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 growth and inequality of liberalization reforms aimed at increasing entry. The main predictions of the model are: (i) liberalization fosters innovation (technology adoption), 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. 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 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.

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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)). Some authors have argued that there are instances, especially in very poor economies, where liberalization is in fact detrimental to growth, by inhibiting infant industries and the local accumulation of knowledge (Krugman (1981), Haussman and Rodrik (2002), Young (1991), Stiglitz (1995, 2002). Others emphasize that, in the presence of capital market imperfections, liberalization exacerbates income inequality within countries, imposing high costs on less favored regions, social groups or sectors of activity, and with ambiguous effects on average performance (see Banerjee and Newman (2003), Trefler and Zhu (2001)).

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 focus, in particular, on the interactions between trade liberalization, state of technological development and domestic institutions. We show how the effect of the same macroeconomic reform can vary substantially across regions and industries in the same country, depending on the institutions and conditions prevailing at the moment of introduction of the reform. Typically, pro-competitive reforms favoring external entry tend to enrich regions and sectors that are initially better positioned, and possibly damage more backward ones. While the view that reforms can generate inequality is not new, the novel point of this paper is to relate explicitly the unequal effects to the process of innovation and growth. According to our theory, on the one hand, trade liberalization induces more productive firms to increase their investments in technology adoption in response to the threat of external competition. 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. The average effect of trade liberalization on productivity will then ultimately depend upon the distribution of productivity across firms and sectors, and in particular on the fractions of sectors that are sufficiently close to the technological frontier to "fight for survival".

Another key aspect of our analysis concerns the role of domestic institutions. We focus, in particular, on labor market regulations determining how the surplus gener-

ated by the process of technology adoption (innovation) is shared between workers and firms (see Besley and Burgess, 2002). As in standard endogenous growth models (e.g., Aghion and Howitt (1992)), the incentive for firms to invest in innovation depends on the surplus share appropriated by firms. Regulations increasing the workers' bargaining power reduce, therefore, the incentive to innovate. Moreover, their effect interacts with that of entry threat in an interesting way.

In particular, 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, relatively speaking, trade reforms hurt growth in regions with pro-labor regulations, while they enhanced growth in regions with pro-employer regulations.

We formalize these ideas in a simple version of a Schumpeterian growth model with entry threat that we use to guide our empirical research. The main theoretical implications that we test are the following

- A reform introducing trade liberalization should give rise to larger increases in productivity and rents in industries-states 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.

- More pro-worker (pro-employer) labor market regulations reduce (increase) productivity and rents, and these effects are strengthened post-liberalization

The empirical analysis focuses on the effects of a recent episode of trade liberalization in India. India underwent a massive reform in 1991 which involved slashing tariffs and opening up different industrial sectors to foreign direct investment. This episode, which is described in detail in a section of the paper, 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 gross output, value added, capital, labor and profits 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 of the distance to frontier for a particular 3-digit 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, i.e., that firms closer to the frontier respond more 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 (2002), who coded state amendments to the Industrial Dispute Act of 1947 as pro-labor, neutral or pro-capital. The level of this variable in 1991, which captures the relative bargaining powers of workers and employers just before reform, is then interacted with the dummy for the reform and used as an explanatory variable in regressions for labor productivity, TFP, profitability, investment, employment and output. The estimated coefficient on this interaction term provides an inference on whether labor regulation in a state at the point of reform mattered affected the performance of 3-digit industries post-liberalization.

The regression analysis provide robust support for the two key predictions of the theory. Namely, state-industries that are closer to the technological frontier experienced larger increases in real manufacturing output, labor productivity, TFP and rents (profits) in the post-reform period. Second, pro-worker labor regulations have a negative effect on the growth of the same variables, and this effect is strengthened by liberalization. Both results hold true after controlling state-industry fixed effects plus time dummies. Robustness checks include adding controls for state dummies interacted with the dummy for reform to show that the results are due, as the theory suggests, to variations within industries. Also, adding industry-specific time trends to account for different convergence patterns across industries does not change the results.

We conclude that the 1991 Indian reform had strong inequalizing effects, and favored states characterized by more flexible labor market institutions as well as firms and regions that were initially more productive. While we do not study explicitly the effect of the reform on income distribution, the findings suggest that globalization increases the cost of redistributive institutions that distort markets, such as pro-workers labor market regulations. On the one hand, this observation can support the market-oriented argument that all frictions, including those due to labor market policies, should be removed to maximize the growth-enhancing potential of globalization. On the other hand, it can be used by opponents to argue that, unless trade globalization is subject to some constraint, capital and rich regions will be the main winner, and redistributive institutions will end up being dismantled. Alternatively, our findings suggest a growth-maximizing development strategy which would combine trade liberalization to boost the most productive industries with adequate government support to innovation and knowledge acquisition by the laggards.

Our paper relates to different strands of literature. First, it is part of the endogenous growth literature emphasizing that productivity growth is the outcome of intentional investments of firms that react to market incentives, policies, etc.. Most of this literature aims at uncovering economic features or policies (e.g savings, property right protection, R&D subsidies, competition policy, education etc) that promote growth or facilitate technological convergence. In our paper, however, trade liberalization has ambiguous and diverse effects across firms, agents and regions in the

same economy. In this respect, the paper is close in spirit to Acemoglu, Aghion and Zilibotti (2002) and Aghion et al (2001), who also identify non-monotonic effects of competition policies on growth. Aghion 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.

Next, the paper 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, 2002), Hall and Jones (1999), La Porta *et al.* (1998, 1999)). None of these papers, however, analyze the interplay between market reforms and technological development that is the main focus of our paper. Third, the papers relates to the recent trade literature focusing on the link between trade and growth at the macro level (such as Frankel and Romer (1999), Rodriguez and Rodrik (2000) and Gancia (2003)). It also relates to empirical studies that document the effect of trade liberalization on productivity growth at the firm or industry level. These include Hanson (1997), Harrison (1994), Krishna and Mitra (1998), Levinsohn (1999), Pavcnik (2002), Trefler (2001) and Tybout *et al.* (1991). This micro literature makes valuable contributions, but ignores the role of institutions and the way in which the effects of liberalization on incentives to innovate may vary across industries and states with distance from the technological frontier.

Finally, there is a literature examining liberalization in India including, among others, Bajpai and Sachs (1999), Sachs et al. (2002), Bhagwati (1998), Datt and Ravaillon (1994), and Kambhampati et al. (1997). Building on the insights of the theoretical model, our empirical analysis makes a number of novel contributions to the debate surrounding Indian liberalization. In particular, we document the role played by initial technology in shaping the uneven effect of liberalization across states and industries, and we demonstrate the interaction between trade policy reform and labor institutions. The idea that there are important interactions between trade policy reform and other institutions is of more general applicability to contexts other than India, and our empirical analysis suggests that these interactions should be taken into account when designing reform programs.

The paper is organized as follows. Section 2 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 Industrial Census 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 Theoretical framework

2.1 The environment

The model economy consists of a set of "states" (or regions) which differ in their factor endowments, distribution of productivities across industries and labor market regulations. The environment described in this section is a slightly modified version of Acemoglu et al (2002), who construct a discrete-time version of the Schumpeterian growth model. 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:

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

$x_{s,t}(\nu)$ 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. 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.[1]

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:

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

[1]The 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.

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 industries. This is a reduced form way of capturing institutions which affect the relative bargaining power of employers and workers. 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 sector, ν, are then simply equal to:

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

Straightforward maximization yields:

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

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

and, therefore:

$$\pi_t(\nu) = A_t(\nu)\,\delta(w_t), \tag{5}$$

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;

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

2.2 Technological states, innovation, and entry

2.2.1 Technological states and transitions

In any period, and within each state, intermediate sectors differ in terms of their current distance to the world "technological frontier". We denote the productivity of the frontier technology at the end of period t by $\overline{A}_t$ and assume that this frontier grows at the exogenous rate g. More formally:

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

At the beginning of period t (or, identically, at the end of period $t-1$), an industry can be in three states:

- "type-1" industries have a productivity level $A_{t-1}(\nu) = \bar{A}_{t-1}$, namely, are at the current frontier.
- "type-2" industries have a productivity level $A_{t-1}(\nu) = \bar{A}_{t-2}$, namely, are one step behind the frontier.
- "type-3" industries have a productivity level $A_{t-1}(\nu) = \bar{A}_{t-2}$, namely, are two steps behind the frontier.

We shall denote by f_1, f_2, f_3 the steady-state fractions of intermediate industries of types 1, 2, and 3, respectively. Transitions between the three technological states will depend on: (i) whether the incumbent firm performs an *innovative investment* in technology adoption or not; (ii) whether the incumbent benefits survives or is replaced by a new producer.

