

The Unequal Effects of Liberalization: Theory and Evidence from India*

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Abstract

This paper exploits the 1991 Indian liberalization to illustrate how such a reform may have unequal effects on industries and regions within a single country. We begin by developing a Schumpeterian growth model to analyze the effects on industrial performance of liberalization reforms aimed at increasing entry. The main predictions of the model are: (i) liberalization enhances productivity, investment, profits and output, in industries that are initially close to the technological frontier, while it has the reverse effect in industries which are initially far below the frontier; (ii) pro-worker labor regulations discourage productivity, investment, profits and output in all industries and this negative effect is magnified by liberalization. We test these predictions in a 3-digit industry panel data set for the sixteen main states of India over the period 1980-1997. The empirical results confirm the main predictions of the model. We find that the 1991 liberalization in India had strong inequalizing effects, by fostering productivity and output growth in 3-digit industries that were initially closer to the Indian productivity frontier and which were located in states with more pro-employer labor institutions. These findings emphasize that the initial level of technology and institutional context mattered for whether and to what extent state-industries in India benefited from liberalization.

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1 Introduction

Globalization and its effects on economic development have been the subject of an intense and passionate debate over the last decade. The optimistic view argues that trade liberalization, and the implied elimination of barriers to competition, is the right road for developing countries to promote growth and eradicate poverty (see, for example, Dollar and Kray (2001, 2002), Frankel and Romer (1999), Sachs and Warner (1995) and World Bank (2001)). Skeptics object that there can be no such progress without an active role for domestic institutions and policies to correct market failures (Rodrik and Rodriguez (2000), Rodrik *et al.* (2002)), and argue that liberalization may even be detrimental to growth, by inhibiting infant industries and the local accumulation of knowledge (Krugman (1981), Haussman and Rodrik (2002), Young (1991), Stiglitz (1995, 2002)).

This paper intends to contribute to this debate from both a theoretical and an empirical standpoint, providing a unifying framework to discuss the effect of globalization on growth and inequality. We analyze how trade liberalization interacts with pre-reform technological capability and domestic institutions in affecting industrial performance. As a result the effect of the same macroeconomic reform can vary substantially across regions and industries in the same country. Domestic institutions such as those governing labor relations will also affect the response of innovative investments to trade liberalization.

We formalize these ideas in a simple version of a Schumpeterian growth model with entry threat that we use to guide our empirical research. We formulate and test two main implications of the theory.

First, a liberalization reform introducing trade liberalization should give rise to larger increases in productivity, investment, rents and output in state-industries that are closer to the frontier. The growth-enhancing effect should be smaller, and possibly negative, in firms and sectors that are farther from frontier. The reason is that incumbent firms that are sufficiently close to the technological frontier can survive or deter entry by innovating. An increased entry threat, thus, results in higher innovation intensity aimed at escaping that threat. On the other hand, firms and sectors that are far below the frontier are in a weaker position to fight external entry. For these firms, an increase in the entry threat reduces the expected payoff from innovating, since their expected life horizon has become shorter.

Second, more pro-worker (pro-employer) labor market regulations reduce (increase) productivity, investment, rents and output, and these effects are strengthened post-liberalization. More precisely, our theory predicts that the response of innovative investments to trade liberalization is dampened in states with more pro-worker labor regulations. In other terms, the anti-innovative effect of pro-workers regulations is less pronounced in less competitive environments. Thus, in relative terms, trade reforms hurt growth in regions with pro-labor regulations, while enhancing growth in regions with pro-employer regulations.

The empirical analysis focuses on the effects of a recent liberalization episode in India. India underwent a massive reform in 1991 which involved slashing tariffs, deregulating entry and opening up different industrial sectors to foreign direct investment. This episode, which is described in more detail below, represents, for its size and impact, an attractive experiment to assess the validity of the theory. More precisely, we construct a three-dimensional panel for the period 1980 to 1997 using “Annual Survey of Industries” (ASI) data with variations over 3-digit industry, state and time. The available data include productivity, investment, rents and output for each industry-state-time observation.

We use a measure of output per worker in the period just before liberalization (relative to the most productive state-industry observation in the same year) as a proxy for the distance to frontier for a particular 3-digit state-industry. We then interact this variable with a reform measure which is zero before 1991 and takes on a value of one thereafter to test whether the distance to frontier prior to reform influences the post-reform performance. We first document the effects of the reform on labor productivity, and then consider separately the effects on total factor productivity, profitability, investment, employment and output. This provides a test of the first prediction of the theory, namely that firms closer to the frontier respond more positively to the threat of entry introduced by liberalization.

Second, we consider state-specific labor market regulations. To this aim, we use a measure of the direction of labor regulation constructed by Besley and Burgess (2003), who coded state amendments to the Industrial Dispute Act of 1947 as pro-labor, neutral or pro-capital. We look first at whether the direction of labor regulation across the 1980-1997 period affected industrial performance at the 3-digit state-industry level. The level of this variable in 1990, which captures the pre-reform relative bargaining powers of workers and employers, is then interacted with the reform dummy and used as an explanatory variable in regressions for profitability, investment, employment and output. The estimated coefficient on this interaction term provides an inference on whether labor regulation in a state at the time of reform affected the performance of 3-digit state-industries post-liberalization.

The regression analysis vindicates the two key predictions of the theory. First, state-industries that are closer to the technological frontier have indeed experienced larger increases real productivity, investment, rents and output in the post-reform period. Second, pro-worker labor regulations had a negative effect on the growth of the same variables, and this effect was magnified by liberalization. Both results hold true after controlling for 3-digit state-industry fixed effects, year dummies and 3-digit industry time trends.

Data on patents taken out by Indian manufacturing firms with the US Patent Office shows that this form of innovative activity increases in after liberalization and the increase is greater in state-industries which were closer to the Indian technological frontier pre-reform. state-industries closer to the Indian technological frontier pre-reform. Though this is a somewhat restrictive measure of innovation we find similar

results for broader measures of investment which together suggest a non-negligible role for innovation. Using a panel of firms which exist in both 1994 and 1997 we also show that the bulk of the productivity improvement that occurred in the post-liberalization period can be accounted for by within firm productivity improvements with only small amount coming from reallocation of labor from less to more productive firms. Though this may in part reflect the specificities of the Indian institutional environment (e.g. limitations on closing firms and firing workers) it does suggest that the innovation response of incumbent firms to the entry threat posed by liberalization is a large part of the story.

Our paper relates to different strands of literature. There is first a theoretical literature on trade, productivity and growth. Of particular relevance for our empirical analysis in this paper, is the recent model by Melitz (2003). In Melitz (2003), trade liberalization induces a process of reallocation of resources across heterogeneous firms. High productivity firms react to liberalization by incurring some additional fixed costs to enter foreign markets as they find it optimal to expand their activity in equilibrium. Low productivity firms, in contrast, exit.¹ On average, profits and productivity increase, although there is no productivity change at the firms level. Thus a common feature between Melitz and our model, is that in both cases high-productivity firms stand better chance to resist the a more competitive environment, whereas low productivity firms more often succumb and exit, so that liberalizing entry shifts the firm distribution towards more productive firms. However, in addition to this “reallocation” effect, in our model liberalization reforms also affect innovation incentives and productivity growth at the firm level. Our empirical analysis confirms that this is an important part of the story in India.

The evidence gathered so far in the debate on globalization and development is mainly at the country level and does not arrive at any clear consensus. A contribution of this paper is to look at how an important liberalization episode affected industrial performance at the microeconomic level. It thus forms part of a literature which is moving in this direction. Other empirical studies that document the effect of trade liberalization on productivity growth at the firm or industry level, include Hanson (1997), Harrison (1994), Krishna and Mitra (1998), Levinsohn (1999), Pavcnik (2002), Trefler (2001) and Tybout *et al.* (1991). Our innovation is to look at the interplay between market reforms, institutions and technological development. As is confirmed in the data there is a strong link between liberalization, the technological choices of firms and growth which has recieved limited attention in the literature. A recent paper by Aghion et al (2003) also pushes in this direction by looking at the effects of entry on innovation and productivity growth in UK firm level data.

On a more general level, our contribution relates to a recent stream of literature on endogenous growth which emphasizes how policies may have different effects at

¹Thus, while in Melitz’ model it is the opportunity to access foreign markets that induces high-productivity firms to invest in foreign market access, in our model firms respond to the threat of outside entry by investing resources to increase productivity and thereby escape the entry threat.

different stages of the process of technological convergence. This includes Acemoglu, Aghion and Zilibotti (2002) and Aghion et al (2001).² It also relates to the recent literature on institutions and development (e.g Acemoglu, Johnson and Robinson (2001, 2002a, 2002b), Banerjee-Duflo (2001), Besley and Burgess (2000, 2003), Hall and Jones (1999), La Porta *et al.* (1998, 1999)).

The paper is organized as follows. Section 2 provides background on the Indian liberalization experiment and on patterns of industrial performance and institutional change. Section 3 outlines the theoretical framework and then derives our main predictions on how the effects of trade liberalization on performance should depend upon technological and institutional characteristics of industries and states. Section 3 confronts these predictions with Annual Survey of Industries data from India and presents our main empirical findings. Section 4 performs a few robustness tests and contrasts the results with the predictions of the neo-classical trade model. Section 5 concludes.

2 Background

1991 brought to a close a long era of socialist policies in India. Political analysis suggests that the size and scope of the liberalization reforms which ensued were largely unexpected. Up to this point central government control over industrial development was maintained through public ownership, licensing and other controls. And planned industrialization took place in highly protected environment which was maintained by high tariff, non-tariff barriers and controls on foreign investment. The New Industrial Policy, introduced in 1991 in the wake of a balance of shattered this old order. Trade liberalization and deregulation were central elements.

Using 6-digit industry data from the UN Trade Analysis and Information Systems Data Base, we find that the average percentage point reduction in tariffs across the 1990-1997 period was 51%, with 97% of products experiencing tariff reductions. This represented one of the most dramatic trade liberalizations ever attempted in a developing country. As part of the liberalization process, the system of import licensing was also radically reformed, with quantitative controls largely eliminated on imports of intermediate products leading to a rise in the ratio of imports to gross output occurring from 1991 onwards.

The New Industrial Policy also opened a large number of industries for automatic approval of foreign technology agreements and to foreign investment of up to 51%

²Aghion et al (2001) analyzes the interplay between innovation and product market competition, and shows that product market competition encourages innovations mostly in “neck-and-neck” sectors where most firms are already close to the technological frontier, whereas it discourages innovations in sectors where innovating firms are far below the frontier. Acemoglu et al (2002) emphasizes the idea that different policies or institutions can be growth-enhancing depending upon a country’s or sector’s distance to the technological frontier. In contrast, this paper emphasize asymmetric effects of trade liberalization across industries and regions in the same economy.

of equity. A Foreign Investment Promotion Board was also established to consider proposals of up to 100% equity. These policy reforms were followed by a dramatic rise in the number of approvals of foreign collaboration and actual foreign direct investment flows showed a similar marked increase.

Dramatic deregulation also ensued with the large-scale removal of industrial licensing. Under the Industries (Development and Regulation) Act of 1952, firms were required to apply for an industrial license from a Licensing Committee in order to set up a new production unit, expand capacity by more than 25% of existing levels or manufacture a new product. These requirements were removed for the majority of industrial sectors in 1991. Similarly, the New Industrial Policy saw a substantial reduction in the number of industrial categories reserved for the public sector from 17 to 8 in 1991 and to 6 in 1993.

