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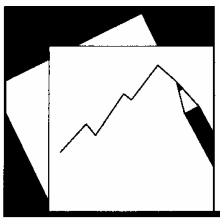

IMF Working Paper

Trade Liberalization and Firm Productivity: The Case of India

Petia Topalova

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Trade Liberalization and Firm Productivity: The Case of India

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Abstract

Using a panel of firm-level data, this paper examines the effects of India's trade reforms in the early 1990s on firm productivity in the manufacturing sector, focusing on the interaction between this policy shock and firm and environment characteristics. The rapid and comprehensive tariff reductions—part of an IMF-supported adjustment program with India in 1991—allow us to establish a causal link between variations in inter-industry and inter-temporal tariffs and consistently estimated firm productivity. Specifically, reductions in trade protectionism lead to higher levels and growth of firm productivity, with this effect strongest for private companies. Interestingly, state-level characteristics, such as labor regulations, investment climate, and financial development, do not appear to influence the effect of trade liberalization on firm productivity.

JEL Classification Numbers: F14, L6, D24

Keywords: Trade policy, firm productivity, Indian manufacturing, endogeneity of protection

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I. INTRODUCTION

Over the past two decades, trade liberalization has become an important part of many countries' development strategies.[2] Advocates of liberalization argue that opening up local markets to foreign competition and foreign direct investment can lead to improvements in the productivity of domestic industries, resulting in a more efficient allocation of resources and greater overall output. Critics warn that domestic firms may not be able to realize efficiency gains, because they are unable to successfully adapt foreign technologies to local methods of production or because domestic firms face binding credit constraints that prevent expansion of efficient industries as well as investments in new technology. Which of these two views is closer to the truth has important implications for trade policy: if the latter holds, benefits of liberalization may not be realized unless additional policies are devised to facilitate technology transfer or ease credit constraints.

The evidence on *whether* trade liberalization increases firm-level efficiency is mixed. Tybout et al. (1991) find no evidence of increased productivity following liberalization in Chile, while Harrison (1994), Tybout and Westbrook (1995), Pavcnik (2002), and Fernandes (2003) do observe productivity increases following liberalization in, respectively, Côte d'Ivoire, Mexico, Chile, and Colombia.

This paper examines the effects of recent trade liberalization in India using a panel of firm-level data. In particular, we try to answer several questions: did India's sweeping trade reforms in the early 1990s lead to higher economy-wide and firm-level productivity, and what was the interaction between this policy shock and various firm and environment characteristics? Were the effects of liberalization influenced by the type of firm ownership or by the initial level of productivity? And did institutional characteristics of the Indian states, such as financial development, investment climate, or labor laws play a role in the propagation of the trade liberalization shock?

India is a particularly relevant setting to seek the answers to these questions: in 1991, in response to a severe balance of payments crisis, India turned to the International Monetary Fund for assistance in solving its external payments problem. Financial assistance was received from the IMF to support India's adjustment program, which included major

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[2] In a recent lecture, Anne Krueger, the First Deputy Managing Director of the International Monetary Fund, argued that liberalization is essential to growth and poverty reduction: "First, no country has achieved rapid and sustained growth in living standards without using the international economy and integrating with it. Second, countries wanting to achieve lasting reductions in poverty will be more successful the sounder are their own economic policies and the more rapid their economic growth. And third, for countries with a sound domestic policy framework, poverty reduction and growth will be more rapid the more open is the international economy and the more rapid the growth of trade in goods and services" (Heinz Arndt Memorial Lecture, August 13, 2003).

structural reforms–a key one being trade liberalization. A massive overall reduction in tariffs and non-tariff barriers, as well as a reduction in the standard deviation of protection, followed. Coinciding with these tariff reductions were significant changes in firm-level productivity, as documented by Unel (2003).

There are strong theoretical reasons to think that, in the absence of external pressure, trade policies are endogenously determined, with increases in firm productivity preceding trade liberalization. However, because trade liberalization in the early 1990s can be characterized as rapid and relatively comprehensive, it is reasonable to assume that the changes in level of protectionism were exogenous. Thus, the reforms initiated in 1991 and completed in the context of the export-import policy announced in the government's Eighth Plan (1992-96) comprise an excellent setup to test whether changes in firm productivity can be attributed to the exogenous variation in tariff changes across industries.[3]

More specifically, in order to estimate the effect of trade liberalization on productivity, we employ methodology similar to that used in Pavcnik (2002) and Fernandes (2003); this methodology overcomes some weaknesses of earlier studies. First, we obtain consistent estimates of the parameters of the industry-level production functions in constructing firm-level productivity measures, using the methodology of Levinsohn and Petrin (2003). Next, we examine the correlation between trade policies and manufacturing productivity in a regression framework. To limit the confounding effect of possible selective protection of industries, we focus on the pre- and immediately post-reform period, leaving us with plausibly exogenous intertemporal variation in nominal tariff levels across industries.

We find that reductions in trade protection lead to higher levels of productivity. While this effect is robust and highly statistically significant for private companies, there is no evidence that trade liberalization leads to any productivity improvements for government-owned or foreign companies. State-level characteristics, such as labor regulations, investment climate, and financial development, do not seem to influence the effect of trade liberalization on productivity.

II. THE CASE OF INDIA: THE 1991 REFORMS

India's post-independence development strategy was one of national self-sufficiency, and stressed the importance of government regulation of the economy. Cerra et al. (2000, p. 3) characterized it as "both inward looking and highly interventionist, consisting of import protection, complex industrial licensing requirements, pervasive government intervention in financial intermediation and substantial public ownership of heavy industry." In particular, India's trade regime was amongst the most restrictive in Asia, characterized by high nominal tariffs and pervasive non-tariff barriers, including a complex import licensing system, an

[3] India's trade policy is developed according to five–year plans. While these plans may be modified during the implementation phase, they are by and large carried out.

"actual user" policy that restricted imports by intermediaries, restrictions of certain exports and imports to the public sector ("canalization"), phased manufacturing programs that mandated progressive import substitution, and government purchase preferences for domestic producers.

It was only during the second half of the 1980s, when the focus of India's development strategy gradually shifted toward export-led growth that the process of liberalization began. Import and industrial licensing were eased, and tariffs replaced some quantitative restrictions, although even as late as 1990 a mere 12 percent of manufactured products could be imported under an open general license; still, the average tariff was more than 90 percent. (Cerra et al. (2000)).

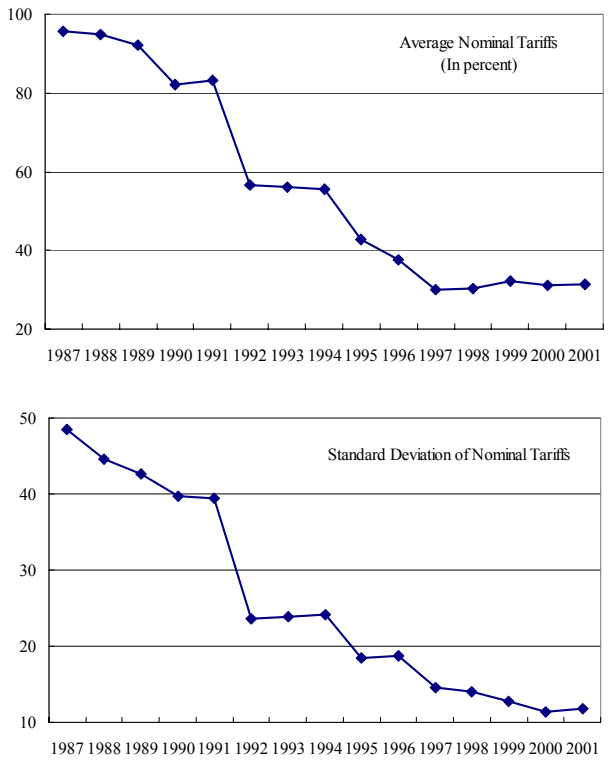
However, concurrent with the gradual liberalization in the mid to late 1980s was a rise in macroeconomic imbalances—namely fiscal and balance of payments deficits—which increased India's vulnerability to shocks. The sudden increase in oil prices, resulting from the conflict in the Middle East in 1990, the drop in remittances from Indian workers in the same region, and the slackened demand of important trading partners, as well as political uncertainty, undermined investor confidence and resulted in large capital outflows. To deal with its external payments problems, the government of India requested a Stand-By Arrangement from the IMF in August 1991. The IMF support was conditional on an adjustment program featuring macroeconomic stabilization and structural reforms. The latter focused on the industrial and import licenses, the financial sector, the tax system, and trade policy. On trade policy, benchmarks for the first review of the Stand-By Arrangement included a reduction in the level and dispersion of tariffs, a removal of quantitative restrictions on imported inputs and capital goods for export production, and elimination of public sector monopoly on imports of all items except petroleum, edible oils, and fertilizer and certain items canalized for health and security reasons (Chopra et al. (1995)).[4]

The government's export-import policy plan (1992–97) ushered in radical changes to the trade regime by sharply reducing the role of the import and export control system (Table 1). The share of products subject to quantitative restrictions decreased from 87 percent in 1987/88 to 45 percent in 1994/95. All 26 import licensing lists were eliminated and a "negative" list was established (Hasan et. al (2003)). Restrictions on exports were also relaxed, with the number of restricted items falling from 439 in March 1990 to 210 in March 1994.

[4] Hasan et. al (2003, p. 5) notes that "given several earlier attempts to avoid IMF loans and the associated conditionalities, the large number of members of the new cabinet who had been cabinet members in past government with inward-looking trade policies and the heavy reliance on tariffs as a source of revenues, these reforms came as a surprise."