An innovative investment allows an incumbent firm to adopt the next most productive technology, i.e., to increase its productivity by a factor $1+g$ and keep the pace with the advancement of the technological frontier.[2] The cost of technology adoption is (weakly) decreasing with the maturity of the technology adopted. In particular, we assume that the cost is positive and identical for incumbent firms in either type-1 or type-2 industries. More precisely, by incurring at the beginning of period t the quadratic cost

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

incumbent producers in either type-1 or type-2 industries increase with probability z its productivity by a factor $1+g$ within that period, i.e., adopt the next most productive technology. With probability $1-z$, instead, the productivity of the firm does not increase, and the productivity gap with respect to the frontier widens by one step.

[2]The assumption that only one step upgrades are possible, similar to Aghion et al. (2001), is for simplicity, and avoids to deal with asymmetries in the decision problems of firms at different points of the quality ladder, other than those due to the entry threat.

In the most backward industries (i.e., type-3 industries), however, technology adoption comes at no cost, and type-3 industries are automatically upgraded by the factor $1 + g$. This assumption, analogous to Aghion, Harris and Vickers (1997), reflects the natural idea that the cost of adoption becomes negligible for sufficiently mature technologies. It is analytically convenient since it sets an upper bound to the technological lag that local industries can accumulate with respect to the frontier, and avoids that the state space expand indefinitely. Clearly, the model can be generalized to a larger (albeit finite) number of technological states, and the focus on three states entails no loss of generality.

Finally, we assume that the technological state of an industry can change due to the exogenous replacement of incumbent firms below the frontier by new local firms in the same sector. More formally, we assume that with an exogenous probability h, and irrespective of its technology, an incumbent firm is phased out and replaced by a new firm in the same sector. This assumption avoids the most backward state becoming an absorbing state. Without any major loss of insight, we assume that the new firm is endowed with the current frontier technology, so that any industry in which an incumbent firm dies and is replaced by a new firm, is automatically upgraded to a type-1 industry.

2.2.2 Entry

In this section, we introduce foreign product competition. We assume that, in each period and industry, a foreign producer can operate a hit-and-run entry in the local market. When product entry occurs, it takes place at the frontier, $\bar{A}_t$. If a foreign firm enters in sector ν, it steals all the market, as long as the local incumbent lags strictly behind after the realization of the innovation process described above. If, however, the incumbent and the entrant have the same productivity, the local incumbent retains the entire market.[3] Therefore, if the incumbent attains the frontier, he is guaranteed that he will retain the monopoly position. Else, the incumbent retains monopoly only if there is no entry. Since product entry has a hit-and-run nature, we assume that it does not affect the future state of technology in the sector, which depends on the

[3]The microfoundations of this incumbency advantage can be derived from the following sequential game. The foreign entrant must pay a small fee to enter and can decide whether to pay this fee after observing the post-innovation technology of the incumbent. If the incumbent lags behind the frontier, the entrant pays the entry fee and seize the market. Else, the entrant anticipates Bertand competition with the local incumbent and find it optimal not to enter.

Aghion et al (2003) analyze an extension of this model in which an incumbent firm at par with the entrant retains the market with a probability less than one, which depends upon the firm's level of cash, and therefore upon the degree of monopoly power measured by δ (i.e negatively upon the degree of product market competition in the corresponding intermediate sector). This extended model provides a framework in which to analyze the interplay between product market competition and entry.

innovative activity of local producers.[4]

We do not model explicitly the entry decisions of foreign producers. Rather, we assume that entrants are subject to institutional or legal barriers such that, in every period, foreign entry can only occur with an exogenous i.i.d. probability, μ. We regard μ as a policy variable: high μ means more openness and a higher threat of entry from foreign products. Trade liberalization reform is modelled in this framework as an increase in the probability μ of hit-and-run entry from foreign producers, which increases the degree of competition within industries.

2.3 Equilibrium innovation investments

We now consider the decisions of incumbent producers in each of the three technological states. 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.

- As specified above, firms in type 3 industries, such that $A_{t-1}(\nu) = \bar{A}_{t-3}$, make no costly investment in technology adoption, since they can adopt the next most productive technology at zero cost. Hence, conditional on the survival of the incumbent monopolist (probability $1-h$), the industry remains in the same state. Else (probability h), productivity jumps up to $\bar{A}_t$ and the industry becomes of type 1.

- Incumbent firms in type 2 industries choose their investment so as to maximize expected, profits, as given by:

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

  whose solution yields:

$$z = (1-h)\,\delta\,(1-\mu)\,g = z_2. \tag{7}$$

  Recall that type-2 firms only retain leadership if there is no entry (probability $1-\mu$). This leadership occurs at productivity level $\bar{A}_{t-1}$ if innovation is successful (probability z) and at productivity level $\bar{A}_{t-2}$ if innovation is not successful (probability $1-z$).

[4]The analysis could be extended to entry through foreign direct investments (FDI) whose effect on technology would be persistent over time. FDI reinforces the case for liberalization, although the analysis should also take into account that part of the rents are repatriated. In spite of large growth after reform, FDI remains small relative to Indian GDP and, therefore, we decided not to focus on this case.

- Incumbents in the most advanced (i.e., type 1) industries, finally, choose their innovation investment in order to solve the following program:

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

whose solution yields:

$$z = (1-h)\,\delta\,(g+\mu) = z_1. \tag{8}$$

In this case, incumbent firms retain their leadership when either they are successful in adopting the last technology (probability z) or they fail to adopt the last technology, but there is no entry (probability $(1-\mu)\,(1-z)$). The leadership is maintained at productivity level $\bar{A}_t$ in the former case and at productivity level $\bar{A}_{t-1}$ in the latter case.

2.3.1 Comparative statics

We are mainly interested in the effects of three variables on innovative investments, profits, productivity growth and technological choice. These three variables are:

1. the state of technology, measured by the distance to the frontier, in each state-industry, $A_{s,t}(\nu)$;
2. the economy-wide level of trade liberalization, measured by the probability of entry, μ_t;
3. the state-specific labor market regulations, parameterized by the minimum wage $w_{s,t}$.

Straightforward differentiation of equilibrium innovation intensities with respect to μ yields:

$$\frac{\partial z_1}{\partial \mu} = \delta > 0 \tag{9}$$

$$\frac{\partial z_2}{\partial \mu} = -\delta g < 0. \tag{10}$$

In other words, *increasing the threat of product entry (e.g., through trade liberalization) encourages innovation in sectors that are close to the frontier and discourages it in sectors that are far from it* (obviously, nothing happens in type-3 industries, due to our simplifying assumptions). 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. Hence, a higher threat of entry will only

lower the expected net gain from innovation, thereby reducing 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_s, 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:

$$\begin{aligned}\frac{\partial z_1}{\partial w} &= \delta'(w)(g+\mu) < 0 \\ \frac{\partial z_2}{\partial w} &= \delta'(w)(1-\mu)g < 0.\end{aligned}$$

Hence, *pro-workers labor market regulations discourage innovation in all types of sectors, but they do so to a larger extent in sectors that are closer to the technological frontier.*

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

$$\begin{aligned}\frac{\partial^2 z_1}{\partial w \delta \mu} &= \delta'(w) < 0 \\ \frac{\partial^2 z_2}{\partial w \delta \mu} &= -\delta'(w)g > 0\end{aligned}$$

An increase in labor market regulation reduces the positive impact of entry on innovative investments in sectors close to frontier. But it also reduces the negative impact of entry on innovative investments in sectors that are far from frontier. This means that *the third order cross derivative of innovation with respect to entry threat, wages, and distance to the technological frontier, is positive.*

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, industries that are close to frontier will increase less their innovative investments and industries that are far from frontier will decrease less their innovative investments compared with states where labor market institutions are more favorable to employers, i.e., which have lower minimum wages.

Another interesting comparative statics concerns profits. We focus on the effects on profit growth of a reform increasing the threat of entry, μ, since this is going to be tested in the empirical section. In particular, we compare the effect of liberalization on type-1 industries (close to frontier) vs. type-2 industries (far from frontier).

