While this may not be the case for physical capital, physical capital per worker and working capital per worker if we considered Textiles as an abnormality, for age and output this remains true.

Table 3: Differences between non-exporters and exporters by sector

Garments						Textiles				
	Non-Exporters	Exporters	Total	diff	t-stat	Non-Exporters	Exporters	Total	diff	t-stat
Age	7.311	7.465	7.442	-0.154	-0.302	9.516	11.53	9.979	-2.014	-2.470
Log Output	11.41	11.26	11.28	0.15	1.830	11.14	11.05	11.12	0.09	0.633
Number of Workers	418.5	471.1	463.1	-52.6	-1.099	340.5	405.7	355.9	-65.2	-1.329
Log Physical Capital	8.771	9.19	9.126	-0.419	-3.759	10.46	9.894	10.33	0.566	3.531
Log Working Capital	8.974	9.107	9.087	-0.133	-1.163	9.458	9.532	9.475	-0.074	-0.469

Food						Leather				
	Non-Exporters	Exporters	Total	diff	t-stat	Non-Exporters	Exporters	Total	diff	t-stat
Age	15.31	33.37	17.74	-18.06	-4.071	15.36	18.3	17.38	-2.94	-2.173
Log Output	9.884	11.07	10.04	-1.186	-4.223	10.01	11.33	10.92	-1.32	-6.630
Number of Workers	126.4	426.9	167.3	-300.5	-3.839	107.8	189.7	164.8	-81.9	-3.013
Log Physical Capital	8.439	10.49	8.715	-2.051	-7.953	9.027	10.42	9.985	-1.393	-5.156
Log Working Capital	7.655	10.08	7.983	-2.425	-8.876	8.605	9.786	9.413	-1.181	-4.810

Electronics						Chemicals				
	Non-Exporters	Exporters	Total	diff	t-stat	Non-Exporters	Exporters	Total	diff	t-stat
Age	13.18	12	13.15	1.18	0.402	20.38	18.97	20.17	1.41	0.520
Log Output	9.678	11.21	9.719	-1.532	-4.311	10.41	12.58	10.78	-2.17	-7.718
Number of Workers	100.8	198.8	103.5	-98	-0.765	159.5	636	241.3	-476.5	-5.319
Log Physical Capital	8.137	9.371	8.17	-1.234	-6.922	9.505	11.82	9.911	-2.315	-8.790
Log Working Capital	7.886	10.06	7.943	-2.174	-3.850	9.046	11.64	9.501	-2.594	-8.841

Source: Bangladesh 2002 Investment Climate Assessment Survey, World Bank

Table 4: Indicators of Financial Constraints

	Non-exporting	Exporting	Total
Access to Finance: Moderate to Severe (2-4) Problem	0.6643	0.6095	0.6407
Access to Finance: Major to Severe (3-4) Problem	0.4506	0.3619	0.4125
Finances for Investment 100% internally financed*	0.262	0.1887	0.2305
Finances for Working Capital 100% internally financed*	0.1907	0.1321	0.1655
Overdraft facility or line of credit	0.6715	0.6506	0.6626
If yes, % currently unused	22.31	30.36	25.63

Source: Bangladesh Investment Climate Assessment survey: 2002, World Bank. Note: All variables are indicator variables except for percent of credit line unused. *100% internally financed and also reported access to finance as a problem.

5.1.3 Access to Finance: Non-exporters are more financially constrained than exporting firms and credit not necessarily allocated according to productivity.

Under perfect financial markets, firms are able to borrow to facilitate production and to overcome the time delays in the receipt of revenue. However, when access to credit is limited, the amount of cash on hand will affect the firm's decision to enter international markets where the time delays are much longer than domestic sales. Table 4 compares financial indicators between exporting and non-exporting firms. Access to finance is a subjective variable where respondents are asked to rank the problem from 0, being no problem to 4 as a severe problem. There is a smaller percentage of exporters who reported access to finance as a problem than the percentage of non-exporters. Furthermore, non-exporters report greater severity of the problem. Respondents are also asked where they sourced their financing for investment and for working capital and report the percentage from each category.[23] Exporters source a smaller percent of their finances internally for both investment and working capital; indicating that exporters do indeed have better access to credit. The last financial indicator is whether the firm has an overdraft facility or a line of credit available to them, and if yes, to report the percent of the line unused. Here, a larger proportion of non-exporters than exporters have overdraft facilities or credit lines however, out of those that do have credit lines, the average percent of credit lines used by non-exporters is higher. This suggests that non-exporters are closer to their borrowing limit than exporters or that exporters generally do not use this type of credit as much. Overall, these statistics suggest that non-exporters have less access to finance than exporters.

