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Essays on Firm Behavior

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ESSAYS ON FIRM BEHAVIOR

by

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The Indian economy has received considerable interest in economic research in the last decade. Economic liberalization, greater participation in world trade and the availability of long panel of firm level data has encouraged empirical work on the Indian economy. My research adds to this growing empirical literature on the behavior and performance of Indian firms post liberalization.

This thesis comprises three chapters. In the first chapter, I provide a brief summary of reforms in India, review some of the papers analyzing firm behavior and performance and put it in the perspective of the liberalization process in India. The literature on Indian liberalization and on various aspects of firm behavior and performance is plentiful. I have limited my review to the papers which have influenced my research.

In the second chapter, I analyze the relationship between financial constraints faced by the Indian manufacturing firms and their export participation decision. I find that the firms that enter the export market are financially healthier than the firms that cater only to the domestic market. I also verify that financial health is the cause and not a consequence of exports.

In the last chapter, I address the relationship between firm size and its total factor productivity in the Indian manufacturing industries (co-authored with Prabal De). While small firms have the advantage of smaller and more flexible management and lower response time to market changes, larger firms have advan-

tages of economies of scale, political clout and better access to government credits, contracts and licenses, particularly in developing countries. We find that small Indian firms are more productive than their larger counterparts

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This journey would have been a much longer one without the enabling support of my two wonderful sons, Aditya and Mayank Iyer. They are two of the most well behaved, loving and giving kids (even after accounting for good genes and good parenting!). Most importantly, my best friend, biggest critic and ardent supporter, my husband Nagaraj Swaminathan - we survived it!!

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[1] Co-authored with Prabal De, City College of New York

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CHAPTER 1

LIBERALIZATION AND FIRM BEHAVIOR - THE INDIAN CONTEXT

1.1 Economic Liberalization in India

Post independence, India's development strategy was two pronged - one, to set up core industries to produce basic manufacturing infrastructure like energy, machinery, automobiles, chemicals and other capital goods; and the other, to develop small enterprises all across the country to produce consumption goods and provide employment.

As part of its planned development program, the government owned a large proportion of the manufacturing plants. Private enterprises had to obtain licenses to set up manufacturing plants or to expand operations. Prices and distribution of most commodities were regulated by the government. Many industries were reserved for small enterprises. While this centralized planning system was successful in establishing the core industries, it also led to inefficiencies. Investment ceilings and reservation for small industries proved to be a disincentive to growth. Inefficiencies and shortages resulted in higher prices. Loss-making public enterprises were subsidized by the government contributing to increasing government deficits. Pre-emptive use of public savings by the government to monetize its deficits and government's policy directing credit towards subsidized sectors at the expense of the private sector stifled economic growth. Ahluwalia (1985) analyzes the stagnation in India's industrial sector pre-reforms.

The financial markets were underdeveloped and highly regulated. Excessive

structural and micro regulations led to a distorted interest rate mechanism. The lack of market driven norms and lack of transparency affected the profitability of the banks as well. There was a massive increase in the Non Performing Assets (NPAs) of the banks (Mathur, 2007; Koeva, 2003). This kind of banking and financial system led to a McKinnon - Shaw[1] kind of inefficiency in the repressed financial market and posed credit constraints on the productive firms [2].

The Indian government initiated economic reforms in the 1980s. However, by 1991 mounting government debt led the economy to the brink of insolvency. The government agreed to IMF's recommendation of a systematic liberalization of its industrial, trade and financial policies.

As part of industrial liberalization the government did away with licensing requirements for most industries except for strategic industries such as defense, essential drugs and pharmaceuticals. Government eliminated investment ceiling that had prevented capacity expansion by manufacturing firms beyond stipulated limits. It opened up industries for private participation that were previously exclusively reserved for the public sector. It also divested its holdings in such industries. It further reduced the number of industries reserved for small enterprises and changed the definition of small enterprises to accommodate firms with larger asset sizes[3]. Sharma (2008) describes the changes in the industrial policy undertaken by the Indian government during this period.

Under trade liberalization, the government allowed imports of previously re-

[1] McKinnon & Shaw refer to an economy with controlled financial markets where the interest rates are held artificially low and credit is rationed; which leads to misallocation of funds. A higher but market-determined interest rates and a unified capital market with competition will improve the quality of investments in such an economy. (Mckinnon 1973).

[2] Please refer Sen & Vaidya, 1999 for a detailed analyses of the reforms in the Indian financial sector.

[3] In India, size of an enterprise is defined by its asset size (value of plant and machinery and other equipments).

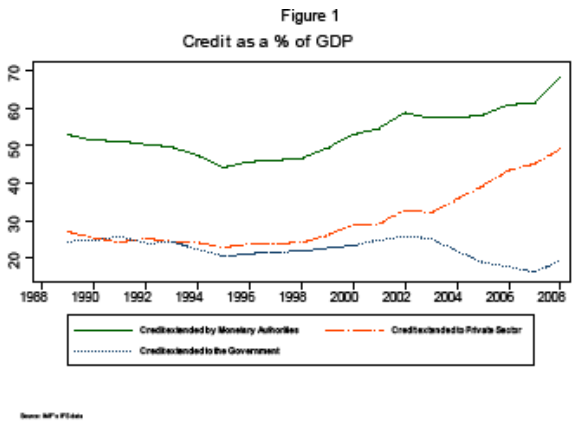

Figure 1.1: Credit as a Percentage of GDP

stricted items. It reduced import duties and simplified the duty structure. It also abolished license requirement for importers.

As part of financial liberalization, the government took multiple steps in the banking sector. It encouraged the privatization of the banking sector by divesting in public sector banks and allowing private sector banks (including foreign banks) to operate. While the government allowed greater flexibility to the banks in their term deposits and loans offering, it mandated better accounting standards to increase transparency and reduce non-performing assets. As part of financial liberalization, the government reduced its administrative control over interest rates and made government borrowings from the public more transparent and at market rates. Figure 1 shows that not only did the banking system provide more credit over the years but also that a larger proportion of this credit was offered to the private sector. It allowed foreign equity in many industries and also allowed firms to raise equity in foreign markets. Figure 2 shows the increase in the amount of equity and debt raised in the international market.

As these changes were implemented over a period of time, India's liberalization has often been called "gradualist" in nature. Though licensing was done away with

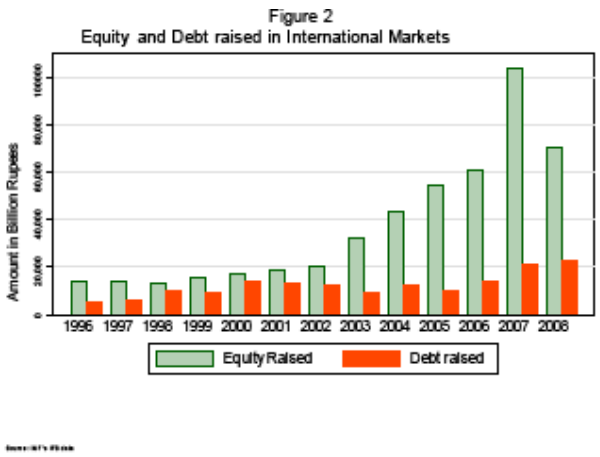

Figure 1.2: Equity and Debt Raised in International Markets

for many industries on a single day, most other changes were made over a period of ten years. In spite of the modest pace of reforms, there has been a substantial bearing on the behavior and performance of Indian firms.

Panagariya (2004) summarizes and compares the early reforms of 1980s to those of the 1990s. He contends that the reforms of 1980s did fuel output and productivity growth but that growth could not have been sustained without more reforms. He further states that the industrial growth after the reforms of the 1990s have been lackluster due to draconian labor laws and continued reservation for small enterprises.

Bollard, Klenow and Sharma (2012) find sizeable productivity growth (about 5 percent per annum) in large Indian firms post reforms. They call it India's "mysterious manufacturing miracle" as they find that the effect of reforms account for a negligible portion of the productivity growth. The increase in productivity is due to the changes within firms and not due to the post-reform reallocation of resources from low productivity firms to high productivity firms. They state that the short length of their data, their metrics for the policy reforms and the fact that the effects of the reforms take longer to show in the data could have contributed

to the surprising results.

Morris and Basant (2006) analyze the impact of banking sector reforms on the availability of funds for private sector firms, especially small enterprises. They find that most of the foreign direct investment has gone to larger firms. Though the gross domestic savings of the economy as a whole went up, the proportion of this savings going to the banking sector reduced, as most of it was sponged off by other small saving schemes like mutual funds. The non-banking sector invested these small savings mostly in the larger firms. Thus, small firms have been starved of finances, notwithstanding the increase in the economy's gross domestic savings.

Topalova (2004) gives a detailed summary of the corporate sectors growth post reforms. She finds that in the two decades following industrial liberalization in 1991, the number of registered firms and paid up capital grew steadily. In spite of the growth in the number of private firms, their paid up capital comprised only about one-third of the corporate sector. The fewer government owned firms still accounted for a large part of the paid up capital. She finds that Indian firms performed well for a period of five to seven years after the reforms, but the growth showed signs of weakening especially with poor financial health of the firms, as I mention in the next section.

The above mentioned papers, underscore the need for further reforms. The reforms of the 1990s encouraged private enterprise only to some extent. For sustained economic growth it is important to not just increase the availability of capital but also improve its allocation amongst firms. This in turn will promote small and medium enterprises for a more equitable and broad-based growth. Economic policy also needs to encourage trade. Both import and exports improves efficiency of the firms and open up a wider marketplace for them.

In the following sections, I concentrate on some of these factors. Specifically, I look at the theoretical and empirical offerings on the analyses of firm behavior and performance especially in the context of the Indian economy. In the first section, I review the literature on financial constraints and firm behavior, in the second I focus on trade and firm behavior and in the last on performance of small enterprises.

1.2 Financial Constraints and Firm Behavior

There is a large body of work on financial constraints and firm behavior. One paper which contributed to this literature is Fazzari, Hubbard and Petersen (1988), hereafter called FHP. FHP finds that in the presence of capital market distortions, internal and external sources of capital are not perfect substitutes. In the face of financial constraints, internal funds have a cost advantage over external funds. Therefore, a firm's investment decision depends on its financing decision. This is especially true for smaller and younger firms due to the presence of information asymmetries in capital markets. FHP studies a panel of US firms and show that firms' investment decision is sensitive to the balance sheet measure of liquidity.

If information asymmetries could trigger financial constraints for small firms, an underdeveloped financial market would only worsen it. Presence of financial constraints and its influence on firms' investment decision for a developing economy is analyzed by Tybout (1983). Tybout builds a theoretical investment model incorporating cost of liquidity and tests this model on Columbian data. He studies the impact of credit rationing (credit directed to certain sectors/industries of the economy to the neglect of others) on investment behavior of Columbian firms.

He finds that for firms which are not favored under the credit rationing regime (therefore face an increased marginal cost of borrowing) investment outlay is more closely tied to availability of liquid internal funding. This result is especially true for small firms. Nabi (1989) finds that manufacturers of farm machinery in Pakistan that do not have access to low cost capital in the organized capital markets are unable to realize their investment plans as compared to those that can. He uses the presence of an organized capital markets (comprising banks and financial institutions) and the unorganized and informal lending institutions (community chit funds [4]) to identify firms with credit constraints.

The papers described above establish the impact of financial constraints on investment behavior in both developed and underdeveloped economies. To address the problem of credit constraints in underdeveloped financial markets, many emerging economies have initiated reforms in the financial sector. This leads us to examine if financial reforms improve efficiency in investment allocation.

Jaramillo, Schianterelli and Weiss (1993) study the effects of liberalization in the financial markets on performance of individual firms in Ecuador. Specifically, they study the effect of removal of administrative control over interest rates and elimination or scaling down of directed credit programs on financial constraints of individual firms. They estimate a modified Euler equation for investment – modified to adjust for increased leverage of financially constrained firms. They find that financial reforms did not have much effect on financial constraints faced by firms. However, they state that a short length of data and macroeconomic changes in Ecuador influencing the effect of financial reforms in the economy might have affected these results.

[4]Chit funds are specified persons in a group who contribute a specific sum of money in periodical installments and each person is entitled to the prize money at his turn.

Gallindo, Schianterelli and Weiss (2003) analyze the above relationship using firm level panel data from twelve developing economies including India. They build an index of efficiency of allocation of investment funds. They find that post liberalization allocation in these countries has been more efficient.

Athey and Laumas (1994) examine the importance of internal funds and depreciation for investment by manufacturing firms in India. They find that both depreciation and availability of internal funds have significant explanatory power in explaining firm level investments. They find that internal funds are relatively more important for large firms. Their study does not capture the post reform changes.

Topalova (2004) looks at the reforms undertaken in India in the 90s and evaluates the financial vulnerabilities of firms post reforms. She finds an initial improvement of financial indicators followed by a worsening in most of these indicators. She finds that Indian firms are highly leveraged and a higher proportion of the total borrowings were short term debt. Indian firms also became less liquid in that time period- their current ratio (current asset to current liabilities) worsened from 1.64 in 1990 to 1.49 in 2001. The number of firms with current ratio lower than one, that is the firms who could not meet their current liability with their current assets rose 11 percent in 1989 to 27 percent in 2002. The share of companies that were unable to generate enough cash to meet their interest payment rose from 15 the sample used in 1989 to 31 percent in 2002. This was in spite of interest rates remaining constant.

Gupta, Hasan and Kumar (2008) analyze the constraints on growth of the manufacturing sector in India post reforms. They conclude that growth in the Indian manufacturing sector has been heterogeneous and that lack of infrastructure

development and financial sector development has adversely affected the growth of many industries.

The papers above underscore the importance of availability of credit for firms' investment decision and also indicate the presence of credit constraints faced by firms in India even in the post reforms period.

1.3 Trade and Firm Behavior

There have been many papers on the effects of international trade. I examine only the ones which study the effect on firm performance. International trade has an impact on not just the amount of imports and exports of the firm but also the variety and quality of products it manufactures, the productivity of the firms, increase in investment on technology and research and development and impact of reforms on labor outcomes. Recent empirical literature on trade and firm behavior has benefitted from two papers; Melitz (2003) and Bernard, Eaton, Jensen and Kortum (2003). I will address the latter as BEJK. Both these papers explain the relation between trade and plant productivity.

Melitz shows how the presence of sunk costs of entry into the export market, separates firms into non-exporting and exporting firms. Only more productive firms, which are able to undertake the investment of market entry, will remain in the export market. The less productive will cater only to the domestic market and the least productive will exit the industry. This churning of firms by productivity level will increase the aggregate productivity of the industry. An economy opening up to international trade or undertaking trade reforms to increase exports, will therefore, experience an increase in aggregate productivity.

BEJK also demonstrate that exporting requires a higher productivity level than catering only to the domestic market. They build a multi country trade model introducing imperfect competition in the Ricardian set-up. They combine transportation costs, costs of inputs, heterogenous productivity and elasticity of substitutions to determine the joint distribution of costs and mark-ups. They fit their model to the US firm data and run simulations that show that only more productive firms export.

A number of other papers have illustrated how trade has improved productivity. Amiti and Konnings (2006) show how imports of intermediate inputs increase productivity of firms in Indonesia. They compare gains in plant productivity from a fall in final goods tariff to the gain from the reduction in tariffs on intermediate goods. Imported inputs raise productivity via learning, variety and quality of inputs whereas a fall in output tariff raises productivity via increased competition. They find that productivity increase linked to fall in tariffs of intermediate inputs is twice as high as that from fall in tariffs on final goods.

Khandelwal and Topalova (2011) conduct a similar study for Indian manufacturing firms. They too compare the effect of lower input tariff to lower output tariff on productivity. They conduct this study on Indian manufacturing firms, pre and post trade reforms. They find that though tariff reduction on both input and output has a positive effect on productivity, reduction of input tariff has a stronger influence on productivity.