From equation (5) we know that, in equilibrium, the average profits (gross of the cost of innovative investments) of firms in type-1 and type-2 industry before the reform is given by

$$\begin{aligned}\pi_t^{i_t=1} &= \bar{A}_t \delta(w), \\ \pi_t^{i_t=2} &= (1-\mu_t)\bar{A}_{t-1}\delta(w),\end{aligned}$$

where $\pi_t^{i_t=\tau}$ denotes the average profit at t of firms that are in type-τ industry at t. Recall that profits are positive for a firm in a type-2 industry only if there is no entry. Now, consider the effect of a reform increasing, at t+1, the threat of entry, i.e., $\mu_{t+1} > \mu_t$. The average profit at t+1 of firms that, in period t, were in type-1 and type-2 industry, are given, respectively, by

$$\begin{aligned}
\pi_{t+1}^{i_t=1} &= z_1 (1+g) \bar{A}_t \delta (w) + (1-z_1) \left(1-\mu_{t+1}\right) \bar{A}_t \delta (w), \\
\pi_{t+1}^{i_t=2} &= z_2 \left(1-\mu_{t+1}\right) (1+g) \bar{A}_{t-1} \delta (w) + (1-z_2) \left(1-\mu_{t+1}\right) \bar{A}_{t-1} \delta (w),
\end{aligned}$$

where z_1 and z_2 are as in (8) and (7), with $\mu = \mu_{t+1}$. Note the asymmetry between advanced and backwards firms: firms in type-2 industries only make positive profits if there is no entry. Firms in type-1 industries, however, always make profits if they successfully innovate.

Now, consider profit changes. Standard algebra yields

$$\begin{aligned}
x^1 &\equiv \frac{\pi_{t+1}^{i_t=1}}{\pi_t^{i_t=1}} = 1-\mu_{t+1}+z_1\left(g+\mu_{t+1}\right) = 1-\mu_{t+1}+(1-h)\,\delta\left(g+\mu_{t+1}\right)^2 \\
x^2 &\equiv \frac{\pi_{t+1}^{i_t=2}}{\pi_t^{i_t=2}} = \left(\frac{1-\mu_{t+1}}{1-\mu_t}\right)(1+gz_2) = \left(\frac{1-\mu_{t+1}}{1-\mu_t}\right)\left(1+(1-h)\,\delta\left(1-\mu_{t+1}\right)g^2\right)
\end{aligned}$$

Clearly, profit growth is decreasing in the extent of liberalization in backward industries (i.e., $\partial x^2/\partial \mu_{t+1} < 0$). The effect of liberalization in advanced industries is, however, ambiguous. The ambiguous nature of the prediction comes from two opposite effects. On the one hand, liberalization increases the incentive for advanced firms to engage in pre-emptive technology adoption, and this increases their realized profits. On the other hand, it reduces the profits of unsuccessful firms, i.e., firms that lag behind because of their failure in innovating. The former effect dominates (i.e., $\partial x^1/\partial \mu_{t+1} > 0$) as long as $(1-h)(g+\mu) > 1/(2\delta)$. While this condition is difficult to assess in our stylized model, we recall that, for simplicity, our analysis has focused on hit-and-run product entry which has no direct effect on industry productivity and profitability. If we allowed for endogenous entry decisions of high productivity firms (either local or through foreign direct investments), the positive effect would be likely to dominate.

In summary, we have the following prediction concerning profits: *an increase in the threat of entry (e.g., trade liberalization) increases average profits in industries close to the frontier relative to industries far from the frontier. In absolute terms, profit may increase in advanced sectors and do decrease in backward sectors.* This prediction distinguishes our analysis from alternative explanations based on purely competitive trade models a la Heckscher-Ohlin, as discussed in more detail in Section 4.7. Since, in our model, innovation is investment, the model also 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.*

2.4 Steady-state distribution of technologies and average TFP

In this section, we analyze the effects of changes in the extent of the entry threat on the average productivity at the state level. Define the average productivity in state s at time t as:

$$A_{s,t} = \int_0^1 A_{s,t}(\nu) d\nu$$

where $A_{s,t}(\nu) \in \{\bar{A}_t, \bar{A}_{t-1}, \bar{A}_{t-2}\}$. In order to evaluate this expression, we must determine the fractions of type-1, type-2 and type-3 sectors in the economy.

We shall restrict attention to steady-states. In steady state, the measure of industries flowing into each technological state $j \in \{1, 2, 3\}$ must equal the measure of those flowing out. Formally, the steady-state distribution is given by the solution to the following linear system:

$$\begin{aligned} h(f_2 + f_3) &= (1-h)(1-z_1) f_1; && (11) \\ (1-h)(1-z_1) f_1 &= ((1-h)(1-z_2) + h) f_2; && (12) \\ (1-h)(1-z_2) f_2 &= h f_3, && (13) \end{aligned}$$

plus the normalization

$$f_1 + f_2 + f_3 = 1.$$

The left hand sides of (11)-(12)-(13) correspond to net inflows and the right hand sides correspond to net outflows. For instance, the left hand side of the first equation describes net flow into state 1, consisting of all firms which were previously in states 2 and 3 and which were upgraded by the effect of knowledge spillovers. The right hand side of the same equation describes instead the net flow out of state 1, given by of all type-1 firms that have neither successfully innovated nor benefited from knowledge spillovers. The remaining equations bear a similar interpretation.

As usual, only two among those three flow equations are linearly independent. Solving for f_1, f_2, f_3, yields the solution:

$$\begin{aligned} f_1 &= \frac{h/(1-h)}{h/(1-h) + 1 - z_1}; \\ f_2 &= \frac{(1-z_1) h/(1-h)}{(h/(1-h) + 1 - z_1)(h/(1-h) + 1 - z_2)}; \\ f_3 &= \frac{(1-z_1)(1-z_2)}{(h/(1-h) + 1 - z_1)(h/(1-h) + 1 - z_2)}. \end{aligned}$$

Given the comparative statics of changes in μ on z_1 and z_2 as in (9) and (10), it is easy to establish (see appendix) that the fraction of firms close to the technological frontier, f_1, increases with the entry threat μ, whereas the fraction f_2 of firms that are two steps below the frontier, decreases with μ. The effect on f_3 is, in general ambiguous.

Having derived the steady-state fractions of sectors in each of the three technological states, we can now re-express the average productivity level A_t as:

$$A_t = f_1\bar{A}_t + f_2\bar{A}_{t-1} + f_3\bar{A}_{t-2} = g\bar{A}_{t-2}\left((2+g)\,f_1 + f_2\right).$$

From this expression, the effect of a change in μ on A_t seems to be ambiguous, since $\partial f_1/\partial\mu > 0$ and $\partial f_2/\partial\mu < 0$. In the appendix, however, we prove that an increase of μ unambiguously increase average productivity, i.e., that:

$$\frac{\partial A_t}{\partial \mu} > 0.$$

Thus, trade liberalization (or other policies reducing barriers to entry), while creating asymmetric effects across industries, increases average productivity growth.

2.5 Main theoretical predictions

Let us conclude this section by summarizing our main theoretical predictions:

1. *Liberalization (as measured by an increase in the threat of entry) encourages innovation and growth in industries that are close to the frontier and discourages innovation and growth in industries that are far from it;*

2. *Pro-worker labor market regulations discourage innovation and growth in all industries, and the negative effect increases with liberalization;*

3. *Equilibrium rents are higher in industries which are closer to the frontier. Moreover, they react more positively to liberalization*

3 The Indian Liberalization Experiment

We exploit the massive liberalization which took place in India in 1991 to test the validity of these predictions. As a prelude to the empirical testing of the predictions above we provide, in this section, background on the liberalization experiment, on how labor regulation is measured in different states and on how industrial performance differed pre and post-1991.

3.1 Liberalization

The 1952 Industries (Regulation and Development) Act marked the onset of central planning of industry in India. 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. Following the

balance of payments crisis in 1991, a New Industrial Policy – which had trade liberalization and deregulation as its central tenets – was introduced. The liberalization of trade and foreign investment included substantial reductions in tariffs, the relaxation of quantitative restrictions on imports, an easing of restrictions on foreign investment (both direct and portfolio), and greater exchange rate flexibility. Entire industrial sectors that had previously been the preserve of public sector activity were opened up to private investment, including power, telecommunications, mining, ports, roads, river transport, air transport, and banking.

Before liberalization, India had some of the highest tariff barriers in the world and a highly restrictive system of import licensing. Table 1 reports descriptive statistics for percentage point reductions in tariffs at the product level (HS 6-digit) for 1990-2, 1992-7 and the period 1990-7 as a whole. Positive numbers in the table correspond to tariff reductions. In the initial phase of reform during 1990-2, the average reduction in tariffs was 22% points, with some products experiencing reductions of up to 235% points. Further liberalization occurred during 1992-7, with a larger average percentage point reduction in tariffs than in the initial phase of reform. Taking the two periods together, the average percentage point reduction in tariffs 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. Figure 1 shows the impact of liberalization on endogenous trade flows, with a marked rise in the ratio of imports to gross output occurring from 1991 onwards.