Overall liberalization in 1991 has had a positive impact on registered manufacturing – whereas the growth rate of real per capita manufacturing was around 4% in the 1960-1991 period this jumped to about 7% in the 1991-1997 period. This pattern gives some support to those who see globalization as having a net positive impact on economic performance. Figure 1 graphs out per capita real registered manufacturing output in the sixteen main Indian states for the period 1980 to 1997. Our focus is on registered manufacturing which covers firms with more than 10 employees with power or more than 20 employees without. It is these firms that are covered in the Annual Survey of Industries and which have been subject to the labor and planning regulations. What is striking about Figure 1 is the fact that manufacturing performance varies so strongly across states and that there is a clear divergence in performance post-1991. This marked heterogeneity in responses to a common liberalization shock *in the same country* is something which we will explore in our theoretical framework. And it gives support to those who believe that globalization is not uniformly beneficial and that institutional and other conditions matter a lot for whether a firm or industry will benefit. Understanding what institutional and policy choices are conducive to a country or region benefiting from liberalization is an open and important question.

Moreover if we dig further we find that productivity levels pre-reform in the same 3-digit industry varied strongly across Indian states. As a result, the same industries in different states were at different distances to the Indian technological frontier. We can exploit this fact to examine whether distance to frontier pre-reform mattered for post-liberalization performance. This has important implications for understanding the impact that liberalization has on incentives for firms to adopt new technology and make investments that increase productivity.

Divergent manufacturing performances across Indian states in the post-91 period is likely to have contributed to growing inequality. We examine this issue in Figure 2 where we graph out the standard deviation of real manufacturing output per worker for each year across the period 1980 to 1997. Whereas differences across states in output were falling in the 1980-1991 period this trend changed direction in this year

and we see growing inequality in productivity across after 1991. Liberalization does indeed seem to have had unequal effects on industrial performance across the 1980-1997 period.

We also exploit the fact that India is a federal democracy which implies that different states have made different institutional and policy choices. Tax and expenditure powers of central and state governments are listed in the Indian Constitution (the Union and State Lists). A third list – the Concurrent List – covers areas where the central and state governments have joint jurisdiction. Industrial relations falls on this list. States therefore have the power to amend central legislation in this area. We use the coding by Besley and Burgess (2003) of all state level amendments to the Industrial Disputes Act of 1947 to capture industrial relations climate in a state. Besley and Burgess (2003) read the text of each state level amendment (121 in all) and coded each one as either being neutral (0), pro-worker (1) or pro-employer (-1).³ In years in which there were multiple amendments, an indicator of the overall direction of change was used. So, for example, if there were four pro-worker amendments in a given state and year, this was coded as plus one rather than plus four. Having obtained the net direction of amendments in any given year, the scores were cumulated over time to give a quantitative picture of the evolving regulatory environment.

Coding the measure this way gives us both cross-state and time series variation.⁴ The measure captures the extent to which can workers appropriate industrial rents. This may affect the incentives for incumbent firms to make innovative investments as a response to entry threats. From Besley and Burgess (2003) we know that the direction of labor regulation is a key determinant of registered manufacturing performance at the state level for period 1958-1992. In this paper we want to exploit this measure to examine whether the pre-reform industrial relations climate in a state affected post-reform performance at the 3-digit industry level. In particular, we want to examine whether the response of innovative investment to trade liberalization is dampened in states with more pro-worker labor market institutions.

The labor regulation measure is displayed in Figure 3. It is clear that the states of India divide into “treatment” and “control” groups. The latter are states that do not experience any amendment activity in a pro-worker or pro-employer direction over the 1958-1997 period. There are six of these: Assam, Bihar, Haryana, Jammu & Kashmir, Punjab and Uttar Pradesh. Among those that have passed amendments, six states are classified as “pro-employer”: Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Rajasthan and Tamil Nadu. Four are classified as “pro-worker”: Gujarat, Maharashtra, Orissa and West Bengal.

Taken together, the stylized facts reviewed in this section confirm that, though

³Summaries of all amendments and their coding is available at <http://econ.lse.ac.uk/staff/rburgess/#wps>.

⁴Using an institutional measure within a country also helps us to abstract from concerns with unobserved heterogeneity and omitted variables which afflict cross-country studies of institutions and growth.

liberalization had an overall positive effect on industrial performance, its effects were highly unequal across Indian states and industries. We now turn to building a theoretical framework which allow us to look at the interactions between liberalization, the technological capability of firms and industries, institutional environment and industrial performance.

3 Theoretical framework

In this section we develop a discrete-time Schumpeterian growth model with product entry. This allows us to capture how an economy-wide liberalization which lowers barriers to entry can affect the investment decisions of firms and thereby their productivity and output. The focus of our analysis is on how initial technological development, which differs across industries, and local institutions (e.g local labor market conditions), which differ across states, mediate this relationship between liberalization and industrial performance. The main prediction of our model is that liberalization, modeled as an exogenous shock on the probability of product entry to capture the Indian liberalization experiment, affects output and productivity growth differently, both, across industries with different initial levels of technology and across states where the allocation of productive surplus between employers and workers varies. Liberalization thus leads to a widening in the productivity and output distributions as the performance of firms and industries closer to pre-reform technological frontier and located in states with pro-employer labor institutions improves whilst the performance of their counterparts far from the frontier and located in pro-worker states declines.

3.1 The environment

Our description of the basic environment builds upon Acemoglu et al (2002), which we adapt to the case of an economy consisting of a set of “states” (or regions) which differ in their factor endowments, distribution of productivities across firms and labor market regulations.

All agents live for one period. In each period t a final good (henceforth the numeraire) is produced in each state by a competitive sector using a continuum one of intermediate inputs, according to the technology:

$$y_{s,t} = \frac{1}{\alpha} \left[\int_0^1 (A_{s,t}(\nu))^{1-\alpha} x_{s,t}(\nu)^\alpha d\nu \right].$$

$x_{s,t}(\nu)$ is the quantity of intermediate input produced in sector ν , state s and date t , $A_{s,t}(\nu)$ is a productivity parameter that measures the quality of the intermediate input ν in producing the final good, and $\alpha \in (0, 1)$. The final good can be used either for consumption, or as an input in the process of production of intermediate goods,

or for investments in innovation. For simplicity, we drop the state index s when this is not a source of confusion.

In each intermediate sector ν only one firm (a monopolist) is active in each period. Thus the variable ν refers both, to an intermediate sector (industry), and to the intermediate firm which is active in that sector. As any other agent in the economy, intermediate producers live for one period only and property rights over intermediate firms are transmitted within dynasties. Intermediate firms use labor and capital (final good) as inputs, according to the following Cobb-Douglas technology:

$$x_t(\nu) = k_t^\beta(\nu)l_t^{1-\beta}(\nu),$$

where $k_t(\nu)$ and $l_t(\nu)$ denote the amounts of labor and capital inputs to produce $x_t(\nu)$ units of intermediate input.

The monopoly power of intermediate producers is limited by the existence of a competitive fringe of firms that can produce one unit of the same intermediate input using χ units of final good, with $\chi < \frac{1}{\alpha}$. Given the potential competition from the fringe, it is optimal for the intermediate good producer to charge the limit price

$$p_t(\nu) = \chi \tag{1}$$

for each unit of the intermediate good ν sold to the final good sector. In equilibrium, the competitive fringe will not be active.⁵

Since the final good sector is competitive, the equilibrium price of each intermediate input, ν , must equal its marginal productivity in the final good sector, namely:

$$p_t(\nu) = (A_t(\nu)/x_t(\nu))^{1-\alpha}. \tag{2}$$

Equating (2) to (1) implies that, in equilibrium,

$$x_t(\nu) = A_t(\nu)\chi^{-\frac{1}{1-\alpha}}.$$

We assume that each state authority imposes a minimum wage (w_t), identical across firms. This assumption is meant to capture not so much wage rigidity but rather, and in a reduced form way, the effect of labor market regulations which affect the relative bargaining power of employers and workers, and therefore workers' ability to extract the surplus generated by firms.⁶

⁵The existence of a competitive fringe that forces monopolist to charge a limit price is introduced for tractability. If firms could charge the unconstrained monopoly price, the analysis would be conceptually similar, but more involved.

⁶An alternative approach would have been to explicitly model the bargaining process between firms and workers, using a framework a la Stole-Zwiebel (1995) to formalize the bargaining game between each firm and its multiple workers, but extending the analysis to an economy with heterogeneous firms. Characterizing the general equilibrium outcome (with unemployment) in such an environment, introduces a number of complications which are largely orthogonal to the effects we are pointing out in this paper.

The minimum wage is assumed to be binding, i.e., to be higher than the market-clearing wage. This implies that, in all states, there is excess supply of labor at the going wage. Workers who cannot find employment in the manufacturing sector are either unemployed or employed in a residual informal sector.

In equilibrium, profits in each intermediate firm, ν , are then simply equal to:

$$\begin{aligned} \pi_t(\nu) &= \max_{k(\nu), l(\nu)} \{ \chi k_t(\nu)^\beta l_t(\nu)^{1-\beta} - k_t(\nu) - w_t l_t(\nu) \} \\ \text{s.t.} \quad & k_t(\nu)^\beta l_t(\nu)^{1-\beta} \geq x_t(\nu) = A_t(\nu) \chi^{-\frac{1}{1-\alpha}}. \end{aligned}$$

Straightforward maximization yields:

$$l_t(\nu) = A_t(\nu) \chi^{-\frac{1}{1-\alpha}} \left(\frac{\beta}{1-\beta} w_t \right)^{-\beta}; \quad (3)$$

$$k_t(\nu) = A_t(\nu) \chi^{-\frac{1}{1-\alpha}} \left(\frac{\beta}{1-\beta} w_t \right)^{1-\beta}, \quad (4)$$

and, therefore:

$$\pi_t(\nu) = A_t(\nu) \delta(w_t), \quad (5)$$

where

$$\delta(w_t) \equiv \chi^{-\frac{1}{1-\alpha}} \left(\chi - w_t^{1-\beta} \beta^{-\beta} (1-\beta)^{-(1-\beta)} \right)$$

and, hence, profits are decreasing functions of the state-specific wage, w_t , and of the extent of potential competition (i.e., the inverse of χ).

Substituting for $x_t(\nu)$ in the production function for final output, we get:

$$y_t = \frac{1}{\alpha} \chi^{-\frac{\alpha}{1-\alpha}} A_t,$$

where

$$A_t = \int_0^1 A_t(\nu) d\nu$$

is the average productivity in the state.

Finally, higher wages imply that firms will choose more capital-intensive techniques. More formally, let $\kappa_t(\nu) = k_t(\nu)/l_t(\nu)$ denote the capital-intensity of the production technique. Then, in equilibrium;

$$\kappa_t(\nu) = \frac{\beta}{1-\beta} w_t = \kappa(w_t). \quad (6)$$

3.2 Technological states, innovation, and entry

3.2.1 Advanced and backward firms

In every period, and within each state, intermediate firms differ in terms of their current distance to the “technological frontier”. We denote the productivity of the frontier technology at the end of period t by \bar{A}_t and assume that this frontier grows at the exogenous rate g ⁷. More formally:

$$\bar{A}_t = \bar{A}_{t-1}(1 + g).$$

At the beginning of period t (or, identically, at the end of period $t-1$), the leading firm in the production of a particular intermediate input can be in two states:

- “advanced” firms have a productivity level $A_{t-1}(\nu) = \bar{A}_{t-1}$, namely, are at the current frontier.
- “backward” firms have a productivity level $A_{t-1}(\nu) = \bar{A}_{t-2}$, namely, are one step behind the frontier.