Trade also influences the variety and quality of goods produced in the economy. Grossman and Helpman (1990) provide a detailed model analyzing the effects of trade on innovation. They mention the various conditions under which trade promotes innovation. They define innovation in terms of quality of the same set of

products and in terms of wider range of differentiated products (variety of products). Their analysis provides the theoretical background for further empirical work.

Goldberg, Khandelwal, Pavcnik and Topalova (2011) examine the effect of trade on number of products for Indian firms. They study the impact of declining import tariff costs and imports of intermediate inputs on increase in the number of final goods produced by Indian firms post trade reform. Input tariffs were reduced differentially across sectors. The industries which experienced the largest declines in input tariff contributed most to the introduction of new products. They find that lower input tariffs of intermediate inputs account for 31 percent of the new products introduced by domestic firms that imported these intermediate inputs.

Bernard, Redding and Schott (2011) in their forthcoming paper analyze the impact of trade on selection of firms into the export market and selection of products by the exporting firms. They develop a general equilibrium model where only the most productive firms export and the exporting firms export only the most profitable products. This churning of firms and products due to trade increases the aggregate industry productivity. They use US transaction level trade data to test their model and find strong support for many of the implications of the model.

There is also a sizeable amount of work establishing the relationship between total factor productivity and export participation (Roberts and Tybout, 1997; Bernard, Eaton et al, 2003; Bernard and Jensen, 2004; Baldwin and Gu, 2003). The work on financial constraints and export participation is still nascent and sparse. Paravisini, et al (2011) analyze the effect of credit shortage following a financial crisis on exports of Peruvian firms. They find no effect on the extensive margin but a fall in the intensive margin of exports. Muuls (2008) builds a heterogeneous firm

model with liquidity constraint and links it to the pecking order of exports (firms exporting to the smallest and furthest away economies are more productive and less credit constrained) and the effect of currency appreciation. She empirically tests her model on Belgian firms using credit scores by a private credit insurance firm, as the measure of liquidity. She finds that firms that have higher productivity levels and lower financial constraints are more likely to export. Greenaway, Guariglia and Kneller (2007) analyze the effect of credit constraint on export participation decision. They study firms in the UK for a ten-year period. They find financial health to be an outcome rather than a determinant of entry into the export market. Berman and Hericourt (2010) study this relationship for a number of countries for three consecutive years. They find financial health to be a determinant rather than an outcome of export-market entry decision. Minetti and Zhu (2011) study the impact of credit rationing on firms export performance for Italian firms using a survey data for the year 2001. They find that firms that said they were credit rationed had a lower probability of exporting. Bernard and Jensen (2004), (referred to as BJ now on) study a panel of US manufacturing plants and analyze their exporting decision. They find plant characteristics and past exporting experience to be very influential in the exporting decision. I follow their methodology closely as described in the empirical section.

The study of this relation between financial constraints and export participation is very important in the context of developing countries. Trade, and specifically export promotion, is important for the growth of developing economies. Other than India a number of developing economies have consciously replaced import substitution policies with export promotion policies in the last two decades. Argentina, Brazil, Turkey are some examples of economies pursuing trade reforms. However, trade liberalization by itself is not sufficient to promote exports. Fi-

nancial constraints faced by firms act as an entry barrier to exports. Therefore, understanding the relation between financial constraints and export participation is critical to trade policy decisions. In the next chapter, I address this relation between financial constraints faced by firms and their export market entry decision.

1.4 Firm Size and Performance

As mentioned earlier, the Indian government gave the growth and development of small enterprises considerable importance. This policy of the government did contribute to the growth of and employment generation by the small enterprises. At the same time, this policy has often been criticized for discouraging investment by these enterprises and the lack of their growth to become mid sized firms. The policy has also been criticized for directing credit away for potentially more productive projects.

The question of whether the government should promote and protect smaller firms needs, among others, a careful analysis of the productivity of smaller firms relative to the larger ones. Smaller firms suffer from scale disadvantages, lower access to credit and necessary political clouts to influence policy (Tybout, 2000). At the same time, there is evidence that smaller firms generate more patents per capita, and have more flexible management style and agility to adapt to technology changes (Dhawan, 2001).

In one of the earliest papers, Williamson (1967) captured this trade-off in a model of hierarchical control; where the benefits of increasing returns from growing in size are countervailed by the increasing cost of managerial complexity. The models that followed, built on this advantage of small firms – leaner and more

flexible management. Further, small firms can be more receptive and adaptive to new technology. One advantage of having a smaller scale is that the production process is less deeply entrenched in existing technology. Dhawan (2001) provides an excellent summary of the theoretical arguments for small firms being more productive.

Jovanovic (1982) proposed an early theorization of small firms being more efficient. In this world, price-taking firms enter the industry knowing the distribution of cost, but ignorant about their individual draws. After the idiosyncratic efficiency draw is made, a firm discovers whether it is efficient enough to survive and grow or not. Firms with bad draws leave the industry, leaving more efficient firms to operate. As a result, in the observed data, small firms appear most efficient. However, this line of research focuses on cost efficiency and not total factor productivity.

Idson and Oi (1999) argue that workers in large firms reap the benefits of increasing returns (brought in by big volumes) by having less idled time and producing more. There is some related literature on Gibrat's Law, which states that firms grow at rates that are independent of their sizes. However, there is no implication for productivity. Tybout (2000) also attributes the (potential) higher productivity of large firms in developing countries to variables like increasing returns and lobbying power.

There are two strands of a related literature that emphasizes a firm's size in influencing variables that potentially affect productivity. The first is access to credit. Information asymmetries and underdeveloped financial markets, common in developing countries, limit small firms' access to finance. In a firm-level survey of 54 countries Beck et al (2005) find that financial, legal and corruption problems limit the growth of the small firms. This provides a channel through which size

may matter for productivity. A second channel is the link between investment in research, innovation and productivity. While large firms are financially able to invest in research and development at a large scale, there is evidence that research investment by smaller firms is more efficient, for example, in terms of generation of number of patents.

Empirical evidence on size-performance relationship too has been mixed. A summary of the extant literature is also complicated by the fact that a wide variety of measures of productivity and firm size has been used in the literature. For instance, the most popular metric of firm size has been employment, regardless of its output, asset or market share. Similarly, labor productivity has often been used instead of total factor productivity. Finally, apart from productivity, a variety of indicators of performance such as profit rate, employment, survival and growth have been used.

For firms in the United States, Dhawan (2001) found results that are largely similar to those of ours - smaller firms are more productive, but are less likely to survive compared to their larger counterparts. Baily et al. (1996) found that if we measure a firm's size in terms of employment, then firms getting smaller (in other words, downsizing) did not gain productivity.

Size heterogeneity in developing countries too is a pervasive phenomenon. Industries within the manufacturing sectors in developing countries have been characterized by size-heterogeneity of such high degree that Tybout (2000) calls it a form of 'dualism'. Unfortunately, the evidence in terms of size and performance in these countries is limited in nature. This is not surprising, because many developing countries either lack a significant manufacturing sector, or dependable data, or both. Fortunately, with both growth in industry and better data collection, new

research is coming up.

In Asia, studying Taiwanese firms, Aw (2000) found that small firms no less productive than their larger counterparts. In a related study, Aw et al. (2001) also found that small and medium size firms contribute a significant amount to the productivity growth of the industries they inhabit. In Africa, analyzing manufacturing firms in nine African countries, Van Biesebroeck (2005) found that large firms are more productive and have higher growth rates. However, Bigsten and Gebreeyesus (2007) find that small firms in Ethiopia actually grow faster than the larger ones. In the Indian context, Mazumdar (2009) points out the absence of the mid size firm in India. He calls the bi modal distribution of employment with the small and large firms employing more than the mid-sized firm - the missing middle. He also finds considerable difference in productivity between the small and large firms – the small firms being less productive. He measures size in terms of employment and productivity in terms of value-added per worker.

As mentioned earlier, most of the above papers measure firm size on the basis of employment. In India, size of an enterprise is determined on the basis of asset size. Policies promoting small enterprises are based on this definition of size. It is therefore pertinent to study the relation between size and performance of firms in the Indian context with the asset definition of size. In the last chapter, I analyze the relation between size of firms (defined in terms of assets) and its productivity.

The papers reviewed above have added to the growing knowledge of firm behavior and performance especially in the Indian context. The data and literature on the Indian economy provides tremendous potential for further research in this area.

CHAPTER 2

FINANCIAL CONSTRAINTS AND EXPORT PARTICIPATION

2.1 Introduction

A firm entering the export market incurs costs for undertaking market research, market development, distribution channel development and other such activities. Many of these costs are non-recoverable fixed costs. A forward-looking manager would weigh these sunk costs incurred during market entry, against the future stream of income. Therefore, entering the export market becomes a question of which firms have the ability to undertake this investment. A financially constrained firm will not be able to undertake this investment, hindering its ability to enter the export market. A financially constrained firm will behave as if its discount rates were higher, which in turn affects its investment allocation. The financial constraint could be a result of asymmetrical information, underdeveloped financial markets, an unfavorable policy regime, regulated bank lending or corporate tax structure (Whited, 1992; Fazzari et al, 1988). In this paper, I investigate the relation between financial constraints and firms' export market entry decision for the manufacturing sector in India for the period 1989-2008.

As discussed in the previous chapter, India underwent both trade and financial liberalization in the last two decades. Trade liberalizing policies were undertaken prior to financial liberalization. The existence of underdeveloped financial markets in such a scenario makes the Indian economy a good candidate to study this relationship between financial constraints and export participation. The availability of panel data over a long period of time helps address the issue of persistence in productivity and export behavior. Having a panel also allows us to address the

issue of unobserved heterogeneity of firms.

In the literature on export participation, much emphasis has been laid on the importance of a firm's productivity in its export participation decision (Melitz, 2003; Roberts & Tybout, 1997; Bernard, Eaton et al, 2003). According to the Melitz (2003) model, firms self-select into the export industry if their productivity is high, as it enables them to undertake the investment associated with new market entry. The Melitz model describes a plant level decision. If the decision to enter the export market is a firm level decision, a number of other factors come into play - one of which is financial constraints. In this paper, I consider the lack of availability of finance, which might constrain a firm's entry into the export market.

I use the data from the balance sheet and audited financial statements of Indian firms collected by Center for Monitoring Indian Economy's (CMIE) in their Prowess database. The data is an unbalanced panel of manufacturing firms for the period 1989 to 2008.

The measures of financial constraint that I consider are liquidity and leverage ratio of these firms. I use a fixed effects estimator, random effect Probit estimator, and a system General Method of Moments (GMM) estimator to estimate the effect of financial constraints on export participation while controlling for firm and industry specific effects. The results suggest strong correlation between financial health and export participation decision. I then establish causality – better financial health encourages export participation and not the other way around- using two estimators. The positive relation between finance and exports does not hold for the intensive margin of exports (increase in exports of continuing exporters). All these results support the hypothesis that presence of financial constraints hinders export market entry. It underscores the importance of having a well-developed

and smoothly functioning financial market to the firms' export participation.

The paper is organized as follows. The next section explains the theoretical background, section 3 discusses the empirical model, section 4 describes the data, section 5 summarizes the estimation results and specification tests and section 6 is the conclusion.

2.2 Theoretical Background

Theoretical explanation of firm-level export participation got an impetus from Marc Meltiz's seminal work on impact of trade on aggregate industry productivity. The Melitz model is a heterogeneous firm model. In his model, the fixed costs associated with entry into the export market creates a hysteresis in the industry with only the more productive firms exporting. The firms that are less productive cater only to the domestic market and the least productive exit the industry.

One of the assumptions of the model is that all firms, exporters and non-exporters, cater to the domestic market. Melitz separates each firm's profit into two - profit earned from the domestic market π_d and profit earned from the export market π_x. As the fixed production cost f has already been incurred for domestic production, he accounts for it entirely in the domestic profit. The fixed cost of entry into the export market f_x partitions the firms based on their productivity into exporters and non-exporters.

Melitz builds productivity into the marginal cost of the firms. This, in turn, affects their profitability. Firms that have lower productivity and hence lower profitability will not be able to undertake the fixed cost of entry and therefore will

not enter the export market.

The domestic profit is given by

$$\pi_d = R(\omega, \rho, \sigma) - f$$

and

$\pi_{i,d} \geq 0 \quad iff \quad \omega_i \geq \bar{\omega}$ where R is the variable profits of the firm i which is a function of its productivity (ω), price (ρ) and elasticity of demand (σ) of the product. Only firms that have productivity higher than a particular amount say $\bar{\omega}$, can remain in the industry. All other firms will not make profits and will be forced to exit the industry. For a firm to export, its productivity should be higher than those of the firms that cater to only domestic market. The Melitz model,however, does not talk about how the export entry cost, f_x, is financed by the firms. The underlying assumption is that the cost of financing is negligible and the same for all the firms.

I introduce here the presence of capital market imperfections as described by Fazzari et al (1998). The presence of information assymetry, capital market imperfections and regulated credit creates a difference in the cost and availability of credit to firms in the economy. The difference in the cost of capital for firms implies that the cost of entry into exports could be financed differently by the different firms. The cost of capital will be higher for firms that have less access to external or internal funds and lower for firms that are cash rich or can raise funds easily. This financial heterogeneity in firms will create a partitioning of firms into exporters and non-exporters irrespective of their productivity.

The profit function for an exporter then is $\pi_x = R(\omega, \rho, \sigma) - (f + f_x)(1 + r_i)$

Here, the fixed cost is a function of the firm's cost of capital. The cost of capital r_i refers to firm specific cost of capital and not the prevalent market interest rate. The possibility of making positive profits attracts new firms to the industry. Firms enter the industry till the last firm entering makes zero profits. As in Melitz (2003), I refer to this as the zero cutoff profit condition where $\pi_x = 0$.

$\Rightarrow R(\omega, \rho, \sigma) = (f_x + f)(1 + r_i)$

The cutoff productivity is given be $\hat{\omega} = R^{-1}((f_x + f)(1 + r_i), \rho, \sigma)$

Only firms with productivity higher than this level of productivity $\hat{\omega}$ will consider entering the export market. The ability of such firms to enter the export market, depends on the cost of capital r_i. It is this relation that I analyze in my paper.

The financial heterogeneity of firms is not just due to capital market imperfections but also due to a number of features intrinsic to the firms. A firm belonging to a business group will benefit from the institutional infrastructure (be it in the form of financial externalities or business reputation and political ties) and will have access to low cost finance. Similarly, a firm owned by a foreign firm will also benefit from such externalities. Size of the firm too influences the availability of finance, as smaller firms might not have access to credit markets due to information asymmetries.

A firm belonging to a business group might gain from prior exporting experience of other firms in that group. Prior exporting experience might significantly lower the fixed cost of entry into the export market. It is quite possible that a firm belonging to a business group that has prior experience in exporting will not incur

any fixed cost of entry.[2] In the absence of fixed cost of entry, there will be no partitioning of firms based on productivity. In other words, a firm that does not face fixed cost of entry will be able to export even at a lower productivity but a firm that faces a fixed cost of entry will need to be more productive to enter the export market. It would therefore be possible for firms with varying levels of productivity to enter the export market.

Given this background, my paper is an empirical investigation of the effect of financial constraints on the firm's probability of exporting, controlling for productivity, ownership and size.