In addition to easing import and export restrictions, tariffs were drastically reduced (Figure 1). Average tariffs fell from more than 80 percent in 1990 to 37 percent in 1996, and the standard deviation of tariffs dropped by 50 percent during the same period (Figure 1). Figure 2 presents the evolution of tariffs in selected industries. Most industries faced a sharp drop in tariffs from 1991 to 1992, although the magnitude of the shock varied widely by industry. The Indian rupee was also devalued by 20 percent against the U.S. dollar in July 1991, and further devalued in February 1992.[5] Subsequently, it became fully convertible for current account transactions. The economy reacted positively to the reduction in trade distortions and, as a result, the ratio of total trade to GDP rose from an average of 13 percent in the 1980s to nearly 19 percent of GDP in 1999/00 (Figure 3). Export and import volumes also increased sharply from the early 1990s, outpacing growth in real output (Figure 3).

Figure 1. India: External Tariffs



Source: Author's estimates.

India remained committed to further trade liberalization, and since 1997, there have been further adjustments to import tariffs. However, at the time, the government announced the export-import policy in the Ninth Plan (1997–2002), sweeping reforms outlined in the previous plan had been undertaken and pressure for further reforms from external sources had abated. In this context, the problem of potential endogeneity of trade policy becomes more pronounced. In particular, if policy decisions on tariff changes across industries were indeed based on expected future productivity or on industry lobbying, our empirical strategy would not be valid. Simply comparing productivity in liberalized industries to productivity in non-liberalized industries would possibly give a spurious correlation between total factor productivity (TFP)

[5] Although exchange rate devaluation may also inhibit imports, Chopra et al. (1995) argue that the magnitude of the exchange rate devaluations can hardly be compared to the impact of pervasive trade reforms in reshaping industry.

Figure 2. Evolution of Tariffs by Industry, 1987–2001

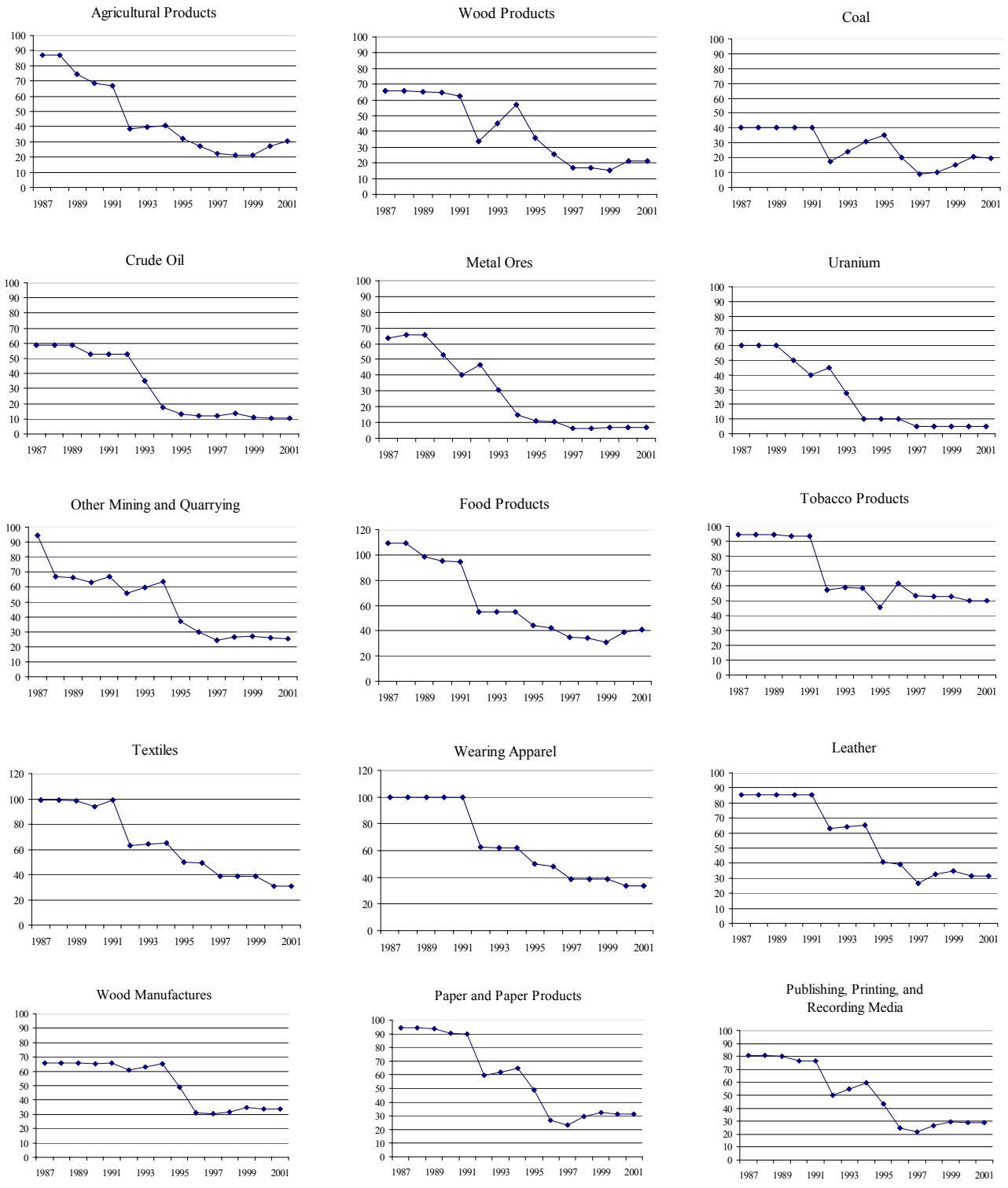
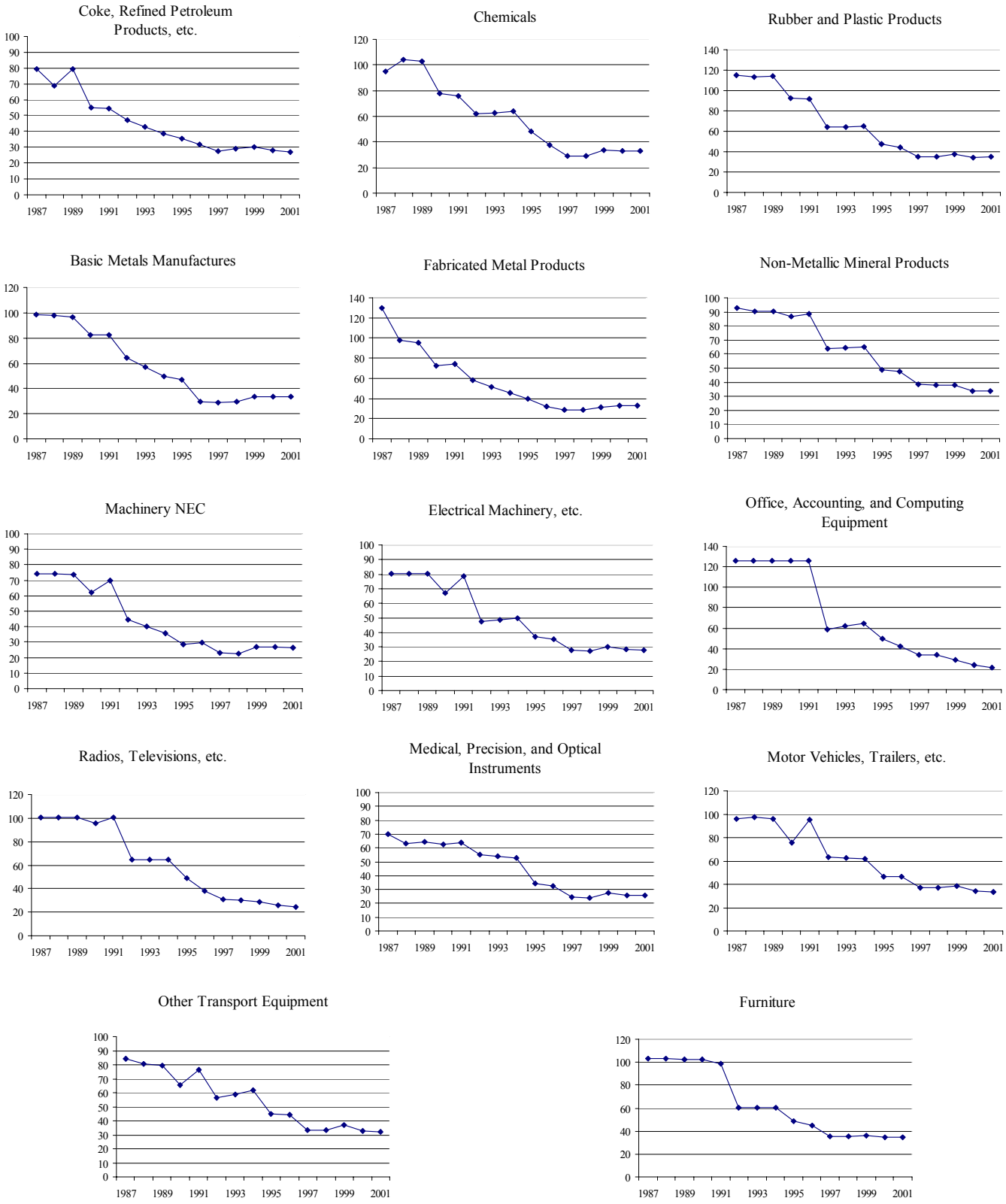


Figure 2. Evolution of Tariffs by Industry, 1987–2001 (Concluded)

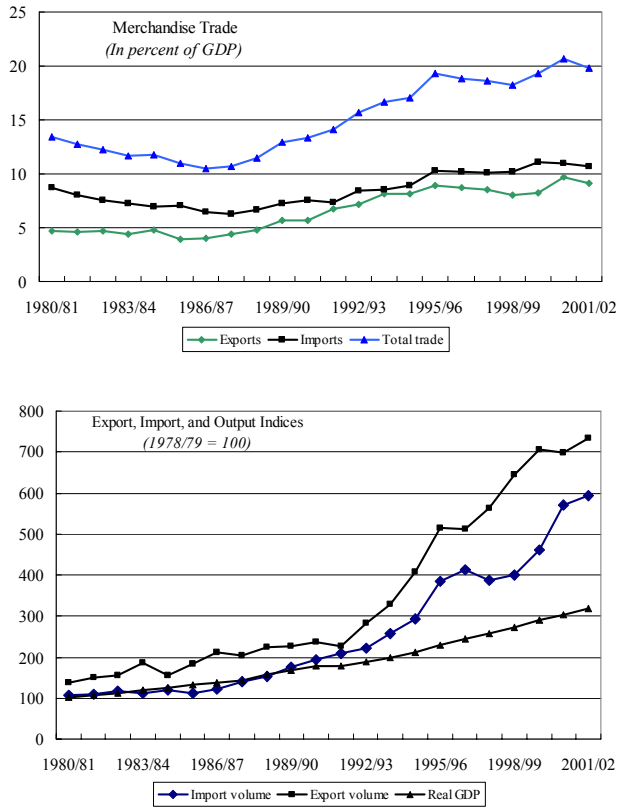


Source: Author's estimates.

