Learning versus Stealing: How Important are Market-Share Reallocations to India's Productivity Growth?*

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December 12, 2011

Abstract

Recent trade theory emphasizes the role of market-share reallocations across firms ("stealing") in driving productivity growth, while the older literature focused on average productivity improvements ("learning"). We use comprehensive, firm-level data from India's organized manufacturing sector to show that market-share reallocations briefly mattered in explaining aggregate productivity gains following the start of India's trade reforms in 1991. However, aggregate productivity gains during the overall period from 1985 to 2004 were driven largely by improvements in average productivity, which suggests that "learning" was more important. We show that India's trade, FDI, and licensing reforms are not associated with productivity gains stemming from market share reallocations. Instead, we find that most of the productivity improvements in Indian manufacturing occurred through "learning", and that such learning was linked to the reforms. In the Indian case, the evidence rejects market share reallocations as the mechanism through which trade reform raises aggregate productivity. While one plausible response would be that India's labor laws do not easily permit market share reallocations, we show that restrictions on labor mobility cannot explain our results.

*This material is based upon work supported by the National Science Foundation under Grant No. SES-0922332. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation. We thank Mr. M.L. Philip, Mr. P.C.Nirala, Dr. Praveen Shukla, and Mr. M.M.Hasija at the Ministry of Statistics and Programme Implementation for their assistance in understanding the Annual Survey of Industries data collection process; Rana Hasan, Karl Jandoc, and Steve O'Connell for discussions regarding the firm-level data; and Pauline Grosjean and Ben Crost for providing us with their district-level concordances, which formed a basis for ours.

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1 Introduction

Over the last two centuries, economists have returned again and again to the question of how nations gain from trade. Early studies focused primarily on the aggregate productivity gains driven by inter-industry specialization according to comparative advantage. In the 1980s, the importance of learning by doing and the role of trade in facilitating the exploitation of economies of scale was emphasized by Paul Krugman and others. Most recently, productivity gains associated with the entry of more productive firms and the exit of less productive ones have generated significant interest. A related question is whether trade reforms lead to redistribution of market share between incumbents with different productivity levels.

This most recent "wave" of trade theory stresses the importance of market-share reallocations in increasing aggregate productivity following a trade liberalization (Bernard, Eaton, Jensen and Kortum 2003, Melitz 2003). The “new new” trade theory emphasizes the gains from trade in the presence of "heterogeneous firms." In these types of models, firms of different productivities, sizes, and profit levels co-exist. A trade reform that exposes firms to greater competition or enables more firms to sell on export markets will lead the less productive firms to exit or to lose market share. In a Melitz (2003) world, the primary sources of productivity gains associated with trade reform are the exit of less productive firms and the expansion of more productive firms.

While the early models of heterogeneous firms such as Melitz (2003) assumed that firms had exogenously given and fixed productivity levels, newer research (Arkolakis and Muendler 2010, Bernard, Redding and Schott 2010b, Bernard, VanBeveren and Vandenbussche 2010a, Bernard, Redding and Schott 2011, Eckel and Neary 2010, Feenstra and Ma 2007, Mayer, Melitz and Ottaviano 2011, Nocke and Yeaple 2008) allows for changing productivity within the firm: some product lines are discontinued and other product lines developed. Consequently, trade reforms could also lead to changes in within-firm productivity as firms increasingly concentrate production in areas where they have higher productivity. This new literature on heterogeneous production within the firm recalls an earlier literature that also emphasized the idea that trade could improve average productivity within surviving firms (Corden 1974, Grossman and Helpman 1991, Helpman

and Krugman 1985).

The policy implications that arise from these explanations for the gains from trade are quite different. In a world where market share reallocation away from less productive firms matters more than learning or product shifting within the same firm, facilitating firm entry, exit and down-sizing is critical. In a world where there is more learning or shifting of product types within the firm, working within the enterprise to assist the learning that accompanies trade reform is more critical. Yet there are few empirical studies that quantify the relative importance of average productivity gains versus gains from market-share reallocations in the wake of a major trade liberalization.

In this paper, we use a comprehensive, firm-level dataset to examine the role played by market-share reallocations in aggregate productivity growth in India's organized manufacturing sector from 1985 to 2004. The organized manufacturing sector in India consists of firms that are registered under Sections 2m(i) and 2m(ii) of the Factories Act; all firms with 20 or more employees (10 if power is used) are required to register.[1] In 1991, India embarked on a series of reforms, including a major trade liberalization, a dismantling of the licensing regime, and a relaxation of constraints on incoming foreign direct investment (FDI). As part of the trade liberalization, non-tariff barriers were converted to tariffs, and tariff levels were gradually reduced from extraordinarily high levels. The licensing regime, which required that firms seek permission from the "license raj" to enter an industry and to change or expand production, was gradually dismantled. Foreign investment restrictions, which prohibited foreign firms from entering some sectors and restricted their participation levels in others, were relaxed. All of these changes were expected to contribute to improvements in firm performance.

We begin by measuring aggregate productivity growth in the manufacturing sector and show that there were three distinct phases to India's manufacturing productivity growth during the period from 1985 to 2004. During this twenty year period, aggregate productivity (defined as output-weighted, mean firm productivity) grew by nearly 20%. From 1985 to 1990, the growth in aggregate productivity was driven by "learning" - that is, an increase in unweighted, average firm

[1] India's organized sector accounts for approximately 80% of manufacturing sector output, though only 20% of employment.

productivity. This measure of learning captures the change in productivity for the average firm, and therefore includes not only changes in productivity among surviving firms, but also changes in average productivity that can be attributed to firm entry and exit. In the period immediately following the start of the reforms (1991-1994), the “stealing” of market share - that is, the reallocation of market share from less productive to more productive firms - became more important than learning in driving aggregate productivity growth. In the longer run (1998-2004), learning once again became the more important factor in aggregate productivity growth, with stealing (reallocation) contributing little. During the 20-year period from 1985 to 2004 as a whole, most of the increase in aggregate productivity can be explained by improvements in average productivity.

We find that for the organized manufacturing sector as a whole, market-share reallocations were an important source of productivity growth in the years immediately following the start of the 1991 reforms, but not during other periods. In other words, the contribution of reallocation of market shares is concentrated at a given point in time in the Indian case. One implication is that trade reforms lead to short-term, one-shot market share reallocations. Our results suggest that in the longer term, opening up to trade in India had more important effects on changes within firms.

Our main results rely on the widely-used decomposition suggested by Olley and Pakes (1996) (OP). This method identifies changes in average productivity and reallocation, but does not disentangle the contributions of survivors, entrants, and exiters. Although firm identifiers are not available for the organized sector data during most of the time period we study, we have also constructed a panel dataset by matching individual firms from one year of the survey to the next. We match firms by using information on beginning and end of period information on capital and other types of stocks, supplemented with other identifying information. This panel allows us to test how our main results change when we employ an alternative decomposition method, suggested by Melitz and Polanec (2010).

We then use the OP decomposition to examine the extent to which individual policy reforms are associated with industry-level productivity gains. In particular, we exploit variations in tariff cuts, FDI liberalization, and industrial licensing reforms across industries to examine the contribution of

each reform to changes in industry-level TFP. We find that the average decline in final goods tariffs during this time period implies a 3% increase in aggregate productivity, while the average decline in input tariffs implies a nearly 22% increase in aggregate and average productivity. Moreover, the FDI liberalization accounts for a 4.7% increase in average productivity. The industrial licensing reforms, which promoted internal competition, are associated with productivity gains among large firms, and in states and industries that were relatively less exposed to external competition prior to the reforms.