It is not only important to verify whether exporters have better access to finance than non-exporting firms but also to see whether access is allocated according to firm productivity. As discussed in the introduction, the results of existing theoretical models is driven by a direct correspondence between productivity and the amount of credit the firm has access to. It is this correspondence that supports the self selection of the most productive firms into exports even under financial distortion. Table 5 shows the average productivity according to each financial variable. There is no significant difference in average productivity between firms that report access to finance as a problem and between firms that fund investment wholly from internal fi-

[23]There are 14 categories the respondents are asked to choose to fill in: a. Internal funds or retained earnings b. Local commercial banks (loan, overdraft) c. Foreign-owned commercial banks d. Leasing or hire purchase arrangement e. Government subsidies f. Investment Funds/Special Development Financing/ Or Other State Services g. Trade credit (Supplier or customer credit) h. Credit cards i. Equity (Capital, sales of stock) j. Family, friends k. Informal sources (e.g. money lender) l By selling other assets m. Letters of credit n. Other (specify source):

Table 5: Productivity by Financial Constrained Indicator Variables

	Average Productivity		
Indicator variable=	No	Yes	t-stat
Access Mod-Severe	4.212	4.127	1.123
	(1.15)	(1.068)	
Access Major-Severe	4.18	4.126	0.7616
	(1.131)	(1.05)	
100% Internally financed Investment	4.177	4.115	0.7433
	(1.107)	(1.105)	
100% Internally financed Working Capital	4.193	4.012	1.906
	(1.108)	(1.09)	
Overdraft Facility/Credit line available	3.978	4.256	-3.8719
	(0.9985)	(1.151)	

Source: Bangladesh 2002 Investment Climate Assessment Survey, World Bank

nance. Productivity is slightly higher for those who can borrow to fund working capital[24] and those who have overdraft facilities. The difference in productivity however, does not appear large and the size of the standard deviations imply considerable overlap in the TFP distribution between constrained and not constrained categories. Therefore there is no strong evidence to suggest that credit is allocated along productivity lines.

5.2 Working Capital and Distance to Export Destination

The 2002 Bangladesh dataset is unique in that the survey asked firms to list their main export destinations and amount exported to each of these destinations for years 2000, 2001 and 2002. From this, a weighted export distance can be calculated for each firm. The availability of data on the distance of the export destination allows a simple test of the relationship between working capital and the export distance by exporting firms. This relationship is a key component of the model: the greater the export distance, the longer the delay in the receipt of payments and the greater the demand for working capital required.[25]

The empirical question is whether the amount of working capital, X, is significantly and positively correlated with export distance among exporting firms controlling for factors that also determine the amount of working capital. If working capital does not vary with distance, than this puts into doubt whether the working capital is driven by delays in the receipt of revenues, or is simply a function of costs. The empirical specification is motivated by the determinants for the amount of cash required to export from Equation 13. Working capital demand increases with time delay S , cost of production C_t, expected cost of production C_{t+1} (to ensure that costs are covered in the interim between production and when revenue is received upon delivery) and with productivity A. The time delay, S , is proxied by the distance to export destination, *distance*. Whether the firm will export in the interim periods during the delays also affect how much working capital is needed. Therefore, working capital demands would also increase with expected relative foreign to domestic price, p.

The stock of working capital kept on hand would decrease with supply of liquidity: the amount the firm can borrow which is measured as short term liabilities, and past export production, proxied by years of exporting, $years\,exporting$.[26]

[24] That is, firms that do not fund working capital wholly internally.

[25] See previous sections as well as refer to Table 2 on page 5 that shows when payments are made and Figure 1 on page 6 for transit times.

[26] Financial constraint variable was not included as this would restrict the sample to one year, and cannot estimate the relationships. Furthermore, the discount rate β could be proxied by reported interest rates but interest rates were also only available for 2002.

Table 6: Working Capital and Distance to Export Destination

Lagged Log Working Capital	(1)	(2)	(3)	(4)
Log weighed distance to export destination	0.382	0.464*	0.668**	0.739**
	(0.237)	(0.241)	(0.338)	(0.349)
Controls for Cost, Productivity, Short Term Liabilities, Years Exporting, Export Price to Domestic Price,		Yes		Yes
Interact sectors*Log distance	No	No	Yes	Yes
Observations	848	780	848	780
R-squared	0.007	0.091	0.017	0.099
Number of firms	459	438	459	438
Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1				