1/ Average tariffs using the NIC2 classification.

growth and trade policies. As a simple check of the validity of our empirical strategy, we look for evidence that tariffs were correlated with past industry-level performance during two periods: the period before and immediately after the crisis (1989-1996), when India's trade policy was significantly affected by externally imposed benchmarks, and the period 1997–2002, when external pressure was virtually absent.[6] In the latter period, there is some evidence to suggest that tariffs may have been used selectively to protect less efficient industries (Table 2), but this is more fully discussed in the next section.

Figure 3. Foreign Trade, 1980/81–2001/02



Sources: Centre for Monitoring the Indian Economy (CMIE); and author's estimates.

III. Empirical Strategy, Data, and Related Literature

The theoretical literature on trade and productivity does not provide an unambiguous prediction of the impact of trade liberalization on firm level productivity. Some argue that trade liberalization in poor economies may have a detrimental effect on growth by preventing a country's involvement in certain industries, thus potentially denying it knowledge accumulation and productivity growth (Young (1991) and Stiglitz (2002)). Others argue the opposite: trade liberalization can actually increase overall domestic productivity through several channels. In the presence of imperfectly competitive domestic markets, trade liberalization and concurrently foreign competition can improve allocative efficiency by forcing firms to lower cost-price mark-ups (i.e., the pro-competitive effects of trade) and thus to move them down their average cost curves, thereby effectively raising firm size and scale efficiency (i.e., scale efficiency gain of trade) (Epifani (2003)). With firm heterogeneity, trade opening may also induce a reallocation of market shares towards more efficient firms and generate an aggregate productivity gain, without any productivity change at the firm level (Melitz (2003)). Going beyond this reallocation effect of trade liberalization, Aghion et al. (2003) suggest another mechanism through which liberalization might affect productivity: the increased threat of

[6] Ideally, we would like to estimate the production function for the periods before 1991, 1991–1996, and after 1996, but due to the small number of observations before 1991, we combine the pre-reform and immediately post-reform period.

foreign competition raises the innovation incentives by domestic producers as they seek to deter entry by foreign competitors. The higher level of innovation leads to productivity growth at the firm level. Finally, the access to superior inputs and technology might also increase technical efficiency. However, whether domestic producers can take advantage of increased access to knowledge remains questionable.

Due to the ambiguity of the theory, the question of whether trade liberalization leads to higher productivity remains largely an empirical one. We employ the natural experiment of the trade liberalization of India in 1991 to answer this question in the Indian context, contributing to a growing body of empirical literature on the topic.[7] In particular, we extend Krishna and Mitra's (1998) attempt to rigorously estimate the effects of trade liberalization on firm performance in Indian manufacturing for the 1986–1993 period and the recent study by Aghion et al. (2003), which models the growth in performance inequality that might occur from trade liberalization as a result of increases in the gap between the best and worst performers and between pro-employer and pro-worker biased regions. While Aghion et al. (2003) test the predictions of their model using state-industry level data from 1980 to 1997 and a post-reform dummy to capture the effect of liberalization (the same approach adopted by Krishna and Mitra (1998)), we use firm-level panel data, employing intertemporal and across-industry variations in trade protection to identify the effect of trade policies. Our methodology follows closely Pavcnik (2002) and Fernandes (2003), who estimate the impact of tariffs on levels of productivity for Chile and Colombia, respectively.

A. Productivity Measure

To begin our analysis, we construct consistent measures of firm-level TFP. Previous studies estimated productivity by ordinary least squares (OLS), taking as TFP the difference between actual and predicted output. This technique is subject to omitted variables bias, as the firm's choice of inputs is likely to be correlated with any unobserved firm-specific productivity shocks. If productivity is assumed time-invariant, the simultaneity problem may be solved by including firm fixed effects (Harrison (1994) and Balakrishnan et al. (2000)); however, this strategy may not be appropriate when we are interested in changes in firm-level productivity.

We construct a consistent firm-level measure of TFP following the methodology of Levinsohn and Petrin (2003). Building on Olley and Pakes (1996),[8] Levinsohn and Petrin

[7] Tybout et al. (1991) find no evidence of increased productivity following liberalization in Chile, while Harrison (1994), Tybout and Westbrook (1995), Pavcnik (2002), and Fernandes (2003) do observe productivity increases following liberalization in, respectively, Côte d'Ivoire, Mexico, Chile and Colombia.

[8] Olley and Pakes (1996) develop a methodology in which an investment proxy controls for correlation between input levels and unobserved productivity shocks, allowing for the consistent estimation of the firm's production function. However, this methodology can only be applied to plants reporting non-zero investment, usually leading to a sizable truncation of the available data. The Levinsohn and Petrin (2003) method avoids this problem.

(2003) use firm's raw material inputs to correct for the simultaneity in the firm's production function.[9] The inclusion in the estimation equation of a proxy that controls for the part of the error correlated with inputs ensures that the variation in inputs related to the productivity term will be eliminated. Levinsohn and Petrin (2003) show that if the demand function for intermediate inputs is monotonic in the firm's productivity for all relevant levels of capital, then raw materials can serve as a valid proxy. Assuming a Cobb-Douglas production function, the equation estimated for company i in industry j at time t in the first step can be written as follows:

$$(1) \qquad y^j_{it} = \alpha + \beta_l l^j_{it} + \beta_p p^j_{it} + \beta_m m^j_{it} + \beta_k k^j_{it} + \omega^j_{it} + \varepsilon^j_{it}.$$

where y denotes output, l denotes labor, p denotes power and electricity expenditures, m denotes raw material expenditures, and k denotes capital used; all variables are expressed in natural logarithm. The simultaneity problem arises from the ω^j_{it} term, a firm-specific, time varying productivity shock that cannot be observed by the econometrician but is correlated with the firm's choice of variable inputs, p, m, and l. Using a process described in Levinsohn and Petrin (2001), we derive consistent estimates of the parameters of the production functions for each industry j.[10] In doing this, we allow for the input demand function as well as the production function to differ across two periods: before 1996 (a period of very high economic growth) and after 1996 (a relative slowdown). In this way, we partially address the concern that the changing economic environment may have affected the relative input and output prices, which are not included in the raw materials demand estimation. The correctly estimated production function coefficients differ substantially from the (biased) OLS estimates, confirming the importance of the Levinsohn and Petrin methodology. Discussion of the OLS result is omitted for the sake of brevity.[11] Using the input coefficients obtained with the Levinsohn and Petrin methodology, we obtain estimates of a firm's Hicks-neutral TFP by subtracting firm i's predicted output from its actual output at time t. In order to make the estimated TFP comparable across industries, we create a productivity index[12] following

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[9] For a detailed description of the production function estimation methodology, see Levinsohn and Petrin (2003).

[10] Due to the small number of companies in some of the 4–digit level industries, the production function parameters were estimated at the 2–digit National Industrial Classification codes.

[11] Because firm exit rates are so low (see Table 1 in Appendix II), we do not correct for potentially endogenous exit decisions by firms. In contrast to Chile, where exit rates were high, exit does not appear to have been an important feature of adjustment in India. However, Pavcnik (2002) does develop a methodology that would allow for this correction if necessary.

[12] The productivity index is calculated as the logarithmic deviation of a firm from a reference firm's productivity in the particular industry in a base year. In other words, we subtract the productivity of a firm with the mean log output and mean log input level in 1989/90 from the estimated firm-level TFP.

the standard methodology in the literature (Aw, Chen, and Roberts (2001), Pavcnik (2002), and Fernandes (2003)).

B. Empirical Strategy

The standard approach to estimating the effects of trade liberalization is to estimate the coefficient of an indicator variable for post-reform period (Tybout et al. (1991), Krishna and Mitra (1998), Balakrishnan et al. (2000), and Aghion et al. (2003)). This estimate captures the cumulative effect of all changes in the economic environment in which firms operate after trade reforms. Since trade liberalization often occurs as a package of a host of other economic reforms, simply looking at "post" effects may not accurately capture the impact of trade liberalization. This is an especially important concern in the case of India, as trade liberalization was just one part of a major package of reforms in the early 1990s, as noted earlier.

Our empirical strategy exploits the specific timing as well as the differential degree of liberalization across industries to identify the effect of trade policy on firm-level productivity. Although we build on the methodology of Pavcnik (2002) and Fernandes (2003), compared to these studies, we benefit here from both a rather clean natural experiment of trade liberalization coming from external factors and the availability of data before and after trade reforms. In this context, our baseline specification takes the following form:

$$(2) \qquad pr^{j}_{it} = \alpha + \beta\, Trade^{j}_{t-1} + X \bullet \gamma + Y_t + I^{j} + v^{j}_{it}.$$

where pr^{j}_{it} is the productivity index of company i in industry j at time t; $Trade^{j}_{t-1}$ is a measure of lagged trade protection at the 4–digit National Industrial Classification (NIC) level; and X is a set of company characteristics, including age, age squared, ownership categories (private stand alone, private group, government-owned, and foreign firms), and size categories (large, if average sales over the entire period are in the top 1 percent of the distribution; medium, if sales are greater than the median, excluding the top 1 percentile; and small if average sales over the period are less than the median). Y_t is a set of year dummies and I^{j} are industry fixed effects. The inclusion of industry fixed effects absorbs unobserved heterogeneity in the determinants of productivity that are industry-specific, while the year dummies control for macroeconomic shocks common to all firms. We are interested in the magnitude and sign of the coefficient on lagged trade protection, β, which captures the percentage change in firm-level productivity associated with industry level differences in trade protection.