Our study was motivated by the emphasis that the new trade theory places on the importance of market-share reallocations in increasing aggregate productivity. Although a number of papers have tested various implications of this literature (see, for example, Arkolakis (2010), Bernard et al. (2003), Bernard, Jensen and Schott (2006), Berthou and Fontagne (2010), Eaton, Kortum and Kramarz (2008), Helpman, Melitz and Yeaple (2004), Manova and Zhang (2010)), few are able to directly test the effect of a trade liberalization episode on market-share reallocations, and existing evidence on the role of reallocation is mixed. For example, Tybout and Westbrook (1995) find that the reallocation of market share to relatively low-cost firms explained little of the overall change in productivity following Mexico's trade liberalization; however, Pavcnik (2002) and Menezes-Filho and Muendler (2007) find that market-share reallocation was an important driver of productivity growth following trade reforms in Chile and Brazil, respectively. Trefler (2004) documents that a fall in Canadian tariffs increased industry-level labor productivity, but not within-plant labor productivity, which he interprets as evidence that reallocation was more important than within-plant improvements. In Colombia, Fernandes (2007) finds that average productivity gains were more important than reallocation, but that reallocation became important in many industries during periods of tariff liberalization.

Our study also contributes to the substantial body of work examining India's 1991 reforms. Topalova and Khandelwal (2011) establish that the reductions in final goods and input tariffs increased productivity among approximately 4,000 large, publicly listed manufacturing firms. Sivadasan (2009) uses a dataset that is similar to ours for the early years of the reforms (1986-

1994) and finds that the reduction in final goods tariffs and the FDI liberalization increased productivity. He also documents that these reforms were linked with average productivity increases, but not reallocation, in the early 1990's. Nataraj (2011) compares the reactions of the organized and unorganized manufacturing sectors to trade liberalization, and finds that while the reduction in final goods tariffs increased productivity significantly in the unorganized sector, the reduction in input tariffs was more important for productivity growth in the organized sector. Aghion, Burgess, Redding and Zilibotti (2008) find that following the removal of licensing requirements, the number of factories and output in the organized sector increased, particularly in states with relatively less restrictive labor regulations.

Our study contributes to these two strands of literature in several ways. First, we document that market-share reallocations were important to overall productivity growth immediately following the start of the 1991 reforms, while average productivity gains were more important during the periods from 1985-1990 and 1998-2004. Over this twenty-year period, which spans the period before and after India's significant trade reforms, we find that most of the productivity improvements in manufacturing occurred because average productivity increased. Market-share reallocations, the focus of most of the heterogeneous trade literature, were not as important. One implication is that in the Indian case, theories that emphasize within-firm changes in response to trade policy changes are more relevant.

Second, we tie these different sources of productivity growth to the various reforms. We find that we cannot explain the increases in productivity due to market-share rellocations using our policy measures. Instead, the trade reforms led to improved firm productivity through within-firm improvements, which we label "learning." These results are at odds with the earlier literature on heterogeneous firms which assumed exogenous productivity draws at the firm level and emphasized that trade reforms raise aggregate firm productivity through market share reallocations. Instead, our constructed panel suggests that trade and FDI reforms contributed substantially by raising average, within-firm productivity. One plausible mechanism is that trade reforms led to productivity improvements by concentrating production within the most productive goods made by

these firms. However, evidence on this type of effect in the Indian case is mixed: while Goldberg, Khandelwal, Pavcnik and Topalova (2010) find that lower input tariffs account for approximately one-third of the increase in new products created by Indian firms, the same authors (2010b) test for evidence of product rationalization in the Indian case and reject this possibility.

In the remainder of the paper we explore whether our results can be explained by regulatory barriers which prevented market share realloocations, such as restrictive labor laws. Our results suggest that labor laws and a legal framework that prevented firm adjustment cannot explain our findings. We also employ an alternative decomposition method, suggested by Melitz and Polanec (2010) which tends to give a greater weight to market share reallocations.

The rest of this paper is organized as follows. Section 2 provides a brief background on the Indian reforms; Section 3 describes the data and outlines the construction of the panel of firms; Section 4 discusses the empirical framework and presents results; and Section 5 concludes.

2 The 1991 Reforms

Prior to 1991, India imposed high tariffs and non-tariff barriers on most goods. FDI (foreign ownership) was capped at 40% for most industries, and large manufacturing firms were required to obtain operating licenses. During the 1980s, India removed licensing requirements from approximately one-third of industries, but retained its trade and FDI restrictions. During this time, the country's fiscal and balance of payments deficits continued to grow.

In 1991, a combination of economic and political shocks created a balance of payments crisis (Topalova and Khandelwal 2011). A new government requested help from the IMF, which was granted on the condition that India undertake several reforms (Hasan, Mitra and Ramaswamy 2007). In July 1991, the government announced a series of major policy changes, including FDI and tariff liberalization, exchange rate liberalization, the removal of the requirement for operating licenses in most industries, and the removal of import licensing requirements for many goods. Many of these policy changes were formalized in India's Eighth Five-Year Plan (1992-97).

Between 1991 and 1997, the average final goods tariff rate on manufactured products fell from 95% to 35%. Tariffs were also harmonized across industries, so that the industries with the highest pre-reform tariffs faced the highest tariff cuts. After the Eighth Five-Year Plan (post-1997), India continued to lower its tariffs, though the reductions were no longer as uniform. Input tariffs also fell significantly during this period. The supplementary appendix illustrates the tariff changes in more detail.

We also consider the licensing and FDI liberalizations that occurred during this time. Until the 1980s, India's "license raj" required every firm with more than 50 employees (100 employees without power) and a certain amount of assets to obtain an operating license. The license specified, among other things, the amount of output a firm could produce, the types of goods it could make, and its location. In 1985, approximately one-third of industries were "delicensed" (the requirement for a license was dropped); in 1991, most industries were delicensed as part of the broader reforms package (Aghion et al. 2008). The licensing requirement was removed from several additional industries in subsequent years, and by the end of the 1990's, over 90% of industries had been delicensed.

In addition, prior to 1991, FDI was capped at 40% for most industries; beginning in 1991, majority FDI shares were allowed in a number of industries with "automatic" approval (Sivadasan 2009). Approximately one-third of industries were FDI liberalized in 1991. A few additional industries were liberalized by 1997, and in 2000, the government indicated that all industries would be eligible for automatic FDI approval, except those requiring an industrial license or meeting several other conditions. Table 1 shows the evolution of the reforms over time.

The fact that most of these policy changes occurred as part of an externally-required reforms package lowers the chance that industries were selected into the reforms based on political factors. In addition, to the extent that industries with certain characteristics may have been more likely to be liberalized, we use a fixed-effects estimation strategy that should address any time-invariant characteristics that could have affected selection. However, if the reforms are correlated with pre-reform trends in industry characteristics, then our results may be biased. To evaluate the potential

extent of this bias, we examine the correlations between changes in reforms (1990-2004) and pre-reform trends in industry characteristics (1985-1989). We follow Topalova and Khandelwal (2011) and consider a number of industry characteristics including wage, share of production workers, capital-labor ratio, total employment and output, and firm size (average employment). We also consider pre-reform trends in total factor productivity (TFP). Table 2 indicates that there are no statistically significant correlations between pre-reform trends in industry characteristics and future reforms. Moreover, in the supplementary appendix we show that our results are robust to limiting our analysis to the period through 1997; since these initial reforms were largely carried out as outlined in the Eighth Five-Year Plan, which was developed in the wake of the 1991 crisis, they are even less likely to be subject to potential selection issues than reforms in later years.