Notes: 2002 ICA World Bank (with recall data from 2000, 2001.). Regressed using fixed effects for the sample exporting firms only. Distance data from Centre d'Etudes Prospectives et d'Informations
Internationales (CEPII), at http://www.cepii.fr/anglaisgraph/bdd/distances.htm using distance measured from the capital city. Up to five countries were reported in the survey (only for 2001 and 2002) and the weighted average distance was calculated by the proportion of export revenue of each country. Productivity calculated from structural estimation of the production function (see Ackerberg et al. (2006)). None of the coefficients for the interactive terms for sector and log distance were significant and are not reported. Log Yrs Exporting is averaged across products. Full regression in Appendix 14 in Table 14

The empirical specification is as follows:

$$X_t = \alpha_0 distance_{t+1} + \alpha_1 C_t + \alpha_2 C_{t+1} + \alpha_3 A_t + \alpha_4 years\,exporting + \alpha_5 credit_t + \alpha_6 p_{t+1} + \varepsilon_t + \mu_i$$

Distance enters the specification as one period ahead as the export distance is realized after the firm makes it's export decision based on current working capital levels.[27] The destination for exports would systematically differ according to industry, and the interaction between sectors and export distance were also included to improve fit.

The specification was estimated using fixed effects and the results are shown in (the full set of estimates are shown in Appendix 14 in Table 14). Column (1) shows the estimation with no other control variables and there is no significant correlation between working capital and the distance to export destination. Column (2) includes controls for cost, productivity and other variables, and columns (3) and (4) include interaction between sectors and export distance.

The estimated results shows that the correlation between working capital and export distance is positive and significant when relevant controls are included. Furthermore, the coefficients for the control variables: Lagged cost, current cost and productivity are correctly signed and significant (see in full estimate results in Appendix 14 in Table 14). The results show that the size of the estimated coefficient for distance is much larger than the estimated coefficients for cost and productivity. The *distance* variable may also be proxying for additional transport costs associated with shipping longer distances. However, the significant and positive coefficient suggests that the distance to the export destination could be the largest factor in determining the

[27]This specification is an approximation given different industries will have different turnover time. The Bangladesh data has a majority of garment and textile firms reflecting the Bangladesh economy and the specification on the timing of working capital and export distance one year ahead fits this particular dataset. Specification using the same time period, i.e. X_t and $distance_t$ yields a negative and insignificant coefficient - that supports the specification for distance as a forward variable.

liquidity needs of the firm, and this could be due to the delays in the receipt of revenues associated with longer shipping times.

5.3 Export Status of the Firm

The model in the Section 4 provides a set of theoretical predictions that could be put to the data: i) when firms are financially constrained, export status is driven by the level of working capital and less by productivity (Areas I, II and IV in Figure 4) and ii) when firms are not financially constrained (Areas III, V and VI in Figure 4), export status of the firm is driven by productivity and changes in working capital does not change the export status of the firm. Thus the main test of the theoretical model is to see whether cash only affects export decisions when firms are financially constrained and at the same time, whether productivity affect export decisions when firms are not financially constrained. Let fc be a dummy that indicates whether the firm is financially constrained, that is whether $X_i < \bar{X}$.[28] [29] The empirical specification is as follows:

$$E_i = \beta_0 fc_i + \beta_1 fc_i * X_i + \beta_2 X_i + \beta_3 fc_i * A_i + \beta_4 A_i + controls_i$$

The test involves four predictions on the estimated coefficients: a) the interaction between financial constraints and working capital, β_1, is positive and significant, b) the coefficient for working capital only, β_2, should not be significantly different from zero, c) the coefficient for productivity when not constrained, β_4, should be positive and significant and d) the coefficient for productivity under constraints β_3 is the negative of β_4 and significant in order for productivity to not affect exports under financial constraints. That is:

$$\begin{aligned} H_0: \quad & \beta_1 > 0 \\ & \beta_2 = 0 \\ & \beta_3 = -\beta_4 \\ & \beta_4 > 0 \end{aligned}$$

The 2002 Bangladesh dataset contains information on the percentage of sales that are exported. Out of the 974 firm observations, only 76 firms reported exporting less than 100 percent. The majority of firms report zero exports with about a third of the firms reporting 100 percent exports. The model does not offer any qualifications on how many firms in the population would export less than 100 percent. However, the fact that the model does predict that there will exist firms who will choose to export less than 100 percent, even in the presence of exporting fixed cost, is a unique and important characteristic of the model. The small number of observations of export percentage makes identification difficult and as a result, the dependent variable used is a export status dummy, E, that is equal to one if the firm engaged in any exports.

The financial constraint variable, fc, is a dummy that is equal to one if the firm reports access to finance as a problem (from minor to major severity) and finances working capital entirely from internal finance (that is, does not use any borrowing from any other sources). The rationale behind interacting these two conditions is that firms may report access to finance as a problem when they actually do have access to borrowing.

[28] Note that financial access questions are only available for 2002, and thus the number of observations available for estimation is 990.