C. Data Description

A firm-level dataset is compiled from the Prowess database, which contains information primarily from the income statements and balance sheets of listed companies comprising

more than 70 percent of the economic activity in the organized industrial sector of India.[13] The size of the dataset, which covers the period 1989–2001, varies by year, as demonstrated in Table 1 in Appendix II. Since overall exit rates are very low, we use an unbalanced panel of companies for estimation purposes.[14] For this reason, we verify the robustness of our results by conducting our analysis using only the subset of companies whose information is available for all years. The dataset contains information on about 4,100 individual manufacturing companies. Firms are categorized by industry according to the 4–digit 1998 NIC code, and span the industrial composition of the Indian economy. There are 116 industries represented in our sample. The largest sectors, measured by the number of companies, are chemicals and basic metals, and manufactures of food products, beverages, and textiles. Tables 2–4 in Appendix II provide other summary statistics on the dataset, including a breakdown of companies by industry classification, ownership, and year of incorporation. For the estimation of the production function and TFP, all relevant variables were deflated using appropriate price deflators from India's national accounts statistics.

The data on firm economic activity are complemented with annual tariff data at the six-digit level of the Indian Trade Classification Harmonized System (HS) code. More than 5,000 product lines have been matched to the 116 NIC codes to calculate average industry-level tariffs. These industry-level tariffs are used as a measure of trade protection, as they reflect the tariffs faced by the industry, as well as potential exposure to foreign competition. However, this is an incomplete measure of protection, as non-tariff barriers have been used as an important tool of trade policy, especially in India. We plan to include these additional measures in the future.

Previous studies have also used volume measures, such as import penetration, in order to capture the importance of actual exposure to foreign competition. However, this type of variable is endogenously determined; while increased competition is expected to cause firms to become more productive, the Ricardian model of trade predicts that certain goods may be imported precisely because domestic productivity in that industry is low (Fernandes (2003)). Thus, our preferred measure of trade protection is lagged nominal tariffs.

IV. RESULTS

A. Endogeneity of Trade Policy

Before proceeding with estimating equation (2), we address the concern of the possible endogeneity of trade policy, which could potentially invalidate our empirical strategy. Specifically, the major trade liberalization in 1991/92 was driven largely by external

[13] The Prowess database comprises firm-level data collected by the Centre for Monitoring the Indian Economy, a private company in India. It is used to derive firm-level productivity, as described in Appendix I.

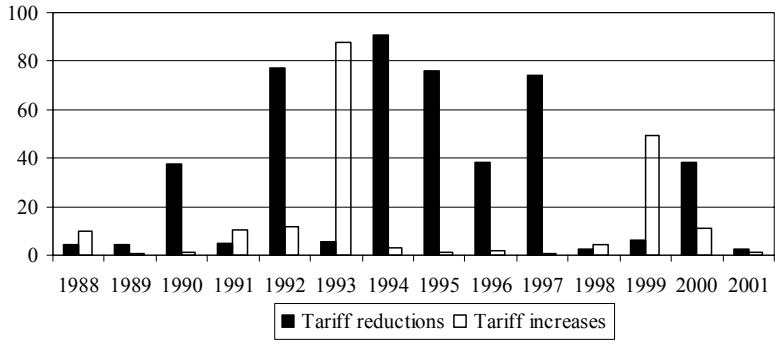
[14] Because firms are under no legal obligation to report balance sheet data, a small percentage of firms exit and re-enter the database. These firms are excluded from the analysis.

pressure, as discussed in Section II, and was completed by the time of the drafting of the export-import policy in the Ninth Plan. Thereby, the concern arises in the post–1996 period that policy decisions on tariff changes may have been based on expected future productivity. Thus, the coefficient on lagged trade protection might be capturing a reverse relationship—tariffs are lowered in certain industries precisely because these industries are more productive.

Ideally, we could alleviate our concern by learning the "true" intentions of Indian policymakers, or, failing this, through a detailed study of the political economy behind tariff changes in India over the period. However, objective and detailed analyses of such policy changes are not available. Instead, we use the available data to conduct a simple test of the validity of our empirical strategy. First, we examine to what extent tariffs moved together. An analysis of the tariff changes of the 5,000 items in our dataset for 1989-96 and for 1997-2001 suggests striking differences: in the first period, the majority of tariff changes across products exhibited similar behavior (either increased, decreased, or remained constant); thereafter, tariff movements were not as uniform. In particular, Figure 4 demonstrates that, conditional on tariffs being changed, the probability of the changes being uniform across items is significantly higher before 1997. This suggests that policymakers were more selective in setting product tariffs during 1997–2001.

If indeed policymakers adjusted tariffs according to an industry's perceived productivity, we should expect current productivity levels to predict future tariffs. Therefore, we calculate the average industry-level productivity as the average firm-level TFP, weighted by companies' sales. We then regress industry-level tariffs in period $t+1$ on industry-level productivity, controlling for industry and year fixed effects and weighting each industry by the number of companies in the industry for the particular year. The results are presented in Table 2. As expected, the correlation between future tariffs and current productivity is indistinguishable from zero for the 1989–96 period. The 1997–2001 period, however, paints a different picture. The coefficient on current productivity is negative and significant at the 1 percent level, suggesting that trade policy may have been adjusted to reflect industries' relative performance.

Figure 4. Tariff Changes, 1988-2001
(In percent of total HS codes)



Source: Author's estimates.

Our test implies that to correctly identify the effect of trade policies on productivity, we should restrict our attention to the period immediately before and after the major trade reforms (1989–96). While there is no evidence that variation in tariffs may have been used to selectively protect the less productive industries during this period, we nevertheless follow Fernandes (2003) and estimate the effect of lagged rather than

contemporaneous tariffs.[15] Including industry fixed effects may also absorb time-invariant political economy factors underlying trade protection across industries (Goldberg and Pavcnik (2001)).

B. Average Impact of Trade Policy and Robustness Checks

The results from estimating equation (2) for the period 1989–96 are presented in Table 3 (Panel A). We correct for heteroskedasticity and adjust standard errors for clustering at the industry–year level. The regression in column (2) includes industry fixed effects at the 4-digit level; column (3) includes industry dummies at the 2-digit level, and column (4) repeats the analysis on the balanced panel of companies. To further test the robustness of our findings, we include firm-level fixed effects in column (5) and account for the Markov process assumed to be followed by firm's productivity in column (6) by including lagged TFP as a regressor. Finally, in column (7), we use the Arellano Bond panel estimator to correct for the bias introduced through the inclusion of lagged dependent variables. The coefficient of interest β is negative and statistically significant at the 1 percent level across all specifications. Since the productivity measure is in log terms, the estimated coefficient implies that a 10 percent reduction in tariffs (at the 4-digit industry level) will lead to about 0.5 percent increase in TFP. The results are highly statistically significant, robust across specifications, and very similar to the estimates of Fernandes (2003) in her study on Colombia's trade policy. Decreasing trade protection in the form of lower tariffs raises productivity at the firm level.

Referring again to Table 3 (Panel B), we estimate equation (2) but look at the effect of liberalization on productivity growth (rather than on levels). The coefficient of lagged tariffs is again negative and statistically significant, implying that lowering tariffs not only generates productivity gains, but also leads to faster productivity growth. The estimates on some firm characteristics are also of interest. Most notably, the coefficient on the indicator for whether a company is public is negative and significant. Government owned companies are on average 10 percent less productive than private companies not associated with a business group. The growth rate of their TFP is also significantly smaller.

If the high level of protection before trade reforms allowed companies with different levels of productivity to co-exist, the higher average productivity associated with tariff reductions could be due to the exit of the least efficient producers, as shown by Melitz (2003). Although exit rates of firms in our sample are low, we investigate whether the productivity gains arise through that channel by reestimating equation (2) only for the set of companies in operation in 1996. The positive impact of tariff reductions on productivity levels is virtually unchanged. While the exit of less efficient companies might contribute to productivity improvements, it does not drive our results. In addition, the probability of exit is not significantly related to trade protection at the industry level, and there is no evidence that

[15] Lagged tariffs are also more appropriate if we expect that productivity adjustments do not occur instantaneously.

exiting companies were less productive. Trade liberalization seems to have induced productivity improvements within the firm.

As an additional robustness check, we aggregate our productivity data at the 4-digit industry level, in order to see whether the significance of our results is driven by the disaggregated nature of the data. We regress industry-level productivity on lagged tariffs, with industry and year fixed effects weighted by the number of companies in each industry. The effect of lagged tariffs on productivity remains negative and statistically significant at the 1 percent level (Table 4). The effect of tariff reductions on productivity growth is similar in magnitude but statistically significant only when the Arellano Bond dynamic panel estimator is used.