3 Data

3.1 Annual Survey of Industries (ASI) Data

Our primary dataset consists of firm-level surveys from the Annual Survey of Industries (ASI). The ASI covers the accounting year that ended on any day during the fiscal year: the 1985-86 survey (which we refer to as the 1985 survey) indicates the factory's accounting year that ended on any day between April 1, 1985 and March 31, 1986. We obtained firm-level data for all available years between 1985 and 2004. Data were not available for 1995. In addition, the way in which input data were collected and made available for the years 1996 and 1997 did not make it possible to construct certain key variables for those two years that were consistent with the other years. Therefore, we restrict our analysis to the firm-level data for the remaining 17 years between 1985 and 2004 (1985 through 1994 and 1998 through 2004).

The sampling universe for the ASI is all firms that are registered under Sections 2m(i) and 2m(ii) of the Factories Act, as well as firms registered under the Bidi & Cigar Workers Act, and a number of utility and service providers. We include only manufacturing firms in our analysis. All firms that have 20 or more employees (10 or more employees if a power source is used) are

required to register.[2] The sampling frame is derived from the registry list of each state's Chief Inspector of Factories, and all but four small states are covered.

The ASI divides firms into the "census" sector, in which firms are surveyed every year, and the "sample" sector, in which firms are sampled every few years. Between 1985 and 2004, the inclusion of firms in the census and sample sectors, as well as the sampling strategy, changed several times. To ensure that our results are representative of the population of firms, we apply the sampling multiplier weights that are provided for each firm in the population analysis (but not the panel analysis).

Each unit surveyed is generally a factory (plant); however, if an owner has two factories in the same state, sector (census versus sample) and industry, a joint return can be furnished. In the population of firms, fewer than 2% of the observations report more than one factory, and we will use the term "firm" to mean one observation in our dataset.

The key variables we construct from the ASI data are output, material input, labor, and capital.[3] We drop closed firms, and we include only firms with positive values of the key variables. To address a few extreme outliers, we also trim the top 0.5% of output and material input values.

We deflate output using industry-specific wholesale price indices (WPI) from the Government of India's Handbook of Industrial Statistics. Similarly, we construct material input deflators using the WPI along with India's 1993-94 IOTT. Labor is measured as the total number of people employed by the firm, and capital is measured by deflating the book value of capital by the WPI for machinery.

Summary statistics for the population are presented in Table 3. Only open firms that have positive values of our key variables are included. Sampling weights are applied to the summary statistics in the first column, so the results are representative of the overall organized sector. The second column shows results for the firms that were sampled, without applying sampling weights.

[2]A significant fraction of ASI firms report fewer than 10 employees. These firms may be registered for various reasons, including the possibility that they used to have more than 10 employees but shrank; that they plan to grow in the future; and that registering may be a signal to creditors or other business partners.

[3]Output includes the ex-factory value of products, the increase in the stock of semi-finished goods, and the value of own construction; material input includes material and fuel.

Since larger firms are surveyed more often than smaller firms, the mean and median values of output, capital, material inputs, and labor are much larger in the sampled population rather than the estimated population.

3.2 Creating a Panel

The ASI data provide unique firm identifiers beginning in 1998. However, it has not previously been possible to track firms prior to 1998, and thus to follow them during the most significant period of reforms. We overcome this challenge by matching individual firms from one year of the survey to the next between 1985 and 1998. We then combine this constructed panel with the pre-formed panel provided by the ASI from 1998-2004.

To construct our panel, we looked for firms that had matching Open and Close values between one year and the next (e.g. we look for a match between the Close value in 1985 and the Open value in 1986) in one of the several variables. To link firms over 1995, a year for which firm-level data have not been released, and over other years in which individual firms may not have been sampled, we matched firms based on a number of static characteristics, as well as on growth projections. Details on panel construction are provided in the supplementary appendix.

Because we observe each firm's year of initial production, we are confident that we can correctly identify survivors and entrants in our panel. However, given the substantial fraction of firms that are not surveyed every year, we are more reserved about our ability to identify exiting firms. The rates of exit that we observe in our panel are significantly higher than the rates that we extrapolate from the change over time of the distribution of years of initial production. Therefore, in estimating productivity we avoid methods that rely on accurately identifying firm exit, and instead employ an index number method that is robust to potentially spurious exit.

Summary statistics for the panel (to which we do not apply sampling multipliers) are presented in the final column of Table 3. Larger firms (those that are in the "census" sector and are surveyed every year) make up 60% of the firm-year observations in the panel, 48% of firm-year observations in the full sample of firms, and only 20% of firm-year observations in the estimated population. The

panel should not be seen as representative of the population, but rather as a selection of relatively large firms. Nonetheless, the bottom rows in Table 3 show that 71% of firm-year observations that appear in the sample, representing 93% of total deflated output over the entire period and 92% of the labor force, are captured for at least two years in the panel.

A key contribution of our panel is that we are confident in the firms we are able to match over time. This allows us to examine the impacts of the reforms on within-firm learning, which has not yet been done for such a large subsample of the organized manufacturing sector.

3.3 Policy Variables

The four policies we consider - final goods tariffs, input tariffs, delicensing, and FDI reform - were discussed in Section 2. We use applied tariff data from the Government of India's Customs Tariff Working Schedules and the Trade Analysis and Information System (TRAINS) database. We match the tariff data with 3-digit National Industrial Classification (NIC-87) codes using the concordance of Debroy and Santhanam (1993), and calculate average final goods tariff rates within each of approximately 140 industries. We also calculate input tariffs using India's Input-Output Transactions Table (IOTT), following the method suggested by Amiti and Konings (2007). For example, if the footwear industry derives 80% of its inputs from the leather industry and 20% from the textile industry, then the input tariff for the footwear industry is 0.8 times the final goods tariff for the leather industry plus 0.2 times the final goods tariff for the textile industry. In our baseline measure of input tariffs, we use both traded and non-traded inputs, assigning tariff rates of zero to non-traded inputs.

To capture the effects of the delicensing reforms, we use data from Aghion et al. (2008) from 1985 to 1997, supplemented by information from Press Notes from the Ministry of Commerce & Industry from 1998 to 2004. The delicensing variable is a dummy that takes on a value of one if any products in a three-digit industry have been delicensed, zero otherwise. Our measure of FDI liberalization is also based on Press Notes from the Ministry of Commerce & Industry, and takes on a value of one if any products in a three-digit industry have been liberalized, zero otherwise.

Table 1 shows changes in these policy variables over time.