2.3 Empirical Model

As the dataset I use is a rich panel of around 6000 firms over a twenty-year period, it allows me to analyze the firms' exporting behavior over a long period. Even though I study the firms' export entry decision in a given year, the persistence in the exporting behavior can be addressed as the data spans a twenty-year period. It also allows me to use the lagged values of the financial health variables in the model to address issues of any endogeniety in the model. Unlike most other papers, I control for total factor productivity using three different measures and find financial health to be an important entry determinant. This result is especially significant as it shows that in imperfect capital markets, sunk costs create a hysteresis in the

[2]Roberts and Tybout (1977) explain the reasons for the presence of entry cost. According to them, a firm must find and inform foreign buyers about its product and learn about the foreign market. It must then research the foreign regulatory environment and then adapt its product to insure that it conforms to the foreign standards (which include testing, packaging and labeling requirements). An exporting firm must also set up new distribution channels in the foreign country and conform to all the shipping rules specified by the foreign customs agency. The costs mentioned here would be significantly reduced when another firm in the business group has already undertaken such activities.

industry based on financial constraints and not just productivity.

The export decision depends on the ease with which the firm is able to raise funds. A firm can choose between internal and external funds to finance its investment. In the presence of capital market imperfections, internal and external funds are not perfect substitutes. Firms' investment decision in such a scenario would depend on its financing decision. Internal funds will have a cost advantage over new debt or equity finance. Therefore, a low cash flow situation would be indicative of financial constraints. Most papers studying financial constraints on firms' investment behavior use cash flow variables like liquidity, retained earnings, dividend payout ratio (Fazzari et al 1988; Hoshi, Kashyap and Scharfstein, 1991; Hubbard, Kashyap and Whited, 1995; Gilchrist and Himmelberg, 1998; Greenaway, Guariglia and Kneller, 2007).

In this paper, I measure financial constraints using two ratios: leverage and liquidity. I measure liquidity as the ratio of the difference between current assets and current liabilities to total assets.[3] The higher the liquidity ratio, the better would be the financial health of the firm. I measure leverage as the ratio of short-term debt to current assets.[4] Lower the leverage, better the ability of firms to raise funds for the entry cost. Thus, a firm with more liquidity and lower leverage is in better financial health.

The main model is estimated as

$$y_{it} = X_{it}\beta + FIN_{it}\gamma + \varepsilon_t$$

The dependent variable y_{it} is exports. The independent variables can be grouped into two - Financial variables (FIN_{it}) and other controls (X_{it}).

[3]Liquidity = (Current Assets-Current Liabilities)/Total Assets
[4]Leverage = Short term debt/Current Assets

Financial Variables : As mentioned above, I consider two main financial variables, leverage and liquidity. A firm's creditworthiness in the debt market and its reputation as a bankable asset is an important factor in its being able to obtain finance and establish itself in the export market. In the absence of firms' credit rating information in the data, I proxy it with the data on commercial paper sold by the firms. In India, when a firm issues short term debt instruments like debenture and commercial paper it is guaranteed by a commercial bank. In case the firm defaults, the bank is liable to repay the lenders. A bank guarantees a commercial paper only after a very careful scrutiny of the firm's financial health. It is also mandatory for the firms to obtain a specified minimum credit rating from a credit rating agency to float a commercial paper. Hence, Commercial paper floated by a firm is a good measure of its creditworthiness. Bandyopadhyay and Das (2005) use the issue of commercial paper to measure firm quality and creditworthiness.

Other control variables: It can be argued that a firm's investment decision might be independent of its financing decision for larger or well connected and/or more mature firms. Therefore, I control for age, size and ownership type of firms. I run both the regressions- one with leverage and the other with liquidity- with controls for ownership (Industrial/Business ownership, Ownership by foreign firms and Government ownership), TFP, age and the size of the firm. I define the size of the firm as the quintiles of asset size within the industry for every year.

Ownership of the firm is a very important determinant of its financial health. It could also influence a firm's exporting decision. If the firm belongs to a large industrial group, it has easier access to not only finance but also other externalities like managerial expertise, experienced leadership, or previous export market experience. A firm owned by an international firm or by a multinational corpora-

tion, will also enjoy the aforementioned advantages. Similarly, ownership by the government will have implications on both the financial situation and the export status of a firm. I have therefore controlled for all three kinds of ownership with dummies. Unobservables like managerial ability could also influence the exporting decision. The TFP measure controls for such unobservables. I address this issue by estimating a fixed effects model.

Exact definitions of the various terms used and a note on other data transformations are given in Annexure A.

2.3.1 Calculation of TFP

I use the Levinsohn-Petrin-Wooldridge method to estimate the Total Factor Productivity. Calculating TFP by estimating the production function using Ordinary Least Square (OLS) poses a simultaneity problem. Productivity defined as the residual from the Ordinary Least Square will be biased due to the correlation of input demands with the productivity shocks. To overcome this endogeneity, Olley & Pakes (1996) developed a model to use investment as a proxy for the productivity shocks. However, the investment demand function needs to be continuous and invertible for it to be used as a proxy. This may not be the case if there are non-convex adjustment costs to capital, making investments lumpy. More importantly, the data on investment is not always available. Levinsohn and Petrin (2003)(referred to as LP in the rest of the paper) use intermediate inputs as a proxy instead of investments. Intermediate inputs, like fuel and material, adjust freely with productivity shocks and there are no adjustment costs attached. Therefore, the demand curve for intermediate goods will be continuous with no kinks and can be easily estimated.

Both these estimators use a two step method to measure productivity. The two step method used in these estimators is not only complicated but also has a few drawbacks as discussed by Ackeberg et al (2008). Wooldridge (2009) shows how two equations using different instruments in a General Method of Moments (GMM) set up can be used to overcome these drawbacks. LP (2011) measure the productivity of Chilean firms with this modified estimator. I employ the same Wooldridge modification of the LP methodology to estimate the TFP in this paper. I use one period input lag, contemporary and lagged material as instruments.

The two-step Instrumental Variable GMM (IV-GMM) simultaneously estimates the labor and capital coefficients and the intercept for each three digit industry. Following LP (2011), I estimate the productivity of each firm as a residual as given below.

$$\omega_{i,t} = y_{i,t} - (\hat{\beta}_j + \hat{\beta}_{lj} l_{jt} + \hat{\beta}_{kj} k_{jt})$$

In the above equation, $\omega_{i,t}$ is the natural log of productivity of firm i in year t. $y_{i,t}$ is the natural log of output for year t. l_{jt} is the log of labor, k_{jt} log of capital stock, and β_j the intercept and β_{lj} and β_{kj} the coefficients for each industry obtained from the IV GMM estimation of the production function. Productivity ω is a function of intermediate input, m and capital, k.

In my paper, output is the Rupee value of output[5]. The intermediate input used is the Rupee value of material consumed. Capital stock for firm i in period t is constructed using the perpetual inventory method as given below:

$$k_{i,t} = (1 - \delta) k_{i,t-1} + I_{i,t}$$

[5]Output is defined as sales less purchase of finished goods and adjusted for changes in inventory. Input is equal to the sum of material and fuel used. All figures are in Rupees and deflated using the wholesale price index.

Investment, I in the current period is taken as addition to the capital stock in the current period a la LP. Depreciation, δ is taken at 10 percent for all firms.

2.4 Data Description

The data used is taken from CMIE's Prowess database. CMIE compiles this data from the audited financial results of listed and unlisted firms. The firms in Prowess accounts for almost 75 per cent of all corporate taxes and over 95 per cent of excise duty collected by the government of India.

The paper uses an unbalanced panel of about 6000 manufacturing firms for the period 1989 to 2008. All variables are deflated by the wholesale price index. The flow variables have been deflated by the annual average Wholesale Price Index (WPI) deflator for the financial year corresponding to the firm in that year. The stock variables have been deflated by the WPI deflator for the corresponding month in that year. The data does not have information on prices and products. As financial statements are drawn for the firm as an entity that might include a number of plants, the data provides only firm level information and not plant level.

Since the database does not provide labor information, I infer the amount of labor by deflating the wage bill by average industry wages. The data on wage per worker has been taken from Central Statistical Organization's (CSO)'s Annual Survey of Industries (ASI) database. The Prowess data has firms from 22 National Industrial Classification-2 (NIC-2) digit industries. The industries range from food processing, manufacture of metals, automobiles to electronics and textiles.

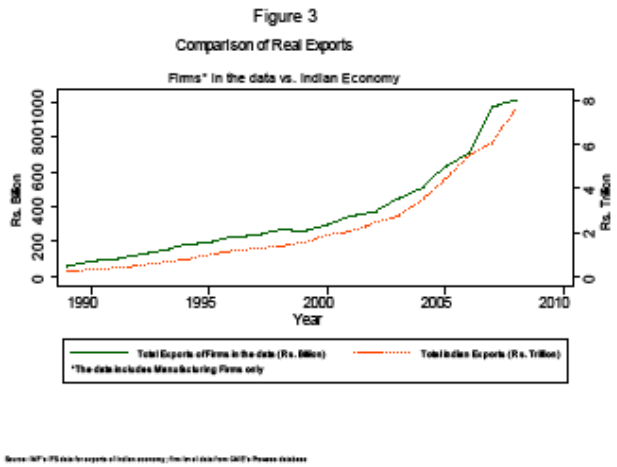

Figure 2.1: Comparison of Real Exports

2.4.1 Summary Statistics

India witnessed a continuous increase in value of exports during the period 1988 to 2008. Figure 3 shows the movement of India's real exports and the movement of real exports of the firms in data during that period. I have constructed the economy's exports from International Monetary Fund's (IMF) IFS database. The value of the total Indian exports is represented in Rupees trillion and includes both exports of goods and services. The value of exports for the firms in the data includes exports of only goods by the firms included in the dataset and is represented in Rupees billion. The behavior of exports in both figures is very similar. It can be seen that the data reflects the export pattern of the economy during the twenty-year period.

Table 2.1 shows mean liquidity, leverage, TFP and proportion of business and foreign ownership of firms by their export status. Firms have been categorized as non-exporters, new entrants, continuous exporters and firms exiting exports.[6] As

[6]Firms in the dataset exit and enter the export industry or remain in the export industry for the total length of years that they exist in the data. I have categorized them as new entrants, continuous exporters, sporadic exporters, non exporters or exiting firms to analyze their characteristics. A firm is categorized as non exporters for the year t if it does not export in that year

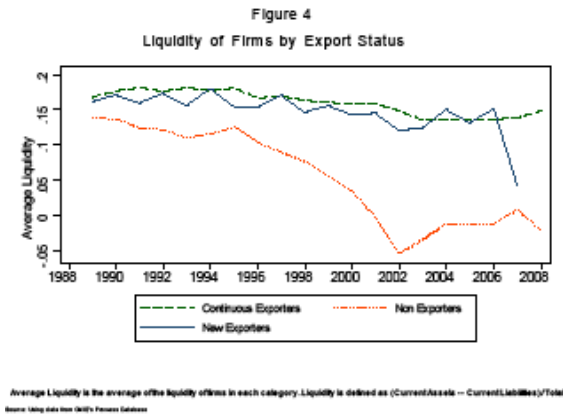

Figure 2.2: Liquidity of Firms by Export Status

can be seen, new entrants and continuous exporters enjoy better financial health than non-exporters. The TFP of new exporters is also higher than other exporters.

Figure 4 shows the liquidity for non-exporters, new entrants and continuous exporters. The liquidity of non-exporters is much lower than the new exporters or continuous exporters.

Large Government owned loss-making businesses, which were eventually sold off, drives the extremely low liquidity. A plot of liquidity without these firms gives a similar pattern without extreme values as shown in Figure 5.

Figure 6 shows the leverage ratio for non-exporters, new entrants and continuous exporters. Unlike liquidity, no visible pattern can be discerned in the case of leverage.

t, or the year before, t-1, or the year after, t+1. Similarly continuous exporters are those that export in all the three period, t-1, t and t+1. A firm entering the export market in year t will have no exports in the year before but will have exports in the time t+1. I also define firms which exit the export market and sporadic exporters on the same basis.

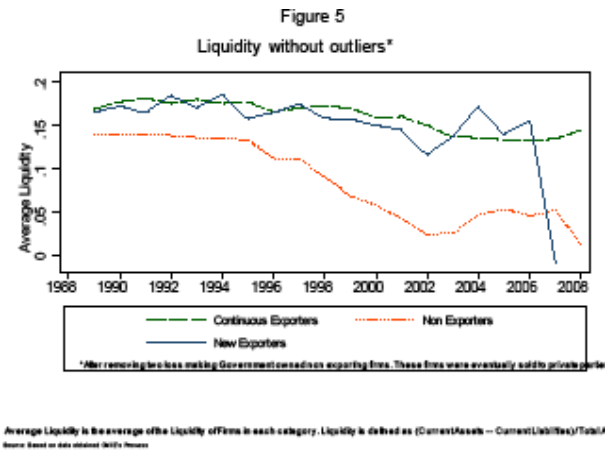

Figure 2.3: Liquidity of Firms by Export Status (without Outliers)

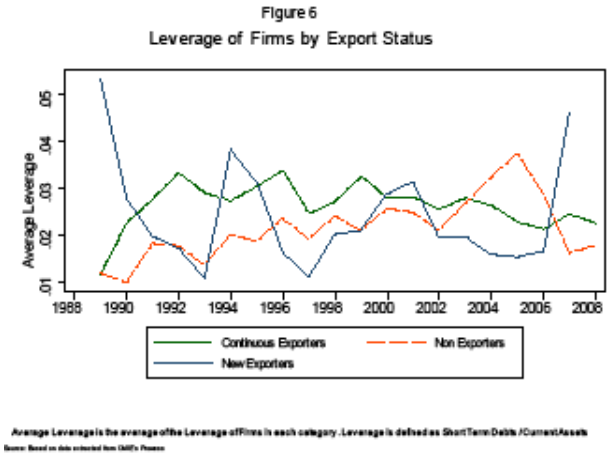

Figure 2.4: Leverage of Firms by Export Status

2.5 Estimation

There are three main questions that I address in this section. First, I analyze how financial constraints impact the extensive margin of trade. Does the presence of financial constraints hinder a firm's participation in the export market? The estimation of this extensive margin is addressed in the next sub-section. The results of the estimation in that sub-section establish the positive relation between export participation and the financial health of firms.

Second, the positive relation between financial health and exporting decision leads to the question of causality. It can be argued that exporters enjoy better financial health and therefore we observe a positive relation between the two. A comparison of the financial health of the firms ex post and ex ante their entry into the export market addresses this question.

Third, I analyze how the financial constraints impact the intensive margin of exports. Does better financial health imply that exporters will start exporting more? I find the evidence inconclusive in answering this question. The absence of a positive relation between financial constraints and the intensive margin of exports confirms the hypothesis that presence of entry cost makes financial health an important determinant of export market entry decision.

Finally, I check for robustness by using alternate estimates of TFP and by using a split sample. I split the sample vertically by size and repeat the estimation.

2.5.1 The Extensive Margin

Since we are analyzing a firm's decision to enter the export market, the dependent variable is a binary variable. The relation to be estimated therefore can be written as

$P(Y_{it} = 1) = X_{it}\beta + FIN_{it}\gamma + \varepsilon_t$ where Y_{it} is the probability that a firm i will export in year t.

First, to establish that financial constraints hinder export participation, I estimate the relation between them using fixed effects, followed by random effects and then a system GMM estimator. As the exporting decision is a binary outcome de-

cision, I then use a probit random effect estimator with a number of specifications to control for various plant level characteristics. To address the issue of endogeneity due to the persistence in the dependent variable, I re-estimate this relation with a system GMM estimator - the Blundell Bond estimator. The following three sub-sections discuss the estimation results of these empirical models.

Fixed Effects Estimates

I start with the Linear Probability model with fixed effects as the baseline model to address the issue of possible correlation between plant characteristics and plant unobservables. The result of this baseline model is given in Table 2.2 and Table 2.3. Table 2.2 shows the results of a regression of probability of export participation on liquidity and Table 2.3 on leverage. The negative coefficient on leverage and positive coefficient on liquidity confirm the hypothesis that financial health and export participation are positively related.