Before deciding about their production plans, firms can undertake innovative investments to increase their productivity. Innovative investments have a stochastic return. In case of success, the incumbent firm can adopt the next most productive technology, that is can increase its productivity by a factor $1 + g$ and thus keep the pace with the advancement of the technological frontier. The cost of technology adoption is assumed to be quadratic in the probability of successful adoption and linear in the current level of technology:

$$c_t(\nu) = \frac{1}{2}z_t^2 A_{t-1}(\nu),$$

where z is the probability of success of the innovative investment. If the investment is not successful (probability $1 - z$), instead, the firm produces with a productivity level equal to its initial state.

We make the following assumptions about firms’ dynamics.⁸ If an advanced firm is successful at time t , it starts as an advanced firm at time $t + 1$. All other firms start as backward firms (note that this implies that firms with a realized productivity equal to A_{t-2} at time t automatically upgrade their initial productivity due to an implicit spillover effect). However, with an exogenous probability h , a backward firm at the end of period t is replaced by a new firm starting as advanced at time

⁷In the empirical section the frontier technology refers to the Indian frontier, not the world frontier. Our choice there is mainly based on the fact that it is harder to find world (i.e essentially US) equivalents for a number of goods manufactured in India.

⁸These assumptions are made for the sake of notational simplicity but they do not affect our analysis and results in any major way.

$t + 1$. Let a_t denote the proportion of “advanced” firms at t , and $z_{A,t}$ denote the innovation intensity of an advanced firm at time t . Then the productivity distribution is characterized by the following dynamic equation:

$$a_{t+1} = z_{A,t}a_t + h(1 - z_{A,t}a_t) = (1 - h)z_{A,t}a_t + h,$$

so that the steady-state proportion of advanced firms is equal to

$$a^* = \frac{h}{1 - z_A(1 - h)}.$$

3.2.2 Entry

Intermediate firms are subject to competition from foreign producers. In particular, we assume that, in every period, a foreign producer can operate a *product* entry in the local market for a particular intermediate good. Product entry means that the foreign producer succeeds in selling his product on the local market in the current period, but that she does not permanently replace local producers and therefore she does not directly affect the distribution of productivities in the next periods. This assumption allows us to formalize the notion of “threat of entry” in the simplest way.⁹

Foreign firms observe the outcome of the innovative investment of the local firm, and face the following decision. They can either stay out of the market, or pay a small fixed cost, ζ , and be granted permission to sell in the local market with probability μ .¹⁰ Foreign entrants at date t are assumed to operate with the end-of-period frontier productivity, \bar{A}_t .

If the foreign firm manages to enter and competes with a local firm which has a lower productivity, it steals all the market. If it competes with a local firm which has the same productivity, however, Bertrand competition drives the profits of both the local and the foreign firm to zero. We assume the parameters to be such that the foreign firm will always find it profitable to try to enter if the local firm has a productivity level lower than the frontier (more formally, we require ζ to be sufficiently

⁹A first interpretation of the product entry assumption is that entry threat is primarily affected by the degree of openness to foreign trade; a second interpretation is that product differentiation and a better knowledge of local market conditions, allow local producers to remain in the market after foreign entry occurs, so that one can analyze how an increase in entry threat affects the dynamics of productivity within a balanced panel of domestic firms. One can show that the main predictions of our theory survive if we replace the product entry assumption can be replaced by a straight entry assumption, although at the cost of complicating the model (see Aghion et al (2003)).

¹⁰We can interpret μ as capturing the easiness for foreign firms and products to enter the Indian market. A higher μ , therefore reflects any reduction in tariffs or regulations which facilitates foreign entry. In the appendix we develop an extension of this model where the probability of entry is endogeneized, and its equilibrium values for the different types of sectors, depend upon an additional entry cost parameter. While the equilibrium probability of entry will typically differ across the different types of sectors, a reduction in entry cost will still have the same qualitative effects on innovation and productivity growth across industries and states, as an increase in μ .

small). However, the foreign firm will never enter in period t if the local firm has achieved the frontier productivity level \bar{A}_t .¹¹ Therefore, the end-of-period probability of entry in the market for input ν will be equal to:

- zero, if (i) the local firm ν was initially “advanced” and (ii) it has undertaken a successful innovative investment;
- μ , otherwise.

3.2.3 Equilibrium innovation investments

We now consider the decisions of local producers, which initially lie at the current frontier (“advanced” producers) or one step behind the current frontier (“backward” producers). Once again, in this model, each intermediate producer corresponds to a different intermediate sector or industry, so the differences between advanced and backward producers are meant to capture differences in the impact of entry across industries at different initial levels of technological development.

Recall that all agents live for one period only, therefore incumbent producers born at date t maximize the expected profits accruing at the end of the same period t . This is a useful simplification that avoids to solve more complicated dynamic problems.

Backward firms choose their investment so as to maximize expected profits, as given by:

$$\max_z \left\{ \delta \left[z(1-\mu)\bar{A}_{t-1} + (1-z)(1-\mu)\bar{A}_{t-2} \right] - \frac{1}{2}z^2\bar{A}_{t-2} \right\},$$

whose solution yields:

$$z = \delta(1-\mu)g = z_B. \tag{7}$$

Recall that backward firms can only make profits if there is no entry (probability $1-\mu$). The productivity is \bar{A}_{t-1} if the investment is successful (probability z) and \bar{A}_{t-2} if the investment is not successful (probability $1-z$).¹²

Advanced firms choose their innovation investment in order to solve the following program:

$$\max_z \left\{ \delta \left[z\bar{A}_t + (1-z)(1-\mu)\bar{A}_{t-1} \right] - \frac{1}{2}z^2\bar{A}_{t-1} \right\}$$

¹¹The more general case where an incumbent at technological par with a potential entrant, retains the market with probability $p \in (0,1)$, is analyzed in Aghion et al (2003), who provide and then test predictions on how the ability to fight entry, as measured by p , interacts with the entry threat measured by μ .

¹²One could generalize the model to allow for the possibility that through aggressive innovative investments backward firms can catch-up with the frontier. This would create scope for defensive innovation from backward firms when the probability of entry increases. As long as the probability that backward firms can make large jumps is sufficiently low, this extension would not change qualitatively the comparative statics of the model.

whose solution yields:

$$z = \delta (g + \mu) = z_A. \quad (8)$$

In this case, incumbent firms can prevent entry by successfully adopting the new leading-edge technology, which in turn occurs with probability z . In this case, the local firm ends up with productivity level \bar{A}_t . The firm also retains the market if the R&D investment is not successful, but there is no entry either. This event occurs with probability $(1 - \mu)(1 - z)$. In this case the firm's productivity at the end of period t is \bar{A}_{t-1} .

3.2.4 Comparative statics

We interpret an increase in the threat of product entry, μ , as a liberalization reform. Straightforward differentiation of equilibrium innovation intensities with respect to μ , yields:

$$\frac{\partial z_A}{\partial \mu} = \delta > 0 \quad (9)$$

$$\frac{\partial z_B}{\partial \mu} = -\delta g < 0. \quad (10)$$

In other words, *increasing the threat of product entry (e.g., through trade liberalization) encourages innovation in advanced firms and discourages it in backward firms.* The intuition for these comparative statics is immediate. The higher the threat of entry, the more instrumental innovations will be in helping incumbent firms already close to the technological frontier to retain the local market. However, firms that are already far behind the frontier have no chance to win over a potential entrant. Thus, in that case, a higher threat of entry will only lower the expected net gain from innovation, thereby reducing ex ante incentives to invest in innovation.

Next, consider the effects of changes in labor market regulations on innovative investments. We define regulations in state s to be more “pro-worker” if the minimum wage, w , is higher in that state. The obvious fact that the profit coefficient $\delta(w) = \chi^{-\frac{1}{1-\alpha}}(\chi - w(\nu)^{1-\beta}\Omega)$ is decreasing in w , immediately implies:

$$\begin{aligned} \frac{\partial z_A}{\partial w} &= \delta'(w)(g + \mu) < 0 \\ \frac{\partial z_B}{\partial w} &= \delta'(w)(1 - \mu)g < 0. \end{aligned}$$

Hence, *pro-worker labor market regulations discourage innovation in all firms, but they do so to a larger extent in advanced firms.*

Finally, we consider the cross effects of entry threat and labor market regulations on innovation incentives. We immediately obtain:

$$\frac{\partial^2 z_A}{\partial w \delta \mu} = \delta'(w) < 0$$

$$\frac{\partial^2 z_B}{\partial w \delta \mu} = -\delta'(w)g > 0$$

An increase in labor market regulation reduces the positive impact of entry on innovative investments in advanced firms. But it also reduces the negative impact of entry on innovative investments in backward firms.

In plain words, the response of innovative investments to trade liberalization will be dampened in states with more pro-worker labor market institutions. In such states, advanced firms will increase less their innovative investments and backward firms will decrease less their innovative investments compared with states where labor market institutions are more favorable to employers.

Another interesting comparative statics concerns profits. It is straightforward to see that an entry-enhancing reform, i.e an increase in μ , decreases the expected profit (gross of the cost of innovative investments) of backward firms, for two reasons: first, it discourages investments in productivity improvements, and second, it increases their probability of “exit”. The effect on the expected profit of advanced firms is ambiguous, although it is positive if δ is sufficiently large. However if we look instead at the effect of liberalization on the average ex-post profit (again, gross of the cost of innovative investments) of surviving firms, i.e., those which remain active in equilibrium, this has the same sign as the comparative statics on innovative investment. Namely, liberalization increases profits for surviving advanced firms and decreases profits for surviving backward firms.

Finally, the model yields the prediction that capital-labor ratios should increase more after reform in sectors closer to the frontier, and that they should increase with workers’ bargaining power, i.e with w , in all sectors.

3.2.5 Predictions for state-industries

We have so far assumed, for simplicity, that there is only one active firm per industry in the whole economy. However, the empirical analysis will be carried out mostly at the level of state-industries which contain many firms. But in fact the stylized model presented above can be reinterpreted as describing a single industry rather than the global economy. Each state-industry should then be viewed as an “island” populated by a set of competitive final producers and a set of non-competitive differentiated intermediate producers. The products of different industries are perfect substitutes in consumption, and the price of all final goods is set equal to unity. Thus, the equilibrium described in the above subsections, as well as its comparative statics, can be regarded as the equilibrium of a state-industry. The average productivity of firms in a particular state-industry (s, i) is $A_{i,s,t} = \int_0^1 A_{i,s,t}(\nu) d\nu$.