4 Empirical Framework and Results

4.1 Measuring Total Factor Productivity

We measure TFP for firm i in industry j at time t using a chain-linked, index number method suggested by Aw, Chen and Roberts (2001):[4]

$$\begin{aligned} TFP_{ijt} &= \underbrace{(q_{ijt} - \overline{q_{jt}})}_{deviation\,from\,avg.\,q} + \underbrace{\sum_{r=2}^{t}(\overline{q_{jr}} - \overline{q_{jr-1}})}_{yearly\,change\,in\,q} \\ &\quad - [\underbrace{\sum_{z=1}^{Z}\frac{1}{2}(\zeta_{ijt}^{z} + \overline{\zeta_{jt}^{z}})(z_{ijt} - \overline{z_{jt}})}_{deviation\,from\,avg.\,z} + \underbrace{\sum_{r=2}^{t}\sum_{z=1}^{Z}\frac{1}{2}(\overline{\zeta_{jr}^{z}} + \overline{\zeta_{jr-1}^{z}})(\overline{z_{jr}} - \overline{z_{jr-1}})}_{yearly\,change\,in\,z}] \end{aligned} \tag{1}$$

where q_{ijt} is the log of output, ζ^z_{ijt} is the revenue share of input z, and z_{ijt} is the log of input z. A firm's TFP is the deviation of its output from average output in that year, along with how average output in that year differs from the base year, minus the deviation of the firm's inputs from average inputs in that year, along with how average inputs in that year differ from the base year. Inputs include labor, capital, and material input, which are measured and deflated as discussed in Section 3.1. Bars over variables indicate average values within a particular industry and year. Revenue shares for labor and material inputs are calculated as the share of each input in total revenue; capital's revenue share is assumed to be one minus the sum of the other two shares.

4.2 Decomposing All-India TFP Growth

We begin by looking at productivity changes for the population of firms from 1985 to 2004. To do so, we first calculate aggregate TFP in year t, Φ_t^{AGG}, by taking the sum of each firm's productivity

[4] We feel that this measure is well-suited to our data, since semi-parametric methods (Olley and Pakes 1996, Levinsohn and Petrin 2003, for example) rely on an accurate determination of entry and exit.

ϕ_{it}, weighted by its market share ψ_{it}. Olley and Pakes (1996) (OP) show that this measure of aggregate TFP can be decomposed into two components:

$$\begin{aligned}\Phi_t^{AGG} &\equiv \sum_i \psi_{it}\phi_{it} \\ &= \overline{\phi_t} + \sum_i [\psi_{it} - \overline{\psi_t}][\phi_{it} - \overline{\phi_t}] \\ &\equiv \Phi_t^U + R_t\end{aligned}$$

where $\overline{\phi_t}$ and $\overline{\psi_t}$ are unweighted average productivity and market share, respectively. The first component, Φ_t^U, is unweighted average productivity. The second component, R_t, measures the covariance between firm productivity and market share; changes in this measure represent a reallocation of market share between firms of different productivity levels.

We first construct these measures at the all-India level. To make the results representative of the population of firms, and consistent over time, we pre-multiply each observation by the sampling weight provided in the ASI. Furthermore, to make the results more comparable with our later regression results, we consider only firms in state-industry groups (collections of firms in a particular state and 3-digit industry) that exist over the entire period.

Figure 1 presents results. Following Pavcnik (2002), we normalize productivity values to be zero in 1985, so changes in productivity levels can be interpreted as growth since 1985. Between 1985 and 2004, aggregate productivity grew by 18%. This increase in productivity implies an annual increase of slightly less than 1% per year, within the range of previous studies.[5]

When we consider the time period as a whole, nearly all of this increase (16.1%) can be attributed to growth in average productivity, rather than reallocation. However, Figure 1 suggests that there are three distinct phases between 1985 and 2004. First, from 1985 to 1990, average

[5] There has been an extensive debate about TFP growth in the organized Indian manufacturing sector, particularly during the 1980's; Goldar (December 7, 2002) provides a summary of a number of TFP growth estimates, and discusses many of the measurement issues involved. It is important to note that our TFP estimates are based on a gross output, rather than value-added, production function; value-added TFP growth rates tend to be much higher than gross output growth rates.

productivity rose by over 8%, while the reallocation component actually fell by more than 6%, indicating that more productive firms lost market share to less productive firms. Starting in 1991, this trend was reversed: average productivity fell, while reallocation productivity rose sharply. By 1998, however, average productivity improvements were once again the more important driver of aggregate productivity growth. Reallocation productivity remained at approximately the level it achieved between 1992 and 1993, but rose no further.

Our results suggest that market-share reallocations did play an important role in aggregate productivity growth, but only during the few years immediately following the start of the 1991 reforms. Over the longer time horizon, average productivity improvements remained more important in explaining the increase in aggregate TFP.

4.3 Industry-Level TFP Changes and Policy Reforms

To what extent can the increase in productivity be attributed to the trade and other policy reforms that occurred during the 1990's? To answer this question, we exploit the variation in policies across industries to examine whether changes in the individual components of productivity are systematically related to specific reforms.

In order to use the policy variation across industries, we re-create our aggregate, average, and reallocation TFP measures at the state-industry level (recall that a state-industry group is the collection of firms in a particular state and 3-digit industry). We use the state-industry level because this level of disaggregation allows us to consider variations in policies and other characteristics across both industries and states, and because the ASI survey is designed to be representative at this level. We weight each group by the total number of firms that appear in that group across all years. Doing so ensures that the results are more comparable to the all-India results, since larger state-industry groups are given more weight.

This weighting scheme ensures that average productivity is nearly the same at the state-industry and all-India levels. The reallocation component follows the same general pattern as that observed

in Figure 1, but is lower across most years at the state-industry level.[6] The reason is that at this level, we can only measure reallocation *within* state-industry groups. For example, suppose that the steel industry in Maharashtra is more productive than the chemical industry in Gujarat, and that all firms in the former state-industry group increase output by 10%, while all firms in the latter state-industry group reduce output by 10%. The all-India reallocation measure will increase, but the state-industry reallocation measure will not. While it would be ideal to capture market-share reallocations between as well as within state-industry groups, our identification strategy (described below) does not allow us to use an all-India measure of productivity. Nonetheless, despite some differences, the reallocation component at the state-industry level follows the same basic pattern as the all-India measure.

We exploit the fact that the trade, licensing, and FDI reforms occurred differentially across industries to isolate the impacts of each policy on each productivity measure. Consider the relationship between our outcomes of interest and the reforms:

$$\widehat{Y_{jst}} = \beta_1 \tau_{j,t-1} + \beta_2 \tau^I_{j,t-1} + \beta_3 Delic_{j,t-1} + \beta_4 FDI_{j,t-1} + \alpha_{js} + \alpha_t + \varepsilon_{jst} \tag{2}$$

where $\widehat{Y_{jst}}$ is estimated aggregate TFP ($\widehat{\Phi^{AGG}_{jst}}$), average TFP ($\widehat{\Phi^{U}_{jst}}$), or reallocation ($\widehat{R_{jst}}$) for industry j and state s at time t, $\tau_{j,t-1}$ and $\tau^I_{j,t-1}$ are final goods tariffs and input tariffs, $Delic_{j,t-1}$ is a dummy variable equal to one if any products in an industry are delicensed, zero otherwise, $FDI_{j,t-1}$ is a dummy variable equal to one if any products in an industry are FDI-liberalized, zero otherwise; and α_{js} and α_t are state-industry and year dummy variables, respectively. Since our firm data are annual, and policy changes occurred throughout the year, we lag all policy variables by one year. We employ a fixed-effects estimator to estimate Equation 2, and cluster all standard errors at the state-industry level. We use the balanced panel of state-industries in order to avoid confounding within-group effects with the entry and exit of certain industries in particular states, and we weight all observations using the total number of firms in each state-industry group over

[6]The state-industry decomposition is presented in the supplementary appendix.

all years. This ensures that industries (and states) with large firm populations will receive higher weight in the analysis, and will make the results more representative of the all-India level.