Firms which exported in the previous year are more likely to export in this period, as they do not face the sunk cost of market entry. To address this, I include two periods of lagged export status as the dependent variable in all specifications. Including the lags of the export status introduces endogeneity in the estimation. I address the issue of endogeneity by using a system GMM estimator. As expected, the lagged export status is strongly related to the probability of exporting in this period.

I introduce productivity as an additional variable which makes liquidity less significant but does not affect leverage. This is not the case in either the random effects model or the system GMM where liquidity and productivity remain significant in all specifications.

Probit Estimates

As the number of firms is large (6991), an individual firm's effect in a particular year can be assumed to be random. Any other firm level unobservables will be accounted for in the TFP variable.

The results from the probit estimation are given in Table 2.4 (with liquidity) and Table 2.5 (with leverage). The results are similar to those from the Linear Probability estimates. Liquidity is positively and leverage negatively related to the exporting probability. Lagged export status is again an important determinant of the current period's export participation probability. As discussed in section 3, we see that more productive firms are more likely to enter the export market. In the random effects model, I am able to measure the effect of other firm characteristics like size, age and ownership.

I introduce size as a regressor in some of the specifications. The smallest firms, the lowest quintile by asset size, comprise the control group. Smaller firms have a lower probability of exporting compared to larger firms. The inability of small firms to raise capital probably influences this result. However, the coefficient on the interaction of size and the financial variables does not support this reasoning.

The firms owned by foreign firms, have a higher probability of exporting as compared to the rest. As discussed earlier, ownership by a foreign firm could ensure better financial health. I have again interacted ownership with the financial variables. The interaction terms are not important for the export decision except in the case of a foreign firm with high leverage. Ownership by the Government with high liquidity is negatively related to export participation.

Creditworthiness is also important for the export decision. Firms that issued

commercial paper (cp) are more likely to export. In Table 2.4 as well as Table 2.5, the coefficient on commercial paper is both positive and significant.

System GMM Estimates

Firms which exported in the previous year are more likely to export in this period, as they do not face the sunk cost of market entry. Therefore, previous period's export status will be correlated to the current period's dependent variable – the probability of exporting. This brings in endogeneity in the model, as the errors are now auto correlated.

A firm that is contemplating entering the export market will start studying the export market and investing in some fixed costs in the period prior to the year of exports. Its decision will be influenced by its financial situation two periods prior to the year of exports. A two period lag of leverage and liquidity could also affect the export decision. To address this persistence in both these financial health indicators and the dependent variable, I use the system GMM methodology.

BJ refer to their 1995 and 1999 paper where they show that plants undergo dramatic contemporaneous changes in their characteristics when their status changes from exporter to non-exporter and vice-versa. This would give rise to simultaneity problem. BJ solve this issue by considering one period lag in all plant characteristics. The data I use is firm level and not plant level data; the question of effect of export decision on plant characteristics cannot be analyzed here. If such endogeneities do exist in my empirical model, the GMM estimation is a good estimator to account for the same.

I use the system GMM estimator as developed by Arellano and Bond (1991),

Arellano and Bover (1995) and Blundell and Bond (1998). The system GMM estimator has the advantage of being able to address the issue of both serial correlation and any endogenous regressors in the model.

I treat TFP and the financial variables as predetermined variables. The persistence in both will affect the participation decision.

The estimation results of the GMM system in Table 2.6 reiterate the importance of export status and the importance of liquidity to the probability of exporting. I have included two period lags for both the exporting decision variable and the independent variables. TFP is not important to the exporting decision and in this dynamic model nor are the other variables that were found to be of importance in the static model. Liquidity is positively related to export participation and is significant. Previous period's liquidity does not influence the exporting decision. The coefficient on leverage and one-period lagged leverage, show a negative relation with the exporting decision. Previous period's leverage has a greater influence on the exporting decision.

This result can be better interpreted by understanding how the two measures, liquidity and leverage, are defined. Liquidity is the ratio of the difference between current assets and current liabilities to total assets. Total assets do not adjust frequently, but the numerator, the difference between current assets and current liabilities, can change frequently to adjust to the needs of the firms. Given the definition of liquidity earlier, the components of liquidity are inventories, receivables, expenses paid in advance, cash and bank balances, on the current assets side and short-term debt, account payable, accrued liabilities and other debts on the liabilities side. A firm's liquidity changes frequently due to the operational liquidity from the cash-conversion cycle (i.e. the time it takes to generate revenue from the

manufacturing process to sale of final good). Therefore, we see changes in liquidity in the current period adjust to the needs of the firms including the needs of a new business requirement - making the current period's liquidity a better indicator of the availability of cash flow. Leverage on the other hand is the ratio of short-term debts to current assets. These debts are contractual in nature and could exist for the entire financial year. A firm facing financial constraints would not be able to adjust spontaneously to their immediate financial needs by raising short-term debt. In other words, leverage would be slower to adjust to financial needs than liquidity. Therefore, previous periods' leverage would be more informative as a financial indicator for this period's investment decision.

A firm already exporting would have undertaken the investment in the sunk cost and therefore would find it easier to export in the next period as compared to a new entrant. This can be seen in the coefficient on lagged export status.

2.5.2 Financial Health - Cause or Consequence of Exports

The above results show a positive correlation between the financial health of firms and their export participation decision. An interesting question here is whether financial health is the cause or the result of export participation.

Though a system GMM addresses this issue by considering lags, I use OLS on a set of firms to establish the causality more clearly. By isolating new entrants and continuous exporters in the data, and studying the impact of the financial health variables on export participation, we can analyze the effect of export participation on financial health.

The Ex Ante Analysis

Isolating firms that did not export for two consecutive periods, helps analyze if ex ante financial health is important for export participation. The firms in this set did or did not export in period t+1 but had not exported in period t and t-1. Therefore, we have either new entrants or non-exporters in this set. The ex ante analysis estimation is given in column 1 and 2 of Table 2.7. The dependent variables here are the financial health variables. Leverage is negatively related to the probability of exporting in the future. Lower the leverage, higher the probability of entering the export market. Lagged leverage and ownership by an industrial group, foreign private group and the government increases the leverage. Similarly, liquidity is positively related to the probability of export participation in the next period.

Using lagged dependent variable as a regressor could also lead to biased estimates of the coefficients. I have therefore used the GMM system estimator to verify the results. The GMM estimator shows coefficients not significantly different from zero. (Columns 1 and 2 of Table 2.8).

The Ex Post Analysis

In this analysis, I retain only new exporters and continuous exporters in the data. I compare the financial health of continuous exporters to that of the new exporters to see if exporting for over two years improves the financial health of the firms. Interestingly, the financial health, leverage and liquidity of firms worsen with exports. The estimation results can be seen in columns 3 and 4 of Table 2.7. Though the OLS estimation shows strong negative relation between financial health and continuous exporter status, the GMM estimation does not corroborate this hypothesis

(Columns 3 and 4 of Table 2.8).

The estimation does not unequivocally support the hypothesis that export participation improves financial health. The OLS estimation shows financial health to be the cause and not the effect of export participation.

2.5.3 Intensive Margin

The presence of sunk costs makes financial health very important for the export participation decision of the firm. As a next step, I test to see if the financial health of the firms has an impact on their ability to export more than before, that is, the intensive margin. Table 2.9 shows the estimation results of an ordinary least square regression of amount of exports of continuous exporters on their financial health and other variables. As can be seen, only lagged export status increases the intensive margin.

I verify the above results by using the change in the amount of exports as the dependent variable. There is no significant change in the estimation result. The financial health variables do not influence the amount of exports by an exporting firm.

2.5.4 Robustness Check

As a robustness check, I split the data vertically by size. There are five categories of size. I club the smaller three (very small, small and medium) in the first group and the larger two in the second group. Table 2.10 shows the estimation results for both groups with leverage and liquidity. Though the firms could have been split

by other variables as well, size is an especially important one as it can impact both the TFP and the financial variables. The results are in line with the regression results on the whole data. Productivity, lagged export status and liquidity impact the exporting decision. Leverage does not remain an important determinant of export participation anymore. Ownership by foreign firm continues to be a a factor influencing export participation and government ownership in once again negatively related. Commercial paper is a significant variable for bigger firms.

Further, I also use the measure of TFP as the residual from the production function measured using OLS in the estimation of the main model (Table 2.11). The results once again confirms our hypothesis that financial health is directly related to the exporting decision.

2.6 Conclusion

The estimation results show significant correlation between leverage and liquidity of the firm with the probability of exporting. This establishes the positive relation between financial health and export participation.

I also show that the ex ante financial health is positively related to the probability of exports where as the ex post financial health is not. This shows that the firms entering the export market are financially healthier than non-exporters; thereby, establishing causality from financial health to export participation. A regression of financial health variables on amount of exports of continuous exporters is negative with the OLS estimator and inconclusive with the GMM. This result shows that the intensive margin of exports does not improve with better financial health.

The above results validate the hypothesis that financial constraints will inhibit a firm from entering the export market. The estimation results imply that any export promotion policy by the government would have to address the issue of credit constraint to be effective.

Table 2.1: Mean of Key Statistics by Export Status

	Leverage	Liquidity	TFP	Indl. Grp. Ownership	Foreign Firm Ownership
Non Exporters	0.023	0.068	0.015	0.281	0.023
New Exporters	0.023	0.155	0.273	0.365	0.053
Continuous Exporters	0.027	0.156	0.203	0.465	0.093
Exiting Exporters	0.036	0.076	0.0001	0.396	0.04

Table 2.2: Fixed Effects Linear Probability with Liquidity as the Financial Health Variable

	(1)	(2)	(3)	(4)
Variables	Dependent Variable Export Dummy			
Productivity	0.0402***		0.0357***	0.0418***
	[0.00473]		[0.00492]	[0.00539]
Lagged Export Status (1 pd.)	0.374***	0.376***	0.372***	0.370***
	[0.0109]	[0.0108]	[0.0108]	[0.0109]
Lagged Export Status (2 pds)	0.0802***	0.0766***	0.0795***	0.0765***
	[0.00919]	[0.00915]	[0.00918]	[0.00927]
Liquidity		0.0431***	0.0305**	0.0320**
		[0.0164]	[0.0134]	[0.0139]
Constant	0.356***	0.356***	0.354***	0.309***
	[0.00712]	[0.00716]	[0.00715]	[0.0117]
Observations	31,752	32,218	31,752	31,752
R-squared	0.184	0.183	0.185	0.188
Number of firms	4,178	4,232	4,178	4,178

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Note: This is a panel linear regression of export participation dummy on liquidity, tfp, and other variables. The dependent variable is the export participation indicator in year t. It equals 1 if the firm exported in year t and 0 if not. Col. 4 includes industry and year fixed effects.

Table 2.3: Fixed Effects Linear Probability with Leverage as the Financial Health Variable

	(1)	(2)	(3)
Variables	Dependent Variable Export Dummy		
Productivity		0.0398***	0.0456***
		[0.00473]	[0.00525]
Lagged Export Status (1 pd.)	0.377***	0.373***	0.371***
	[0.0110]	[0.0109]	[0.0109]
Lagged Export Status (2 pd.)	0.0767***	0.0801***	0.0773***
	[0.00921]	[0.00919]	[0.00928]
Leverage	-0.0427***	-0.0352**	-0.0342**
	[0.0146]	[0.0141]	[0.0143]
Constant	0.362***	0.357***	0.312***
	[0.00717]	[0.00714]	[0.0117]
Observations	31,782	31,752	31,752
R-squared	0.180	0.185	0.187
Number of firms	4,180	4,178	4,178

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Note: This is a panel linear regression of export participation dummy on leverage, tfp and other variables. The dependent variable is the export participation indicator in year t. It equals 1 if the firm exported in year t and 0 if not. Col. 3 includes ind and year fixed effects.

Table 2.4: Random Effects Probit Estimation with Liquidity as the Financial Health Variable

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Dependent Variable Export Dummy					
Small					0.102***	0.101***
					[0.0292]	[0.0292]
Medium					0.223***	0.223***
					[0.0330]	[0.0331]
Large					0.302***	0.301***
					[0.0391]	[0.0392]
Very Large					0.430***	0.431***
					[0.0482]	[0.0483]
Productivity	0.180***		0.164***	0.145***	0.137***	0.133***
	[0.0126]		[0.0129]	[0.0133]	[0.0137]	[0.0143]
Liquidity		0.197***	0.141***	0.137***	0.145***	0.278***
		[0.0214]	[0.0221]	[0.0223]	[0.0228]	[0.0654]
Export Status (1 lag)	1.959***	1.964***	1.956***	1.936***	1.889***	1.887***
	[0.0268]	[0.0265]	[0.0268]	[0.0271]	[0.0287]	[0.0287]
Export Status (2 lag)	0.982***	0.965***	0.982***	0.983***	0.927***	0.926***
	[0.0268]	[0.0265]	[0.0269]	[0.0273]	[0.0278]	[0.0278]
Owner Indl. Grp.					0.0478*	0.0739***
					[0.0258]	[0.0274]
Owner For. Pvt					0.371***	0.346***
					[0.0566]	[0.0832]
Owner Govt					-0.286***	-0.265***
					[0.0610]	[0.0614]
Commercial Paper					0.516***	0.521***
					[0.125]	[0.125]
For. OwnerxLiquidity						0.156
						[0.428]
Indl. Owner x Liquidity						-0.206***
						[0.0654]
TFP x Liquidity						-0.0598*
						[0.0310]
Govt Owner x Liquidity						-0.199***
						[0.0765]

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Note: This is a panel probit regression of export participation dummy on leverage, productivity, ownership and other variables. The dependent variable is the export participation indicator in year t. It equals 1 if the firm exported in year t and 0 if not. Col. 1 to 3 do not include ind and year fixed effects.

Table 2.5: Random Effects Probit Estimation with Leverage as the Financial Health Variable

	(1)	(2)	(3)	(4)	(5)	(6)
Variables			Dependent Variable Export Dummy			
Small				0.101***	0.0986***	0.102***
				[0.0290]	[0.0290]	[0.0292]
Medium				0.216***	0.214***	0.225***
				[0.0328]	[0.0328]	[0.0331]
Large				0.296***	0.295***	0.304***
				[0.0388]	[0.0389]	[0.0392]
Very Large				0.425***	0.419***	0.434***
				[0.0479]	[0.0480]	[0.0483]
Productivity		0.179***	0.161***	0.152***	0.150***	0.136***
		[0.0126]	[0.0130]	[0.0134]	[0.0136]	[0.0137]
Leverage	-0.172**	-0.112	-0.119*	-0.182**	-0.135	-0.135*
	[0.0720]	[0.0698]	[0.0703]	[0.0749]	[0.137]	[0.0759]
Export Status (1 lag)	1.973***	1.960***	1.939***	1.896***	1.895***	1.889***
	[0.0267]	[0.0268]	[0.0271]	[0.0286]	[0.0286]	[0.0287]
Export Status (2 lag)	0.965***	0.983***	0.985***	0.930***	0.931***	0.927***
	[0.0267]	[0.0268]	[0.0272]	[0.0277]	[0.0277]	[0.0278]
Owner Industrial Grp.				0.0418	0.0401	0.0492*
				[0.0256]	[0.0259]	[0.0258]
Owner Foreign Private				0.373***	0.419***	0.373***
				[0.0564]	[0.0599]	[0.0567]
Owner Government				-0.305***	-0.326***	-0.283***
				[0.0604]	[0.0619]	[0.0610]
Commercial Paper				0.523***	0.522***	0.517***
				[0.125]	[0.125]	[0.125]
Foreign OwnerxLeverage					-1.167**	
					[0.492]	
Indl. Owner x Leverage					0.0369	
					[0.167]	
TFP x Leverage					0.109	
					[0.113]	
Govt Owner x Leverage					0.491	
					[0.315]	

Note: This is a panel probit regression of export participation dummy on leverage, tfp, ownership and other variables. The dependent variable is the export participation indicator in year t. It equals 1 if the firm exported in year t and 0 if not. Col. 1 and 2 do not include ind and year fixed effects. Col. 6 shows specification with both leverage and liquidity in the same equation.