[29] See Chan (2008) for further examination of the financial access variable including sources of variation that determines access to finance.

Table 7: Export Status Estimation Results

Probit	Export Status		
	(1)	(2)	(3)
Financially Constrained	-0.4867***	-0.420***	-0.314
	(0.0917)	(0.137)	(0.202)
FC*Log Working Capital	0.1070***	0.101***	0.0682**
	(0.0317)	(0.0281)	(0.0298)
FC*Productivity	-0.1284	-0.169*	-0.126
	(0.0937)	(0.0966)	(0.107)
Log Working Capital	0.0162	0.0288**	0.0298**
	(0.0112)	(0.0123)	(0.0124)
Productivity	0.3353***	0.355***	0.0621
	(0.0357)	(0.0477)	(0.0419)
Controls	No	Yes	Yes
Sector dummies	No	No	Yes
Observations	959	936	936
Pseudo Rsqr	0.149	0.261	0.391
Log pseudolikelihood	-557.6	-472.7	-389.6

Source: Bangladesh 2002 Investment Climate Assessment Survey, World Bank

Notes: Only 2002 data used for estimation, Bootstrap standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Reported marginal effects, Base line for Equation (3) is Garments.

The measure does however, leave out firms that are able to borrow but remain financially constrained due to reaching borrowing limits or quotas. In this sense, it may not capture all possible financially constrained firms.

Working capital, X , is measured according to the accounting definition: current assets (inventories, accounts receivable, cash and short term credit) minus current liabilities (accounts payable and any short term debt). Productivity, A, is measured as total factor productivity estimated according to Ackerberg et al. (2006) and the production function is estimated for each sector.[30] Controls for other variables in the model that were available from the dataset are: export price to domestic price ratio, log labor cost, log weighted input price, age and sector dummies are also included (base sector as Garments).[31]

The results of export status is shown in Table 7 (full results in Appendix A.4 in Table 13). Results show that under financial constraints, working capital is significant and positive in determining export status of the firm, and this result remains robust even with additional controls across all three specifications. The effects of working capital, without the interaction with financial constraints, is small or insignificant in determining export status. This suggests that working capital increases the likelihood of a firm exporting mainly when the firm is financially constrained. A 10 percent increase in working capital raises the probability of exporting by over 10 percent for a financially constrained firm but by only about 3 percent for a firm that is not constrained. All estimates pass joint significance tests of β_1 and β_3. A possible explanation as to why working capital for non financially constrained firms remains significant under additional controls, even though the size is small (in regressions (2) and (3)), could be due to the financial constraint measure not capturing all possible firms that are constrained.

The estimates for productivity for all regressions are signed according to the model's prediction, that

[30] Estimates using Levinsohn- Petrin (LP2) does not change sign nor significance, but do to some extent change the size of the coefficients. See Appendix for productivity measures.

[31] See Appendix A.3 for table of variables used in estimation.

is, β_2 is negative and β_4 is positive. However the size and significance of the coefficients vary across the 3 regressions. Joint significance test of β_2 andβ_4 can reject the null for specifications (1) and (2). In the specification (3), both coefficients for productivity are jointly insignificant when sector specific dummies are included. This could be due to the small sample size within each sector in the dataset. However, in other empirical studies, such as Greenaway et al. (2007) where empirical specifications always include controls for sectors, they too find that the estimated coefficient for productivity is not significant and their sample contains 23,641 observations. This could be due to the fact that there is more variation in productivity between sectors than between firms within a sector, and this may be in part due to how productivity is estimated. Specification (3) show that within sectors, productivity does not affect export status at all -regardless of whether firms are constrained or not.

In the first and second regression, without sector dummies, the productivity coefficient is large and highly significant, in accordance to theory. The coefficients for the interacted productivity and financial constraint is substantially sized, and only significant in the regression with additional controls. The estimates with additional controls resonates more due to specification and better fit. The results from regression (2) suggest that productivity matter less to the export status of financially constrained firms than unconstrained firms, but the effect does not completely negate the effects of productivity.

Looking at the estimates overall, results provide support for the model's predictions that the effects of working capital and productivity will differ between financially constrained and unconstrained firms. Intuitively, working capital matter more for financially constrained firms, and productivity matters less when firms are unconstrained.

6 Conclusion

Empirical evidence suggests that, particularly in developing countries, financial factors matter for exporting. By extending firm trade models to include dynamic borrowing constraints points to the importance of working capital, as well as productivity for determining the decision to export, the percentage of output that will be exported and their destination. As such, the working capital model adds an important caveat to the established literature on the relationship between productivity and the export decision of the firm. Testing this model empirically with a unique dataset from Bangladesh supports the proposition that working capital and productivity affect export status of the firm and their effects are differentiated by financial constraints. Empirical results also confirm the relationship between working capital and the distance to export destination. The empirical results provide support for the model's predictions that the affects of working capital and productivity will differ between financially constrained and unconstrained firms. Specifically, for financially constrained firms, productivity matters less than for unconstrained firms while working capital matters much more. The correlation between working capital and export distance is shown empirically to be positive and significant, lending support for the working capital model of the firm's export decision.