Prior to reform, the Foreign Exchange and Regulation Act of 1973 (FERA) had, with a few exceptions, limited foreign shareholdings in Indian companies to 40%. As a result, operations by subsidiary branches of foreign registered companies had been largely eliminated. The New Industrial Policy implemented in 1991, opened a large number of industries for automatic approval of foreign technology agreements and foreign investment up to 51% of equity, and a Foreign Investment Promotion Board was established to consider proposals of up to 100% equity. Policy reform was followed by a dramatic rise in the number of approvals of foreign collaboration (whether investment or technology agreements) as shown in Figure 2. Actual FDI flows show a similar marked increase. Beginning from a very small initial level, Indian inward Foreign Direct Investment (FDI) flows increased rapidly during the 1990s. By 1995-8, they amounted to $2.7bn compared with $3.1bn for Korea, and the ratio of FDI to GDP quadrupled during the period 1993-7. In spite of this rapid increase, FDI remains small relative to GDP, averaging about 0.5% of GDP in the 1990s.[5]

The New Industrial Policy of 1991 also saw the large-scale removal of industrial licensing. Under the Industries (Development and Regulation) Act, 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

[5]Source: UNCTAD, World Investment Directory (2000). See also IMF Economic Survey.

a new product. While these requirements were removed for the majority of sectors in 1991, 18 broad categories of industries remained subject to compulsory industrial licensing including, for example, motor cars and the distillation and brewing of alcoholic drinks. 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. Manufacturing industries opened up to private sector activity included iron and steel and shipbuilding. We exploit both sources of variation in the degree of deregulation across industries in our empirical analysis below.

3.2 State-level institutions

Since Independence in 1947 India has been a federal democracy. 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 (2002) of all state level amendments to the Industrial Disputes Act of 1947 to capture industrial relations climate in a state. Besley and Burgess (2002) 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-emplyer (-1).[6] 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.[7] In line with the theory 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 (2002) 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

[6]Summaries of all amendments and their coding is available at http://econ.lse.ac.uk/staff/rburgess/#wps.

[7]Using 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.

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.

3.3 Economic performance

Figure 4 graphs out per capita real registered manufacturing output in the sixteen main Indian states for the period 1970 to 1997. 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. What is more striking is the fact that manufacturing performance varies so strongly across states and that there is a clear divergence in performance post-1991. Some states like Assam, Bihar, Jammu and Kashmir and Orissa show very little improvement post 1991 whereas other state such as Andra Pradesh, Gujarat, Maharashtra and Tamil Nadu show spectacular increases. This marked heterogeneity in responses to a common liberalization shock *in the same country* is consonant with our theory. And it gives support to those who believe that globalization is not uniformly beneficial and that institutional conditions matter a lot for whether an country or region 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 three 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. And this in turn can help us understand why we see such heterogeneity in industrial performance post 1991.

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 5 where we graph out the standard deviation of real manufacturing output per capita for each year across the period 1960 to 1997. In the graph we distinguish between two types of manufacturing – *registered manufacturing* which covers firms with more than 10 employees with power or more than 20 employees without power and *unregistered manufacturing* which covers firms below this cut-off. It is firms in the registered manufacturing sector that are studied in the Annual Survey of Industries. They have

been the focus of state-led industrialization efforts in India and are subject to range of industrial and labor regulations and planning controls. In contrast, firms in the unregistered manufacturing sector are not covered either by planning controls or by industrial and labor regulations. These firms constitute the informal manufacturing sector in India. The pattern we observe in the evolution of inequality is strikingly different across these two sectors. Inequality in output per capita across states has been trending steadily upwards in unregistered manufacturing across the period. This is likely to reflect agglomeration and other effects where informal firms choose to locate in industrially developed states. In contrast, inequality in registered manufacturing output per capita across states trended downwards between 1960 and 1985. This reflects the fact the Indian planning authorities used their licensing powers to force firms to locate in the more industrially backward states of India. After these controls began to be dismantled in 1985 and as the full force of liberalization began to be felt from 1991 we see a strict reversal in this pattern. Inequality in registered manufacturing output per capita across states is strictly rising after 1990. This suggests that industrial expansion was more rapid in technologically advanced states with more favorable investment climates. In Figure 6 we observe exactly the same pattern when we examine the evolution of standard deviation of log output per worker across the 1980-1997 period.

There is also substantial heterogeneity in economic performance across 3-digit industries within states. For example, even in a state such as Gujarat which saw rapid increases in aggregate manufacturing employment, 16 industries experienced employment reductions post 1991, while 38 industries had employment increases. In a state that experienced a decline in aggregate manufacturing employment post liberalization such as Bihar, 9 industries saw employment declines, while 6 industries had employment rises. Our theoretical model suggests that this heterogeneity in economic performance across industries within states is linked to pre-reform distance to the technological frontier and state institutions, hypotheses that we examine econometrically in our empirical analysis below.

Taken together, the stylized facts reviewed in this section confirm that, though liberalization had an overall positive effect on industrial performance, its effects were highly unequal across Indian states and industries. Building on the predictions of our theory we will now attempt to better understand the technological and institutional factors that might account for why incumbent firms fared so differently in the post-liberalization environment in India.

4 Empirical Analysis

We now turn to directly test the key predictions from our theory. To do this we use a panel 3-digit industry level data for the period 1980-1997 to look at how distance from the technological frontier and labor institutions affected industrial performance following the massive trade liberalization in India in 1991. By using micro-level data

we are able to study the heterogeneity of industry level responses to the liberalization shock and also how the institutional context in which liberalization occurs affects industrial performance.

4.1 Econometric specification

Our econometric strategy is to use the Indian liberalization of 1991 as an experiment to shed light on the role of technology and institutions in the growth process. Trade liberalization was a nationwide phenomenon, common across all states, but the theoretical model predicts heterogeneous effects on individual industries within states, depending on initial technology levels and state institutions. In our baseline econometric specification, we use the timing of reform (pre and post-1991) to identify the uneven effects of liberalization. In an augmented specification, we exploit both the timing of reform and variation in the degree of liberalization across industries to identify of the effects of initial technology levels and institutions.

Our baseline is a 'difference in differences' econometric specification of the following form:

$$Y_{sit} = \alpha(X_{si} \times R_t) + \beta Z_{st} + \gamma\left(Z_{st} \times R_t\right) + \delta C_{sit} + \eta_{si} + \mu_t d_t + u_{sit} \qquad (14)$$

where Y is an economic outcome of interest (e.g. labor productivity), X_{si} is a measure of how close a state-industry was to the technological frontier pre-reform, and R_t is a dummy that is 0 pre-reform and 1 post-reform (1991 onwards); Z_{st} is a measure of state-level institutions (the direction of labor regulation); C_{sit} is a vector of control variables; η_{si} is a state-industry fixed effect; and d_t is a vector of time dummies.

The inclusion of the state-industry fixed effect η_{si} 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 time dummies d_t control for changes in economic performance over time. They will, therefore, capture the overall effect of reform across states and industries, as well as controlling for common macroeconomic shocks. Equation (14) is therefore a 'differences in differences' specification because we difference out both the time-mean for individual state-industries (the state-industry fixed effect) and the common trend over time for state-industries (captured in the year dummies).

Our main parameter of interest is the coefficient α on pre-reform distance to the technological frontier interacted with the reform dummy. The presence of the state-industry fixed effect and time dummies means that this coefficient captures the *differential change* in economic performance across state-industries between the pre and post-reform periods. The first of the theoretical model's predictions is that α should be positive and statistically significant, implying that an economic outcome increases by more in the post-reform period in state-industries that were close to the technological frontier pre-reform.[8]

[8] An important feature of the theoretical model is that the adoption of more productive technolo-

Two other parameters of interest are the coefficient β on state pro-worker labor regulation and the coefficient γ on the interaction term between state pro-worker labor regulation and reform. The inclusion of the state-industry fixed effect and time dummies mean that β is identified from *differential changes* in labor regulation over time in individual Indian states. The theoretical model implies that more pro-worker labor regulation will reduce innovation and productivity, implying a negative and statistically significant value of β for most of the economic outcomes considered below. One exception is the capital-labor ratio where, as labor becomes more expensive relative to capital in states that pass pro-labor amendments, manufacturing industries substitute labor for capital resulting in an increase in the capital-labor ratio. The theory also predicts that the effect of institutions is magnified in the post-reform period, implying that γ should be statistically significant and take the same sign as β. Since our measure of pro-worker labor regulation is defined at the state-level, it takes the same value across all industries within a state and, therefore, we adjust the regression standard errors for clustering on state-year cells (Moulton, 1986).