Table 4 presents baseline results for 1986 to 2004.[7] Column (1) suggests that the trade liberalization is strongly correlated with aggregate productivity increases. The coefficient on final goods tariffs (-0.051) indicates that a 10 percentage point reduction in final goods tariffs yields an 0.51% increase in aggregate productivity. The impact of input tariffs is an order of magnitude larger, with a 10 percentage point reduction in input tariffs yielding a 5.7% increase in aggregate productivity.

Columns (2) and (3) present results for the average and reallocation components of productivity, respectively. Column (2) indicates that 10 percentage point declines in final goods and input tariffs raise average productivity by 0.44% and 5.5%, respectively, though the coefficient on final goods tariffs is not statistically significant at the 10% level. FDI liberalization increases average productivity by 5%. However, Column (3) shows that the variation in individual polices cannot explain the increase in reallocation. The only statistically significant result, for FDI reform, indicates that liberalization would lower rather than raise reallocation productivity.

In Table 5, we use the baseline, population results to show the extent to which the policy reforms can explain overall productivity growth. In particular, we multiply the coefficients from the results in Table 4 by the average policy change, to estimate the productivity growth implied by each reform. The results suggest that trade liberalization, in particular the decline in input tariffs, is largely responsible for aggregate and average productivity growth. The decline of 60 percentage points in final goods tariffs implies an aggregate productivity increase of 3%, and an average productivity increase of 2.6% (though the related regression coefficient is not statistically significant). Meanwhile, the decline of 40 percentage points in input tariffs implies aggregate and average productivity increases of approximately 22%. The FDI liberalization also plays a role, implying a 4.7% increase in average productivity.[8] As discussed above, the variation in policies across industries cannot explain the gains in reallocation productivity that were observed

[7]We exclude 1985 because we do not have lagged policy variables for this year.

[8]In fact, the average policy changes can explain somewhat more than the total increase in productivity during this time period. In the regression framework, the coefficients on several year dummies are negative, implying that in the absence of the policy reforms, productivity would have fallen.

in the initial years following the reforms. However, the policies do explain the gains in average productivity, which was the more important driver of aggregate productivity growth during this period.

4.4 Firm-Level Regressions

We now use the constructed panel to examine the results on average productivity in more detail. We estimate the following equation at the firm level:

$$\widehat{\phi_{ijst}} = \beta_1 \tau_{j,t-1} + \beta_2 \tau^I_{j,t-1} + \beta_3 Delic_{j,t-1} + \beta_4 FDI_{j,t-1} + \alpha_i + \alpha_t + \varepsilon_{ijst} \tag{3}$$

As discussed in Section 3.2, our constructed panel makes it difficult to accurately identify firm exit. However, we are confident in the firms we are able to match, so that the fixed effects estimator shown in Equation 3 should allow us to identify within-firm changes in productivity.

Table 6 presents results. In Column (1), we include all firms that were used in the state-industry level analysis (the estimated population). This specification includes industry and year dummy variables. As we would expect, the coefficients on the policy variables are similar to the average productivity results at the state-industry level.

Column (2) presents results for firms that appear in the panel for at least two years, without sampling multipliers. This specification includes industry and year dummy variables, but not firm fixed effects, and indicates that the results for the sample of firms that are in the panel are similar to the overall results. Column (3) controls for a number of firm characteristics, and shows that public firms and young firms (less than 3 years old) are relatively unproductive, while multiplant firms are relatively more productive. We also created dummy variables for firms in three size categories: <20 employees (small), 20-99 employees (medium), and 100+ employees (large, the omitted category). The results indicate a positive correlation between size and productivity.[9]

In Column (4), we present results with firm fixed effects, thus isolating within-firm changes in

[9]The public, multiplant, and young firm dummies are allowed to change over time to reflect switching into or out of the public sector, acquiring more factories, and firm aging. However, to avoid endogeneity of firm growth, we classify firm size based on the first time we observe a firm.

productivity. The coefficient on final goods tariffs is slightly larger (-0.042 instead of -0.037) in this specification than in the specification without firm fixed effects. In contrast, the coefficient on input tariffs is smaller (-0.14 rather than -0.52), as is the coefficient on FDI reform (0.031 instead of 0.054), though both coefficients remain statistically significant at the 1% level.

These results confirm that the trade and FDI liberalizations are associated with substantial increases in productivity within individual firms. However, they also indicate that the changing composition of firms, as well as unobserved, firm-level characteristics, may play important roles in the observed, average productivity gains for the population of firms.[10]

4.5 State, Industry and Firm Characteristics

We now explore whether the effects of the reforms varied across states or industries with different pre-reform characteristics, and among firms of different sizes. These analyses use the population of firms rather than the panel.

First, we consider whether the impact of liberalization on firm productivity was influenced by exposure to trade. We use three measures as proxies for trade exposure. First, firms located close to ports may have been more exposed to trade competition prior to the reforms, or may have been more affected by trade liberalization. We create a dummy variable that is equal to one if a state-industry group is located in a state with a port, zero otherwise. We also develop measures of the extent to which particular industries might have been more or less exposed to competition from imports, or to foreign markets through exports. To so do, we use data from the COMTRADE database to estimate total exports and total imports for each industry in 1990. We then calculate the shares of imports and exports in output for each industry. Our importing (exporting) variable is a dummy equal to one if the industry has an import (export) share in output that is above the median, zero otherwise.

Table 7 shows that the delicensing and FDI reforms have larger effects on productivity among

[10] Similarly, Topalova and Khandelwal (2011), who study productivity among 4,100 large Indian firms, find that the effects of final goods and input tariffs are somewhat attenuated when including firm fixed effects.

firms that were relatively less exposed to trade. The most notable finding is that the delicensing and FDI reforms have larger effects on productivity in industries and states that were relatively less exposed to trade. In states without ports, and in non-importing industries, delicensing is associated with a 4-5% increase in average productivity. Meanwhile, FDI reform is associated with a 7.7% increase in average productivity among non-exporting industries. The effect of the FDI reform on average productivity is attenuated in exporting industries, while the effect of the delicensing reforms is actually reversed in importing industries and in states with ports. These results suggest some degree of substitutability between external competition and internal competition: where states or industries were not already exposed to trade through proximity to ports, import competition, or exposure to foreign markets, industrial reforms that encouraged competition had a larger effect.

Next, we consider the role of labor regulations, using the measure developed by Besley and Burgess (2004), based on state amendments to the Industrial Disputes Act, and using data from the Ministry of Labor on how often firm requests to close down or lay off workers are granted. Both measures vary by state, but not over time. The supplementary appendix shows that the effects of the policy reforms are largely similar across states, regardless of labor regulations. However, FDI reform is associated with a 7.4% increase in average productivity in states where it is difficult to lay off workers, but only a 2.7% increase in average productivity in states where it is easy to lay off workers. This difference suggests that in states where it is difficult for firms to achieve an optimal input mix by laying off workers, they may instead be able to increase their productivity through other means, such as attracting FDI. In other words, FDI reform matters more when existing rigidities make it difficult for firms to optimize their production.