There are many exciting directions future research in this area need to explore, both at the micro and macro level. On a macro level, the partial equilibrium model of working capital of the firm can be incorporated into general equilibrium models to look at the propagation of the effects of financial constraints across the economy and across countries. Further research and exploration into the dynamic interaction between the financing needs due to time delays and the financial structure of countries has the potential to add insights to international trade patterns. The distortion that financial constraints introduces to the self-selection of the most productive firms into exporting warrants further investigation as to how this may affect overall industry

productivity and thereby the aggregate growth of the economy. In terms of theories of development, if the results of the model is drawn analogously for an economy represented by a single firm, this could potentially prescribe a development path where trade liberalization may play a very minor role at low levels of wealth. This may provide further impetus for developing countries to move quickly in the development of functioning financial systems that allocate financial resources closely in line with productivity and the availability of short term credit and trade credit so that the most productive firms enter exports, and aggregate industry productivity improvements can be reaped from trade liberalization.

On micro level, the working capital model exhibits distortions to factor ratios (also see Chan (2008)) and this could potentially lead to different sectors that export within an economy than those predicted by comparative advantage trade theories. Of particular significance is the need to develop theoretical models and empirical tools that will allow the analysis of the firm at sub optimal production levels, and this is crucial in the study of developing economies where financial constraints are the norm. The estimation of productivity under these conditions warrants urgent attention.

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A Appendix

A.1 Production Function Estimation

The production function is estimated using the ACF method[32], Levinsohn and Petrin (2003)[33] (LP) as well as OLS, fixed effects, random effects by industry. The OLS estimate suffer from collinearity and is shown as a comparison. Fixed effects and random effects estimates relies on strong assumptions on ω_{it} and has not worked well in practice. The LP estimates relies strictly on specific assumptions on the data generating process of the inputs to production that may not hold generally (see Ackerberg et al. (2006)) whereas the ACF estimates allows for more generally plausible assumptions as to when inputs are chosen, and that certain inputs, such as labor, is 'less variable' than other inputs, such as materials.

The ACF method is derived from Ackerberg et al. (2006). The production function is assumed to take the form:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + \varepsilon_{it}$$

Capital is decided at time $t-1$. Assuming that labor is "less variable" than materials, suppose that $l_{it}$is chosen at time $t-b$ after $k_{it}$was chosen at $t-1$ but before m_{it} was chosen at t. Assume that ω_{it}evolved according to a first order Markov process between sub periods $t-1$,$t-b$ and t. Given these timing assumptions, the firm's material input demand at t will depend on $l_{it}$and k_{it}chosen prior to period t: $m_{it} = f_t(\omega_{it}, k_{it}, l_{it})$. Inverting this function will yield:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + f_t^{-1}(m_{it}, k_{it}, l_{it}) + \varepsilon_{it}$$

An estimate, $\hat{\Phi}_{it}$ of the composite term $\Phi_t(m_{it}, k_{it}, l_{it}) = \beta_k k_{it} + \beta_l l_{it} + f_t^{-1}(m_{it}, k_{it}, l_{it})$ can be obtained at this first stage. This represents output net of ε_{it}. Given the first-order Markov assumption on ω_{it},

$$\omega_{it} = E[\omega_{it}|I_{it-1}] + \xi_{it} = E[\omega_{it}|\omega_{it-1}] + \xi_{it}$$

$\xi_{it}$is mean independent of all information known at $t-1$. The first moment condition is derived on the timing assumption that $k_{it}$was decided at $t-1$ and thus uncorrelated with information set I_{it-1}.

$$E[\xi_{it}|k_{it}] = 0$$

The second moment conditions is derived on the timing assumption that lagged labor l_{it-1} was chosen at time $t-b-1$ and is thus also in the information set I_{it-1}. Thus we get two moment conditions to identify β_k and β_l:

$$E[\xi_{it}| \begin{matrix} k_{it} \\ l_{it-1} \end{matrix}] = 0$$

$$E[\xi_{it} \cdot \begin{pmatrix} k_{it} \\ l_{it-1} \end{pmatrix}] = 0 \quad (14)$$

First, use OLS to estimate initial values of (β_k, β_l) and compute: $\omega_{it}(\beta_k, \beta_l) = \hat{\Phi}_{it} - \beta_k k_{it} - \beta_l l_{it}$. Secondly,