C. Average Impact of Trade Policy and Company Characteristics

Trade liberalization allows us to test whether certain company characteristics interact with trade liberalization shocks in determining post-reform firm-level performance. For example, it is argued that private firms more quickly adapt to changing circumstances such as policy shocks (Shleifer (1992) and World Bank (1995)). Because there are both public and private firms operating in most industries in India, we can compare how the productivity of public and private companies changes with increased competition from imported goods. Similarly, within the private sector, we investigate whether the effect of lower tariffs on productivity is different for stand-alone companies, companies that are part of a business group, and foreign companies. Although firm size is arguably endogenous (as a firm's size in the years before the reform may be directly related to firm's productivity), we examine whether it is correlated with firm's ability to adapt to a new environment. We also test whether trade liberalization favored firms that were closer to the industry technological frontier at the eve of the reform. The results are presented in Table 5. For each subgroup, we estimate equation (2), allowing industry and year fixed effects and the coefficients on firm characteristics to differ across the various groups. The specification in row (1) in Table 5 is equivalent to column (2) in Table 3, i.e., we include industry fixed effects at the NIC 4-digit level. In row (2) of Table 5, we control for firm fixed effects. In row (3), we introduce the lagged firm productivity as a regressor, while in row (4), we present the Arellano Bond panel estimator.

Columns (1) and (2) of Table 5 show evidence that while trade liberalization raises productivity in private companies, the same increase in efficiency may not be experienced by public companies. Although the coefficient on lagged tariffs is imprecisely estimated, the point estimates for the effect of trade policy on productivity of the public enterprises are much smaller in magnitude than almost all those for private enterprises. Thus, we find support for the view that public sector firms are less productive than privately held firms by providing evidence that public firms react differently to shocks. Unlike private companies, the productivity of public sector firms does not respond to trade liberalization.

On the other hand, no difference is found in the way private stand-alone companies and companies belonging to a business group responded to decreased trade protection (see columns (3) and (4) of Table 5). We might have expected, say, that the easier access to financing to members of a business group to result in a more favorable response to the new environment, however this is not borne out in the data. In addition, foreign companies

operating in India experienced no change in their productivity as a result of the tariff reductions (column (5)), which is not surprising given that many were already exposed to foreign competition.

A somewhat unexpected result is the comparatively higher effect of trade liberalization on dispersed companies versus companies with concentrated ownership (columns (6) and (7) of Table 5).[16] Again, the results are not significantly different, but the point estimate is much lower for companies with concentrated ownership. Corporate finance theory does not provide a clear-cut answer on which set of companies we should expect to adjust faster to the new economic environment. On the one hand, we might expect concentrated ownership to be more conducive to a faster response to foreign competition since the coordination problem among owners is smaller. On the other hand, we might expect companies with dispersed ownership to more quickly undertake productivity improvements, as absent this, these companies as opposed to ones dominated by block shareholders might be more subject to takeovers or mergers. Using a slightly more refined distinction, under which the top third most concentrated companies (column (8)) are separated from the bottom most concentrated companies (column (9)), we still find that the effect of trade liberalization on dispersed companies is much larger in magnitude, while the effect on companies with concentrated ownership is statistically insignificant in all specifications.

Unlike Aghion et al. (2003), we do not find that trade liberalization leads to a divergence in productivity, in the sense that it fosters productivity growth most among firms already close to the technological frontier. We split the sample of firms into two groups: those whose average TFP from 1989–1991 was above and below the industry median. Estimating equation (3) for each of the two subsamples, we find no compelling evidence that trade liberalization had a differential impact (columns (10) and (11) of Table 5). Similar results are obtained if we modify the classification of high TFP and low TFP firms to be the top and bottom third of the distribution of the average pre-reform TFP by industry (columns (12) and (13)). While the Arellano Bond estimator (row (4)) does suggest that firms with higher initial productivity might have experienced a higher rise in productivity as a result of the lower trade protection, the result is not robust across specifications. To further investigate this possibility, we estimate the coefficient on the interaction of lagged tariffs and pre-reform productivity relative to the industry's best performer. Table 6 shows no consistent pattern across specifications. The positive coefficient on the interaction term in some of the specifications suggests that if anything, trade liberalization lead to convergence in firm performance. This finding is in sharp contrast with the post–1991 divergence in state-industry performance documented and attributed to trade liberalization by Aghion et al. (2003). Lastly, referring back to Table 5, the size of the firm does not seem to affect the ability of firms to respond to the trade liberalization shock (columns (14), (15) and (16)).

[16] Dispersed companies are considered those in which the share of promoters is less than half, while companies with concentrated ownership are otherwise.

D. Average Impact of Trade Policy and Environment Characteristics

We have established that there is some evidence at least to suggest that certain firm characteristics such as type and concentration of ownership might matter for the transmission of the trade liberalization shock. However, other characteristics like institutions, geography, and level of development of the state in which firms operate do not seem to affect the way firms respond to lower trade protection.[17]

- First, we look at whether firms that are located in coastal states were more affected by the reform. In a country where product markets might not be fully integrated across regions due to the sheer size of the country or poor infrastructure, firms in the heart of the country or in less accessible regions might not experience the threat of increased foreign competition as much as firms in regions in more immediate contact with internationally traded goods. However, columns (1) and (2) of Table 7 do not confirm this hypothesis. The estimated effect of trade does not significantly differ across firms in coastal and non-coastal states.[18] In fact, the point estimate is slightly higher for companies operating in non-coastal states.

- The investment climate in the state also does not seem to matter. Using the Goswami et al. (2002) classification of the states' investment climates, we see in columns (3) and (4) that there is little difference in the estimated impact of lagged tariffs, and if anything, the firms in states with poor investment climate seem to benefit more from the trade reforms.

- Surprisingly, the level of financial development of the state (measured as credit per capita in 1992, with states above the median classified as having "high financial development") also makes no difference (columns (8) and (9)). Although the estimated effect of trade liberalization on productivity is almost never statistically significant for the subset of firms operating in less financially developed states, the point estimates are virtually identical. This finding is unexpected since a major concern regarding trade liberalization has been the ability of domestic firms to access sufficient credit to invest in more efficient technologies and survive in the face of foreign competition.

- We also do not find evidence that the rise in firm-level productivity as a result of trade liberalization contributed to the disparity between state performances in

[17] See Table 4 in Appendix II for the classification of states by various categories.

[18] Since the Prowess data are at the company rather than plant level, a particular company may report data from business activity in more than one state. In addition, data on the location of a company's headquarters are not available at this time. Thus, assuming a company has an equal number of plants in all states, we classify it as operating in a coastal state if more than 50 percent of the company's plants are in coastal states. A similar methodology is used to classify companies in the other state categories.

the 1990s. For example, firms in states that experienced rapid growth in the 1980s, did not react much differently than firms in low growth states (columns (10) and (11)). And similarly firms in states with above median per capita income in 1991 did not reap any more benefit from trade liberalization than firms in states with below median income in 1991 (columns (12) and (13)).

- Finally, we examine the role of institutions. Besley and Burgess (2003) classify Indian states as having pro-worker, neutral, or pro-employer labor laws. We find no difference in firms' response to trade liberalization by the quality of the state's institutions as they relate to workers (columns (5), (6) and (7)).

V. CONCLUSION

This paper makes several important contributions to the empirical literature on trade liberalization using the case of India to examine the link and causality between tariff reform and firm productivity. As India's economy still remains highly protected compared to other large developing economies, establishing this link may have important implications for future trade reforms and growth prospects.

Using a consistent empirical methodology to estimate productivity, we first find that trade liberalization in India causes increased efficiency among firms. Specifically, a decrease in tariffs by 10 percent leads to about 0.5 percent increase in TFP. Our results are derived from a period when trade liberalization, specifically tariff reductions, can be viewed as largely exogenous. This is important because there are strong theoretical reasons to think that, in the absence of external pressure, trade policies are endogenously determined (Grossman and Helpman (2002)). We also show that our result is not driven by the demise of unproductive companies—exit rates are in fact low for the period under study—but rather by the increasing efficiency of existing manufacturers.

Second, this paper pays careful attention to industry-specific tariff reduction, using both inter-temporal and inter-industry variations from over 5,000 tariff line items, during an eight-year period (1989–96), to increase the power and precision of the estimates. Unlike other pre-reform and post-reform comparisons, which rely on the assumption of no common secular trend, we include year fixed effects, ensuring that our results are not driven by a common year trend. We also include industry fixed effects to control for unobserved time-invariant political economy factors underlying trade protectionism across industries.

Third, we use trade liberalization in India to shed light on how the effect of this comprehensive reform differed across companies with different economic characteristics. While it has been established that public sector firms are less productive than privately held firms, there has been less evidence on how these firms react to shocks. We find that the productivity of public sector firms does not change with trade liberalization. This may be because public sector firms do not face hard budget constraints, and the government of India continues to run many firms at a loss in the face of competition. There is also some evidence that less concentrated firms might have been forced to adapt faster to foreign competition. Other firm characteristics such as initial level of productivity and firm size do not seem to have influenced the way in which firms reacted to the lower trade protection. Surprisingly,

the environment in which firms operate (i.e., geography, institutions, financial development, investment climate) does not appear to have any effect on the transmission of the trade liberalization shock.

While we find that liberalization leads to higher firm-level productivity, this result cannot necessarily be linked to welfare improvement without including the cost of productivity gains (Tybout (2001)). Still, two lessons can be drawn from India's experience with trade liberalization. First, trade policy, in the absence of external pressure, may be strongly related to the productivity of firms. Therefore, simply looking at the effects of tariffs on productivity could give misleading results. Second, trade liberalization can increase productivity, but the effect might be limited to privately held industries. Consequently, liberalization may lead to greater productivity gains if combined with more intensive privatization efforts.

Table 1. India: Non-Tariff Barriers on Imports

1987/88	Banned	Limited Permissible	Open General License	Canalized	Not-Identified	Total
In percent of H.S. codes	33	18	13	7	29	100
In percent of imports	16	23	16	27	18	100
1992/93	**Banned**	**Restricted**	**Free**	**Canalized**	**Not-Specified**	**Total**
In percent of H.S. codes	1	56	40	2	1	100
In percent of imports	0	21	46	33	0	100
1994/95	**Banned**	**Restricted**	**Free**	**Canalized**	**Not-Specified**	**Total**
In percent of H.S. codes	0	43	55	2	0	100
In percent of imports	0	20	55	25	0	100
1997/98	**Banned**	**Restricted**	**Free**	**Canalized**	**Not-Specified**	**Total**
In percent of H.S. codes	0	41	57	2	0	100
In percent of imports	0	15	64	21	0	100

Source: Nouroz, 2001.