Finally, we consider whether productivity changes may have differed across firms of different sizes. Using the population data, but harnessing information from the panel, we classify firms into three categories: small (<20 employees), medium (20-99 employees), and large (100+ employees) based on the size the firm was the first time we observed it. In the supplementary appendix, we show that changes in average productivity are more important than reallocation in driving aggregate

productivity growth for small and medium firms; interestingly, though, reallocation and average productivity are both equally important for large firms. Moreover, the appendix also shows that the effects of final goods tariffs vary by firm size: a decline in final goods tariffs increases aggregate productivity among small and medium-sized firms, as well as reallocation productivity among small firms. FDI liberalization is most important for large firms: reform is associated with a 7.5% (9.2%) increase in aggregate (average) productivity for firms with 100 or more employees, approximately twice the magnitude of the average effect. The delicensing reforms, while not associated with overall productivity increases, are associated with a 4.6% increase in aggregate productivity among large firms and a 3.8% increase in average productivity among mid-sized firms. This heterogeneity is consistent with the fact that only firms with 50 or more employees, and a certain amount of assets, were required to obtain operating licenses under the license raj.

4.6 Robustness Tests

We test the robustness of our baseline results in a number of ways; results are presented in the supplementary appendix. First, we examine whether our results are robust to constructing TFP in different ways. We begin by using two variations on our baseline productivity measure (a winsorized measure, and a measure that uses cost shares instead of revenue shares). We then calculate TFP using a simple OLS method. Next, we examine several other modifications of the baseline specification: using an alternative measure of capital; restricting the analysis to the inital years of the reforms, during which policy changes were less likely to be influenced by political considerations; using an alternative measure of input tariffs; removing outlier values in tariff changes; and estimating Equation 2 without state-industry weights. The appendix shows that although there is some variation in the magnitude of results, they are robust to each of these tests.

Finally, to test the robustness of our productivity decomposition, we use an alternative method suggested by Melitz and Polanec (2010) (MP). The advantage of the MP method is that it explicitly separates the contributions of entrants, exiters, and survivors to productivity growth. We first divide the panel of firms in any two consecutive periods $t-1$ and t into firms present in both periods

(*survivors*), firms that exit after period $t-1$ (*exiters*), and firms that enter in period t (*entrants*). In period $t-1$ only exiters and survivors are present; $S_{X,t-1}$ denotes the market share associated with exiters. In period t only entrants and survivors are present; $S_{E,t}$ denotes the market share associated with entrants. MP show that the change in aggregate productivity from period $t-1$ to t can be decomposed as follows:

$$\Phi_t^{AGG} - \Phi_{t-1}^{AGG} = [\Phi_{S,t}^{U} - \Phi_{S,t-1}^{U}] + [R_{S,t} - R_{S,t-1}] + S_{E,t}[\Phi_{E,t}^{AGG} - \Phi_{S,t}^{AGG}] + S_{X,t-1+}[\Phi_{S,t-1}^{AGG} - \Phi_{X,t-1}^{AGG}]$$

The first and second terms on the right-hand-side represent changes in within-firm productivity, and the covariance between productivity and market share, of firms that survive from $t-1$ to t. The third term represents the contribution of firms that enter in period t, weighted by the market share of entrants, $S_{E,t}$. Similarly, the last term represents the contribution of firms that exit in period $t-1$, weighted by the market share of exiters, $S_{X,t-1}$. We use this method to calculate the change in TFP between period $t-1$ and period t, then add the change in TFP to the existing level of TFP in period $t-1$. TFP is normalized to be zero in 1985. In this analysis, we do not use the sampling multipliers.

To use this method, we have to assign every firm in our panel to the category of survivor, entrant, or exiter in every year. Given the nature of our panel data, this requires two relatively strong assumptions. First, to address the fact that we do not directly calculate TFP for 1995-1997, we impute missing values for TFP and output for each series that bridges these years using linear interpolation. We perform a similar linear interpolation of TFP and output for individual firms for which we have bridged over another year.[11]

Second, we have to make some assumptions regarding firm exit. When we observe a potential exiter, it is unclear whether the firm actually exited, whether it still existed but was not surveyed in the following year, or whether it was surveyed but we failed to match it.[12] We address this challenge by estimating the "true" rate of exit for each cohort of firms (e.g., firms born between

[11] For example, if a firm was surveyed in 1992 and 1994, and we are able to link that firms across those years, we use a linear interpolation to estimate TFP and output for that firm in 1993.

[12] In the pre-formed panel from 1998-2004, the third case is not a concern, though we are still unable to distinguish between the first two cases in many instances.

1974 and 1976), based on the number of surviving firms we observe. In each year, we then consider the potential pool of exiting firms (i.e., firms we do not observe in any subsequent year), and we assign exit to the number of the firms we estimate to have exited from each cohort.[13] The remaining firms are assigned to the group of survivors.

Table 8 shows that the baseline results are robust to this alternative decomposition method.[14] A 10 percentage point decline in input tariffs is associated with a 4.1% increase in aggregate productivity, and a 4.4% increase in average productivity. FDI liberalization also increases aggregate productivity by 4.1%, and average productivity by 4.3%. The policy reforms are not associated with the other components of productivity growth (reallocation among survivors or entry/exit).

5 Conclusion

Our results confirm that the market-share reallocations predicted by recent trade theory were important in increasing India's productivity growth during the years immediately following the start of the major trade reforms. We document three distinct periods during the years from 1985 to 2004. From 1985 to 1990, increases in aggregate (output-weighted) productivity were nearly exclusively due to increases in average (unweighted) productivity, while reallocation productivity actually fell. Between 1991 and 1994, reallocation productivity rose sharply while average productivity initially fell, then rose more slowly. From 1998 onwards, reallocation productivity stagnated, while average productivity improvements once again became more important.

The increases in aggregate productivity are linked to the trade and FDI liberalization that took place during the 1990's, particularly the decline in input tariffs. Using a constructed panel of firms

[13]To determine an appropriate method for assigning exit, we examined the distribution of TFP for potential exiters versus survivors, for two years (1999 and 2000) in which observed exit rates are relatively close to estimated exit rates, indicating that the pool of potential exiters is likely to be representative of "true" exiters. We also examined TFP distributions in two years (1995 and 2004) when the observed exit rate is significantly higher than the estimated, true exit rate, indicating that many true survivors are classified as exiters. In both cases, the distributions of potential exiters are slightly left-shifted, indicating that exiters are, on average, less productive than survivors. However, the two distributions of potential exiters are similarly left-shifted relative to the distributions of survivors, suggesting that the pool of potential exiters is fairly representative of the actual exiters. Therefore, we assign exit by selecting a random sample of firms from the pool of potential exiters.

[14]In this case, the number of state-industry observations is larger due to the imputation of TFP in the panel.

from from 1985 to 2004, we confirm that the trade and FDI reforms were associated with increases in within-firm productivity, after controlling for unobservable, time-invariant firm characteristics.

Our results lend support to the importance of market-share reallocations in increasing productivity. In the case of India, however, we show that such reallocations were only important at the beginning of the major trade liberalization period, and that over the 20-year period from 1985 to 2004, average productivity improvements played a larger role in determining aggregate productivity growth.