Steady-state productivity differences across state-industries are assumed to be driven both, by idiosyncratic state-industry effects affecting the exogenous probability of upgrading, h , and by differences in the state-specific parameter w (labor market regulation). More formally,

$$a_{i,s}^* = \frac{h_{i,s}}{1 - z_{A,i,s} (1 - h_{i,s})},$$

where

$$h_{i,s} = h + \varepsilon_{i,s},$$

and

$$z_{A,i,s} = z_{A,s} = \delta(w_s) (g + \mu).$$

This representation captures in a parsimonious way steady-state productivity differences across state-industries: more advanced state-industries (conditional on labor market regulations) are those with high $h_{i,s}$'s.

Now suppose that, initially, all state-industries are in a steady-state equilibrium. Then a liberalization reform occurs, which increases the entry threat in all state-industries. Then, our analysis in the previous subsections implies that investments and TFP will be pushed up in more advanced state-industries, both in absolute terms and relative to backward industries. Moreover, pro-worker labor market institutions will discourage innovative investments, especially in more advanced state-industries.

The model also provides predictions on the steady-state effect of such reform on industry productivity, rents and output. In fact, from Section 3.1.1 we know that in equilibrium at any date t in each state-industry (s, i) , both monopoly rents and output are proportional to productivity, namely:

$$\pi_{i,s,t} = A_{i,s,t} \delta(w_{s,t})$$

and

$$y_{i,s,t} = \frac{1}{\alpha} \chi^{-\frac{\alpha}{1-\alpha}} A_{i,s,t}.$$

Next, we know that productivity moves up one step, i.e by a factor $(1+g)$, with probability z_A if the sector is advanced and with probability h if the sector is backward. Furthermore, we have just seen that the equilibrium innovation rate z_A is increasing in μ (the escape-entry effect), whereas h is a constant. This implies that following an increase in μ , the output and rents of advanced sectors will increase more often those of backward sectors. But so will the proportion of advanced sectors. Indeed, let the pre-reform proportions of advanced firms in each state-industry, $a_{i,s}$, be in steady-state before liberalization. Then,

$$\frac{\partial^2 a_{i,s}^*}{\partial \mu \partial h_{i,s}} = \frac{((1 - h_{i,s}) (1 - \delta (g + \mu)) - h_{i,s}) \delta}{(1 - \delta (g + \mu) (1 - h_{i,s}))^3},$$

which in turn is always negative if $h_{i,s} < 1/2$, in other words if backwardness is persistent, a natural assumption to make. Thus liberalization has an unequalizing long-run effect, as it increases productivity more in “advanced” industries than in “backward” industries and it also increases the overall market share of advanced industries.

Moreover

$$\frac{\partial^2 a_{i,s}^*}{\partial \mu \partial w} = \frac{(1 + \delta (g + \mu) (1 - h_{i,s})) (1 - h_{i,s}) h_{i,s}}{(1 - \delta (g + \mu) (1 - h_{i,s}))^3} \delta' (w) < 0,$$

in other words pro-workers regulations decrease the positive effect of liberalization on long-run productivity.

The latter comparative static results show how liberalization changes the equilibrium distributions of productivities across different state-industries, each of which is characterized by given state-level labor institutions w_s paired with a state-industry specific upgrading probability $h_{i,s}$. This in turn relates our analysis to that of Melitz (2003), which also analyzes how liberalization affects the distribution of productivities across firms in the local economy. However, as already explained in the introduction, in Melitz’ model liberalization opens up export opportunities which local firms can explore if they make the required investment, whereas in our model liberalization threatens the monopoly power of incumbent firms but these can escape that threat through innovating. Clearly, our model can be extended to allow advanced firms to sell in foreign markets. Suppose, for instance, that an advanced firm can sell abroad with probability μ_F and that the reform increases this probability. This extended model would deliver the same basic predictions as our benchmark model: advanced firms would find innovative investments more attractive after reform, while the incentive of backward firms would not change.

3.3 Main theoretical predictions

Let us conclude this section by summarizing our main findings:

1. *Liberalization (as measured by an increase in the threat of entry) encourages innovation in industries that are close to the frontier and discourages innovation in industries that are far from it. Productivity, investment and output are higher in industries and firms that are initially more advanced.*
2. *Equilibrium rents are higher in industries which are closer to the frontier. Moreover, they react more positively to liberalization.*
3. *Liberalization increases output more in an advanced industry than in a backward industry, and it also increases the market share of advanced industries.*
4. *Pro-worker labor market regulations discourage innovation and growth in all industries, and the negative effect increases with liberalization.*

4 Empirical Analysis

To test the main predictions of our theory we run panel regressions of the form:

$$y_{ist} = \alpha_{is} + \beta_t + \gamma_i t + \delta(x_{is})(d_t) + \eta r_{it} + \theta(r_{it})(d_t) + u_{ist} \quad (11)$$

where y_{ist} is a 3-digit state-industry manufacturing performance outcome expressed in logs. Specifically we look at productivity, investment, profits and output. x_{is} is pre-reform distance to the Indian technological frontier defined as state-industry labor productivity in 1990 divided by the highest state-industry labor productivity in 1990 within the 3-digit industry. This measure equals 1 for the frontier and is less than 1 for non-frontier state-industries. A higher x_{is} therefore corresponds to being closer to the technological frontier. The source of the data is the Annual Survey of Industries which allows us to construct a representative and consistent panel on registered manufacturing performance at the 3-digit industry level across the 1980-1997 period. This is the most disaggregated level at which we can gather data on industrial performance in India for this period. We capture the liberalization reform with a dummy d_t which takes a value of 0 before 1991 and a value of 1 after. The coefficients on the interaction of pre-reform distance and the reform dummy for regressions where the outcome measures are productivity, investment, profits and output provides us with a direct test of the first three main theoretical predictions.

To capture state level institutions we use a labor regulation measure r_{it} which codes amendments to the central 1947 Industrial Disputes Act as pro-worker, pro-employer or neutral and cumulates these over time to give a state level picture of state level changes in the industrial relations climate (see Figure 3). These labor regulations are specific to firms in the organized or registered manufacturing sector which are the same firms that are included in the Annual Survey of Industries. We are thus linking a sector specific labor institution to economic performance measures for the same sector. The source of this data is Besley and Burgess (2003). The coefficient on this measure and on the interaction with the reform dummy provide us with a direct test of our fourth main theoretical prediction.

We include 3-digit state-industry fixed effects (α_{is}) in the regressions. This implies that we are looking at the impact of pre-reform technological capability and labor institutions on changes in industrial performance within 3-digit industries. Inclusion of these fixed effects allows for unobserved heterogeneity in the determinants of economic performance that is specific to individual state-industry pairs and that may be correlated with the right-hand side variables. The year fixed effects (β_t) captures state invariant but year specific factors which might influence economic performance such as macroeconomic and climatic shocks. We also include industry time trends $\gamma_i t$ where γ_i is a dummy variable which is equal to one for 3-digit industry i and t is a time trend. The inclusion of 3-digit industry time trends in the regressions helps to control for the possibility that industries experience different rates of technological change. A standard concern with difference in difference estimation using panel data

is serial correlation. We therefore cluster our standard errors by state. This procedure gives us an estimator of the variance covariance matrix which is consistent in the presence of any correlation pattern within states over time (Bertrand, Duflo and Mullainathan, 2003).

4.1 Basic Results

Table 3 looks at measures of productivity and their link to pre-reform technological capability and institutional conditions. As our main interest is in innovation and technological change we focus on total factor productivity.¹³ Column (1) shows that 3-digit state-industries closer to the most productive state-industry in India pre-reform experienced faster total factor productivity growth following liberalization in 1991. This is a key result as it signals that pre-reform technological capability has a bearing on the productivity of industries post liberalization. A common liberalization reform is having heterogenous impacts on industries within the same 3-digit industrial sector. In column (2) we include an interaction an interaction between state dummies and the reform dummy. This helps to control for a host of unobserved state characteristics whose effects on industrial performance may vary across the pre and post-reform periods. Being closer to the frontier pre-reform continues to imply larger increases in productivity post-reform.

In column (3) we introduce our time varying measure of the direction of labor market regulations in Indian state. As predicted by the theory we see that the rate of technological progress is slower in states moving a pro-worker direction. Greater rent extraction by workers blunts incentives to invest and innovate. This is evidence that institutional environment in which firms are embedded affected productivity growth across the 1980-1997 period. What is more striking is the evidence shown in column (4) that liberalization magnifies the negative impact of pro-worker regulations on productivity. This is line with the theory which shows how greater rent extraction by workers blunts the incentives of firms to make innovative investments in order to fight entry. State specific regulatory policies therefore have a central bearing on whether or not industries in different parts of India benefit from liberalization.

The baseline regressions in Table 1 are run on all 3-digit industries which remain in the panel for at least ten years. In column (5) we restrict our sample to only those industries which exist in all eighteen years of our data. This is to guard against the worry that our results are being driven by entry and exit of industries over the period. Our key results remain robust to this procedure. These balanced panel results emphasize that pre-reform labor institutions and technological capability affect how a given 3-digit industry performs post-liberalization. In our data we can break out the labor force into production and non-production workers. In column (6) we control for variation in labor force quality in our measure of total factor productivity by

¹³The total factor productivity measure we construct allows for variations in factor intensity across 3-digit industries (see Data Appendix).

using information on the wages and employment of production and non-production workers. Adjusting for skills in this way does not affect our results in any significant way. In column (7) we take an alternative simpler measure of productivity, output per worker, and again find a similar pattern of results.

In our theory productivity increases in firms closer to the frontier because they make innovative investments as a means of countering the threat of entry. Table 2 looks at this mechanism by examining investment behavior within 3-digit industries. Investment here refers to gross fixed capital formation in registered manufacturing a large component of which is investment in plant and machinery. Column (1) confirms that industries closer to the frontier pre-reform exhibit an increase in investment post-reform. This result persists when we include state- reform dummies (column (2)), when we include labor regulation effects (columns (3) and (4)), when only include industries that exist in all eighteen years in the sample (column (5)) and when we use fixed capital our left hand side variable (column (6)) . This is a central result as it indicates that firms make greater investments in plant, machinery and other forms of fixed capital post-reform when they are closer to the frontier pre-reform. These regressions thus help to establish a link between liberalization, which leads to a reduction in barriers to entry, and the technology adoption choices of firms. Importantly we find evidence that incentives to engage in innovative investments are greater for firms in industries closer to the Indian technological frontier. Through this mechanism liberalization has an unequalizing long-run effect where it increases productivity more in advanced industries than in backward industries.

We find less robust evidence that the direction of labor regulation reduces investment across the 1980-1997 period. There is evidence, in column (4), that industries located in states with more pro-worker industrial relations climates pre-reform experienced less investment activity post liberalization. This is direct evidence that the type of institutions extant in a state affect the investment response of firms to liberalization. Pro-worker regulations decrease the positive effect of liberalization on investment. We also find the same effect when we look at fixed capital as a left hand side variable (column (6)). Domestic reforms which improve the institutional environment in which manufacturing firms function stands out as one means of improving the extent to which industries in a given region benefit from liberalization.

In column (7) we look at capital labor ratios in 3-digit industries. In the first row we see that this ratio increases in industries closer to the frontier following liberalization as firms increase their investments in fixed capital as a means of escaping the threat of entry. Becoming more capital intensive is thus one response to liberalization. Even more interesting is the fact having more pro-worker labor institutions in the pre-reform period leads firms to become more capital intensive post-liberalization. Where rent extraction by workers is greater firms respond to the liberalization threat by investing more heavily in capital. This result makes us more confident that our labor regulation measure is capturing the bargaining power of workers versus employers.