Table 2. Trade Policy Endogeneity: Effect of Current Productivity on Future Tariffs

	Period		
	1989-2001	1989-96	1997-2001
Panel A			
Total factor productivity 1/ 2/	-0.130 **	-0.028	-0.180 ***
	(0.056)	(0.070)	(0.065)
Year fixed effects	Y	Y	Y
NIC4	Y	Y	Y
R^2	0.88	0.89	0.93
Number of observations	1,317	817	500
Panel B			
Total factor productivity growth 1/ 2/	-0.120	0.030	-0.274
	(0.125)	(0.142)	(0.196)
Year fixed effects	Y	Y	Y
NIC4	Y	Y	Y
R^2	0.90	0.92	0.93
Number of observations	1,185	691	494

Source: Author's estimates.

1/ Robust standard errors are in parentheses. Errors are adjusted for clustering at the industry level. Regressions are weighted by the number of companies in a given industry and year.
2/ Significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively.

Table 3. Effect of Trade Protection on Total Factor Productivity 1/ 2/

	1	2	3	4	5	6	7
Panel A: Total Factor Productivity							
Lagged Tariffs	-0.070 ***	-0.085 ***	-0.089 ***	-0.065 ***	-0.056 ***	-0.050 ***	-0.050 ***
	(0.022)	(0.018)	(0.021)	(0.016)	(0.016)	(0.015)	(0.016)
Private Group Company	-0.024 **	-0.023 **	-0.027 ***	0.014			
	(0.011)	(0.010)	(0.010)	(0.014)			
Government Owned	-0.103 ***	-0.101 ***	-0.106 ***	-0.073 **			
	(0.031)	(0.031)	(0.029)	(0.037)			
Foreign	0.002	-0.003	0.006	0.076 ***			
	(0.018)	(0.018)	(0.018)	(0.021)			
Medium	-0.030 **	-0.034 ***	-0.027 **	-0.025			
	(0.012)	(0.013)	(0.012)	(0.015)			
Small	-0.060 ***	-0.082 ***	-0.072 ***	-0.081 ***			
	(0.015)	(0.016)	(0.015)	(0.021)			
Age	-0.001 ***	-0.001 **	-0.001 **	0.000			
	(0.001)	(0.000)	(0.000)	(0.001)			
Age^2	0.001	0.001	0.001	0.008 ***			
	(0.001)	(0.001)	(0.001)	(0.002)			
Year fixed effects	Y	Y	Y	Y	Y	Y	Y
Industry fixed effects (NIC4)		Y		Y			
Industry fixed effects (NIC2)			Y				
Company fixed effects				Y			
Balanced panel of companies					Y	Y	
Lagged total factor productivity						Y	
Arellano Bond estimator							Y
R^2	0.05	0.20	0.13	0.22	0.80	0.85	...
Number of observations	13,884	13,884	13,884	7,238	13,884	10,754	7,765
Panel B: Total Factor Productivity Growth							
Lagged Tariffs	-0.021 **	-0.047 *	-0.015 *	-0.044 **	-0.043	-0.056	-0.086 ***
	(0.009)	(0.027)	(0.008)	(0.021)	(0.030)	(0.041)	(0.021)
Private Group Company	0.005	0.005	0.003	0.000			
	(0.003)	(0.003)	(0.003)	(0.002)			
Government Owned	-0.015	-0.014	-0.017	-0.014			
	(0.005)	(0.005)	(0.005)	(0.006)			
Foreign	0.006	0.005	0.002	0.001			
	(0.005)	(0.005)	(0.005)	(0.004)			
Medium	0.007	0.007	0.005	0.000			
	(0.003)	(0.003)	(0.003)	(0.003)			
Small	-0.001	-0.001	-0.005	-0.007			
	(0.005)	(0.005)	(0.004)	(0.005)			
Age	0.000	0.000	0.000	0.000			
	(0.000)	(0.000)	(0.000)	(0.000)			
Age^2	0.001	0.001	0.001	-0.001			
	(0.000)	(0.000)	(0.000)	(0.000)			
Year fixed effects	Y	Y	Y	Y	Y	Y	Y
Industry fixed effects (NIC4)		Y		Y			
Industry fixed effects (NIC2)			Y				
Company fixed effects					Y	Y	
Balanced panel of companies				Y			
Lagged total factor productivity						Y	
Arellano Bond estimator							Y
R^2	0.04	0.06	0.05	0.08	0.36	0.37	...
Number of observations	10,754	10,754	10,754	6,186	10,755	7,940	5,553

Source: Author's estimates.

1/ Robust standard errors are in parentheses. Errors are adjusted for clustering at the industry-year level in columns (1)-(6).
2/ Significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively.

Table 4. Effect of Trade Protection on Total Factor Productivity at the Industry Level 1/ 2/

	(1)	(2)	(3)
Panel A: Total Factor Productivity			
Lagged tariffs	-0.066 *	-0.043 **	-0.054 **
	(0.040)	(0.022)	(0.025)
Year fixed effects	Y	Y	Y
Industry fixed effects (NIC4)	Y	Y	
Lagged total factor productivity		Y	
Arellano Bond estimator			Y
R^2	0.84	0.90	...
Number of observations	817	693	568
Panel B: Total Factor Productivity Growth			
Lagged tariffs	-0.045	-0.050	-0.082 **
	(0.028)	(0.033)	(0.037)
Year fixed effects	Y	Y	Y
Industry fixed effects (NIC4)	Y	Y	
Lagged total factor productivity growth		Y	
Arellano Bond estimator			Y
R^2	0.31	0.37	...
Number of observations	691	567	446

Source: Author's estimates.

1/ Robust standard errors are in parentheses. Errors are clustered at the industry level in columns (1) and (2).
2/ Significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively.

Table 5. Firm Characteristics and the Effect of Trade Protection on Productivity 1/ 2/

Specification	Public (1)	Private (2)	Private Non-group (3)	Private Group (4)	Foreign (5)	Dispersed Ownership 3/ (6)	Concentrated Ownership 4/ (7)	Dispersed (bottom third) 5/ (8)	Concentrated (top third) 5/ (9)
(1) Industry fixed effect (NIC4) 6/	-0.034	-0.087 ***	-0.087 ***	-0.071 ***	0.012	-0.121 ***	-0.050 *	-0.160 **	0.037
	(0.052)	(0.020)	(0.029)	(0.027)	(0.036)	(0.031)	(0.026)	(0.068)	(0.059)
No. of observations	769	12,033	5,809	6,224	1,082	4,509	5,214	1,060	1,163
(2) Company fixed effects	-0.024	-0.063 ***	-0.058 **	-0.068 ***	0.029	-0.085 ***	-0.041	-0.119 **	0.052
	(0.056)	(0.018)	(0.025)	(0.025)	(0.035)	(0.027)	(0.026)	(0.056)	(0.060)
No. of observations	769	12,033	5,809	6,224	1,082	4,509	5,214	1,060	1,163
(3) Company fixed effects and lagged total factor productivity	-0.011	-0.056 ***	-0.053 *	-0.060 ***	-0.003	-0.078 **	-0.035 *	-0.106 **	-0.022
	(0.055)	(0.018)	(0.029)	(0.021)	(0.022)	(0.032)	(0.018)	(0.046)	(0.039)
No. of observations	639	9,224	4,165	5,059	891	3,499	4,161	794	945
(4) ArellanoBond	-0.056	-0.047 ***	-0.04	-0.05 ***	-0.039	-0.086 ***	-0.026	-0.132 ***	-0.041
	(0.067)	(0.017)	(0.029)	(0.019)	(0.037)	(0.034)	(0.020)	(0.044)	(0.050)
No. of observations	514	6,553	2,677	3,876	698	2,545	3,121	549	725

Table 5. Firm Characteristics and the Effect of Trade Protection on Productivity (concluded) 1/2/

Specification	Below Median Initial TFP 7/ 10	Above Median Initial TFP 7/ 11	Bottom third of TFP 8/ 12	Top third of TFP 8/ 13	Large 9/ 14	Medium 9/ 15	Small 9/ 16
(1) Industry fixed effect (NIC4) 6/	-0.065 ***	-0.043 **	-0.063 **	-0.027	-0.112 ***	-0.059 **	-0.067 **
	(0.021)	(0.021)	(0.028)	(0.027)	(0.029)	(0.023)	(0.030)
No. of observations	4,500	4,870	2,664	3,594	2,395	6,934	4,555
(2) Company fixed effects	-0.059 ***	-0.045 **	-0.055 *	-0.031	-0.103 ***	-0.040 *	-0.059 **
	(0.022)	(0.022)	(0.028)	(0.027)	(0.029)	(0.023)	(0.027)
No. of observations	4,500	4,870	2,664	3,594	2,395	6,934	4,555
(3) Company fixed effects and lagged total factor productivity	-0.038 **	-0.058 ***	-0.025	-0.055 **	-0.069 ***	-0.048 ***	-0.045
	(0.019)	(0.019)	(0.022)	(0.023)	(0.024)	(0.017)	(0.034)
No. of observations	3,810	4,119	2,254	3,037	2,021	5,583	3,150
(4) Arellano Bond	-0.027	-0.067 ***	-0.015	-0.069 ***	-0.020	-0.086 ***	-0.006
	(0.019)	(0.020)	(0.023)	(0.025)	(0.018)	(0.019)	(0.039)
No. of observations	3,051	3,306	1,797	2,427	1,635	4,209	1,921

Source: Author's estimates.