[32] Stata code developed by Sivadasan and Balasubramanian (2007)

[33] Utilizing the Stata program `levpet` developed by authors.

non-parametrically regress $\omega_{it}(\beta_k, \beta_l)$ on lag $\omega_{it-1}(\beta_k, \beta_l)$ and constant term to obtain $\xi_{it}(\beta_k, \beta_l)$. Finally, we can obtain estimates (β_k, β_l) from minimizing the sample analogue to the moment conditions in 14 using the implied $\xi_{it}(\beta_k, \beta_l)$.

$$\frac{1}{T}\frac{1}{N}\sum_t \sum_i \xi_{it}(\beta_k, \beta_l) \cdot \begin{pmatrix} k_{it} \\ l_{it} \end{pmatrix}$$

Implementation with Bangladesh Data:

In Sivadasan and Balasubramanian (2007), the ACF method is implemented using capital, skilled labor and unskilled labor with electricity as the intermediate input/proxy. The Bangladesh data has labor, capital, raw materials and well as energy costs. The variability over time of each of these variables within firms in increasing order are: labor, capital, materials and energy. I estimate the production function using two specifications: 1) using materials as an intermediate input and 2) including materials as an input and using energy as the proxy:

$$\begin{aligned}
1. \quad y_{it} &= \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + \varepsilon_{it} \\
m_{it} &= f_t(\omega_{it}, k_{it}, l_{it}) \\
2. \quad y_{it} &= \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \omega_{it} + \varepsilon_{it} \\
e_{it} &= f_t(\omega_{it}, k_{it}, l_{it}, m_{it})
\end{aligned}$$

The estimates are given in Table 8 and Table 9 using the full panel Bangladesh data from 2003-2006 (semi-annual). The estimated coefficients for OLS and FE do not differ greatly in their magnitude. The estimates produced ACF1 using materials as an intermediate input yield unusually large coefficients and ACF2 using electricity as proxy appear to produce more realistic estimates.

Average productivity calculated by each estimation method is reported in Table 10 and the correlation matrix is given in Table 11. The productivity estimate from RE is almost perfectly correlated with the OLS estimate; and the OLS estimate is the naive estimate that suffers from collinearity. Thus, ACF2 estimate and possibly LP2 may provide good proxy for productivity.

Table 8: Production Function Estimates by Sector

	ACF1	ACF2	LP1	LP2	OLS	FE	RE
Garments							
lnl	0.925	0.311	0.227***	0.0718	0.258***	0.202***	0.249***
	.	.	(0.0532)	(0.131)	(0.0568)	(0.0396)	(0.0243)
lnk	0.149	0.085	0.181***	0.0413***	0.0684***	0.0167	0.0642***
		.	(0.0603)	(0.0141)	(0.0163)	(0.0276)	(0.0136)
lnm		0.603	0.466***	0.596***	0.620***	0.552***	0.598***
		.	(0.109)	(0.0269)	(0.0275)	(0.0193)	(0.0135)
Observations	861	861	861	861	861	861	861
# of firms						303	303
Textiles							
	ACF1	ACF2	LP1	LP2	OLS	FE	RE
lnl	0.413	0.245	0.327***	0.399**	0.326***	0.126***	0.295***
	.	.	(0.0438)	(0.167)	(0.0390)	(0.0442)	(0.0267)
lnk	0.753	0.114	0.0536	0.0506*	0.0534**	-0.0233	0.0868***
			(0.0897)	(0.0284)	(0.0250)	(0.0393)	(0.0187)
lnm		0.616	0.462**	0.653***	0.652***	0.290***	0.620***
		.	(0.209)	(0.0298)	(0.0271)	(0.0415)	(0.0180)
Observations	730	730	730	730	730	730	730
# of firms						250	250
Food							
	ACF1	ACF2	LP1	LP2	OLS	FE	RE
lnl	1.176	0.315	0.300***	0.698**	0.345***	0.421***	0.363***
	.	.	(0.0314)	(0.335)	(0.0311)	(0.101)	(0.0326)
lnk	0.294	0.132	0.0236	0.0683***	0.0708***	-0.0277	0.0725***
		.	(0.157)	(0.0231)	(0.0263)	(0.0593)	(0.0236)
lnm		0.665	0.565***	0.374	0.669***	0.511***	0.643***
		.	(0.207)	(0.272)	(0.0316)	(0.0451)	(0.0212)
Observations	427	427	427	427	427	427	427
# of firms						147	147