As a result of the innovative investments they make, we would expect profits

to be greater post liberalization in firms in advanced industries relative to those in backward industries. Column (1) of Table 3 confirms that this is the case. It is the lure of these greater profits that leads firms to invest in new procedures and technologies in advanced industries whereas exactly the reverse is true for firms in backward industries which stand little chance of competing in the post-liberalization environment. In column (2) we see that this result remains when we include state-reform dummies which capture unobserved state characteristics which make affect profit differently pre- and post-reform. Column (3) shows that states which moved in a pro-worker direction in the 1980-1992 exhibited lower industry profits. This makes sense as returns on investments will be lower in industries located in these states. Moreover as columns (4) and (5) indicate the blunting effect of having a pro-worker institutional environment is greater post-liberalization. Liberalization thus both creates the lure of greater profits but also magnifies the negative impact of having anti-business institutional environments.

A natural question to ask is how the size of different manufacturing sectors was affected by liberalization. This is often what people have in mind when considering the welfare implications of liberalization. In column (1) we confirm what we would expect from the theory. Advanced industries experience greater output expansions following liberalization than do backward industries. Inclusion of state-reform dummies does not affect this result (column (2)). Column (3) shows that moving in a pro-worker direction is associated with lower output in registered manufacturing industries. This result thus lines up with the state-level findings of Besley and Burgess (2003) who show that states which amended the Industrial Disputes Act in a pro-worker direction experienced lowered output, employment, investment and productivity in registered or formal manufacturing across the 1958-1992 period. They also find that they find that regulating in a pro-worker direction was associated with increases in urban poverty. This points to potential negative welfare implications of having institutional environments which are not conducive to firms making innovative investments. And as column (4) indicates the negative impacts of having pro-labor institutions pre-reform were amplified post-liberalization. Our key results remain intact when we restrict our sample to industries that exist in all eighteen years of our data period (column (5)). These results indicate that the technological capability of industries and the institutional environment in which they are positioned have fundamental consequences for whether they expand or contract following a liberalization shock.

4.2 Robustness

Using a 3-digit state-industry panel for the period 1980-1997 we have managed to validate the main predictions of our theory. Our 3-digit results are robust to a variety of specifications and robustness checks. A further remaining concern is that, so far, we have used a somewhat encompassing measure of investment to capture innovation.

Here we instead focus a much more restrictive measure – patents taken out by Indian firms with the US Patent Office across the 1980-1997 period. This is a measure of research and development activity undertaken within Indian manufacturing firms. Using the NBER Patent Citation Data File we identified patents taken out by Indian manufacturing firms. This allowed us to trace patenting activity across the pre- and post-liberalization periods. Figure 4 exhibits this information at the state level across the 1980-1997 period. The differences across states are striking with some states like Andhra Pradesh, Karnataka and Maharashtra experiencing rapid increases in patenting post-liberalization whilst others remain stagnant. The suggestion from Figure 4 is that liberalization acted as spur for innovative activity within Indian manufacturing industries.

Our next step was to ask whether increases in patenting happened more in industries closer to the Indian technological frontier as would be predicted by our theory. We look at two measures. First the number of patents granted by the US Patent Office in any given year between 1980 and 1997 and second the cumulative number of patents granted since 1980. We thus have a flow and a stock measure of patenting activity. We then matched the description of each patent with the Indian 2-digit classification code for manufacturing industries. This allowed us to relate patenting activity with pre-reform distance to frontier for 2-digit state-industries.¹⁴ Table 5 asks whether patenting activity in 2-digit state-industries closer to the Indian frontier increased post-liberalization. The regressions include 2-digit state-state industry fixed effects and year dummies to control for fixed characteristics of state-industries and common time trends. In column (1), for our cumulative patents measure, we see that state-industries closer to the frontier did experience a larger increase in patenting. The same is true for our flow measure in column (2). As we see in columns (3) and (4) these results hold up when we include 2-digit industry time trends in the regressions. This is an important finding as it indicates that liberalization acted as a spur for innovative activity in industries closer to the frontier pre-reform. Though patenting activity does not underpin all of the productivity increases experienced by advanced state-industries post-liberalization these results do confirm that technological innovation was part of the story. We therefore have evidence, both from a broad investment measure and a restrictive patenting measure, that liberalization incentivised advanced firms to engage in innovative activities as a means of escaping the threat of entry. This is directly in line with our theory and helps to draw a link between liberalization, the technological choices of firms and economic performance.

Another remaining concern has to do with composition and reallocation. We have so far been running regressions at the 3-digit state-industry level. The fact that we our main results go through in regressions that include state-industry fixed effects and which only include state-industries which exist in all eighteen years of our data

¹⁴This is defined in an analogous way to the 3-digit distance measure. We look at the ratio of labor productivity in a 2-digit state-industry in 1990 relative to that in the most productive state-industry in that year.

set imply that we are not worried about compositional effects at the 3-digit level and above. However, the productivity and other effects we observe could be driven in part by labor and firms crowding out of less productive and into more productive 3-digit sectors. That is though productivity in an individual firm may not have changed labor and firms may have crowded into sectors closer to the frontier (and exited sectors far from frontier) leading to an overall increase in productivity as measured at the 3-digit industry level. Therefore below the 3-digit level composition and reallocation effects remain a concern.

To deal with this concern we shift our analysis to the firm level. We cannot trace individual firms into the pre-reform period but we have managed to assemble a two wave firm panel between the Annual Surveys of Industries in 1994 and 1997. This allows us to identify 9792 factories which exist in both years. By looking at the same factories in 1994 and 1997 we can be sure that the effects we observe are not driven entry and exit of factories. This allows us to focus on the relative contributions of labor reallocation and within firm productivity improvements in explaining the overall change in productivity. Between 1994 and 1997 labor productivity in this panel of firms increased by 31.82% (column (2)). In Table 6 we decompose this productivity change into average within and between components. In columns (3) and (4) we observe that the within contribution accounts for about 80% of the increase and the between component for about 20%. In other words though labor reallocation from low to high productivity factories is accounting for a small amount of the increase in overall productivity the dominant effect is coming via within factory productivity improvements. This accords well with our theory and indicates that is it productivity increases within incumbent firms that account for the bulk of the productivity improvements witnessed after liberalization.

In columns (5) and (6) we carry out an analogous decomposition within state-3-digit industries (which corresponds to the level at which our main regressions are run). The factory level data are aggregated to the level of the state-3-digit industry, and the decomposition is undertaken for each state-3-digit industry. We now find that the within contribution is 90% and the between contribution 10%. At this level of aggregation therefore reallocation of labor from backward to advanced firms only accounts for a small part of the overall increase in productivity. The dominant route is via productivity improvements within state-3-digit industries which by construction consist of the same set of firms in 1994 and 1997.

Figure 5 makes a similar point graphically. Here for the set of factories which exist in both 1994 and 1997 we estimate the change in factory employment shares between 1994 and 1997. We then map this measure with a pre-reform distance to frontier measure for the state-industry to which the factory belongs. The distance measure is constructed so that 0 corresponds to factories from state-industries that were on the Indian technological frontier in 1990. We then graph the 1994-1997 change in factory employment share against this distance measure. If labor reallocation from less to more productive factories was an important part of our story we would expect

factories closer to the frontier to be absorbing labor and factories far from frontier to be losing labor. In Figure 5 we would expect a downward sloping relationship. Instead we find a relationship which is essentially flat. There is no indication that labor absorption is more pronounced for factories which belong to state-industry sectors which were closer to the frontier in 1990.

5 Conclusion

The question of how liberalization affects innovation and growth is real and important one. Whether industries and regions within a country benefit or are harmed by the increased entry threat will have large consequences for both poverty and inequality. Given the stakes it is not surprising that there such is an intense debate over this issue. This paper contributes to this literature by allowing us to think about why and how a common liberalization shock may have unequal effects on different industries and regions within a single country. We began by developing a simple endogenous growth model to discuss the effects of increased product entry on growth and inequality. We then used this theory to guide our analysis of how growth and innovation in industries and states in India were affected by the massive 1991 liberalization. To this end we constructed a 3-digit industry panel data set for the sixteen main states of India over the period 1980-1997. Our key findings from this analysis match up with the key predictions from the model: (i) liberalization fosters innovation, profits and growth, in industries that are initially close to the technological frontier, while it reduces innovation, profits and growth in industries which are initially far below the frontier; (ii) pro-worker labor regulations discourage innovation and growth in all industries and this negative effect increases with liberalization. Our overall finding therefore is that the 1991 liberalization in India had strong inequalizing effects, by fostering productivity growth and profits in 3-digit industries that were initially closer to the Indian productivity frontier and in states with more flexible labor market institutions. These findings emphasize that the initial level of technology and institutional context mattered for whether and to what extent industries and states in India benefited from liberalization.

We believe that our findings bear interesting policy implications on how to conduct trade liberalization reforms. First, the institutional environment matters in the extent to which liberalization will be truly growth-enhancing. For instance, rigidities in the labor market may limit the positive impact of trade liberalization. Second, liberalization may have averse effects on industries and regions that are initially less developed. This may call for complementary measures to offset the negative distributional consequences of reforms, e.g., investment in infrastructure and support for knowledge acquisition in backward areas.

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A Theory Appendix: Endogeneizing entry

We shall denote by p_A and p_B the probabilities of entry in backward and advanced sectors respectively. Suppose that to get an entry opportunity entrants at time t need to pay an entry cost

$$E_t = c\bar{A}_t,$$

where c is random and uniformly distributed between 0 and C .

1. Since an entrant in a backward sector is never challenged by the incumbent in that sector, the probability of entry in a backward sector is simply equal to the probability that the entrant's profit $\delta\bar{A}_t$ be greater than the entry cost E_t , namely:

$$\begin{aligned} p_B &= pr(\delta\bar{A}_t > E_t) \\ &= \frac{\delta}{C}. \end{aligned} \tag{12}$$

2. The expected profit of an entrant in an advanced sector is $\delta\bar{A}_t(1 - z_A)$, where z_A denotes the probability that the incumbent firm in that sector innovates. In Section 3.2.3 we showed that this innovation probability itself depended upon the probability of entry p_1 , with

$$z_A = \delta(p_A + g).$$

Thus

$$\delta\bar{A}_t(1 - z_A) = \delta\bar{A}_t(1 - \delta(p_A + g)),$$

so that the probability p_A must satisfy the fixed point equation:

$$\begin{aligned} p_A &= pr(\delta\bar{A}_t(1 - z_A) > E_t) \\ &= \frac{\delta - \delta^2g - \delta^2p_A}{C}, \end{aligned}$$

or equivalently

$$p_A = \frac{\delta - \delta^2g}{C + \delta^2}. \tag{13}$$

We are interested by the effects on innovation incentives and productivity growth of an increased *entry threat*, which here is captured by any change in variable(s) that leads to higher values of p_A and p_B . A natural candidate in this respect is a reduction in the entry cost parameter C .

B Data Appendix

B.1 Data Sources and Definitions

The main source for the state-3-digit industries data is the Indian *Annual Survey of Industries* during 1980-97. This reports information on production activity in registered manufacturing at the level of 3-digit industries for the 16 Indian states listed in Table A1. A factory is part of registered manufacturing under sections 2m(i) and 2m(ii) of the Factory Act 1948 if it employs 10 or more workers with power or 20 or more workers without power.