In the previous section, we argued that liberalization in 1991 marked a dramatic change in the environment in which Indian manufacturing industries operated and provided evidence that economic outcomes display clear and large changes at the time of reform. Nonetheless, there remains the econometric concern that there are other unobserved variables that change at the same time as reform and that influence economic outcomes. The differences in differences specification means that, in order to explain our results, these unobserved variables must not only change over time and influence economic outcomes, but must also be correlated in a particular way with pre-reform distance to the technological frontier and institutions.

To address this concern, we also consider an augmented specification which exploits both the timing of reform and variation in the degree of liberalization across industries. The theoretical model predicts that pre-reform distance to the technological frontier should matter most in those industries experiencing the greatest degree of liberalization. Therefore, we distinguish between 'high' and 'low'-reform industries, where a high-reform industry is defined as one with above median tariff reductions during 1991-7, no compulsory industrial licensing after 1991 and no restriction to public sector activity after 1991. The specification in equation (14) is augmented with interaction terms between each of the explanatory variables and a {0,1} dummy (M_i) for whether the industry is high or low-reform:

$$\begin{aligned} Y_{sit} &= \alpha_1(X_{si} \times R_t) + \beta_1 Z_{st} + \gamma_1 (Z_{st} \times R_t) + \mu_{1t} d_t + \delta_1 C_{sit} \\ &\quad + \alpha_2(X_{si} \times R_t \times M_i) + \beta_2 (Z_{st} \times M_i) + \gamma_2 (Z_{st} \times R_t \times M_i) \end{aligned}$$

gies requires intentional costly investments or the development of 'absorptive capacity.' Mechanistic models of convergence that ignore the role of intentional investments would predict that those state-industries *furthest* from the technological frontier would experience the largest increases in output and productivity in the post-reform period.

$$+\delta_2 (C_{sit} \times M_i) + \mu_{2t} (d_t \times M_i) + \eta_{si} + u_{sit}$$

This specification is extremely general and includes separate year dummies (capturing potentially different time effects) for each group of industries. The coefficient α_2 is identified from variation in the extent to which distance to the technological frontier matters for the pre/post-reform change in an economic outcome between high and low-reform groups of industries. Positive and statistically significant values of both α_1 and α_2 imply that state-industries closer to the technological frontier pre-reform experience the largest increases in economic outcomes in the post-reform period for each group of industries, but that distance to the technological frontier is most important in high-reform industries as predicted by the theory.

We consider six economic outcomes (Y_{sit}) for the registered manufacturing sector. Since the central implications of the model are for technology and profitability, we begin by examining the effects of liberalization on labor productivity and total factor productivity (TFP). A central feature of the model is that liberalization has differential effects on profitability depending on pre-reform distance from the technological frontier. Profitability is, therefore, our third economic outcome. To measure to effect of reform on investment, we use data on the real fixed capital stock per worker. To the extent that new technologies are embodied in physical capital, this will also capture effects of reform on innovation. Finally, we consider how distance to frontier and labor institutions mediate the impact of trade liberalization on total manufacturing output and employment in India.

Our measure of pre-reform distance to the technological frontier (X_{si}) exploits information on the position of a state in the pre-reform productivity distribution within an industry. In measuring states' locations within the industry productivity distribution, we wish to abstract from year-on-year fluctuations and, therefore, we take average values over a 3-year window prior to reform (the years 1988, 1989 and 1990).[9] Our baseline measure of a state-industry's pre-reform distance to frontier is average labor productivity in the state-industry divided by average productivity in the state with the highest level of labor productivity within the industry (the 'Indian frontier') over these three years. Thus, a higher value of X_{si} corresponds to a state-industry closer to the technological frontier.

This measure directly captures a state's position relative to the Indian technological frontier. The world technological frontier in an industry will be common across all Indian states. Therefore, the pre-reform ranking of states relative to the world frontier will be the same as their ranking relative to the Indian frontier, and the two measures are equivalent up to an industry-specific constant.

[9] As a robustness test, we experiment with averaging over longer and shorter windows.

4.2 Data sources and estimation samples

Our main data source is the Indian *Annual Survey of Industries*, which reports information on production activity in the registered manufacturing sector by state for more than 100 3-digit industries during 1980-97. We focus on the 16 major states of India, which account for around 95% of the total population and are listed in the Data Appendix.

In the *Annual Survey of Industries*, information is not reported separately on state-industries which are so small they violate confidentiality requirements (the minimum state-industry size reported is less 25 employees). To ensure that the results are not driven by small state-industries which enter and exit the data as they rise above or fall below the confidentiality threshold, we restrict attention to state-industries with an average employment of 100 employees or more and on which data exist for at least 10 years.[10]

This yields our baseline estimation sample, which consists of an unbalanced panel of 19,623 observations on 107 3-digit manufacturing industries in the 16 Indian states during 1980-97. Table A2 of the Data Appendix presents further information on the distribution of observations across states, industries and time. On average, the data exist for around 65% of all possible state-industry-time observations, and the number of industries observed in a state ranges from 10 in Jammu & Kashmir in 1980 to 101 in Maharashtra in 1994.

Our measure of pre-reform distance to the technological frontier uses a state's location in the pre-reform distribution of productivity within the industry. The minimum number of states per industry across time ranges from 2 in, for example, 'Copper manufacturing' (NIC87, 333) to 13 in 'Manufacture of electrical industrial machinery, apparatus and parts thereof' (NIC87, 360). The average number of years for which a state-industry exists is over 16, with data existing for all 18 years in approximately one half of the observations.

We use the unbalanced panel for our baseline estimation results. However, the birth and death of industries may be non-random and related to reform. The central predictions of the theoretical model are for changes in economic behavior within surviving state-industries. Therefore, as a robustness test, we also report estimation results for a balanced panel of 10,259 observations on state-industries that exist in all years in the raw data. We also consider additional robustness tests for the unbalanced panel, where we condition on state-industries remaining within the sample for 5 rather than 10 years or more; where we require the minimum number of states within an industry across time to be greater than or equal to 5; and where we sequentially exclude individual industries from the sample as a check that our results are not

[10]We exclude miscellaneous manufacturing industries, as these are likely to be heterogeneous across states. We also exclude 'Minting of Currency Coins' and 'Processing of Nuclear Fuels' industries, as outcomes in these industries are likely to be determined by special considerations. To match the 1970 and 1987 Indian industrial classifications, a small number of 3-digit manufacturing industries are aggregated together. See the Data Appendix for further discussion of the data.

driven by any one industry.

There remains huge variation in the size of state-industries. In the unbalanced panel, average employment over time ranges from just over 100 employees in 'Manufacture of wearing apparel of leather and substitutes of leather' (NIC87 292) in Punjab to over 200,000 employees in 'Manufacture of bidi' (NIC87 226) in Andhra Pradesh. To control for measurement error that may be correlated with industry size, our main estimation results use weighted regressions with log time-averaged state-industry employment as weights. As robustness tests, we also estimated unweighted regressions and regressions weighted using the level (rather than the log) of time-averaged employment.

4.3 Labor productivity

The theoretical model predicts that the increased threat of entry post-reform encourages innovation in state-industries closer to the frontier, so that we should observe greater productivity in these state-industries relative to state-industries further from the frontier. Industries in states with more pro-worker environments should also innovate less relative to industries in pro-employer environments and this divergence in incentives to innovate should become more pronounced as the threat of entry increases. As a result, we would expect labor productivity to be lower in pro-worker states overall and also lower in these states post-reform.

We take these central implications of the model to the data in Table 2 where real output per employee is our outcome measure and we are using pre-reform labor productivity in a state-industry relative to the Indian maximum as our measure of distance to frontier. Column (1) of Table 2 reports the results of regressing real manufacturing output per employee on this measure (X_{si}) interacted with the {0,1} dummy for reform (R_t), a state-industry fixed effect (η_{si}) and year dummies (d_t) for the unbalanced panel. As predicted by theory, we find that state-industries closer to the technological frontier pre-reform experienced statistically significantly larger increases in real manufacturing output per employee in the post-reform period.

Column (2) introduces state-level institutions, measured by the degree of pro-worker labor regulation (Z_{st}). As predicted by theory, and consistent with empirical evidence for the pre-reform period in Besley and Burgess (2002), we find that more pro-worker labor regulation within a state reduces real manufacturing output per employee. Column (3) allows the effect of labor regulation to vary between the pre and post-reform periods by interacting the variable with the reform dummy.[11] Again, as predicted by the theory, we find that the negative effect of pro-worker labor regulation is strengthened by liberalization. This finding is consistent with the idea that the response of innovative investments to trade liberalization will be dampened in states with more pro-worker labor regulations. In both specifications, the effect of

[11]The variable does not change after 1990 so this interaction captures the impact of the pre-reform institutional context on post-reform performance.

pre-reform distance to the technological frontier remains constant in magnitude and highly statistically significant.