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors in parentheses

Table 9: Production Function Estimates by Sector

Leather							
	ACF1	ACF2	LP1	LP2	OLS	FE	RE
lnl	0.927	0.192	0.166***	0	0.184***	0.261	0.189***
	.	.	(0.0556)	(0.367)	(0.0540)	(0.186)	(0.0617)
lnk	0.306	-0.005	0	0.0247	0.0394	0.106	0.0467
		.	(0.222)	(0.0352)	(0.0314)	(0.115)	(0.0356)
lnm		0.705	0.671***	0.646***	0.680***	0.674***	0.670***
		.	(0.0480)	(0.0586)	(0.0405)	(0.0832)	(0.0352)
Observations	275	275	274	274	275	275	275
# of firms						99	99
Electronics							
	ACF1	ACF2	LP1	LP2	OLS	FE	RE
lnl	0.722	0.422	0.275***	0.285*	0.279***	0.0576	0.169***
	.	.	(0.0383)	(0.168)	(0.0328)	(0.0362)	(0.0277)
lnk	0.348	0.001	0.0496	0.00273	0.0168	-0.0454	0.0183
		.	(0.135)	(0.0239)	(0.0209)	(0.0343)	(0.0193)
lnm		0.853	0.704***	0.691***	0.733***	2.568***	1.943***
		.	(0.212)	(0.0308)	(0.0253)	(0.506)	(0.182)
Observations	268	268	268	268	268	268	268
# of firms						91	91
Chemicals							
	ACF1	ACF2	LP1	LP2	OLS	FE	RE
lnl	0.775	0.143	0.225***	0	0.228***	0.237***	0.346***
		.	(0.0731)	(0.260)	(0.0652)	(0.0845)	(0.0579)
lnk	0.528	0.082	5.84e-08	0.168***	0.140**	0.321***	0.278***
		.	(0.245)	(0.0649)	(0.0643)	(0.0864)	(0.0386)
lnm		0.759	0.284	0.660***	0.660***	0.334***	0.438***
		.	(0.193)	(0.0744)	(0.0564)	(0.0277)	(0.0268)
Observations	222	222	222	222	222	222	222
# of firms						80	80

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors in parentheses

Table 10: Productivity Measures: Summary Statistics

Calculated TFP	ACF1	ACF2	OLS	FE	RE	LP1	LP2
Garment	4.546	2.300	2.567	4.090	2.894	3.359	4.155
	(0.668)	(0.316)	(0.314)	(0.344)	(0.316)	(0.363)	(0.352)
Textile	2.896	2.221	2.042	7.664	2.201	4.020	1.678
	(0.816)	(0.401)	(0.391)	(1.030)	(0.395)	(0.523)	(0.399)
Food	2.782	1.479	1.860	3.873	2.010	3.405	3.198
	(1.488)	(0.499)	(0.486)	(0.663)	(0.489)	(0.589)	(0.780)
Leather	3.684	2.825	2.680	1.729	2.688	3.247	4.001
	(0.998)	(0.506)	(0.503)	(0.532)	(0.503)	(0.512)	(0.562)
Electronic	4.140	0.589	2.054	2.568	1.946	2.060	2.517
	(1.010)	(0.492)	(0.352)	(0.463)	(0.369)	(0.356)	(0.364)
Chemical	1.833	1.781	1.781	3.156	2.037	6.882	2.585
	(0.908)	(0.486)	(0.472)	(0.682)	(0.542)	(1.129)	(0.534)
Total	3.502	1.999	2.220	4.540	2.397	3.684	3.060
	(1.300)	(0.724)	(0.515)	(2.114)	(0.563)	(1.212)	(1.118)
Observations	2786	2783	2783	2783	2783	2783	2783

Notes: Reported means with standard deviation in parentheses

Table 11: Correlation Matrix of TFP Measures

	ACF1	ACF2	OLS	FE	RE	LP1	LP2
ACF1	1						
ACF2	0.2486*	1					
OLS	0.5947*	0.7498*	1				
FE	-0.1046*	0.2700*	-0.0402*	1			
RE	0.6124*	0.7743*	0.9582*	0.0344*	1		
LP1	-0.2637*	0.3435*	0.0323*	0.2835*	0.1374*	1	
LP2	0.6113*	0.3989*	0.7011*	-0.5176*	0.7352*	-0.0918*	1

Table 12: Interquartile Range and Median of Productivity by Industry

	Productivity:TFP	25th percentile	Median	75th percentile
Garments	Non-Exporters	2.14	2.24	2.47
	Exporters	2.09	2.24	2.46
Textiles	Non-Exporters	2.06	2.2	2.34
	Exporters	2.04	2.22	2.42
Food	Non-Exporters	1.19	1.42	1.71
	Exporters	1.02	1.35	1.62
Leather	Non-Exporters	2.55	2.77	2.88
	Exporters	2.68	2.83	3.03
Electronics	Non-Exporters	0.31	0.517	0.892
	Exporters	0.293	0.363	1.06
Chemical	Non-Exporters	1.48	1.71	1.95
	Exporters	1.48	1.75	2.18