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Table 1: Trade, FDI, and Licensing Reforms

	Final Goods Tariffs		Input Tariffs		FDI reform		Delicensed	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1985	0.89	0.33	0.58	0.12	0.00	0.00	0.33	0.47
1986	0.96	0.39	0.61	0.11	0.00	0.00	0.34	0.48
1987	0.95	0.38	0.59	0.10	0.00	0.00	0.34	0.48
1988	0.96	0.38	0.60	0.10	0.00	0.00	0.34	0.48
1989	0.96	0.41	0.60	0.10	0.00	0.00	0.35	0.48
1990	0.96	0.41	0.60	0.10	0.00	0.00	0.35	0.48
1991	0.96	0.41	0.60	0.10	0.36	0.48	0.83	0.37
1992	0.64	0.28	0.40	0.05	0.36	0.48	0.83	0.37
1993	0.64	0.32	0.39	0.05	0.36	0.48	0.85	0.36
1994	0.64	0.37	0.37	0.06	0.36	0.48	0.85	0.36
1995	0.53	0.32	0.30	0.05	0.36	0.48	0.85	0.36
1996	0.42	0.25	0.23	0.05	0.36	0.48	0.85	0.36
1997	0.34	0.19	0.18	0.04	0.43	0.50	0.89	0.31
1998	0.35	0.18	0.19	0.04	0.43	0.50	0.92	0.27
1999	0.36	0.17	0.20	0.04	0.43	0.50	0.92	0.27
2000	0.35	0.16	0.21	0.04	0.93	0.26	0.92	0.27
2001	0.34	0.17	0.21	0.05	0.93	0.26	0.92	0.27
2002	0.31	0.16	0.19	0.05	0.93	0.26	0.92	0.27
2003	0.31	0.16	0.19	0.05	0.93	0.26	0.92	0.27
2004	0.31	0.16	0.19	0.05	0.93	0.26	0.92	0.27

Mean values and standard deviations of policy variables from 1985 to 2004. Final goods and input tariff variables are fractions, with 1 representing an ad valorem tariff of 100%; FDI Reform is a dummy variable equal to 1 if any products within the industry are liberalized, 0 if not; and Delicensing is a dummy variable equal to 1 if any products within the industry are delicensed, 0 if not. Source: Authors' calculations based on various publications of the Government of India, the TRAINS database, and Aghion et al. (2008).

Table 2: Changes in Reforms and Pre-Reform Trends in Industry Characteristics

	ΔFinal Goods Tariffs	ΔInput Tariffs	ΔFDI Reform	ΔDelicensing
Δ log(wage)	-0.0039	-0.043	0.088	-0.15
	(0.19)	(0.052)	(0.12)	(0.26)
Δ Production Share	-0.10	-0.15	0.16	0.79
	(0.93)	(0.25)	(0.60)	(1.27)
Δ log(K/L Ratio)	-0.12	0.0071	0.040	0.040
	(0.080)	(0.022)	(0.052)	(0.11)
Δ log(Employment)	-0.080	-0.027	-0.0083	-0.054
	(0.061)	(0.016)	(0.04)	(0.084)
Δ log(Firm Size)	-0.01	-0.036	0.017	-0.038
	(0.12)	(0.031)	(0.076)	(0.16)
Δ log(Output)	-0.032	-0.0067	0.022	-0.0032
	(0.041)	(0.011)	(0.026)	(0.056)
Δ TFP (Total)	0.038	-0.0067	0.062	0.014
	(0.072)	(0.020)	(0.047)	(0.099)
Observations	136	136	136	136

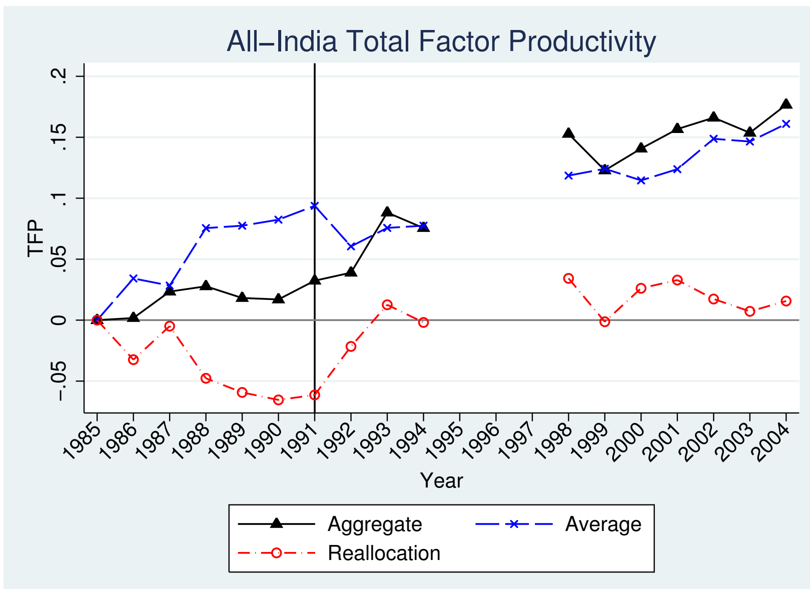
Results are coefficients from regressions of the change in reforms (final goods tariffs, input tariffs, delicensing, FDI reform) from 1990 to 2004 on changes in industry characteristics from 1985 to 1989. Each value represents a result from a separate regression. Standard errors are in parentheses.

Table 3: Summary Statistics for the Firm-Level Data

	Estimated population	Sampled Firms	Panel
Firm-years	1,410,717	580,937	414,092
Firms per year, mean	82,983	34,172	24,358
Census firm-years	277,171	277,171	247,774
Census firms per year, mean	16,304	16,304	14,574
Unique firm series			147,703
Output, mean (million Rs.)	18.7	32.0	41.8
Output, median (million Rs.)	2.6	3.6	5.3
Capital, mean (million Rs.)	6.9	12.8	17.0
Capital, median (million Rs.)	0.4	0.5	0.8
Materials, mean (million Rs.)	12.5	21.1	27.3
Materials, median (million Rs.)	1.9	2.6	3.9
Labor, mean (no. employees)	74.1	133.4	171.9
Labor, median (no. employees)	21	31	43
In panel, as fraction of total in sampled population:			
Output			0.93
Capital			0.95
Labor			0.92
Firm-years > 100 employees			0.94
Firm-years > 200 employees			0.96
Firm-years			0.71
Census firm-years			0.89

Summary statistics for the estimated population (using sampling weights), for the sampled population (not using sampling weights), and for firms that appear for two or more years in the panel. Only open firms with positive values of key variables are included. "Firm-years" indicates the total number of observations, while "Census firm-years" indicates the number of observations in the census sector. Mean and median values are averages across all years used in the analysis (1985-1994 and 1998-2004). Output, material inputs and capital have been deflated to 1985 values and are expressed in millions of rupees. Fractions of output, capital, etc. that appear in the panel are given in relation to the sampled (rather than the estimated) population. Source: Authors' calculations based on Annual Survey of Industries data.

Figure 1: All-India Total Factor Productivity



Total factor productivity (TFP) decompositions for the population of firms, conducted at the all-India level, using the OP method. "Aggregate" indicates market-share weighted mean productivity, "Average" indicates unweighted mean productivity, and "Reallocation" indicates the covariance between market share and productivity. Source: Authors' calculations based on Annual Survey of Industries data.