The variables used are defined as follows:

Gross output: the ex-factory value of products and by-products manufactured during the accounting year. Also includes the receipt for non-industrial services rendered to others, the receipt for work done for others on materials supplied by them, value of electricity sold and net balance of goods sold in the same condition as purchased.

Employment: total employees, including workers as defined below; persons receiving wages and holding supervisory or managerial positions engaged in administrative office; store keeping section and welfare section; sales department; those engaged in the purchase of raw materials etc; those engaged in the production of fixed assets for the factory; watch and ward staff.

Profits: value-added minus rent paid, minus interest paid, minus labor compensation, minus supplements to labor compensation (i.e. contribution to provident and other funds plus workmen and staff welfare expenses).

Fixed Capital: represents the depreciated value of fixed assets owned by the factory as on the closing day of the accounting year. Fixed assets are those which have a normal productive life of more than one year. Fixed capital covers all types of assets, new or used or own constructed, deployed for production, transportation, living or recreational facilities, hospitals, schools, etc for factory personnel. It includes the fixed assets of the head office allocable to the factory and also the full value of assets taken on hire-purchase basis (whether fully paid or not) excluding interest element. It excludes intangible assets and assets solely used for post manufacturing activities such as sale, storage, distribution etc.

Investment: gross fixed capital formation, defined as the excess of fixed capital at the end of the accounting year over that at the beginning of the accounting year, plus depreciation.

Labor Productivity: gross output divided by employment.

Pre-reform Distance to Frontier: defined as state-industry labor productivity in 1990 divided by the highest state-industry labor productivity in 1990 within the 3-digit industry. This measure equals 1 for the frontier and is less than 1 for non-frontier state-industries.

Labor regulation: this variable comes from Besley-Burgess (2003) who code state specific text amendments to the Industrial Disputes Act 1947 as reported in Malik

[1997]. Coding is done in the following way: a 1 denotes a change that is pro-worker or anti-employer, a 0 denotes a change that we judged not to affect the bargaining power of either workers or employers and a -1 denotes a change which we regard to be anti-worker or pro-employer. There were 113 state specific amendments coded in this manner. Where there was more than one amendment in a year we collapsed this information into a single directional measure. Thus reforms in the regulatory climate are restricted to taking a value of 1, 0, -1 in any given state and year. To use these data, we then construct cumulated variables which map the entire history of each state beginning from 1947 – the date of enactment of the Industrial Disputes Act.

Patents: the flow of patents is the number of patents granted by the US patent office in any given year from the NBER Patent Citation Data File, <http://www.nber.org/patents/>. The cumulative number of patents cumulates these flows over time.

The following variables are not used directly, but are employed in the construction of Total Factor Productivity (TFP), defined below.

Production employment: workers, defined to include all persons employed directly or through any agency whether for wages or not and engaged in any manufacturing process or in cleaning any part of the machinery or premises used for manufacturing process or in any other kind of work incidental to or connected with the manufacturing process or the subject of the manufacturing process.

Non-production employment: employment minus production employment.

Labor compensation: total emoluments including wages paid to all employees, plus the imputed value of benefits in kind (i.e. the net cost to the employer on those goods and services provided to employees free of charge or at markedly reduced cost which are clearly and primarily of benefit to the employees as consumers).

Production employment compensation: wages, defined as all remuneration capable of being expressed in monetary terms and also payable more or less regularly in each pay period to workers (as defined above) as compensation for work done during the accounting year.

Non-production employment compensation: labor compensation minus production employment compensation.

Value-added: the increment to the value of goods and services that is contributed by the factory, obtained by deducting the value of total inputs and depreciation from gross output.

Total Factor Productivity (TFP): our baseline measure is defined as follows:

$$\ln TFP_{sit} = \ln VA_{sit} - \alpha_i \ln L_{sit} - (1 - \alpha_i) \ln K_{sit}$$

where VA denotes real value-added, L denotes employment, K denotes real fixed capital stock, and α_i denotes the average share of labour compensation in value-added in a 3-digit industry across states and time.

As a robustness test, we also consider a measure that controls for variation in labor quality across states, industries and time using information contained in the

wages and employment of production and non-production workers:

$$\ln TFP_{sit} = \ln VA_{sit} - \alpha_i^N \ln N_{sit} - \alpha_i^P \ln P_{sit} - (1 - \alpha_i^N - \alpha_i^P) \ln K_{sit}$$

where N denotes non-production employment, P denotes production employment, α_i^N denotes the average share of non-production employment compensation in value-added in a 3-digit industry across states and time, α_i^P denotes the average share of production employment compensation in value-added in a 3-digit industry across states and time.

Price deflators are from the Indian *Handbook of Industrial Statistics* (various issues), 1980-97. For fixed capital, we use the price deflator for Machinery and Transport Equipment.

There is a change in industrial classification in 1987 and, in order to match the 1970 and 1987 National Industrial Classifications (NIC), we aggregate a small number of 3-digit industries. We exclude miscellaneous manufacturing industries, as these are likely to be heterogeneous across states. The industries ‘Minting of Currency Coins’ and ‘Processing of Nuclear Fuels’ are also excluded, as outcomes in these industries are likely to be determined by special considerations.

Our baseline estimation sample for the state-3-digit industries data consists of an unbalanced panel of 22,883 observations, where we condition on a minimum of 10 time-series observations for each state-industry and on at least two states being active within an industry in any time period. We also consider a balanced panel of 16,758 observations, where we condition on data existing for each state-industry for the full 18 years and on at least two states being active within an industry in any time period. In our baseline regression specifications, observations are weighted by time-averaged employment in a state-industry.

In the robustness section, we also exploit factory-level data on registered manufacturing from the *Annual Survey of Industries*, which are available for the years 1994 and 1997. Matching the two cross-sections and conditioning on data existing for both years yields a sample of 9,792 factories in each year.

B.2 Within-Between Decompositions

Aggregating the factory data to the level of India as a whole, aggregate labour productivity is defined as:

$$\frac{Y}{L} = \frac{\sum_z Y_z}{L} = \sum_z \frac{L_z}{L} \frac{Y_z}{L_z}$$

where z is an index of state-industries. Differencing this equation between 1994 and 1997, one obtains:

$$\Delta_{97-94} \left(\frac{Y}{L} \right) = \underbrace{\sum_z \left[\Delta_{97-94} \left(\frac{L_z}{L} \right) \times \left(\frac{Y_z}{L_z} \right)_{94} \right]}_{\text{Between contribution}}$$

$$+ \underbrace{\sum_z \left[\left(\frac{L_z}{L} \right)_{94} \times \Delta_{97-94} \left(\frac{Y_z}{L_z} \right) \right]}_{\text{Within contribution}}$$

One can also undertake an analogous decomposition within state-3-digit industries. The factory level data are aggregated to the level of the state-3-digit industry, and the decomposition is undertaken for each state-3-digit industry. In this second decomposition, we report the average between and within contributions across all state-3-digit industries.

Table 1: Liberalization and Productivity in Indian Industries 1980-1997: Examining the Role of Technology and Institutions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Log TFP	Log TFP	Log TFP	Log TFP	Log TFP	Log TFPS	Log Y/L
Pre-Reform Distance*Reform	0.181* (0.100)	0.195*** (0.050)	0.149** (0.073)	0.157*** (0.042)	0.187*** (0.045)	0.157*** (0.041)	0.229*** (0.035)
Labor Regulation			-0.093*** (0.022)	-0.066*** (0.017)	-0.066*** (0.015)	-0.066*** (0.017)	-0.055* (0.030)
Labor Regulation*Reform				-0.035*** (0.011)	-0.031*** (0.012)	-0.035*** (0.011)	-0.010* (0.005)
State-industry fixed effects	YES	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES	YES
Industry-time trends	YES	YES	YES	YES	YES	YES	YES
State-reform dummies	NO	YES	NO	NO	NO	NO	NO
Balanced panel	NO	NO	NO	NO	YES	NO	NO
Observations	22883	22883	22883	22883	16758	22842	22883
R-squared	0.68	0.68	0.68	0.69	0.70	0.71	0.94

Notes: Robust standard errors in parentheses adjusted for clustering by state, * significant at 10%; ** significant at 5%; *** significant at 1%. Regressions are weighted using time-averaged state-industry employment shares. Sample is a three-dimensional panel of 3-digit industries from 16 Indian States during 1980-97. Log TFP is log total factor productivity. Log TFPS is log total factor productivity controlling for state-industry variation in labor quality. Log Y/L is log real gross output per worker. Pre-reform distance is pre-reform state-industry labor productivity relative to the state with the highest level of pre-reform labor productivity within the industry. Reform is a dummy which equals 0 for 1990 and earlier and equals 1 from 1991 onwards. State amendments to the Industrial Disputes Act are coded 1=pro-worker, 0=neutral, -1=pro-employer and then cumulated over the pre-reform period to generate the labor regulation measure. Column (2) includes interactions between the reform dummy and state dummies. Columns (1)-(4) and (6)-(7) are an unbalanced panel, conditioning on a minimum of 10 time-series observations for each state-industry and conditioning on at least two states being active within an industry in any time period. Column (5) is a balanced panel, conditioning on 18 time series observations for each state-industry. See the Data Appendix for details on the construction and sources of the variables.

Table 2: Liberalization and Investment in Indian Industries 1980-1997: Examining the Role of Technology and Institutions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Log investment	Log investment	Log investment	Log investment	Log investment	Log fixed capital	Log K/L
Pre-Reform Distance*Reform	0.557*** (0.170)	0.464*** (0.160)	0.533*** (0.164)	0.539*** (0.168)	0.616*** (0.195)	0.381*** (0.104)	0.170** (0.083)
Labor Regulation			-0.070 (0.045)	-0.052 (0.042)	-0.052 (0.043)	-0.014 (0.028)	0.021 (0.034)
Labor Regulation*Reform				-0.023*** (0.008)	-0.014 (0.011)	-0.014* (0.008)	0.038*** (0.012)
State-industry fixed effects	YES	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES	YES
Industry-time trends	YES	YES	YES	YES	YES	YES	YES
State-reform dummies	NO	YES	NO	NO	NO	NO	NO
Balanced panel	NO	NO	NO	NO	YES	NO	NO
Observations	21494	21494	21494	21494	15949	22883	22883
R-squared	0.87	0.87	0.87	0.87	0.87	0.94	0.94

Notes: Robust standard errors in parentheses adjusted for clustering by state, * significant at 10%; ** significant at 5%; *** significant at 1%. Regressions are weighted using time-averaged state-industry employment shares. Sample is a three-dimensional panel of 3-digit industries from 16 Indian States during 1980-97. Log investment is log real gross fixed capital formation in registered manufacturing in a state-industry. Reform equals 0 for 1990 and earlier and equals 1 from 1991 onwards. Pre-reform distance is pre-reform state-industry labor productivity relative to the state with the highest level of pre-reform labor productivity within the industry. Reform is a dummy which equals 0 for 1990 and earlier and equals 1 from 1991 onwards. State amendments to the Industrial Disputes Act are coded 1=pro-worker, 0=neutral, -1=pro-employer and then cumulated over the pre-reform period to generate the labor regulation measure. Column (2) includes interactions between the reform dummy and state dummies. Columns (1)-(4) and (6)-(7) are an unbalanced panel, conditioning on a minimum of 10 time-series observations for each state-industry and conditioning on at least two states being active within an industry in any time period. Column (5) is a balanced panel, conditioning on 18 time series observations for each state-industry. See the Data Appendix for details on the construction and sources of the variables.