1/ Robust standard errors are in parentheses. Errors are clustered at the industry level in rows (1)-(3).
2/ Significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively.
3/ Companies where promoters hold less than 50 percent of total equity.
4/ Companies where promoters hold at least 50 percent of total equity.
5/ Columns 8 and 9 are for the bottom third and top third of companies in terms of share of equity held by promoters.
6/ Controls for a company's ownerhip, size, age, and age squared.
7/ Coumns 10 and 11 are for companies that had an average TFP during the period 1989-1991 below and above median TFP for the same period and industry.
8/ Columns 12 and 13 are for the bottom third and top third of companies in terms of average TFP during 1989-1991 within each industry group.
9/ A company is classified as large if its average sales over the entire period are in the top percent of the distribution; medium, if sales are above the median, excluding the top 1 percentile; and small, if average sales are less than the median.

Table 6. Relative Initial Productivity and the Effect of Trade Protection on Productivity 1/ 2/

	(1) 3/	(2) 3/	(3) 3/	(4)	(5)	(6)
Lagged tariffs	-0.083 *	-0.164 ***	-0.116 **	-0.156 ***	-0.083 **	-0.038
	(0.049)	(0.046)	(0.047)	(0.050)	(0.037)	(0.032)
Lagged tariffs * relative initial TFP	0.045	0.147 **	0.081	0.151 **	0.049	-0.023
	(0.067)	(0.063)	(0.062)	(0.065)	(0.046)	(0.043)
Relative initial TFP	1.272 ***	0.636 ***	1.255 ***			
	(0.074)	(0.062)	(0.082)			
Year fixed effects	Y	Y	Y	Y	Y	Y
Industry fixed effects (NIC4)	Y		Y			
Industry fixed effects (NIC2)		Y				
Balanced panel of companies			Y			
Company fixed effects				Y	Y	Y
Lagged total factor productivity					Y	
Arellano Bond estimator						Y
R^2	0.60	0.37	0.63	0.77	0.83	...
Number of observations	9,370	9,370	7,202	9,370	7,929	6,357

Source: Author's estimates.

1/ Robust standard errors are in parentheses. Errors are adjusted for clustering at the industry-year level in colums (1)-(5).
2/ Significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively.
3/ Controls for company's ownerhip, size, age, and age squared.

Table 7. Geography, Institutions, Financial Development, and Growth and the Effect of Trade Protection on Productivity 1/ 2/

Specification	Coastal State (1)	Not-Coastal State (2)	Good Investment Climate (3) 3/	Poor Investment Climate (4) 3/	Pro-employer labor laws (5) 4/	Neutral labor laws (6) 4/	Pro-worker labor laws (7) 4/
(1) Industry fixed effects (NIC4) 5/	-0.075 ***	-0.100 **	-0.066 ***	-0.131 ***	-0.072 **	-0.088 **	-0.075 ***
	(0.017)	(0.043)	(0.018)	(0.037)	(0.028)	(0.042)	(0.025)
No. of observations	10,102	3,583	8,138	3,240	4,536	3,850	5,299
(2) Company fixed effects	-0.046 ***	-0.091 **	-0.042 **	-0.097 ***	-0.038	-0.058	-0.069 ***
	(0.015)	(0.039)	(0.017)	(0.033)	(0.025)	(0.037)	(0.022)
No. of observations	10,102	3,583	8,138	3,240	4,536	3,850	5,299
(3) Company fixed effects and lagged total factor productivity	-0.040 ***	-0.070 *	-0.035 **	-0.052	-0.054 **	-0.023	-0.053 **
	(0.014)	(0.042)	(0.015)	(0.033)	(0.023)	(0.031)	(0.021)
No. of observations	7,885	2,751	6,313	2,583	3,497	3,060	4,079
(4) Arellano Bond estimator	-0.037 **	-0.076 ***	-0.023	-0.076 **	-0.058 **	-0.053 **	-0.028
	(0.017)	(0.030)	(0.018)	(0.036)	(0.029)	(0.026)	(0.020)
No. of observations	5,758	1,947	4,569	1,928	2,520	2,264	2,921

Table 7. Geography, Institutions, Financial Development,and Growth and the Effect of Trade Protection on Productivity (concluded) 1/ 2/

Specification	High Financial Development (8) 6/	Low Financial Development (9) 6/	High Growth States (10)	Low Growth States (11)	Rich States (12) 7/	Poor States (13) 7/
(1) Industry fixed effects (NIC4) 5/	-0.089 ***	-0.079	-0.082 ***	-0.066	-0.085 ***	-0.063 **
	(0.017)	(0.051)	(0.018)	(0.043)	(0.019)	(0.031)
No. of observations	11,531	2,353	9,924	3,262	8,626	4,531
(2) Company fixed effects	-0.056 ***	-0.054	-0.055 ***	-0.046	-0.058 ***	-0.046
	(0.016)	(0.045)	(0.016)	(0.041)	(0.018)	(0.029)
No. of observations	11,531	2,353	9,924	3,262	8,626	4,531
(3) Company fixed effects and lagged total factor productivity	-0.049 ***	-0.048	-0.048 ***	-0.042	-0.041 **	-0.051 **
	(0.014)	(0.044)	(0.016)	(0.032)	(0.017)	(0.025)
No. of observations	8,958	1,796	7,736	2,514	6,733	3,500
(4) Arellano Bond	-0.045 ***	-0.054 **	-0.038	-0.076	-0.024	-0.080
	(0.017)	(0.027)	(0.018)	(0.033)	(0.021)	(0.028)
No. of observations	6,511	1,254	5,627	1,798	3,840	2,518

Source: Author's estimates.

1/ Robust standard errors are in parentheses. Errors are clustered at the industry level in rows (1)-(3).
2/ Significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively.
3/ Columns 1 and 2 for companies in composite states with above and below median investment climates, as ranked by the World Bank (2002).
4/ Columns 5, 6, and 7 for companies in composite states with pro-employer, neutral, and pro-worker labor laws, as classified by Besley and Burgess (2003).
5/ Controls for a company's ownerhip, size, age, and age squared.
6/ Columns 8 and 9 for companies in those states with above and below median credit per capita.
7/ Columns 12 and 13 for companies in those states with median gross state domestic product per capita above and below the national average in 1991.

Estimating the Production Function

For the estimation of the production function, the following variables were used: value of total output, gross fixed assets, salaries and wages, raw materials expenses, power and fuel expenses, and depreciation. The data provided in the Centre for Monitoring the Indian Economy (CMIE) database are drawn from companies' balance sheets and income statements. The values of output and power and fuel expenses were converted in real terms by industry-specific wholesale price indices. As for the salaries and wages and raw materials expenses, the wholesale price index was used.

The difficult task of measuring capital employed by the firm in its production process was done by closely following the methodology of Balakrishnan et al. (2000). It applies the Perpetual Inventory Model, while correcting for the fact that the value of capital is recorded at historic and not replacement cost. In order to arrive at a measure of the capital stock at its replacement cost for a base year (in our case assumed to be 1997), we follow Balakrishnan et al. and construct a revaluation factor assuming a constant rate of change of the price of capital and a constant rate of growth of investment throughout the 20-year lifetime assumed for capital stock. This revaluation factor converts the capital in the base year into capital at replacement cost at current prices, which is then deflated using a deflator constructed from the series on gross capital formation. To get at the capital stock for every time period, we take the sum of investment in subsequent years.

Table II.1. Distrubtion of Companies by Year and Exit Rates

(In percent of total, unless otherwise indicated)

Year	Number of Companies	Companies That Exited the Sample by 1996				Companies That Exited the Sample by 2001			
		Share of Companies	Share of Output	Share of Labor	Share of Capital	Share of Companies	Share of Output	Share of Labor	Share of Capital
1989	1,029	3.4	1.0	1.3	0.6	12.3	5.5	6.9	5.1
1990	1,175	3.7	1.0	1.4	0.9	13.6	5.5	7.0	4.9
1991	1,483	3.6	1.1	1.4	0.9	14.2	4.9	6.5	4.6
1992	1,690	4.1	1.2	1.6	1.0	15.9	4.9	6.3	4.5
1993	2,050	4.2	1.0	1.6	1.1	18.1	4.9	6.4	4.7
1994	2,597	4.6	1.1	1.5	1.0	21.0	5.8	6.5	5.2
1995	3,105	3.2	1.1	1.1	1.0	23.6	6.4	6.8	5.8
1996	3,243	...	...	...	...	23.9	6.2	6.5	5.6
1997	3,241	...	...	...	...	22.9	5.3	6.2	5.4
1998	3,260	...	...	...	...	20.9	4.9	6.0	4.9
1999	3,375	...	...	...	...	19.0	4.3	6.0	4.4
2000	3,545	...	...	...	...	15.3	3.5	5.9	3.8

Sources: Centre for Monitoring the Indian Economy (CMIE); and author's estimates.