Table 2.6: System GMM Estimation

	(1)	(2)
Variables	Export Dummy	Export Dummy
Small	0.349**	-0.291*
	[0.154]	[0.165]
Medium	0.0411	-0.420**
	[0.146]	[0.205]
Very Large	0.638***	
	[0.206]	
Lagged Export Status (1 pd.)	0.387***	0.397***
	[0.00778]	[0.00774]
Productivity	-0.00537	0.00191
	[0.00786]	[0.00745]
Leverage	-0.0191*	
	[0.0101]	
Lagged Leverage (1 pd)	-0.0442***	
	[0.0123]	
Liquidity		0.0406***
		[0.00727]
Lagged Liquidity (1 pd)		0.00227
		[0.00734]
Ownership by Industrial Grp.	0.303***	0.199***
	[0.0591]	[0.0634]
Ownership by Foreign Pvt.	0.0207	-0.0259
	[0.212]	[0.220]
Ownership by Govt.	0.167	0.00772
	[0.243]	[0.191]
Commercial Paper	0.0155	0.0166
	[0.0153]	[0.0154]
Age at time t	1.49e-06	-0.000217
	[0.000168]	[0.000169]
Constant	0.158	0.623***
	[0.154]	[0.173]
Number of Observations	38,692	38,692
Number of Firms	5,300	5,301

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Table 2.7: Financial Health Ex Ante and Ex Post Export Participation (OLS)

	(1)	(2)	(3)	(4)
Variables	Leverage	Liquidity	Leverage	Liquidity
	Ex Ante		Ex Post	
Leverage (1pd)	0.521***		0.641***	
	[0.00491]		[0.00487]	
Export Participation (1 pd forward)	-0.00551***	0.00743***		
	[0.00174]	[0.00251]		
Size	0.00298***	0.00120	0.00179***	0.00260***
	[0.000644]	[0.000932]	[0.000623]	[0.000873]
Industrial Group Ownership	0.00668***	-0.00651**	0.00526***	-0.0101***
	[0.00178]	[0.00257]	[0.00176]	[0.00247]
Ownership Foreign Private	0.00693**	-0.00185	0.00379	-0.00308
	[0.00319]	[0.00463]	[0.00322]	[0.00453]
Ownership Government	0.0159***	-0.0350***	0.0107***	-0.0413***
	[0.00409]	[0.00595]	[0.00400]	[0.00565]
Age at time t	-4.94e-06	2.28e-06	-8.83e-07	4.77e-06
	[6.13e-06]	[8.92e-06]	[4.41e-06]	[6.22e-06]
Liquidity (1pd lag)		0.993***		0.966***
		[0.00238]		[0.00218]
Continuous or New Exporter Dummy			0.00350**	-0.00804***
			[0.00141]	[0.00198]
Constant	-0.000268	0.00674	-0.00595	0.0265***
	[0.00484]	[0.00701]	[0.00572]	[0.00804]
Number of Observations	31,359	31,801	38,718	39,248
R-squared	0.272	0.852	0.315	0.840

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Note:Ex ante analysis done on firms which do not export in period t-1 and t but might export in period t+1. Ex post analysis done on firms which are either new or continuous exporters. For Col. 1 and 2, leverage and liquidity are regressed on lagged leverage and liquidity, and on the probability of exporting in the next period. In col. 3 and 4, leverage and liquidity are regressed on lagged leverage and liquidity and on their export status as a new exporter or a continuous exporter.

Table 2.8: Financial Health Ex Ante Ex Post (system GMM)

	(1)	(2)	(3)	(4)
Variables	Leverage	Liquidity	Leverage	Liquidity
	Ex Ante		Ex Post	
Leverage (1pd)	0.209***		0.0295***	
	[0.00723]		[0.00548]	
Export Participation (1 pd forward)	-0.00457	0.00454		
	[0.00384]	[0.00498]		
Size	-0.00369	0.0152***	-0.00430*	0.0229***
	[0.00281]	[0.00364]	[0.00241]	[0.00364]
Industrial Group Ownership	-4.724***	-0.225	-0.146***	-0.247***
	[0.205]	[0.154]	[0.0378]	[0.0465]
Ownership Foreign Private	-0.192	10.60***	1.825***	-0.983***
	[0.244]	[0.548]	[0.127]	[0.209]
Ownership Government	0.972***	-7.078***	2.995***	-1.965***
	[0.231]	[0.342]	[0.127]	[0.155]
Age at time t	0.00674***	0.00145***	0.000584***	0.00161***
	[0.000593]	[0.000532]	[0.000126]	[0.000165]
Liquidity (1pd lag)		0.640***		0.819***
		[0.00674]		[0.00536]
Continuous or New Exporter Dummy			-0.0109***	-0.00454
			[0.00213]	[0.00321]
Constant	2.144***	2.164***	-0.396***	1.174***
	[0.314]	[0.173]	[0.0759]	[0.0978]
Number of Observations	31,359	31,801	38,718	39,248
R-squared	3765	3817	5301	5364

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Note: Ex ante analysis done on firms which do not export in period t-1 and t but might export in period t+1. Ex post analysis done on firms which are either new or continuous exporters. For Col. 1 and 2, leverage and liquidity are regressed on lagged leverage and liquidity, and on the probability of exporting in the next period. In col. 3 and 4, leverage and liquidity are regressed on lagged leverage and liquidity and on their export status as a new exporter or a continuous exporter.

Table 2.9: OLS Estimation of Intensive Margin of Exports

	(1)	(2)	(3)	(4)
Variables	Exports	Exports	Change in Exports	Change in Exports
Productivity	-9.765e+06	-9.405e+06	0.317	0.307
	[9.442e+06]	[9.498e+06]	[0.257]	[0.258]
Lagged Export Status (1 pd)	1.325***	1.325***		
	[0.00224]	[0.00224]		
Leverage	4.459e+06		1.547	
	[7.768e+07]		[2.112]	
Lagged Leverage (1 pd)	-3.039e+07		-0.0631	
	[9.565e+07]		[2.601]	
Liquidity		6.121e+07		0.0436
		[5.630e+07]		[1.531]
Lagged Liquidity (1 pd)		-7.497e+07		-0.289
		[6.451e+07]		[1.754]
Ownership by Indl. Group	425,333	-199,285	0.302	0.303
	[1.499e+07]	[1.502e+07]	[0.408]	[0.409]
Ownership by Foreign Pvt.	-4.626e+06	-5.237e+06	-0.525	-0.525
	[2.293e+07]	[2.294e+07]	[0.623]	[0.624]
Ownership by Government	-2.335e+08***	-2.370e+08***	2.414**	2.443**
	[3.945e+07]	[3.949e+07]	[1.072]	[1.073]
Commercial Paper	2.995e+06	2.794e+06	-0.672	-0.640
	[3.348e+07]	[3.344e+07]	[0.910]	[0.909]
Age at time t	-12,042	-12,584	0.000392	0.000379
	[46,444]	[46,182]	[0.00126]	[0.00126]
Constant	4.417e+07	5.145e+06	4.962***	5.034***
	[5.002e+07]	[4.898e+07]	[1.328]	[1.332]
Number of Observations	19,453	19,453	19,453	19,453
Number of firms	2,693	2,694	2,693	2,694

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Note: Col. 1 and 2 is the regression of total exports of the continuous exporters on TFP, ownership and the financial health variables -leverage and liquidity respectively. Col. 3 and 4 is the regression of the change in exports on the same independent variables. Change in exports is defined as the ratio of the increase in exports in one year to previous periods exports. Year and industry dummies included in all the specifications.

Table 2.10: Probit Estimates with Vertical Split of Data by Size of Firm

	(1)	(2)	(3)	(4)
Variables	Export Dummy	Export Dummy	Export Dummy	Export Dummy
Small	-0.136	-0.167	-0.147**	-0.151**
	[0.108]	[0.110]	[0.0676]	[0.0677]
Medium	-0.123	-0.146	-0.0647	-0.0699
	[0.111]	[0.113]	[0.0563]	[0.0564]
Productivity	0.116***	0.104***	0.191***	0.168***
	[0.0164]	[0.0168]	[0.0301]	[0.0306]
Leverage	-0.153		-0.167	
	[0.0952]		[0.123]	
Liquidity		0.108***		0.240***
		[0.0264]		[0.0605]
Lagged Export Status (1 pd)	1.854***	1.851***	1.930***	1.925***
	[0.0351]	[0.0352]	[0.0533]	[0.0534]
Lagged Export Status (2 pd)	0.912***	0.910***	0.907***	0.905***
	[0.0357]	[0.0357]	[0.0520]	[0.0520]
Ownership by Industrial Group	-0.0274	-0.0218	0.0233	0.0291
	[0.0337]	[0.0338]	[0.0524]	[0.0525]
Ownership by Foreign Private	0.278***	0.275***	0.513***	0.512***
	[0.0775]	[0.0775]	[0.106]	[0.106]
Ownership by Government	-0.386***	-0.366***	-0.256***	-0.235**
	[0.116]	[0.117]	[0.0913]	[0.0915]
Commercial Paper	1.020	1.012	0.503***	0.495***
	[0.806]	[0.806]	[0.137]	[0.137]
Constant	-1.041***	-1.306***	-1.332***	-1.378***
	[0.139]	[0.145]	[0.123]	[0.123]
Number of Observations	15,748	15,748	13,343	13,343
Number of Firms	3,053	3,053	1,587	1,587

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Note: Col. 1 and 2 refer to the estimates on the first group containing firms which are very small, small and medium. Col. 3 and 4 give the estimates for the second group containing firms which are large and very large. Medium and large firms are the control variables in the two groups respectively. Year and industry dummies and age are included. Export dummy takes unit value if the firm exported that year and zero otherwise.

Table 2.11: Random Effects Probit Using Productivity Measured as OLS

	(1)	(2)
Variables	Export Dummy	Export Dummy
Small	0.0667**	0.0716**
	[0.0291]	[0.0293]
Medium	0.165***	0.179***
	[0.0330]	[0.0334]
Large	0.224***	0.239***
	[0.0389]	[0.0394]
Very Large	0.306***	0.326***
	[0.0487]	[0.0494]
Productivity	0.150***	0.133***
(Panel Reg. Ui error)	[0.0158]	[0.0161]
Lagged Export Status (1 pd.)	1.895***	1.888***
	[0.0286]	[0.0287]
Lagged Export Status (2 pd.)	0.919***	0.917***
	[0.0276]	[0.0277]
Leverage	-0.213***	
	[0.0765]	
Liquidity		0.160***
		[0.0228]
Ownership by Industrial Grp.	0.0288	0.0368
	[0.0253]	[0.0256]
Ownership by Foreign Pvt.	0.358***	0.357***
	[0.0562]	[0.0565]
Ownership by Govt.	-0.320***	-0.298***
	[0.0602]	[0.0610]
Commercial Paper	0.519***	0.513***
	[0.125]	[0.126]
Age at time t	-6.33e-05	-6.27e-05
	[8.25e-05]	[8.29e-05]
Constant	-1.403***	-1.596***
	[0.0685]	[0.0734]
Number of Observations	31,752	31,751
Number of Firms	4,178	4,178

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

CHAPTER 3

PRODUCTIVITY AND FIRM SIZE - EVIDENCE FROM INDIA

3.1 Introduction[1]

Should governments in developing countries protect and promote small firms? Smaller firms suffer from scale disadvantages, lower access to credit and necessary political clouts to influence policy (Tybout, 2000). At the same time, there is evidence that smaller firms generate more patents per capita, and have more flexible management style and agility to adapt to technology changes (Dhawan, 2001). Economic policies around the developing world offer incentives and protections to firms under certain threshold sizes. However, effects of such policies on aggregate productivity cannot be known unless we know if smaller firms are more productive than their larger counterparts, so that, an industry characterized by many small firms is more productive in aggregate than the one dominated by a few large firms.

Using a large panel of Indian firms that report balance sheet information, we estimate and compare total factor productivities for large and small firms for the 1994-2008 period. Total factor productivity, or the amount of output that is not explained by the amounts of inputs, has been identified as a key variable in explaining the heterogeneous growth performances of developing countries (Klenow and Rodriguez-Clare (1997) and Hall and Jones (1999)). We perform the following exercise – we divide firms in an industry into five asset quintiles and examine if firms in the lowest quintile, the smallest ones, are more productive than their larger counterparts. We have defined size in terms of asset holdings of a firm and not in terms of employment, a more common measure in the context of developing

[1] Co-authored with Prabal De, City College of New York

countries. We use asset size because of lack of employee data and the fact that the official definition of firm size in India is asset-based and not employment-based. We find that smaller firms, particularly firms in the lowest asset percentile, are more productive than the rest. This result is robust to a variety of alternative definitions of size and productivity such as using a different estimation method for TFP, using all five asset classes instead of two, and using a continuous measure of size such as market share.

A second key finding is that productivity is dependent both on healthy cash flow and the propensity to invest in research and development; smaller firms that invest in research and development and have a healthy cash flow are more productive. This confirms the theoretical assertion later that smaller firms can be more productive if they can leverage their advantage of having flexible management and overcome liquidity constraints.

Identification is based on a combination of strategies. First, we show that there is little inter-asset-size mobility for firms in India in the sense that only a handful of firms in the lowest quintile have moved to upper quintiles in the post-reform period. This phenomenon is not limited in our data, it is present in Indian manufacturing in general. Therefore, it is unlikely that a firm's current or past productivity would affect its size. Second, we use industry and year fixed effects to purge our estimates of confounding time-invariant unobservable variables at various levels.

There are several reasons why a firm's size may be instrumental in explaining its performance. Intuitively, there is a trade-off between growing bigger and gaining productivity. While small firms have the advantage of smaller and more flexible management and lower response time to market changes, larger firms can reap the benefits of economies of scale, particularly in some industries like the au-

tomobile industry. Larger firms also wield political clout and garner better access to government credits, contracts and licenses. This is especially true for developing countries. Even private financial institutions are likely to favor big firms for the latter's better liquidity and more stable operations.

Size-productivity relationship at the micro level has implications for overall industry productivity as well, particularly in the background of a variety of policies that often focus on threshold size. If small firms are more productive, these policy incentives are likely to enhance overall productivity in the relevant industry. The puzzle here is that small productive firms do not seem to grow enough, and fast enough, to use claim more resources. Though the issue if life-cycle growth of firms is beyond the scope of this paper, it has been recently shown elsewhere (Hseih and Klenow (2012)) that older and more mature Indian firms do not grow in size reducing the aggregate productivity of the Indian economy.

Finally, this polemic has become particularly important in the last decade or so for two more reasons. A number of economies including India have liberalized their trade and licensing regimes to allow easy entry of firms and to reduce monopolies of either big state enterprises, or big private firms. Second, much richer micro-datasets are increasingly available to empirically assess the dynamic changes in productivity[2].

The rest of the paper proceeds as follows. In the next section, we discuss the characteristics and brief history of small scale industries in India. The section after that we discusses data with some of the details being relegated to the Appen-

[2]Though it is more usual to estimate productivity at the plant level, firm-level productivity is more appropriate in our context as size-restriction is imposed at the firm-level and not the plant-level. Admittedly, they are not identical as a firm may have several plants and as Winter (1999) shows firm financials may affect plant productivity. Using balance sheet data is a more modern trend, partly because of availability of such database. One example is Khandelwal and Topalova (2010),who use the same database to estimate TFP.

dices. The remaining sections are devoted to empirical specification, estimation and discussion of results along with some major caveats. We conclude with a brief discussion of the policy implications of our findings.