Table 3: Liberalization and Profits in Indian Industries 1980-1997: Examining the Role of Technology and Institutions

	(1)	(2)	(3)	(4)	(5)
	Log profits	Log profits	Log profits	Log profits	Log profits
Pre-Reform Distance*Reform	0.678*** (0.228)	0.589*** (0.193)	0.649*** (0.201)	0.685*** (0.201)	0.769*** (0.209)
Labor Regulation			-0.262*** (0.085)	-0.236*** (0.090)	-0.263*** (0.092)
Labor Regulation*Reform				-0.043 (0.032)	-0.044* (0.026)
State-industry fixed effects	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES
Industry-time trends	YES	YES	YES	YES	YES
State-reform dummies	NO	YES	NO	NO	NO
Balanced panel	NO	NO	NO	NO	YES
Observations	16204	16204	16204	16204	12005
R-squared	0.75	0.75	0.75	0.75	0.75

Notes: Robust standard errors in parentheses adjusted for clustering by state, * significant at 10%; ** significant at 5%; *** significant at 1%. Regressions are weighted using time-averaged state-industry employment shares. Sample is a three-dimensional panel of 3-digit industries from 16 Indian States during 1980-97. Log profits is log real registered manufacturing profits in a state-industry. The smaller sample reflects missing or negative values for real profits. Reform equals 0 for 1990 and earlier and equals 1 from 1991 onwards. Pre-reform distance is pre-reform state-industry labor productivity relative to the state with the highest level of pre-reform labor productivity within the industry. Reform is a dummy which equals 0 for 1990 and earlier and equals 1 from 1991 onwards. State amendments to the Industrial Disputes Act are coded 1=pro-worker, 0=neutral, -1=pro-employer and then cumulated over the pre-reform period to generate the labor regulation measure. Column (2) includes interactions between the reform dummy and state dummies. Columns (1)-(4) are an unbalanced panel, conditioning on a minimum of 10 time-series observations for each state-industry and conditioning on at least two states being active within an industry in any time period. Column (5) is a balanced panel, conditioning on 18 time series observations for each state-industry. See the Data Appendix for details on the construction and sources of the variables.

Table 4: Liberalization and Output in Indian Industries 1980-1997: Examining the Role of Technology and Institutions

	(1)	(2)	(3)	(4)	(5)
	Log output	Log output	Log output	Log output	Log output
Pre-Reform Distance*Reform	0.473*** (0.122)	0.502*** (0.065)	0.426*** (0.091)	0.440*** (0.059)	0.461*** (0.061)
Labor Regulation			-0.137*** (0.039)	-0.090*** (0.034)	-0.090*** (0.033)
Labor Regulation*Reform				-0.061*** (0.015)	-0.057*** (0.015)
State-industry fixed effects	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES
Industry-time trends	YES	YES	YES	YES	YES
State-reform dummies	NO	YES	NO	NO	NO
Balanced panel	NO	NO	NO	NO	YES
Observations	22883	22883	22883	22883	16758
R-squared	0.94	0.94	0.94	0.94	0.95

Notes: Robust standard errors in parentheses adjusted for clustering by state, * significant at 10%; ** significant at 5%; *** significant at 1%. Regressions are weighted using time-averaged state-industry employment shares. Sample is a three-dimensional panel of 3-digit industries from 16 Indian States during 1980-97. Log output is log real registered manufacturing output in a state-industry. Reform equals 0 for 1990 and earlier and equals 1 from 1991 onwards. Pre-reform distance is pre-reform state-industry labor productivity relative to the state with the highest level of pre-reform labor productivity within the industry. Reform is a dummy which equals 0 for 1990 and earlier and equals 1 from 1991 onwards. State amendments to the Industrial Disputes Act are coded 1=pro-worker, 0=neutral, -1=pro-employer and then cumulated over the pre-reform period to generate the labor regulation measure. Column (2) includes interactions between the reform dummy and state dummies. Columns (1)-(4) are an unbalanced panel, conditioning on a minimum of 10 time-series observations for each state-industry and conditioning on at least two states being active within an industry in any time period. Column (5) is a balanced panel, conditioning on 18 time series observations for each state-industry. See the Data Appendix for details on the construction and sources of the variables.

Table 5: Liberalization and Patenting Activity in Indian Industries: 1980-1997

	(1)	(2)	(3)	(4)
	Cumulative Patents	Flow of Patents	Cumulative Patents	Flow of Patents
Pre-Reform Distance*Reform	4.058*** (1.215)	0.647*** (0.190)	4.047*** (1.294)	0.511** (0.204)
State-industry fixed effects	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES
Industry-time trends	NO	NO	YES	YES
R-squared	0.58	0.56	0.63	0.58
Observations	1655	1655	1655	1655

Notes: Robust standard errors in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%. Sample is a three-dimensional panel of 2-digit industries from 16 Indian States during 1980-97. Cumulative Patents is the cumulative number of US patents granted in a state-2-digit industry since 1980. Flow of patents is the number of US patents granted in a state-2-digit-industry year. Reform equals 0 for 1990 and earlier and equals 1 from 1991 onwards. Pre-reform distance is pre-reform state-industry labor productivity relative to the state with the highest level of pre-reform labor productivity within the industry. See the Data Appendix for details on the construction and sources of the variables.

Table 6: Within Firm and Between Firm Contributions to Productivity Growth: Evidence from a 1994-1997 Firm Panel

(1)	(2)	(3)	(4)	(5)	(6)
Change Y/L 1994-97	% Growth Y/L 1994-97	Within Contribution	Between Contribution	Within Contribution (within 3-digit)	Between Contribution (within 3-digit)
76770.08	31.82%	79.58%	20.42%	89.69%	10.31%

Notes: Y/L denotes real gross output per worker. Decompositions based on 9792 surviving factories between 1994 and 1997. Column (1) reports the aggregate change in real gross output per worker for India as a whole (aggregating the factory level data). Column (2) reports the percentage rate of growth of aggregate real gross output per worker. Column (3) reports the contribution of productivity growth within surviving factories. Column (4) reports the contribution of changes in the employment shares of factories with different productivity levels. Employment shares are defined as the share of a factory in all India employment, so that the decomposition takes account of changes in factory employment shares across both states and industries. Column (5) reports the average contribution of productivity growth of surviving factories within 3-digit industries. Column (6) reports the average contribution of changes in the employment shares of factories with different productivity levels within state-3-digit industries. Since employment shares are defined as the share of a factory in state-3-digit industry employment, this decomposition focuses on compositional changes within state-3-digit industries.