Table II.2 Distribution of Companies by Industry

Industry	1989-2001								1989-1996							
	No. of companies	(In percent of total)	Output (in Rs. billion)	(In percent of total)	Labor Expenditure (in Rs. billion)	(In percent of total)	Capital Expenditure (in Rs. billion)	(In percent of total)	No. of companies	(In percent of total)	Output (in Rs. billion)	(In percent of total)	Labor Expenditure (in Rs. billion)	(In percent of total)	Capital Expenditure (in Rs. billion)	(In percent of total)
1 Agriculture	67	1.6	182.4	0.5	7.7	0.3	93.5	0.3	53	1.6	124.2	0.5	4.9	0.2	58.7	0.3
14 Other mining and quarrying	35	0.9	31.9	0.1	2.3	0.1	52.8	0.2	33	1.0	21.7	0.1	1.7	0.1	39.7	0.2
15 Manufacture of food products and beverages	456	11.2	1,921.3	5.0	146.6	5.6	1,139.0	3.8	373	11.0	1,483.6	5.4	106.2	5.2	790.4	3.7
16 Manufacture of tobacco products	11	0.3	277.6	0.7	28.8	1.1	124.0	0.4	9	0.3	248.3	0.9	15.8	0.8	87.0	0.4
17 Manufacture of textiles	438	10.8	2,094.1	5.5	206.0	7.9	1,653.1	5.5	390	11.5	1,474.1	5.4	175.4	8.6	1,128.8	5.3
18 Manufacture of wearing apparel, dressing and dying of furs	58	1.4	106.6	0.3	6.3	0.2	47.3	0.2	45	1.3	49.2	0.2	3.7	0.2	31.0	0.1
19 Tanning and dressing of leather	44	1.1	145.0	0.4	15.7	0.6	71.8	0.2	36	1.1	132.2	0.5	13.4	0.7	53.7	0.3
20 Manufacture of wood	19	0.5	50.8	0.1	3.8	0.1	44.4	0.1	14	0.4	48.0	0.2	2.8	0.1	30.6	0.1
21 Manufacture of paper and paper products	115	2.8	510.8	1.3	40.1	1.5	695.0	2.3	98	2.9	414.2	1.5	32.3	1.6	493.6	2.3
22 Publishing, printing and reproduction of recorded media	31	0.8	166.6	0.4	19.8	0.8	121.7	0.4	22	0.6	133.0	0.5	12.7	0.6	68.8	0.3
23 Manufacture of coke, refined petroleum products etc	36	0.9	8,722.4	22.8	105.9	4.1	2,948.5	9.9	29	0.9	5,112.2	18.8	69.1	3.4	1,587.3	7.4
24 Manufacture of chemicals	852	21.0	6,020.7	15.7	405.0	15.6	5,977.6	20.0	728	21.4	4,601.3	16.9	304.9	15.0	4,552.4	21.3
25 Manufacture of rubber and plastic products	260	6.4	1,007.8	2.6	62.6	2.4	792.5	2.6	223	6.6	726.9	2.7	47.3	2.3	527.4	2.5
26 Manufacture of non-metallic mineral products	168	4.1	1,189.0	3.1	94.8	3.6	1,621.0	5.4	148	4.4	929.3	3.4	77.7	3.8	1,153.0	5.4
27 Manufacturing of basic metals	358	8.8	4,366.0	11.4	389.4	15.0	6,960.7	23.3	287	8.4	3,531.8	13.0	330.3	16.2	5,631.0	26.3
28 Manufacturing of fabricated metal products	116	2.9	434.2	1.1	38.7	1.5	295.9	1.0	91	2.7	321.9	1.2	28.9	1.4	183.2	0.9
29 Manufacturing of machinery and equipment NEC	268	6.6	2,106.4	5.5	270.8	10.4	1,074.8	3.6	231	6.8	1,690.5	6.2	220.7	10.8	862.4	4.0
30 Manufacture of office, accounting and computing machinery	31	0.8	256.3	0.7	16.4	0.6	67.7	0.2	24	0.7	119.7	0.4	8.5	0.4	35.7	0.2
31 Manufacture of electrical machinery etc.	161	4.0	1,063.1	2.8	91.5	3.5	577.1	1.9	133	3.9	785.8	2.9	73.9	3.6	385.2	1.8
32 Manufacture of radios, televisions etc.	106	2.6	1,035.1	2.7	85.4	3.3	508.5	1.7	90	2.6	712.6	2.6	70.9	3.5	359.9	1.7
33 Manufacture of medical, precision and optical instruments	51	1.3	165.3	0.4	23.1	0.9	116.7	0.4	41	1.2	100.3	0.4	11.6	0.6	83.5	0.4
34 Manufacture of motor vehicles, trailers etc.	202	5.0	2,182.2	5.7	203.6	7.8	1,580.3	5.3	151	4.4	1,481.5	5.4	152.1	7.5	869.7	4.1
35 Manufacture of other transport equipment	42	1.0	825.5	2.2	109.3	4.2	449.0	1.5	36	1.1	628.8	2.3	95.0	4.7	395.7	1.8
36 Manufacture of funiture, manufacture NEC	55	1.4	307.3	0.8	5.6	0.2	36.2	0.1	42	1.2	169.4	0.6	3.2	0.2	15.5	0.1
72 Computer and related activities	18	0.4	132.7	0.3	16.1	0.6	57.5	0.2	13	0.4	58.4	0.2	5.6	0.3	20.1	0.1
97 Miscellaneous goods and services	5	0.1	1.3	0.0	0.2	0.0	1.4	0.0	4	0.1	1.2	0.0	0.1	0.0	1.3	0.0
98 Diversified	59	1.5	2,934.1	7.7	203.7	7.8	2,813.2	9.4	56	1.6	2,148.3	7.9	165.8	8.2	1,955.8	9.1
Total	4,062		38,236.2		2,599.3		29,921.0		3,400		27,248.4		2,034.7		21,401.4	

Sources: CMIE; and author's estimates.

Table II.3. Distribution of Companies by Ownership and Size

	1989-2001								1989-1996							
	No. of companies		Output		Labor Expenditure		Capital Expenditure		No. of companies		Output		Labor Expenditure		Capital Expenditure	
		(In percent of total)	(In Rs. billion)	(In percent of total)	(In Rs. billion)	(In percent of total)	(In Rs. billion)	(In percent of total)		(In percent of total)	(In Rs. billion)	(In percent of total)	(In Rs. billion)	(In percent of total)	(In Rs. billion)	(In percent of total)
By Type of Ownership																
Private Stand-Alone Companies	2,302	56.7	4,936	12.9	288	11.1	3,172	10.6	1,854	54.5	3,124	11.5	169	8.3	1,922	9.0
Private Companies belonging to a Business Group	1,383	34.0	18,756	49.1	1,256	48.3	16,607	55.5	1,217	35.8	12,649	46.4	989	48.6	11,125	52.0
Government Owned Companies	137	3.4	10,897	28.5	760	29.2	8,221	27.5	131	3.9	8,969	32.9	654	32.1	7,207	33.7
Foreign Companies	240	5.9	3,646	9.5	295	11.4	1,921	6.4	198	5.8	2,507	9.2	222	10.9	1,147	5.4
Total	4,062		38,236		2,599		29,921		3,400		27,248		2,035		21,401	
By size of firm 1/																
Large	413	10.2	27,970	73.1	1,777	68.4	21,692	72.5	381	11.2	20,150	74.0	1,444	71.0	16,028	74.9
Medium	1,608	39.6	8,656	22.6	682	26.2	6,453	21.6	1,385	40.7	6,032	22.1	508	24.9	4,211	19.7
Small	2,041	50.2	1,611	4.2	140	5.4	1,776	5.9	1,634	48.1	1,066	3.9	83	4.1	1,162	5.4
Total	4,062		38,236		2,599		29,921		3,400		27,248		2,035		21,401	

Sources: CMIE; and author's estimates.

1/ A company is classified as large if its average sales over the entire period are in the top 1 percent of the distribution; medium, if sales are above the median, excluding the top 1 percentile; and small, if average sales are less than the median.

Table II.4. State Classifications

Geographical classification

Coastal States	Land Locked States
Andhra Pradesh	Assam
Daman and Diu	Bihar
Dadra and Nagar Haveli	Chandigarh
Goa	Chattisgarh
Gujarat	Delhi
Karnataka	Haryana
Kerala	Himachal Pradesh
Maharashtra	Jammu and Kashmir
Orissa	Jharkhand
Pondicherry	Madhya Pradesh
Tamil Nadu	Nagaland
West Bengal	Punjab
	Rajasthan
	Uttar Pradesh

Investment climate (World Bank, 2002)

Best	Good	Medium	Poor
Gujarat	Tamil Nadu	Delhi	Kerala
Maharashtra	Andhra Pradesh	Punjab	West Bengal
	Karnataka		Uttar Pradesh

Labor laws (Besley and Burgess, 2002)

Employer Friendly	Worker Friendly	Neutral
Andhra Pradesh	Gujarat	Assam
Karnataka	Maharashtra	Bihar
Kerala	Orissa	Haryana
Madhya Pradesh	West Bengal	Punjab
Rajasthan		Uttar Pradesh
Tamil Nadu		Jammu and Kashmir

Financial Development (credit per capita)

Above median	Below median
Andhra Pradesh	Andaman & Nicobar Islands
Chandigarh	Arunachal Pradesh
Daman & Diu	Assam
Delhi	Bihar
Goa	Dadra & Nagar Haveli
Gujarat	Lakshadweep
Haryana	Madhya Pradesh
Himachal Pradesh	Manipur
Jammu & Kashmir	Meghalaya
Karnataka	Mizoram
Kerala	Nagaland
Maharashtra	Orissa
Pondicherry	Rajasthan
Punjab	Sikkim
Tamil Nadu	Tripura
West Bengal	Uttar Pradesh

Pre-Reform Growth (1980s)

High growth	Low growth
Arunachal Pradesh	Bihar
Delhi	Uttar Pradesh
Goa, Daman and Diu	Andhra Pradesh
Gujarat	Meghalaya
Haryana	Tripura
Himachal Pradesh	Madhya Pradesh
Karnataka	Manipur
Maharashtra	West Bengal
Nagaland	Kerala
Punjab	Assam
Rajasthan	Pondicherry
Sikkim	Orissa
Tamil Nadu	Jammu &Kashmir
	Andaman & Nicobar Islands

Pre-Reform Per Capita GDP (1990/91)

High Per Capita GDP	Low Per Capita GDP
Andaman & Nicobar Islands	Karnataka
Arunachal Pradesh	Nagaland
Delhi	Rajasthan
Goa, Daman and Diu	Kerala
Gujarat	Jammu &Kashmir
Haryana	Andhra Pradesh
Himachal Pradesh	Manipur
Maharashtra	Meghalaya
Pondicherry	Madhya Pradesh
Punjab	Uttar Pradesh
Sikkim	Tripura
Tamil Nadu	Assam
West Bengal	Orissa
	Bihar

Sources: Government of India, National Accounts Statistics, unless otherwise indicated; and author's estimates.

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