Column (4) demonstrates the robustness of the results to using a categorical measure of pre-reform distance to the technological frontier, which is 1 if a state is above median labor productivity within the industry and 0 otherwise. Again, we find a very similar pattern of results – states with above median labor productivity pre-reform experience, on average, about a 6% larger increase in real manufacturing output per employee than states at or below median pre-reform labor productivity. This suggests that firms closer to the frontier react differently to the entry threat posed by trade liberalization than do firms far from frontier.

In column (5) we include an interaction between state dummies and the {0,1} dummy for reform post-1991. The coefficient on distance to the frontier remains positive but is only significant at the 11% level. The inclusion of this interaction helps to guard against the possibility that our results are being driven by states with favorable business environments having both industries close to frontier pre-reform and high growth post-reform. Even in high growth states there is clearly a heterogeneity in responses to liberalization which is what the model would predict. Inclusion of the state–reform interaction term also helps to control for a host of unobserved state-level institutions whose effects on industrial output may vary across the pre and post-reform periods.

Our baseline specification includes time dummies that are common across industries. However, industries may experience different rates of technological progress and column (6) allows for this possibility by replacing the time dummies with industry-specific time trends. Once again, we find that state-industries closer to the technological frontier experience larger increases in real manufacturing output per employee post-reform. An additional feature of this specification is that we can now also include the reform dummy (pre and post-1991) separately. Previously, this was captured in the year dummies, but is now identified as an average deviation from the industry-specific time trends.

Since the interaction term between pre-reform proximity to the frontier and reform is defined as $[(Y/L)_{si}^{\mathrm{Pre}}/\max_s(Y/L)_i^{\mathrm{Pre}}] * dummy91_t$, the sum of the coefficients on the interaction term and the reform dummy is the effect of reform on the most productive state within the industry prior to reform for whom $[(Y/L)_{si}^{\mathrm{Pre}}/\max_s(Y/L)_i^{\mathrm{Pre}}] = 1$. Similarly, from the two coefficients, one can evaluate the effect of reform on state-industries with a pre-reform productivity equal to a particular fraction of productivity in the frontier. In column (6), we find that state-industries with low levels of labor productivity relative to those in the frontier saw substantially below trend increases in real manufacturing output per employee in the post-reform period, capturing the idea that the industries far from the frontier will actually be harmed by liberalization.

Because state pro-worker labor regulation is common across all industries within a state-time period, standard errors in our baseline specifications are adjusted for clustering on state-year cells. As an additional robustness test, column (7) returns to

our preferred specification from column (3), including the pre-reform distance to the frontier interaction, institutions and institutions interacted with reform, and reports standard errors adjusted for clustering on state-industry cells. Duflo et al. (2002) suggest this as a method for dealing with serial correlation concerns in difference in difference regressions. In column (7) we observe that, though the standard errors are higher, the parameters of interest remain statistically significant.

4.4 Total factor productivity (TFP)

The previous section has provided evidence that changes in labor productivity in the post-reform conform closely to the predictions of the theoretical model. However, increases in labor productivity can be achieved through either investment or technological change. As the emphasis in the model is on technological change we also examine whether we see similar effects using a total factor productivity (TFP) measure.

An advantage of TFP as a measure of productivity is that it captures the technical efficiency with which all factors of production are employed. The TFP index we consider allows for variations in factor intensity across 3-digit industries and controls for variation in labor force quality using data on the wages and employment of non-production and production workers.[12] A disadvantage of TFP as a measure of productivity in the Indian context is that India was a centrally planned economy pre-reform and remains so in some respects. Therefore, the market structure assumptions underlying standard TFP indices may not be satisfied, although the inclusion of a state-industry fixed effect in all regressions will control for time-invariant effects of departures from these assumptions.

Table 3 examines the effects of reform on TFP levels using our baseline measure of pre-reform distance to technological frontier.[13] We find a very similar pattern of results to those for labor productivity. Across all specifications (columns (1) - (7)) we find that state-industries which are closer to the Indian frontier pre-reform experience higher TFP growth after liberalization. State-industries in states with more pro-labor regulation experience less TFP growth and the interaction between labor regulation and reform is negative and significant in all specifications. These key effects, which are consistent with the predictions of the model, are robust to including state-reform interactions (column (5)), industry time trends (column (6)) and adjusting standard errors for clustering standard errors on state-industry cells (column (7)).

[12] See the Data Appendix for further discussion.

[13] The inclusion of a state-industry fixed effect in the regressions means that we are essentially concerned with the within growth in TFP within 3-digit state-industries. Our baseline measure of pre-reform distance to the frontier exploits a state's location in the pre-reform within-industry labor productivity distribution. As a robustness test, we also considered a measure based on a state's location in the pre-reform within industry TFP distribution. We consider this only as a robustness tests, because the measurement error in TFP levels across state-industries at a point in time is likely to be larger than measurement error within state-industries over time.

The estimated effects of pre-reform distance to the technological frontier are typically somewhat smaller in magnitude than those for labor productivity. This may reflect the fact that some of the impact of reform was on capital accumulation as well as through measured technical efficiency (though if new technology is embodied in physical capital, changes in capital accumulation may also reflect the differential patterns of technology adoption emphasized in the model and discussed further below). The smaller estimated coefficients may also reflect the greater amount of measurement error in standard TFP indices. When we consider a categorical {0,1} measure of pre-reform distance to the technological frontier, we actually find larger effects than for labor productivity. In column (4) of Table 3, state-industries with above median labor productivity within the industry experience, on average, about a 8% larger increase in TFP post-reform. This may be compared to a figure of about 6% for labor productivity. In the specification including industry-specific time trends in column (6), we again find a below trend increase in productivity post-reform for state-industries far from the technological frontier within the industry.

4.5 Profitability and capital accumulation

The model has additional predictions for real profitability which we examine in columns (1) to (3) of Table 4. Column (1) reports our baseline specification including the interaction between pre-reform distance to the technological frontier and reform, pro-worker labor regulation and pro-worker labor regulation interacted with reform. As predicted by the model, we find that state-industries closer to the technological frontier experience larger increases in real profitability in the post-reform period; more pro-worker labor regulation within states reduced real profitability in registered manufacturing; and the interaction term between pro-worker labor regulation and reform is negative and highly statistically significant providing further evidence of the complementarity between liberalization and labor market institutions. These results survive the complete battery of robustness tests undertaken for labor productivity and TFP above, including adjusting the standard errors for clustering on state-3-digit industry cells. In the interests of brevity, Table 4 reports two of these robustness tests only - the inclusion of state-reform dummies in column (2) and the introduction of industry time-trends in column (3). Consonant with the theory we thus have strong evidence that rents are higher in industries which are closer to the frontier and, moreover, that they react more positively to liberalization

Columns (4) to (6) of Table 4 examine effects of liberalization and labor market institutions on the real capital stock per employee. Capital accumulation does not play a central role in the theoretical model. However, if new technologies are embodied in physical capital, a larger increase in the capital stock per employee post-reform in state-industries closer to technological frontier pre-reform is consistent with the differential patterns of technological adoption emphasized in the model. We may think that the capital stock as in part picking up innovative investments that firms

are undertaking in response to the threat of entry. In column (4) of Table 4, we provide evidence that state-industries closer to the technological frontier pre-reform do indeed experience the largest increases in capital stock per employee in the post-reform period.

We saw above than more pro-worker labor regulation within states reduces real profitability. But, well as reducing real profitability, more pro-worker labor regulation also increases the cost of labor relative to capital, strengthening firms' incentives to substitute capital for labor. We developed this result in a theoretical context above, and it is confirmed empirically in column (4) of Table 4, where we find a positive effect of pro-worker labor regulation on the real capital stock per employee which becomes statistically significant in the post-reform period.[14] Again these findings survive the complete battery of robustness tests performed in Tables 2 and 3 above, including adjusting the standard errors for clustering on state-3-digit industry cells. Columns (5) and (6) report the robustness tests including state-reform dummies and industry time-trend in full. Looking at columns (3) and (6), we find that state-industries with pre-reform productivities less than half those at the frontier experience below trend increases in both real profitability and the real capital stock per employee in the post-reform period.