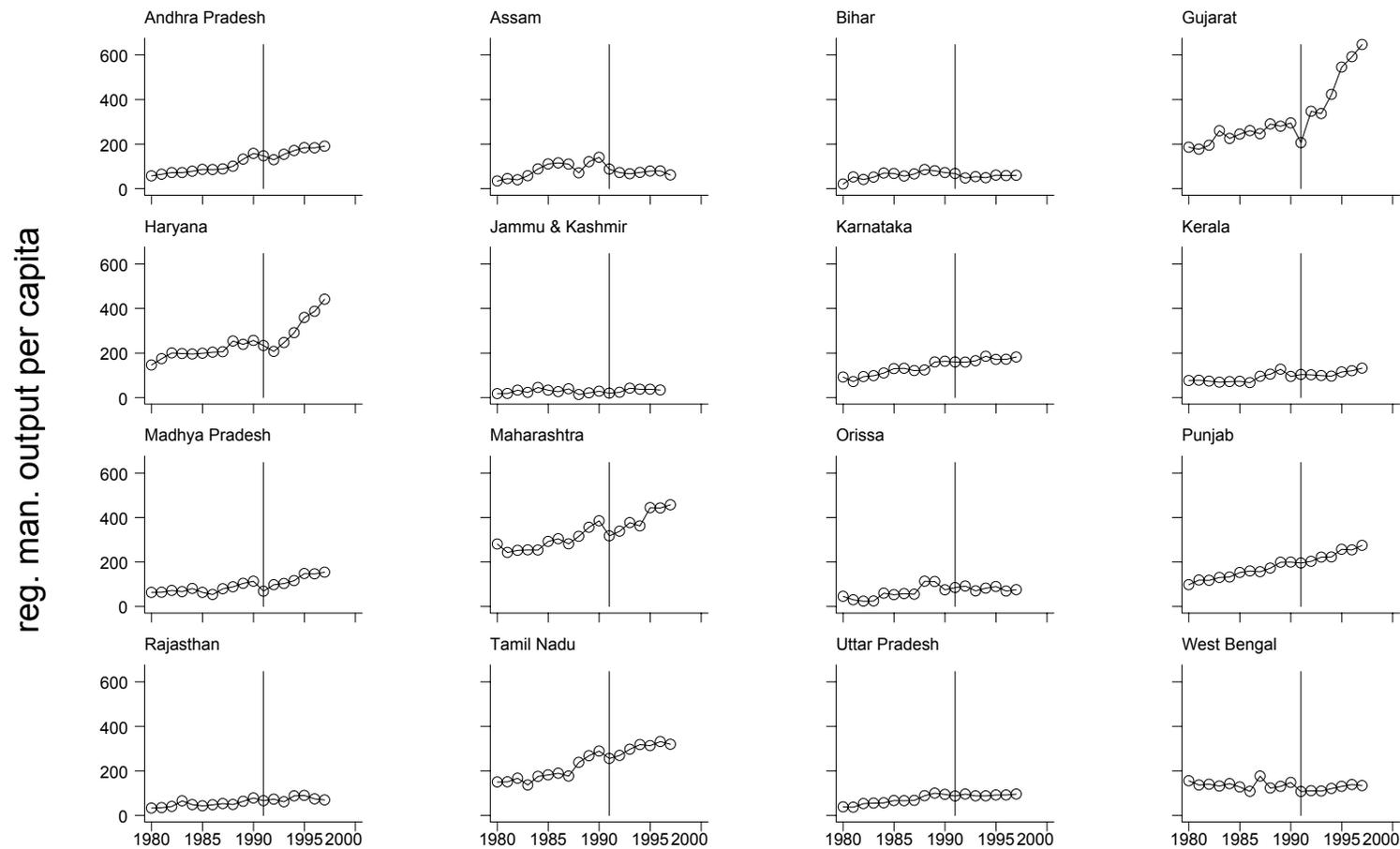


Figure 1: Registered Manufacturing Output Per Capita: 1980-2000

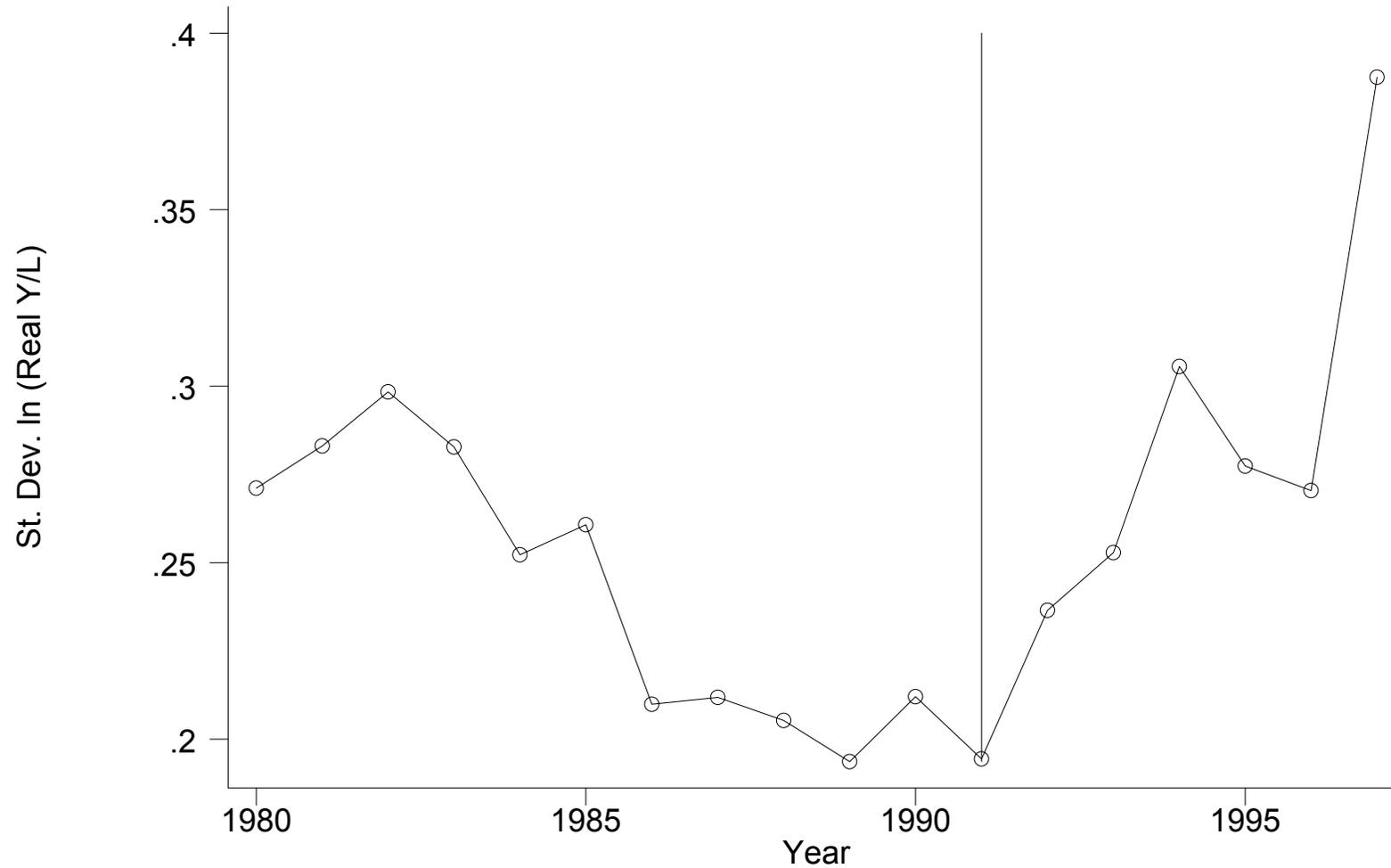


Figure 2 : St. Dev. Registered Manufacturing In (Real Y/L)

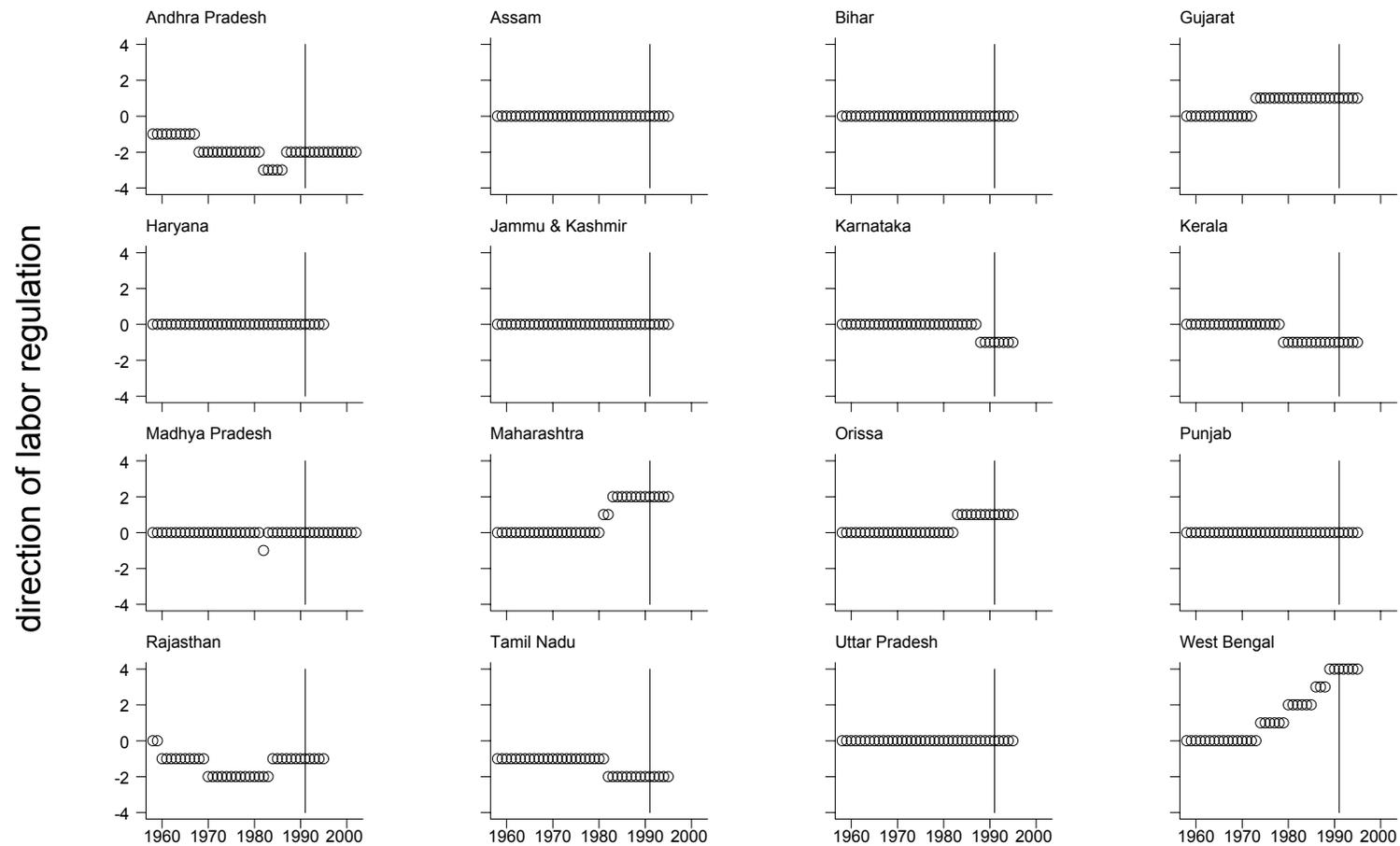
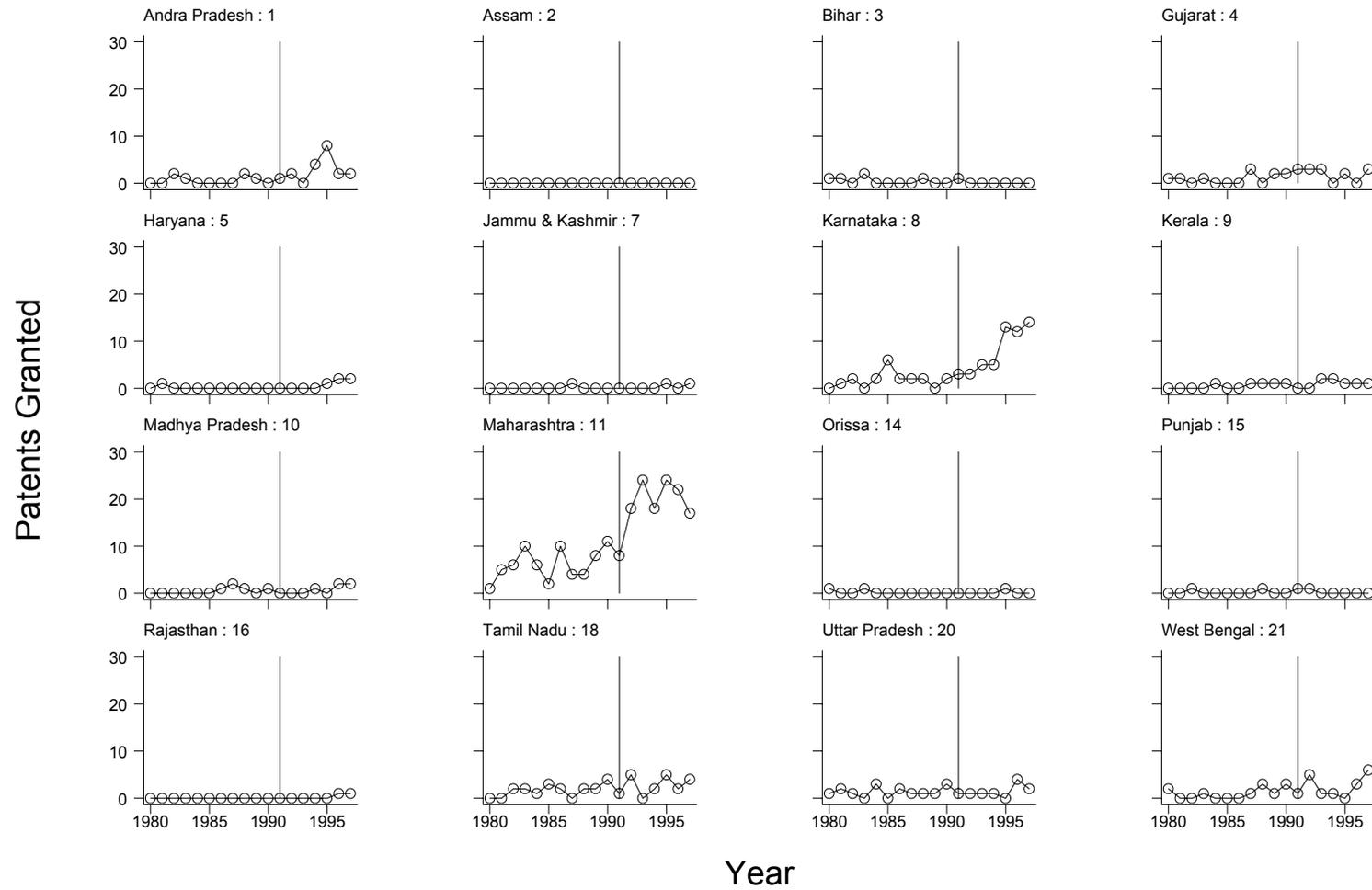


Figure 3: Labor Regulation in India: 1958-2000



Year
Figure 4: Flow of Patents Granted by State and Year

Figure 5: Change in factory employment shares and state-3d-ind pre-reform distance