3.2 Background: Small Enterprises in India

Small and medium enterprises play an important role in economic growth by contributing to the GDP (Beck et al, 2005). In India, classification of firms by size is based on a firm's asset size (unlike in the US and EU where it depends on employment). According to the Micro, Small and Medium Enterprises Development Act, 2006 of the Government of India, micro, small and medium enterprises are defined as the production units where the investment in plant and machinery does not exceed 2.5 million rupees, 50 million rupees and 100 million rupees respectively ($1 = 55 INR approximately). This is subject to the condition that the unit is not owned, controlled or a subsidiary of any other undertaking. A set of small firms do not report their balance sheets and hence become part of the "unorganized sector" in official classification. These firms are not included in our study as the balance sheet-based database we use does not capture them[3].

Among the Asian countries, India has been unique in terms of its focus on the development of small and medium enterprises since independence. Post-independence, the avowed industrial development strategy in India was to set up the core capital-intensive infrastructure industries accompanied by a number of small-scale labor intensive consumer goods manufacturers. These small firms were to be spread

[3]The unorganized sector accounts for about 45 percent of the employment in the manufacturing sector and contributes to about 44 percent of the GDP as estimated by the Central Statistical Organisation, India. The data we use does include firms which are not publicly traded. A detail discussion of the informal manufacturing sector in India is beyond the scope of this paper.

across the nation in rural and urban locations, which would not only increase employment opportunities but also help in industrial dispersal.

By 2003-2004, the Small Scale Industry (SSI) units accounted for more than 40 percent of gross value of output in manufacturing sector and about 34 percent of total exports. It is the highest employment-providing sector after agricultural sector. Though 87 percent of the SSI units are unregistered, the registered units account for 72 percent of the total SSI production and 87 percent of total SSI exports[4].

However, in spite of the policy rhetoric and 40 percent contribution to gross value of output, small enterprises have been plagued by inadequate working capital, delay in sanction of working capital, poor and obsolete technology, inadequate demand and other marketing problems and infrastructural constraints among others. With liberalization, small firms have not only been facing the challenges of increased competition but have been further disadvantaged by the credit squeeze. With the increase in foreign direct investment and portfolio investment, the central bank tries to sterilize their impact and hold on to the monetary targets. This leads to a credit squeeze, which is distributed unevenly in the economy, with the small firms feeling the credit constraint more[5].

3.3 Data

The data used in this research has also been obtained from the Centre for Monitoring Indian Economy (henceforth, CMIE)'s PROWESS database. We use an

[4]Source: Development Commission (SSI), Third Census, Government of India

[5]Morris and Basant (2006) present a detailed discussion of the financial constraints faced by small firms in India.

unbalanced panel data of manufacturing firms for the period 1994 to 2008. The choice of time period has been dictated by the intention to keep the most recent data and avoid having a sample including years containing too few firms. The number of firms covered in the PROWESS database has jumped steeply in 1994 and remained within the band of 10% more or less until 2008.

We use one more source of data for robustness checks. There is some evidence that large firms pay higher wage[6]. If this is systematically the case, then our calculation of labor is biased, as we use an industry-wide deflator. This will underestimate the TFP of larger firms affecting our regression results. Since firm-level wage data is missing for a large majority of firms, we cannot deal with this directly as it will lead to a drastic loss of sample size. Therefore, we deal with this in a couple of indirect ways. First, we see if, given the limited data, there is any evidence that large firms systematically pay more. We next look at a roughly comparable database on Indian manufacturing sector the Annual Survey of Industries and estimate the average wage premium between small and large firms[7]. The average wage rate of firms in the fifth quintile is approximately three times of that in the first quintile. That is, large firms pay almost three times the wage an average small firm pays. We recalibrate our wages to account for this wage premium and then recalculate labor and TFP[8]. On estimating our various specifications, we find that the small firms still have significantly higher TFP than the larger firms; though the coefficients become smaller.

We are unable to identify the firms officially registered as small enterprises in

[6]Brown and Medoff (1989) analyze six reasons for wage premium paid by large firms and find that better quality of labor force explains only some of this wage premium and a significant amount of wage premium remains unexplained. Idson and Oi (1999) find this wage premium exists for US firms. They explain this in terms of better productivity of these firms.

[7]We thank Gunjan Sharma for providing us this data. Please see Chamarbagwala & Sharma (2011).

[8]The details of this estimation are available upon request.

our data. If we use the definition of small enterprises as defined by the MMSME, about 36 percent of the data would be the size of a small enterprise, and 29 percent of the data would qualify to be small enterprises not belonging to a big industrial group (which is one of the other conditions for belonging to the small industries sector). We discuss the main variable of our interest – size of the firms in detail here, relegating the detail discussion of the construction of the other variables to Appendix 1.

3.4 Empirical Strategy

3.4.1 Specification

We have the following testable hypotheses: 1. Ceteris paribus, small firms, appropriately defined, are more productive than their larger counterparts (i.e. after controlling for alternative explanations such as ownership, age, research and development). 2. Size-productivity relationship transmits through other variables such as R&D and availability of liquidity in the form of cash and bank balances.

In order to estimate the effects of a firm's size on its productivity, we start with the following reduced form baseline specification (equation 1):

$$TFP_{ijt} = \beta_0 + \beta_s SMALL_{ijt} + \beta_m imports_{ijt} + \beta_x exports_{ijt} + \beta_r rnd_{ijt} + \beta_o Ownership_{ijt} + \beta_b BusinessHouse_{ijt} + age_{it} + agesq_{it} + \lambda_i + \lambda_j + \lambda_t + \eta_{ijt} \quad \text{.....(1)}$$

The dependent variable is the Total Factor Productivity of a firm i, in industry j and period t. SMALL is an indicator of the size of the firm by assets within the industry it belongs to. For each industry and year, firms have been categorized

into five quintiles according to their asset sizes. The size variable is therefore comparable across industries and across years. The indicator small here refers to the lowest quintile in the industry, that is, the lowest twenty percent of the firms by asset size. β_s is our coefficient of interest.

The calculation of total factor productivity using the traditional method of Ordinary Least Square may suffer from simultaneity bias. For example, with a positive shock to productivity, the use of inputs also increases. The residual will therefore be a biased estimate of productivity.

To overcome this simultaneity issue, Levinsohn and Petrin (2007) use intermediate inputs as instruments to control for the correlation between input levels and unobserved productivity shocks. Conditional on capital, profit-maximizing behavior leads more productive firms to use more intermediate inputs. We use the Levinsohn- Petrin estimation as the main measure of TFP in this paper.

Wooldridge (2009) shows how proxy variables used for controlling unobserved productivity can be implemented by using the generalized method of moments estimation[9]. We use Wooldridge's modification of the Levinsohn-Petrin method as another measure for TFP for our robustness check. The rest of the control variables in equation (1) have been chosen to ameliorate the omitted variable bias. The choice of variables is driven mostly by either previous literature or theoretical prediction. A firm importing from other countries is likely to gain in terms of productivity. This gain can be in terms of quality embodied in the imported goods or by the learning-by-doing phenomenon. Moreover, this gain in productivity would be more pronounced if the firm imports intermediate goods or capital goods. The imports variable is defined as total imports as a percentage of sales. Total

[9]Please refer to Van Beveren (2010) for a detailed discussion on the various measures of TFP.

imports include imports of raw material, finished goods, spares and capital goods.

To be able to export, a firm needs to invest in developing a product that not only caters to the international market but is also better than those produced by other firms world-wide. This encourages the firm to invest in product development activities and improve the quality of the product or improve the production process. Both Melitz (2003) and Bernard et al. (2003) explain the phenomenon of how exporting firms are more productive than the non-exporting ones. Exports are also expressed as percentage of sales in our estimation.

Being part of a business group has important externalities for a firm. Loosely defined, a business group or business house is a conglomerate with a number of nominally independent firms under its umbrella such that the firms have unique identities but operate under a common administrative or financial management. Most of these business houses are family -owned. Business houses provide institutional infrastructure to the firms under its umbrella. The advantages of belonging to a business house ranges from being able to get low cost internal funds to business reputation and government ties. The concentrated ownership could provide long- term perspective on R&D investment (Claessens et al, 2000). It is therefore reasonable to assume that ownership by a business house could influence a firm's productivity. The business- house ownership variable is an indicator variable that takes unit value if the firm belongs to a business house and zero otherwise.

Type of ownership (government, foreign, private) can also have important implications for productivity. This is particularly true for India between 1994 and 2008 as various economic reform measures and its effects were spreading across industries. While privatization shifted ownership from government to private entities, liberalization of foreign investment regime implied greater ownership by

foreign firms. There is a body of work on the effects of ownership – both government vs. private and domestic vs. foreign. In what follows, we will estimate a variety of this baseline specification.

3.4.2 Relationship Between Size, Productivity and Firm Capabilities

There is a body of research on the link between firm size and the various aspects of research and development. Firm size has been linked either to the investment in R&D (in terms of patent-to-expenditure ratio (Acs and Audertesch, 1990; Bound et al., 1982; Cohen and Klepper, 1996; Hausman et al., 1984; Kim et al, 2010; Syrneonidis 1996) or to the magnitude of investment (Acs and Audertesch, 1987, Bound et al., 1984; Scherer, 1986). A natural extension to this literature is to examine if size-productivity relationship is mediated by R&D expenditure of a firm[10].

Apart from R&D, other firm capabilities, such as human capital and technological gap and development expenditure industry play important roles in productivity determination (Blalock and Gertler, 2009). We focus on a variable that is particularly relevant in the context of developing countries like India. We test a firm's cash flow proxying for liquidity, as a predictor of productivity. This strategy is motivated by the dual recent evidence that firms are credit-constrained, and that credit constraint influences firm performance and investment decisions (Nagaraj, 2011). In an environment characterized by imperfect credit markets, small firms

[10]For brevity, we forego a fuller discussion of the size-R&D literature here. Please see Henderson (1993) for an early exposition and Shefer and Frenkel (2005) and Kim (2009) for a summary of empirical research.

suffer from liquidity constraints because of the lack of political clout and economic collateral that they can offer. Cash flow has been defined as cash in hand (including bank balance) as a proportion of the firm size measured by total assets. We estimate a modified equation (1) that includes cash flow, R&D and their interaction with size respectively.

3.5 Identification

Equation (1) captures the relationship between (small) size and total productivity. For identification of the causal effect of smallness, we rely on the random effects specification. For observational data, the choice of specification between fixed and random effects is complicated by the fact that both random effects specification (which assumes that firm-specific unobserved heterogeneities λ_i are uncorrelated with time-invariant firm-specific unobserved variables), and fixed-effects specification (that assumes that those two are correlated), have advantages and drawbacks. Fixed-effects models are particularly unsuitable for the situations where the main explanatory variable of interest does not change over time. Since SMALL is our main variable of interest, we need variations in the values of SMALL to identify its relationship with productivity.

In India, one of the peculiar characteristics of the manufacturing sector is that there is very little size mobility over time. This is true in our sample and is also found out independently by other researchers. In our sample, inter-asset size mobility is limited – only 5% of the firms move up in the size ladder within a year and 7% do in a window of two years. Hsieh and Klenow (2012) have also recently documented how "surviving Indian plants exhibit little growth in terms

of either employment or output". Therefore, random effects specification is more appropriate for our purpose. Our choice is also bolstered by the fact that we have a rich dataset and can control for a large number of firm-characteristics that the extant literature specifies, alleviating the concerns of omitted variables to a large extent.

Finally, we have controlled for time fixed effects to capture the effects of any overall economy-wide changes in policy and industry fixed effects to capture industry specific unobserved characteristics.

3.6 Main Results

3.6.1 Firm Size and Total Factor Productivity

Table 3.1 summarizes the main results of the paper. The columns of Table I present results from the estimation of four variations of equation 1. We start from estimating the simplest relationship between size and productivity with no controls (column (1)). We see that there is a strong positive correlation between belonging to the lowest asset quintile and productivity. Smallest firms are 7% more productive than their larger counterparts.

Column (2) introduces year and industry fixed effects to control for unobserved industry and time variability. Interestingly, the coefficient estimate standard errors remain almost unchanged. This shows that the relationship is strong across industries and over time. Column (3) and column (4) present results from the random effects (generalized least square) models having included the control vari-

ables. Column (4) includes industry dummies; column (3) does not. For both these columns, we see that being small means more productive and significantly so. Coefficient estimates go down slightly when we introduce controls to our estimation. These results are obtained after controlling for a large number of firm characteristics such as government vs. private vs. foreign ownership, holding pattern, import and export behavior, research and development expenditure and liquidity.

3.6.2 Firm Characteristics and Productivity

Table 3.2 examines which variables are potentially responsible for driving productivity for small firms. The three columns report results from random effects estimation of equation (1). Column (1) shows the effect of size interacted with a measure of research and development expenditure. The positive and significant coefficient provides evidence that small firms that invest more in R&D are more productive. The second column reports results from specification where firm size in interacted with a measure of liquidity, cash-in-hand, and shows that small firms that suffer less from liquidity constraints are more productive. Finally, the third column controls for both and shows that both liquidity and R&D are important drivers of productivity for small firms.

The summary message from Table 3.2 is that being small may have advantages in terms of leaner and more agile management and more flexible operation, but it is also important to invest in research and be able to maintain enough liquidity to be productive. As we will see later, liquidity is an important variable in determining firm survival and exit too.

3.7 Robustness Checks

3.7.1 Results with an Alternative Definition of TFP

Despite its widespread use, Levinsohn-Petrin method of TFP estimation has been criticized as being inappropriate under certain conditions, notably by Ackerberg et al. (2007) who argued that total factor productivity may not be identified separately from the labor productivity of the former is a deterministic function of the latter. Wooldridge (2012) gets around this problem by proposing a GMM method that uses multiple lags, yielding multiple moment conditions for identification. He goes on to show that even if labor were a deterministic function of productivity, one can still identify and estimate productivity.

Results using TFP estimates derived from the Wooldridge method are presented in Table 3.3. Only specifications from Table 3.1 have been used, as they are our main results. From row 1, we can see that using an alternative definition of TFP does not change our core results. Small firms are still significantly more productive than their counterparts.

3.7.2 Results with All Five Size Categories

In this section we use all five size-categories with the smallest size as base category. This specification allows us to see whether all larger categories are more productive than the smallest category, or there is some discontinuity in that relationship.

Rows 1-4 of Table 3.4 repeat the key results of row 1 in Table 3.1, controlling for the same variables. From the sign and significance pattern of the coefficients of all

the other size categories, we see that firms belonging to all four categories of firms larger than the smallest category are (statistically) significantly less productive than the smallest category, the base category in this specification. To recall, this base category is the same as our SMALL category in the previous specification. Therefore, the message from this table is that even category by category, bigger firms are less productive significantly. This test provides a more transparent picture of the nature of size-productivity relationship reported in the section above.

3.7.3 Results with a Balanced Panel

Table I reports estimation results of equation (1) with an unbalanced panel of firms. Firms enter and leave industries all the time. However, as discussed in the earlier section, some exit behavior may bias the sample towards firms with higher productivity. Therefore, we restrict the sample to firms that stayed on throughout the sample period of 1994-2007 to form a balanced panel of firms. The results from estimating the same set of models (except for the single-regressor regressions to avoid clutter) are presented in table 3.5.

Except for the first two columns, Table 3.5 is organized in the same way as Table 3.1. Evidence in this table also confirms the earlier evidence from unbalanced panel of firms that small firms are significantly more productive than their larger counterparts. The sign and significance pattern of the other control variables confirm that entry and exit of firms do not seem to affect the results in any particular way.

3.7.4 Results with a Continuous Measure of Size

Even though size of an enterprise is defined in terms of assets in India, it will be interesting to investigate how other measures of size are related to productivity. One such measure is market share – share of a firm's sales within the industry to which it belongs. Therefore, instead of a binary variable as SMALL, we now have a continuous variable market share in equation (1). The rest of the equation is left unchanged. Results from the estimation of this modified equation are presented in table 3.6.