Therefore, all of the key predictions of the model for the effects of pre-reform distance to the technological frontier, the impact of labor market institutions and the enhanced role of labor market institutions in the post-reform period are confirmed empirically for labor productivity, TFP, real profitability and the real capital stock per employee. These results are robust across a wide range of econometric specifications. They continue to be observed once one allows, for example, for unobserved state effects that vary between the pre and post-reform periods, once one introduces industry-specific time trends and when one correct adjusts standard errors for clustering by state-industry. For all four economic outcomes, real profitability, real capital stock per worker, labor productivity and TFP, we find that state-industries far from the technological frontier saw below trend increases in economic performance in the post-reform period. This confirms that the effect of trade liberalization have indeed been unequal.

4.6 Output and employment

To complete our analysis, it is also interesting to examine whether state-industries closer to the Indian frontier or in pro-employer states experience bigger increases in output and employment post-reform. In this way, we can link the innovation story which underpins our model to the development of manufacturing in India. Table 5 presents estimation results for real output and employment for our baseline specifica-

[14]Excluding the interaction term between pro-worker labor regulation and reform, the coefficient on the level of pro-worker regulation becomes statistically significant: the estimated coefficient (*standard error*) are 0.034 (*0.012*).

tion and for the robustness tests including state-reform dummies and industry time trends. The model's predictions are again confirmed empirically, and we see a very similar pattern of results to those for productivity, profitability and the real capital stock per employee.

Industries which are closer to frontier pre-reform experience larger output and employment growth after liberalization. States with more pro-worker labor regulation have lower manufacturing output and employment, with this effect strengthened in the post-reform period. We find that the effects are of a smaller magnitude for employment than for output, which is consistent with firms being able to make less adjustments to entry threats through employment. Again these results survive the complete battery of robustness tests undertaken for labor productivity and TFP above, including adjusting the standard errors for clustering on state-3-digit industry. Using a discrete measure of pre-reform proximity to the technological frontier (not reported in the table), we find that state-industries with above median labor productivity within the industry pre-reform experience, on average, about a 21% larger increase in manufacturing output post-reform compared to a 15% larger increase in employment. The magnitude of these effects is large – whether or not a state-industry is technologically advanced pre-reform is an important predictor of post-reform performance. In the specification including industry-specific time trends in columns (4) and (6), we find a below trend increase in both output and employment post-reform for state-industries with pre-reform levels of labor productivity less than one third of those in the frontier, consistent with the predictions of the theoretical model.

Taken together, these results provide strong evidence on the importance of initial technology and labor market institutions in shaping the uneven effects of liberalization across the states of India. In the next section, we examine the robustness of the results in a variety of additional ways.

4.7 Additional Robustness Checks

Our baseline estimation results use an unbalanced panel of 3-digit industries in states over time. One potential concern is that the birth and death of industries may be non-random, in which case our results will not only capture within-industry changes in industrial performance, but will also include effects through industry birth and death. Since the theoretical model predicts changes in economic behavior within surviving state-industries, our first robustness test is, therefore, to re-estimate the model for a balanced panel of 10,259 observations on state-industries that exist in the raw data in all years.

As shown for our preferred specification in columns (1) to (6) of Table 8, we find an extremely similar pattern of results across all six economic outcomes. Those state-industries closest to the technological frontier prior to reform experience the largest increases in real manufacturing output, employment, real profitability, real capital stock per worker and labor productivity. This suggests that the increased threat of

entry implied by trade liberalization led *incumbent* firms to change their behavior. And as we can observe in the second and third rows of Table 8 the form of labor regulation in a state affected the vigor with which state-industries responded to the threat of entry. The balanced panel is, of course, itself a non-random sample, but these results provide evidence of important effects for surviving state-industries as predicted by the model.

In our baseline estimation results, we have already controlled for an important time-varying institution at the state-level (labor regulation) and allowed for industry-specific effects of unobserved time-invariant institutions through the inclusion of the fixed effect. We also demonstrated the robustness of the results to allowing for unobserved state-specific effects that vary between the pre and post-reform periods.

As an alternative approach to addressing the concern that there may be unobserved time-varying state policies and institutions – which affect industrial performance and are correlated with pre-reform distance to the technological frontier – we check in columns (1) to (6) of Table 9 whether our results are robust to the inclusion of political controls. Specifically we include the proportions of the state legislature controlled by the six main political groupings in India: the Congress party, Hard Left, Soft Left, the Janata parties, Hindu Nationalists, and regional parties.[15] Other papers have shown that the link between the political composition of state legislatures and choices of policy and institutions. Having greater hard left party representation, for example, is associated with more pro-worker regulation and more land reforms (see Besley and Burgess, 2000, 2002). One cannot directly observe all state level policy and institutional choices that might have a bearing on industrial performance, and we include the political variables in the regression to control for these unobservables. In this specification, we model observed and unobserved variation in policies across states using information on their underlying political composition. As shown in columns (1) to (6) of Table 9, our main results are robust to the inclusion of these political controls.

In our baseline estimation results, we use the timing of reform in 1991 to identify the relationship between pre-reform distance to the technological frontier, institutions and economic performance. One potential concern is that there are unobserved variables which change at the time of reform and are correlated with our independent variables. An alternative identification strategy is to exploit not only the timing of reform but also the fact that the degree of liberalization in 1991 varied substantially across sectors. The theoretical model predicts that the impact of pre-reform distance to the technological frontier and pro-worker labor regulation on the change in economic performance between the pre and post-reform periods should be strongest in those industries which experience the greatest increases in foreign competition and the most deregulation.

[15]The Congress party has been the dominant political force in India since Independence. It has faced strong competition from these different political groupings in different states, as reflected in changes in control of state legislatures over time.

We examine this prediction using a categorical variable which is equal to 0 if an industry experiences low levels of reform and equal to 1 if an industry experience high levels of reform. 'High reform' industries are defined as those which experience above median proportional reductions in tariffs in the post-reform period 1991-7, retain no compulsory industrial licensing after 1991, and that are not restricted to the public sector post-reform. In addition to the level of each variable of interest, we extend our preferred specification to include an interaction term between each variable and the dummy for high reform industries. We also interact the time dummies with this industry indicator variable to allow for different time effects between the two groups of industries.

The estimated coefficient on the levels of variables captures effects in low reform industries, while the level plus the interaction term corresponds to the effect in high reform industries. In columns (7) to (12) of Table 9, we find positive and statistically coefficients on the three-way interaction term between pre-reform distance to the technological frontier variable, the reform dummy and the high reform industry dummy for labor productivity, real output and employment. In addition, we find negative and statistically significant coefficients on the three-way interaction term between pro-worker labor regulation, the reform dummy and the high reform industry dummy for labor productivity and real output. Thus, exploiting the 'difference in difference' between pre versus post-reform and high versus low-reform industries, provides some additional empirical support for the theoretical model's predictions.

Another of the theoretical model's predictions is that the interaction between pre-reform distance to the technological frontier and reform should be stronger in states in states with less pro-worker labor regulation. In practice, it is hard to separately identify this three-way interaction term from the two-way interaction between pro-worker labor regulation and reform on which we focused on above. Across economic outcomes, the two-way interaction typically dominates, with the three-way interaction term statistically insignificant and the sign changing across specifications. This is likely due to the high covariance between the two-way and three-way interactions, making it hard to separately identify effects.[16]

4.8 Discussion

Both our baseline estimation results and the findings of the robustness tests vindicate the key predictions of our theoretical model. In this section, we discuss the interpretation of the results and other potential explanations.

[16]For example, including the three-way interaction term in column (3) of table 2 concerned with labor productivity, the estimated coefficients (*standard errors*) are: distance to frontier-reform interaction 0.160 (*0.070*); labor regulation -0.031 (*0.015*); labor regulation-reform interaction -0.025 (*0.024*); distance to frontier-labor regulation-reform interaction 0.029 (*0.048*). Excluding the two-way interaction between pro-worker labor regulation and reform from this specification, the three-way interaction term becomes negatively signed though statistically insignificant (the estimated coefficient (*standard error*) on this term are -0.011 (*0.017*)).

One possible alternative conceptual framework within which to analyze the effects of trade liberalization is the Heckscher-Ohlin model. In the aftermath of trade liberalization, this predicts increased specialization and a reallocation of resources towards sectors where India has a comparative advantage. If the sectors where India has a comparative advantage tend to be high productivity, this reallocation would give rise to an increase in measured productivity through a change in industry composition.