A.2 Productivity Distribution Between Exporters and Non Exporters by Sector

A.3 Variable Description

Variable	Description
FC	Indicator variable: Finances for Working Capital 100% internally financed and the firm access to finance as a problem (of any levels)
lnwc	Log Working Capital. Working capital as defined by accounting definition: current assets (inventories, accounts receivable, cash and short term credit) minus current liabilities (accounts payable and any short term debt)
FC*Log Working Capital	Interactive term: financial constraint and log working capital.
Productivity: ACF	Total factor productivity estimated according to Ackerberg et al. (2006)
FC*Productivity	Interactive term: financial constraint and productivity total factor productivity estimated according to Ackerberg et al. (2006)
Export Price to Domestic Price ratio	Ratio of export price to domestic price. For firms where ratio is missing, filled in with average ratio taken across year and sector.
Log Labor Cost	Total wage bill divide by the number of employees.
Log Input Price	Weighted average price of top three most important inputs.
Age	Years since establishment.

A.4 Export Status

A.5 Working Capital and Distance to Export Destination

Table 13: Export Status Estimation Results

Probit	Export Status		
	(1)	(2)	(3)
Financially Constrained	-0.4867***	-0.420***	-0.314
	(0.0917)	(0.137)	(0.202)
FC*Log Working Capital	0.1070***	0.101***	0.0682**
	(0.0317)	(0.0281)	(0.0298)
FC*Productivity	-0.1284	-0.169*	-0.126
	(0.0937)	(0.0966)	(0.107)
Log Working Capital	0.0162	0.0288**	0.0298**
	(0.0112)	(0.0123)	(0.0124)
Productivity	0.3353***	0.355***	0.0621
	(0.0357)	(0.0477)	(0.0419)
Export Price to Domestic Price ratio		0.185***	-0.0506
		(0.0207)	(0.0984)
Log Labor Cost		-0.0479	0.00266
		(0.0430)	(0.0349)
Log Input Price: Weighted		0.0163*	0.0320***
		(0.00990)	(0.0100)
Age		-0.000668	0.00246
		(0.00142)	(0.00160)
Textile Sector			-0.574***
			(0.0881)
Food Sector			-0.519***
			(0.0284)
Leather Sector			-0.333**
			(0.132)
Electronics Sector			-0.512***
			(0.0375)
Chemical Sector			-0.461***
			(0.0265)
Observations	959	936	936
Pseudo Rsqr	0.149	0.261	0.391
Log pseudolikelihood	-557.6	-472.7	-389.6

Source: Bangladesh 2002 Investment Climate Assessment Survey, World Bank

Notes: Only 2002 data used for estimation, Bootstrap standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Reported marginal effects, Base line for Equation (3) is Garments.

Table 14: Working Capital and Distance to Export Destination

Lagged Log Working Capital	(1)	(2)	(3)	(4)
Log weighed distance to export destination	0.382	0.464*	0.668**	0.739**
	(0.237)	(0.241)	(0.338)	(0.349)
Lagged Log Total Cost		0.339***		0.322***
		(0.107)		(0.108)
Log Total Cost		0.233**		0.222**
		(0.0917)		(0.0929)
Lagged Total Factor Productivity		0.212*		0.205*
		(0.111)		(0.112)
Log Short Term Liabilities		-0.00735		0.00681
		(0.116)		(0.117)
Log Yrs Export		0.160		0.174
		(0.117)		(0.120)
Export Price to Domestic Price ratio		0.0230		0.0229
		(0.0220)		(0.0222)
Interact sectors*Log distance	No	No	Yes	Yes
Constant	5.971***	-1.877	4.267*	-3.054
	(2.112)	(3.031)	(2.479)	(3.664)
Observations	848	780	848	780
R-squared	0.007	0.091	0.017	0.099
Number of firms	459	438	459	438
Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1				

Notes: 2002 ICA World Bank (with recall data from 2000, 2001.). Regressed using fixed effects for the sample exporting firms only. Distance data from Centre d'Etudes Prospectives et d'Informations
Internationales (CEPII), at http://www.cepii.fr/anglaisgraph/bdd/distances.htm using distance measured from the capital city. Up to five countries were reported in the survey (only for 2001 and 2002) and the weighted average distance was calculated by the proportion of export revenue of each country. Productivity calculated from structural estimation of the production function (see Ackerberg et al. (2006)). None of the coefficients for the interactive terms for sector and log distance were significant and are not reported. Log Yrs Exporting is averaged across products.