Row (1) in Table 3.6 summarizes the main results for the coefficient of interest here. Market share has a negative and significant impact across all specifications. This is in line with the previous results with asset size. Since smaller firms are likely to have lesser market share, the positive small- size high-TFP relationship is likely to translate to negative market share – productivity relationship.

3.8 Caveats

There are some limitations in the data that will affect the interpretation of our results.

First, we do not have a measure of the human capital of a firm in terms of education and training of its employees. Therefore, the measure of capital solely represents physical capital. Though such information can be found in census-based surveys, such surveys have other issues of misreporting that a balance sheet-based database does not.

Second, we cannot provide a complete analysis of exit (and entry). It has been noted elsewhere also that PROWESS database does not allow tracking entering and exiting firms with precision. We can only define exit if a firm disappears from the dataset. However, firms may drop out from our database for a variety of reasons. It may become so small that it may not have to report; it may adopt a different name, may shift into informality or may actually shutdown.

Similarly, firms may exit and reappear in the database not because they closed down and reopened again, but simply because they resumed reporting their balance sheet results (and PROWESS database records them again). However, there is no evidence of this discrepancy in our sample. The main problem exit behavior creates is that in retrospect, we may have a selected sample – only the firms that are more efficient survive and if most of the entrant firms are small, which is a reasonable assumption, then our results will be biased upward because we are looking at the more efficient firms selectively. This problem is present in survey-based measures too. To tackle this problem, we look at the exit behavior of firms. The results are reported in Table 3.7.

The main question here is whether lower-productivity firms are more likely to exit. That is, we examine the effects of lagged productivity on the binary variable EXIT that equals unity when a firm ceases to exist in a particular year conditional on the fact that it was in operation in the previous year. We also control for other plausible explanations such as size, age, age-squared, net profit, cash flow and leverage, the last two variables being the proportion of cash in hand and short term debt to total assets respectively . Columns (1) and (2) report estimated results from the Linear Probability Model and Probit model respectively.

Table 3.7 shows us that TFP is not a driving force behind firm exit. Small

firms do exit at a higher rate, which is consistent with findings in the literature. Similarly, older firms tend to exit less, another common finding in the literature. However, firms fail to survive because of their low cash balance. Capital market in India, despite the recent liberalization is still relatively underdeveloped. Firms that generate enough cash flow and earn and reinvest profit survive in their respective industries. Hence, we fail to find evidence that positive productivity-based selection is driving our results.

3.9 Summary and Policy Implications

In this paper, we have used firm level panel data to estimate the differences in the productivity of large and small firms in the manufacturing sector in India. Such exercise has been motivated by several stylized, theoretical, empirical and policy observations. Firm size heterogeneity is widespread among developing countries. Mammoth firms coexist with smaller firms and continue to produce similar products. However, theoretically both small and large firms have productivity advantages and disadvantages such as scale economies versus smaller and more flexible management structure. Empirical evidence from the US and the rest of the world has been piecemeal and mixed. Finally, several countries including India have been pursuing policies to promote small and medium scale enterprises. With availability of new firm-level micro data, new evaluation of size-productivity relationship contribute to both researchers' and policymakers' understanding of the implications of firm size heterogeneity for productivity and growth in the economy.

We calculate total factor productivity by using both Levinsohn-Petrin method and its modification proposed by Wooldridge to control for simultaneity between

input choice and productivity shocks. In estimating our main results, we use a variety of specifications. Our results are also robust to a variety of alternative definitions. Finally, we investigate if firm size mobility is driven by lagged productivity and find no evidence of such behavior.

Our findings provide support for policies that aim at encouraging small firms. However, this does not mean that large firms need to be broken up or firm growth should be stifled or firms should be stopped from being merged or acquired. A paradoxical result that remains to be explored in future studies is this – despite the productivity advantage, firm growth is largely absent. The answer may lie in various institutional details such as some government incentive remaining available to only smaller firms, lack of quality workers and difficulty of expanding in size in an unfriendly regulatory environment can provide some potential explanations.

Table 3.1: Size-Productivity Relationship - Regression Results for UNBALANCED PANEL (Dependent Variable: Total Factor Productivity at Firm-Level)

	(1)	(2)	(3)	(4)
			Random Effects Model	
SMALL	0.0748***	0.0745***	0.0695***	0.0694***
(Firms in the lowest 20% in asset size)	(0.0075)	(0.0071)	(0.0072)	(0.0071)
Industrial Group Dummy			-0.0861	-0.0843
			(0.1132)	(0.1145)
Ownership Indian Private			-0.0204	-0.0136
			(0.1127)	(0.1142)
Ownership Foreign Private			-0.0975	-0.1064
			(0.113)	(0.1134)
Observations	39886	39886	39822	39822
Year Fixed Effects		Yes	Yes	Yes
Industry Fixed Effects		Yes		Yes
Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1				

Notes: I. All regressions include firm demographics such as age and age squared and exports, imports and RandD as percentage of sales. II. Ownership is a categorical variable with categories "Indian private ownership", "foreign private ownership" "Indian government ownership" respectively. The third one is the base category in regression. III. Industrial group dummy represents if a firm belongs to a large industrial house.

Table 3.2: Firm Characteristics and Productivity (Dependent Variable: Total Factor Productivity at Firm-Level)

	(1)	(2)	(3)
	Random Effects Model		
SMALL*research_share	0.0052**		0.0053**
	(0.0025)		(0.0025)
SMALL*Cashflow		0.4380*	0.4441*
		(0.2289)	(0.229)
Constant	0.6500***	0.6532***	0.6525***
	(0.1397)	(0.1397)	(0.1396)
Observations	39821	39821	39821
Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1			

Notes: I. All regressions include firm demographics such as age and age squared and exports, imports and RandD as percentage of sales. II. Ownership is a categorical variable with categories "Indian private ownership", "foreign private ownership" "Indian government ownership" respectively. The third one is the base category in regression. III. Industrial group dummy represents if a firm belongs to a large industrial house.

Table 3.3: Robustness Check I: Results with TFP Calculated by an Alternative (Wooldridge) Method (Dependent Variable: Total Factor Productivity at Firm-Level)

	(1)	(2)	(3)	(4)
	Random Effects Model			
SMALL	0.2051***	0.3520***	0.1849***	0.2934***
(Firms in the lowest 20% in asset size)	(0.0691)	(0.0600)	(0.0674)	(0.0592)
Industrial Group Dummy			4.1452***	0.5817**
			(1.4159)	(0.2474)
Ownership Indian Private			5.7886***	1.0520***
			(1.3924)	(0.2465)
Ownership Foreign Private			1.1183	0.2919
			(1.6371)	(0.2728)
Observations	26,138	26,138	26,091	26,091
Year Fixed Effects		Yes	Yes	Yes
Industry Fixed Effects		Yes		Yes
Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1				

Notes: I. All regressions include firm demographics such as age and age squared and exports, imports and R and D as percentage of sales. II. Ownership is a categorical variable with categories "Indian private ownership", "foreign private ownership" "Indian government ownership" respectively. The third one is the base category in regression. III. Industrial group dummy represents if a firm belongs to a large industrial house.

Table 3.4: Robustness Check II: Results with all Five Categories of Size (Base is Smallest) (Dependent Variable: Total Factor Productivity at Firm-Level)

	(1)	(2)	(3)	(4)
			Random Effects Model	
Second Quintile	-0.0550***	-0.0565***	-0.0553***	-0.0551***
	(0.0092)	(0.0083)	(0.0084)	(0.0084)
Third Quintile	-0.1169***	-0.1197***	-0.1144***	-0.1142***
	(0.0124)	(0.0114)	(0.0115)	(0.0114)
Fourth Quintile	-0.1736***	-0.1782***	-0.1676***	-0.1676***
	(0.0148)	(0.0138)	(0.0140)	(0.0140)
Fifth Quintile	-0.2184***	-0.2225***	-0.2052***	-0.2050***
	(0.0162)	(0.0149)	(0.0153)	(0.0153)
Industrial Group Dummy			-0.0204	-0.0258*
			(0.0159)	(0.0140)
Ownership Indian Private			-0.0725	-0.0649
			(0.1009)	(0.1036)
Ownership Foreign Private			-0.0969	-0.1042
			(0.1010)	(0.1017)
Observations	39,886	39,886	39,822	39,822
Year Fixed Effects		Yes		Yes
Industry Fixed Effects		Yes		Yes

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Notes: I. All regressions include firm demographics such as age and age squared and exports, imports and R and D as percentage of sales. II. Ownership is a categorical variable with categories "Indian private ownership", "foreign private ownership" "Indian government ownership" respectively. The third one is the base category in regression. III. Industrial group dummy represents if a firm belongs to a large industrial house.

Table 3.5: Robustness Check III: Regression Results for BALANCED PANEL (Dependent Variable: Total Factor Productivity at Firm-Level)

	(1)	(2)
	Random Effects Model	
SMALL (Firms in the lowest 20% in asset size)	0.0875***	0.0876***
	(0.0101)	(0.0098)
Industrial Group Dummy	-0.0669***	-0.0727***
	(0.0154)	(0.0266)
Ownership Indian Private	0.1036***	0.1257***
	(0.0132)	(0.0165)
Ownership Foreign Private	0.0657***	0.0655***
	(0.0123)	(0.0131)
Observations	13496	13496
Year Fixed Effects	Yes	Yes
Industry Fixed Effects		Yes
Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1		

Notes: I. All regressions include firm demographics such as age and age squared and exports, imports and R and D as percentage of sales. II. Ownership is a categorical variable with categories "Indian private ownership", "foreign private ownership" "Indian government ownership" respectively. The third one is the base category in regression. III. Industrial group dummy represents if a firm belongs to a large industrial house.

Table 3.6: Robustness Check IV: Effects of Market Share on Productivity (Dependent Variable: Total Factor Productivity at Firm-Level)

	(1)	(2)	(3)	(4)
			Random Effects Model	
Firm's Market Share	-0.3238***	-0.5070***	-0.2384***	-0.3503***
	(0.0588)	(0.0753)	(0.0553)	(0.0735)
Exports as % of Sales			-0.0003	-0.0003*
			(0.0002)	(0.0002)
Imports as % of Sales			0.0000	0.0000
			(0.0000)	(0.0000)
Expenditure on Research			0.0002	0.0002
as % of Sales			(0.0002)	(0.0002)
Industrial Group Dummy			-0.0905	-0.0888
			(0.1137)	(0.1149)
Ownership Indian Private			-0.0124	-0.0067
			(0.1133)	(0.1147)
Ownership Foreign Private			-0.1044	-0.1135
			(0.1134)	(0.1137)
Observations	39,886	39,886	39,822	39,822
Year Fixed Effects		Yes	Yes	Yes
Industry Fixed Effects		Yes		Yes
Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1				

Notes: I. All regressions include firm demographics such as age and age squared and exports, imports and R and D as percentage of sales. II. Ownership is a categorical variable with categories "Indian private ownership", "foreign private ownership" "Indian government ownership" respectively. The third one is the base category in regression. III. Industrial group dummy represents if a firm belongs to a large industrial house.

Table 3.7: Firm Exit Behavior (Dependent Variable: Dummy for EXIT; = 1 if Firm Exited)

	(1)	(2)
	Linear Model	Probit
SMALL	0.075***	0.575***
	(0.007)	(0.048)
Lagged TFP	0.001	0.048
	(0.006)	(0.038)
Age	-0.002***	-0.018***
	(0.000)	(0.003)
Age Squared	0.000	0.000***
	(0.000)	(0.000)
Net Profit	-0.000***	-0.000***
	(0.000)	(0.000)
Cash Flow	-0.117**	-0.452
	(0.052)	(0.42)
Leverage	0.012**	0.046
	(0.005)	(0.031)
Constant	0.000	-2.391***
	(0.000)	(0.121)
Observations	30920	30920

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

APPENDIX A

ESTIMATION USING EMPLOYMENT AS A MEASURE OF SIZE

In some of the previous literature size is measured in terms of employment. We measure size of a firm in quintiles of asset size. As mentioned in the paper, one of the reasons for doing this is the absence of sufficient employment data in a dataset that is balance sheet-based and not plant-level. We however do have information on the total wage bill and impute employment numbers as described in the previous appendix. This allows us to examine, albeit imperfectly, how our results would change when we measure size in terms of employment.

We create size quintiles of our measure of employment by industry and by year. We then estimate the relation between TFP and (small) size. We use both our measures of TFP – the Levinsohn-Petrin method and the Wooldridge modification of the Levinsohn-Petrin method. As shown in the table below, TFP is once again positively correlated to being small. Columns of Table A I are comparable to Table 3.1 and Table 3.3 in the text.

Table A.1: Results with Size Defined as Quintiles of Employment

	(1)	(2)	(3)	(4)
	TFP LP		TFP LP-Wooldridge	
SMALL	0.0134**	0.0134**	0.1984***	0.2676***
(Firms in the lowest 20% in employment size)	(0.0061)	(0.0061)	(0.0446)	(0.0433)
Industrial Group Dummy	-0.0892	-0.0872	4.1378***	0.5754***
	(0.1135)	(0.1148)	(1.2306)	(0.1892)
Ownership Indian Private	-0.0115	-0.0047	5.7828***	1.0569***
	(0.1130)	(0.1145)	(1.1976)	(0.1856)
Ownership Foreign Private	-0.1034	-0.1127	1.1106	0.28
	(0.1133)	(0.1137)	(1.3429)	(0.2038)
Observations	39,822	39,822	26,091	26,091
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects		Yes		Yes
Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1				

Notes: SMALL is the indicator for firms in the lowest quintile of employment size. Employment is measured as number of workers in the firm. Number of workers is estimated by dividing the firms' wage bill by average wage per worker. Col 1 and 2 use TFP estimated using the LP method and col 3 and 4 use TFP estimated using the Wooldridge modificaiton of the LP method.

APPENDIX B

DEFINITIONS OF TERMS USED AND DATA TRANSFORMATIONS

Output: Output is deflated sales adjusted for change in inventory and purchase of finished goods. An increase in inventory is added to sales to arrive at output while a decrease is subtracted. Purchase of finished goods is defined as finished goods purchased from other manufacturers purely for resale purpose and is also subtracted from sales to arrive at the firms' manufactured output.

Value Added and Input: Value Added is defined as the difference between output and inputs. The variable input is defined as the sum of material, fuel, packaging and distribution expenses. Value Added is used in the calculation of Total Factor Productivity (TFP).

Liquidity: Liquidity is defined as ratio of the difference in current assets and current liabilities to total assets. Current assets and current liabilities are provided by Prowess. Current liabilities is defined as the amount owed by a company and due within one year. It usually represents the liabilities generated from the operations of the firm and thus includes sundry creditors, bills payable, etc. The variable, total assets, is defined as the sum of current assets and gross fixed assets, investments and loans and advances. The variable, current assets, is the sum of inventories, accounts receivable, expenses paid in advance and cash and bank balances.

Leverage: Leverage is defined as the ratio of short term debt to current assets. Short term debt is the variable in Prowess called current portion of secured and unsecured borrowings. It includes the portion of the long-term borrowings of banks that are due within a period of one year of the date of the balance sheet.

Very Small, Small, Medium, Large and Very Large: These size dummies are quintiles of assets by industry and by year.

Industry: Defined as the two digit National Industrial Classification (NIC-2) 1998. The NIC 1998 is consistent with the ISIC revision 3 classification.

Total Factor Productivity (TFP): Calculated by the Levinsohn-Petrin method, uses material as the proxy variable. Both labor and fuel are considered as freely varying inputs. TFP has been calculated using both output and value added as the dependent variable.

Labor: Labor is calculated by dividing the compensation to employees by emoluments per employee. Emoluments per employee is the all industry average emoluments per employee as given by the Central Statistical Organization (CSO). CSO is a part of the Ministry of Statistics and Planning.