Table 4: Productivity Decompositions and Policy Changes: Baseline Results

	Aggregate	Average	Reallocation
	(1)	(2)	(3)
Final Goods Tariff	-.051	-.044	-.008
	(.026)**	(.030)	(.015)
Input Tariff	-.566	-.546	-.020
	(.105)***	(.116)***	(.061)
FDI Reform	.021	.050	-.030
	(.013)	(.014)***	(.010)***
Delicensed	-.006	.005	-.011
	(.017)	(.017)	(.011)
Obs.	17106	17106	17106
R^2	.082	.077	.014

Each observation is a state-industry. Dependent variable names are given at the top of each column. "Aggregate" indicates market-share-weighted mean productivity, "Average" indicates unweighted mean productivity, and "Reallocation" indicates the covariance between market share and productivity. All specifications are fixed-effects analyses at the state-industry level, and include year dummies. Each observation is weighted by the total number of firms in the state-industry across all years, and standard errors are clustered at the state-industry level.

Table 5: Productivity Increases Implied by Policy Changes

	Final Goods Tariffs	Input Tariffs	FDI Liberalization	Delicensing
Aggregate	**3.0%**	**22.1%**	2.0%	-0.4%
Average	2.6%	**21.3%**	**4.7%**	0.3%
Reallocation	0.5%	0.8%	**-2.8%**	-0.6%

Implied increases in aggregate, average, and reallocation productivity. Results are based on regression coefficients and average policy changes. Bold font indicates that the underlying regression results are statistically significant at the 10% level.

Table 6: Firm-Level Productivity

	Population	Panel Firms	Controls	Firm FE
	(1)	(2)	(3)	(4)
Final Goods Tariff	-.046	-.038	-.037	-.042
	(.027)*	(.019)**	(.019)**	(.008)***
Input Tariff	-.486	-.532	-.521	-.136
	(.108)***	(.088)***	(.087)***	(.034)***
FDI Reform	.045	.055	.054	.031
	(.015)***	(.012)***	(.011)***	(.004)***
Delicensed	-.005	-.002	-.002	-.002
	(.016)	(.013)	(.013)	(.005)
Public			-.164	-.059
			(.014)***	(.063)
Multiplant			.044	.004
			(.011)***	(.008)
Young			-.092	-.013
			(.005)***	(.004)***
Small			-.056	
			(.009)***	
Midsize			-.010	
			(.009)	
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	No
Firm FE	No	No	No	Yes
Obs.	1322794	388448	388448	388448
R^2	.065	.057	.064	.002

Each observation is a firm. Dependent variable is total factory productivity (TFP). Column (1) includes all firms that were part of the state-industry level analysis; Columns (2)-(4) include only firms that appear in the panel for at least two years. Columns (1)-(3) include industry and time dummies, and standard errors are clustered at the state-industry level. Column (4) includes year dummies and firm fixed effects, and standard errors are clustered at the firm level.

Table 7: Productivity Decompositions and Policy Changes: Trade Exposure

	Aggregate	Aggregate	Aggregate	Average	Average	Average	Reallocation	Reallocation	Reallocation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Final Goods Tariff	-.036 (.035)	-.027 (.019)	.013 (.025)	-.065 (.045)	.018 (.032)	.033 (.030)	.029 (.026)	-.045 (.026)*	-.021 (.023)
Input Tariff	-.599 (.113)***	-.537 (.109)***	-.621 (.102)***	-.502 (.123)***	-.616 (.111)***	-.588 (.115)***	-.097 (.069)	.079 (.065)	-.033 (.072)
FDI Reform	.026 (.017)	.027 (.017)	.044 (.019)**	.053 (.019)***	.054 (.019)***	.077 (.018)***	-.027 (.012)**	-.027 (.013)**	-.033 (.013)**
Delicensed	.007 (.019)	.042 (.018)**	-.013 (.025)	.043 (.021)**	.045 (.019)**	.010 (.024)	-.036 (.015)**	-.003 (.014)	-.023 (.014)*
Port in state X Final Goods Tariff	-.0002 (.0005)			.0003 (.0006)			-.0005 (.0003)		
Port in state X Input Tariff	.0006 (.0009)			-.0005 (.001)			.001 (.0006)*		
Port in state X FDI Reform	-.008 (.017)			-.004 (.020)			-.004 (.015)		
Port in state X Delicensed	-.019 (.027)			-.058 (.027)**			.038 (.019)**		
Importing industry X Final Goods Tariff		-.0003 (.0005)			-.001 (.0005)**			.0008 (.0003)**	
Importing industry X Input Tariff		-.001 (.0009)			.0007 (.001)			-.002 (.0006)***	
Importing industry X FDI Reform		-.013 (.016)			-.004 (.019)			-.009 (.015)	
Importing industry X Delicensed		-.160 (.044)***			-.125 (.039)***			-.035 (.025)	
Exporting industry X Final Goods Tariff			-.001 (.0004)**			-.001 (.0005)**			.0002 (.0003)
Exporting industry X Input Tariff			.001 (.0008)			.001 (.001)			.00006 (.0007)
Exporting industry X FDI Reform			-.039 (.017)**			-.048 (.018)***			.009 (.014)
Exporting industry X Delicensed			.011 (.031)			-.013 (.030)			.024 (.020)
Obs.	17106	17106	17106	17106	17106	17106	17106	17106	17106
R^2	.083	.091	.085	.078	.083	.081	.015	.016	.014

Each observation is a state-industry. Dependent variable names are given at the top of each column. "Aggregate" indicates market-share-weighted mean productivity, "Average" indicates unweighted mean productivity, and "Reallocation" indicates the covariance between market share and productivity. All specifications are fixed-effects analyses at the state-industry level, and include year dummies. Each observation is weighted by the total number of firms in the state-industry across all years, and standard errors are clustered at the state-industry level. "Port in state" is a dummy variable equal to one if the state-industry group is located in a state with a port, zero otherwise. "Importing" ("Exporting") is a dummy variable equal to one if the industry's share of imports (exports) in total output is greater than the median, zero otherwise.

Table 8: Robustness Test: Alternative Decomposition

	Aggregate	Avg Surv	Realloc Surv	Entrants	Exiters
	(1)	(2)	(3)	(4)	(5)
Final Goods Tariff	-.023	-.031	.008	.0009	-.0008
	(.022)	(.026)	(.017)	(.006)	(.003)
Input Tariff	-.406	-.445	.032	-.007	.013
	(.095)***	(.107)***	(.080)	(.022)	(.023)
FDI Reform	.041	.043	-.004	-.0006	.002
	(.013)***	(.014)***	(.011)	(.002)	(.003)
Delicensed	-.008	.006	-.013	-.001	-.0008
	(.015)	(.017)	(.014)	(.004)	(.004)
Obs.	19328	19328	19328	19328	19328
R^2	.058	.064	.033	.066	.002

Decomposition performed using the method suggested by Melitz and Polanec (2010), with false exit addressed as discussed in the text. Each observation is a state-industry. Dependent variable names are given at the top of each column. "Aggregate" indicates market-share weighted mean productivity, "Avg Surv" and "Realloc Surv" indicate unweighted mean productivity and the covariance between market share and productivity for surviving firms, respectively, and "Entrants" and "Exiters" indicate the contributions of entering and exiting firms. All specifications are fixed-effects analyses at the state-industry level, and include year dummies. Each observation is weighted by the total number of firms in the state-industry across all years, and standard errors are clustered at the state-industry level.