Capital Stock: Capital stock has been constructed by adding current period investment to last period's capital stock net of depreciation. Capital has been depreciated at the rate of 10%.

Ownership: Prowess defines ownership broadly as Government owned (either Central or State), private sector owned, cooperative sector and joint sector. The private sector comprises Indian private sector and foreign private sector. Both Indian and foreign private sector are further divided into Private (Indian /foreign) and Business groups (Indian/foreign). I have combined the last two categories, Indian business groups and foreign business houses into one indicator for ownership by a large business group. The variable takes unit value if the firm is owned by a large Indian business group or by a foreign business house and zero otherwise. The category foreign business houses, includes NRI business houses like the Hinduja

group, and the Ispat (Mittal) group.

Age: Age in any year t, is defined as the year t minus the year of incorporation of the firm. The variable year of incorporation is not always equal to or more than the length of the firm in the data. According to the Prowess documentation, "year of incorporation pertains to the most recent incarnation of the company. In the case of companies that were re-organized, the year of incorporation may not reflect the true age of a company." In such cases, I have taken the age of the firm as the length of the firm's existence in the data.

Indicator for Export participation: The indicator for export participation takes the value 1 when value of exports for the year exceeds zero. The value of exports is the sum of exports of goods and of services.

Non exporters, New Entrants, Exiting Exporters and Continuous Exporters: Firms that do not export in year t-1, t and t + 1 are categorized as non exporters. Firms that do not export in year t-1 but export in year t and t+1 are categorized as new entrants. Firms that export in t, t+1 and t-1 are continuous exporters. Firms that export in time t-1 and t but not in t+1 have been categorized as firms exiting the export industry.

Classification of NIC -2 digit industry: Prowess gives the National Industrial Classification (NIC) of the firms in its dataset. NIC classification is consistent with the ISIC rev.3. The classification in some cases is only two digits while in others it is five digits. I have maintained a 2-digit classification. The dataset saves this classification as a number instead of saving it in text format. As a consequence, some of the classifications are incorrect as the zero is missing. On careful examination of the company name and economic activity, I found nineteen such

codes that were to be preceded by a zero. The NIC codes were then converted to 2-digit.

Classification of industry as manufacturing: Prowess classifies the firms as manufacturing or non-manufacturing. Careful examination showed five NIC codes which had been wrongly coded as non-manufacturing. I have changed those to manufacturing maintaining conformity to ISIC rev3. In my data, there are some firms that purchase more finished goods than they sell. The variable purchase of finished goods is greater than sales. These firms have been classified as manufacturing though they seem to be traders. I have classified these as non-manufacturing and removed them from the dataset.

APPENDIX C

BIBLIOGRAPHY

Ackerberg, D.A., Caves, K., and Frazer, G., (2006). "Structural identification of production functions", mimeo, UCLA Department of Economics.

Acs, Z. J., & Audretsch, D. B. (1987). "Innovation, market structure, and firm size." The Review of Economics and Statistics, 69(4), 567-574.

Acs, Z. J., & Audretsch, D. B. (1990). "Innovation and small firms "The MIT Press, Cambridge, MA.

Ahluwalia, Isher J. (1985). "Industrial Growth in India: Stagnation since the Mid-Sixties." Delhi; New York: Oxford University Press.

Amiti, Mary and Jozef Konings. (2007). "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia" The American Economic Review, 97(5): pp. 1611-1638.

Arellano, Manuel and Stephen Bond. (1991). "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations" The Review of Economic Studies, 58(2): 277-297.

_____. (1995). "Another Look at the Instrumental Variable Estimation of Error-Components Models" Journal of Econometrics, 68(1): 29-51.

Athey, Michael J. and Prem S. Laumas. (1994). "Internal Funds and Corporate Investment in India" Journal of Development Economics, 45(2): 287-303.

Aw, B. Y. (2002). "Productivity dynamics of small and medium enterprises in

taiwan." Small Business Economics, 18(1), 69-84.

Aw, B. Y., Chen, X., & Roberts, M. J. (2001). "Firm-level evidence on productivity differentials and turnover in taiwanese manufacturing." Journal of Development Economics, 66(1), 51-86.

Baily, M. N., Bartelsman, E. J., & Haltiwanger, J. (1996). "Downsizing and productivity growth: Myth or reality?" Small Business Economics, 8(4), 259-278.

Baldwin, John R. and Wulong Gu. (2003). "Export-Market Participation and Productivity Performance in Canadian Manufacturing" The Canadian Journal of Economics / Revue canadienne d'Economique, 36(3): 634-657.

Bandyopadhyay, Arindam and Sandwip K. Das. (2005). "The Linkage between the Firm's Financing Decisions and Real Market Performance: A Panel Study of Indian Corporate Sector" Journal of economics and business, 57(4): 288-316.

Beck, Thorsten, Asli Demirgüç-Kunt, and Vojislav Maksimovic. (2005). "Financial and Legal Constraints to Growth: Does Firm Size Matter?" The Journal of Finance, 60(1): 137-177.

Berman, Nicolas and Jérôme Héricourt. (2010). "Financial Factors and the Margins of Trade: Evidence from Cross-Country Firm-Level Data" Journal of Development Economics, 93(2): 206-217.

Bernard, Andrew B., Jonathan Eaton, J. B. Jensen, and Samuel Kortum. (2003). "Plants and Productivity in International Trade" The American Economic Review, 93(4): 1268-1290.

Bernard, Andrew B. and J. B. Jensen. (2004). "Why some Firms Export" The

review of economics and statistics, 86(2): pp. 561-569.

Bigsten, A., & Gebreeyesus, M. (2007). "The small, the young, and the productive: Determinants of manufacturing firm growth in Ethiopia." Economic Development and Cultural Change, 55, 813-840.

Blalock, G., & Gertler, P. J. (2009). "How firm capabilities affect who benefits from foreign technology." Journal of Development Economics, 90(2), 192-199.

Blundell, Richard and Stephen Bond. (1998). "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models" Journal of Econometrics, 87(1): 115-143.

Bollard, Albert, Stephen Redding, and Peter K. Schott. (2011). "Multiproduct Firms and Trade Liberalization" The Quarterly Journal of Economics, 126(3): 1271-1318.

Bound, J., Cummins, C., Griliches, Z., Hall, B. H., & Jaffe, A. B. (1982). "Who does R&D and Who Patents?", NBER Working Paper

Brown, C., & Medoff, J. (1989). "The employer size-wage effect." The Journal of Political Economy, 97(5), pp. 1027-1059.

Chamarbagwala, R., & Sharma, G. "Industrial de-licensing, trade liberalization, and skill upgrading in India". Journal of Development Economics, In Press, Corrected Proof.

Claessens, S., Djankov, S., & Lang, L. H. P. (2000). "The separation of ownership and control in East Asian corporations." Journal of Financial Economics, 58(1-2), 81-112.

Cohen, W. M., & Klepper, S. (1996). "A reprise of size and R & D." The Economic Journal, 106(437), 925-951.

Cohen, W. M., Levin, R. C., & Mowery, D. C. (1987). "Firm size and R&D intensity: A re-examination." Journal of Industrial Economics, 35(4), 543-565.

Dhawan, Rajeev. (2001). "Firm Size and Productivity Differential: Theory and Evidence from a Panel of US Firms" Journal of Economic Behavior & Organization, 44(3): 269-293.

Fazzari, Steven M., R. G. Hubbard, Bruce C. Petersen, Alan S. Blinder, and James M. Poterba. (1988). "Financing Constraints and Corporate Investment" Brookings Papers on Economic Activity, 1988(1): 141-206.

Galindo, Arturo, Fabio Schiantarelli, and Andrew Weiss. (2007). "Does Financial Liberalization Improve the Allocation of Investment?: Micro-Evidence from Developing Countries" Journal of Development Economics, 83(2): 562-587.

Gilchrist, Simon and Charles Himmelberg. (1998). "Investment: Fundamentals and Finance" NBER Macroeconomics Annual, 13: 223-262.

Goldberg, Pinelopi K., Amit K. Khandelwal, Nina Pavcnik, and Petia Topalova. (2010). "Imported Intermediate Inputs and Domestic Product Growth: Evidence from India" The Quarterly Journal of Economics, 125(4): pp. 1727-1767.

Greenaway, David, Alessandra Guariglia, and Richard Kneller. (2007). "Financial Factors and Exporting Decisions" Journal of International Economics, 73(2): 377-395.

Grossman, Gene M. and Elhanan Helpman. (1990). "Trade, Innovation, and

Growth" The American Economic Review, 80(2, Papers and Proceedings of the Hundred and Second Annual Meeting of the American Economic Association): pp. 86-91.

Gupta, Poonam; Hasan, Rana and Kumar, Utsav. (2008). "What constraints Indian Manufacturing" http://ssrn.com/abstract=1347183 or http://dx.doi.org/10.2139/ssrn.1347

Hall, R. E., & Jones, C. I. (1999). "Why do some countries produce so much more output per worker than others? "The Quarterly Journal of Economics, 114(1), pp. 83-116.

Haramillo, Fidel, Fabio Schiantarelli, and Andrew Weiss. (1996). "Capital Market Imperfections before and After Financial Liberalization: An Euler Equation Approach to Panel Data for Ecuadorian Firms" Journal of Development Economics, 51(2): 367-386.

Hasan, Rana and Jandoc, Karl Robert. (2010) "The Distribution of Firm Size in India: What can Survey Data Tell Us?" Asian Development Bank Economics Working Paper Series No. 213. Available at SSRN: http://ssrn.com/abstract=1681268 or http://dx.doi.org/10.2139/ssrn.1681268

Henderson, R. (1993). "Underinvestment and incompetence as responses to radical innovation: Evidence from the photolithographic alignment equipment industry". The Rand Journal of Economics, 24(2), pp. 248-270.

Hoshi, Takeo, Anil Kashyap, and David Scharfstein. (1991). "Corporate Structure, Liquidity, and Investment: Evidence from Japanese Industrial Groups" The Quarterly Journal of Economics, 106(1): 33-60.

Hsieh, Chang-Tai and Peter Klenow. (2012). "The Life Cycle of Plants in India

and Mexico".

Hubbard, R. G., Anil K. Kashyap, and Toni M. Whited. (1995). "Internal Finance and Firm Investment" Journal of Money, Credit and Banking, 27(3): 683-701.

Idson, T. L., & Oi, W. Y. (1999). "Workers are more productive in large firms". American Economic Review, 89(2), 104-108.

Jovanovic, Boyan. (1982). "Selection and the Evolution of Industry" Econometrica, 50(3): 649-670.

Khandelwal, A., & Topalova, P. (2010). "Trade liberalization and firm productivity: The case of India". Forthcoming, Review of Economics and Statistics.

Kim, J., Lee, S. J., & Marschke, G. (2009). "Relation of firm size to R&D productivity". International Journal of Business, 8(1), 7-19.

Klenow, P. J., & Rodriguez-Clare, A. (1997). "The neoclassical revival in growth economics: Has it gone too far?" In B. Bernanke, & G. Rotemberg (Eds.), NBER macroeconomics annual 1997 (pp. 73-102). Cambridge, MA: MIT Press.

Koeva, Petya and International Monetary Fund. Asia and Pacific Dept. (2003). "The Performance of Indian Banks during Financial Liberalization". Washington, D.C.: International Monetary Fund.

Levinsohn, James and Amil Petrin. (2003). "Estimating Production Functions using Inputs to Control for Unobservables" The Review of Economic Studies, 70(2): 317-341.

(2011). "Measuring Aggregate Productivity Growth using Plant-Level Data" .

Manova, Kalina. (2010). "Credit Constraints, Heterogeneous Firms, and International Trade".

Mathur, K. B. L. (2007). "Financial Sector in India" Economic and Political Weekly, 42(13): 1098-1101.

Mazumdar, Dipak. (2009). "A Comparative Study of the Size Structure of Manufacturing in Asian Countries." Asian Development Bank, Manila. Processed

McKinnon, Ronald I. (1973). "Money and Capital in Economic Development". Washington: Brookings Institution.

Melitz, Marc J. (2003). "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity" Econometrica, 71(6): 1695-1725.

Minetti, Raoul and Susan C. Zhu.(2011) "Credit Constraints and Firm Export: Microeconomic Evidence from Italy" Journal of International Economics, In Press, Corrected Proof.

Ministry of Law and Justice, Government of India (2006). The Micro, Small And Medium Enterprises Development Act, 2006

Morris, Sebastian and Rakesh Basant. (2006). "Small-Scale Industries in the Age of Liberalization.", INRM Policy Brief No. 11: Asian Development Bank.

Muuls, Mirabelle. (2008). "Exporters and Credit Constraints. A Firm Level Approach", Working Paper Research No 139, National Bank of Belgium.

Nabi, Ijaz. (1989). "Investment in Segmented Capital Markets" The Quarterly Journal of Economics, 104(3): pp. 453-462.

Nagaraj, P. (2012). "Financial constraints and export participation". Unpublished manuscript.

Olley, G. S. and Ariel Pakes. (1996). "The Dynamics of Productivity in the Telecommunications Equipment Industry" Econometrica, 64(6): 1263-1297.

Panagariya, Arvind. (2004). "India in the 1980s and 1990s: A Triumph of Reforms." International Monetary Fund

Paravisini, Daniel, Veronica Rappaport, Philipp Schnabl and Daniel Wolfenzon.(2011)."Dissecting the Effect of Credit Supply on Trade: Evidence from Matched Credit-Export Data". Unpublished Manuscript.

Roberts, Mark J. and James R. Tybout. (1997). "The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs" The American Economic Review, 87(4): 545-564.

Scherer, F. M. (1986). Innovation and growth: Schumpeterian perspectives. MIT Press Books, 1

Sen, Kunal and Rajendra Vaidya. (1999). "The Process of Financial Liberalization in India." Delhi; Oxford: Oxford University Press.

Sharma, Gunjan (2008)."Competing or Collaborating siblings? Industrial and trade policies of India". Unpublished Material

Shaw, Edward S. (1973) "Financial Deepening in Economic Development". New York: Oxford University Press.

Shefer, D., & Frenkel, A. (2005). "R&D, firm size and innovation: An empirical analysis". Technovation, 25(1), 25-32.

Syrneonidis, G. (1996). "Innovation, firm size and market structure: Schumpeterian hypotheses and some new themes". OECD Economic Studies, 27, 35–70.

Syverson, C. (2010). "What determines productivity?" NBER Working Paper.

Topalova, Petia and International Monetary Fund. Asia and Pacific Dept. (2004). "Overview of the Indian Corporate Sector, 1989-2002". [Washington, D.C.]: International Monetary Fund.

Tybout, James R. (1983). "Credit Rationing and Investment Behavior in a Developing Country" Review of economics and statistics.-, 1983: 598-607.

———————(2000). "Manufacturing firms in developing countries: How well do they do, and why?" Journal of Economic Literature, 38(1), 11-44.

Van Beveren, I. (2012). Total Factor Productivity Estimation: A Practical Review. Journal Of Economic Surveys, 26(1), 98-128.

Van Biesebroeck, J. (2005). "Firm size matters: Growth and productivity growth in African manufacturing". Economic Development and Cultural Change, 53, 545-583.

Whited, Toni M. (1992). "Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data" The Journal of Finance, 47(4): 1425-1460.

Williamson, O. E. (1967). "Hierarchical control and optimum firm size". The Journal of Political Economy, 75(2), 123-138.

Winter, J. K. (1999). "Does firms' financial status affect plant-level investment and exit decisions?" Publications 98-48, University of Mannheim.

Wooldridge, Jeffrey M. (2009). "On Estimating Firm-Level Production Functions using Proxy Variables to Control for Unobservables" Economics Letters, 104(3), 112-114