Our main empirical analysis is undertaken at the level of individual state-3-digit industries, and the inclusion of a fixed effect means that the effects we estimate are driven by *within state-industry* changes in economic performance. Also our results survive running our regressions on a balanced panel. The fact that we are using such disaggregated data and only including surviving industries strongly suggests that it is changes in the behavior of incumbent firms rather than reallocations of economic activity across industries that are driving our results.

Two additional considerations suggest that the reallocation of resources across industries was not central to the heterogeneous economic performance observed across Indian states post-reform. First, it is extremely difficult in India to lay-off workers and to close establishments or firms. Employers are required to obtain the government permission in order to 'retrench labor' which is rarely given, and India still does not have a well-functioning bankruptcy law. This suggests that large-scale entry and exit and substantial movements of labor across sectors did not play a major role.

Second, observed employment patterns across 3-digit industries are relatively stable in the post-reform period. Figure 7 displays graphically bilateral values of the Krugman Specialization index over time for Andra Pradesh. The Krugman index compares the employment structure of Andhra Pradesh to that of each other Indian state, and is defined formally for state s, partner state p at time t by $KI_{spt} = \sum_k abs\left(\frac{L_{skt}}{L_{st}} - \frac{L_{pkt}}{L_{pt}}\right)$ where k indexes 3-digit industries. If two states have exactly the same employment structure the index takes the value 0 while, if two states' employment structures are mirror images of one another, the index takes the value 2. Thus, lower values of the index for states s and p imply that they share a more similar employment structure. As shown in Figure 7, there is no major change in the relative employment structure of Andra Pradesh and the other states post-1991. Similar conclusions hold comparing each state individually with the other Indian states.

A Heckscher-Ohlin based explanation also faces additional problems. In its simplest form, the model is perfectly competitive and therefore yields no predictions for the evolution of industry profitability where we find important effects of both reform and labor market institutions. The model also cannot account for productivity growth that is not purely reallocative, whereas we find that changes in capital accumulation and TFP within state-industries are an important channel through which the effects of reform and pro-worker labor regulation operate.

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 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. 1991. 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

Proof of the claim that $\frac{\partial A_t}{\partial \mu} > 0$:

. Let $\tilde{h} \equiv h/(1-h)$. Then

$$\begin{aligned}
\frac{\partial f_1}{\delta \mu} &= \frac{\tilde{h}\delta}{\left(1-\delta(g+\mu)+\tilde{h}\right)^2}; \\
\frac{\partial f_2}{\delta \mu} &= -\tilde{h}\frac{1-z_1}{1-z_1+\tilde{h}}\frac{1}{\left(1-z_2+\tilde{h}\right)^2}\delta g - \tilde{h}^2\frac{1}{1-z_2+\tilde{h}}\frac{1}{\left(1-z_1+\tilde{h}\right)^2}\delta; \\
\frac{1}{g\bar{A}_{t-2}}\frac{\partial A_t}{\delta \mu} &= (2+g)\frac{\partial f_1}{\delta \mu} + \frac{\partial f_2}{\delta \mu} \\
&= (2+g)\frac{\tilde{h}\delta}{\left(1-z_1+\tilde{h}\right)^2} - \tilde{h}\frac{1-z_1}{1-z_1+\tilde{h}}\frac{1}{\left(1-z_2+\tilde{h}\right)^2}\delta g - \tilde{h}^2\frac{1}{1-z_2+\tilde{h}}\frac{1}{\left(1-z_1+\tilde{h}\right)} \\
&= \frac{\tilde{h}\delta}{\left(1-z_1+\tilde{h}\right)}\left(\frac{(2+g)}{1-z_1+\tilde{h}} - g\frac{(1-z_1)}{\left(1-z_2+\tilde{h}\right)^2} - \tilde{h}\frac{1}{1-z_2+\tilde{h}}\frac{1}{1-z_1+\tilde{h}}\right).
\end{aligned}$$

That the latter expression is strictly positive, or equivalently

$$2+g > g\frac{(1-z_1)\left(1-z_1+\tilde{h}\right)}{\left(1-z_2+\tilde{h}\right)^2} + \frac{\tilde{h}}{1-z_2+\tilde{h}},$$

in turn follows from the following two facts. First:

$$\frac{(1-z_1)\left(1-z_1+\tilde{h}\right)}{\left(1-z_2+\tilde{h}\right)^2} < \frac{\left(1-z_1+\tilde{h}\right)^2}{\left(1-z_2+\tilde{h}\right)^2} < 1$$

since $z_1 > z_2$. Second:

$$\frac{\tilde{h}}{1-z_2+\tilde{h}} < 1.$$

This establishes the claim.

B Data Appendix

The main source of data is the Indian *Annual Survey of Industries* 1980-97. This reports information on gross output, value-added, employment, labour compensation, employment of production workers, production workers compensation, fixed capital stock, investment and profitability at the level of 3-digit industries for the 16 Indian

states listed in Table A1. Price deflators are from the Indian *Handbook of Industrial Statistics* (various issues) 1980-97.

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.

In the *Annual Survey of Industries*, information is not reported separately on state-industries which are so small they violate confidentiality requirements (the minimum state-industry size reported is less 25 employees). To ensure that the results are not driven by small state-industries which enter and exit the data as they rise above or fall below the confidentiality threshold, we restrict attention to state-industries with an average employment of 100 employees or more and on which data exist for at least 10 years.

This yields our baseline estimation sample, which consists of an unbalanced panel of 19,623 observations on 107 3-digit manufacturing industries in the 16 Indian states during 1980-97. Table A2 of the Data Appendix presents further information on the distribution of observations across states, industries and time. As discussed in the main text, we also consider a balanced panel of 10,259 observations on 100 3-digit industries where observations exist on each state-industry for the full 18 years.

Data on imports and tariffs for more than 5000 Harmonised System (HS) 6-digit products are from the United Nations *Trade Analysis and Information System (TRAINS)* and were matched to 3-digit industries. Average tariffs for 3-digit industries were calculated using beginning of period import weights. As robustness tests, we also considered measures based on end of period import weights and arithmetic averages.

Total factor productivity (TFP) is measured at the level of 3-digit state-industries and controls for variation in labor force quality using information on 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 VA is real value-added, N is non-production workers employment, P is production workers employment, K is real fixed capital stock, α_i^N is the average share of payments to non-production workers in value-added, and α_i^P is the average share of payments to production workers in value-added.

Tariff Reduction	1990-2	1992-7	1990-7
Mean	22%	29%	51%
Median	10%	30%	40%
Standard Deviation	34%	18%	41%
Minimum	-50%	-125%	-90%
Maximum	235%	170%	270%

Notes: source is United Nations Trade Analysis and Information System Database (UN TRAINS). Percentage point reduction during 1990-2 is calculated as follows: 1990 tariff minus 1992 tariff. A positive number therefore corresponds to a tariff reduction and a negative number corresponds to a tariff increase. Percentage point reductions during other periods are calculated analogously.

Table 1: Indian Tariff Reductions at the HS 6-digit Level, 1990-7

Table 2: liberalization, within-industry proximity to the Indian frontier and labour productivity							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ln (Y/L)	ln (Y/L)	ln (Y/L)	ln (Y/L)	ln (Y/L)	ln (Y/L)	ln (Y/L)
Pre-reform proximity * reform	0.165***	0.158***	0.162***	-	0.081	0.104**	0.162**
	(0.045)	(0.045)	(0.044)		(0.050)	(0.042)	(0.069)
Pre-reform {0,1} proximity * reform	-	-	-	0.058***	-	-	-
				(0.021)			
Reform	-	-	-	-	-	-0.153***	-
						(0.023)	
Labour regulation	-	-0.042***	-0.032***	-0.034***	-0.014	-0.026***	-0.032**
		(0.010)	(0.010)	(0.010)	(0.009)	(0.010)	(0.015)
Labour regulation * reform	-	-	-0.012***	-0.011***	-	-0.012***	-0.012
			(0.004)	(0.004)		(0.004)	(0.008)
State-industry fixed effects	yes	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes		yes
State-reform dummies					yes		
Industry-time trends						yes	
Three-digit industries	yes	yes	yes	yes	yes	yes	yes
Unbalanced Panel	yes	yes	yes	yes	yes	yes	yes
Discrete proximity to frontier				yes			
Observations	19623	19623	19623	19623	19623	19623	19623
R-squared	0.83	0.83	0.83	0.83	0.83	0.85	0.83
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: sample is a three-dimensional unbalanced panel on 3-digit industries in 16 Indian States during 1980-97 (see Data Appendix for further details concerning the data used). ln (Y/L) is log real registered manufacturing output per employee. Reform equals 0 for 1990 and earlier and equals 1 from 1991 onwards. Pre-reform proximity is pre-reform state-industry labour productivity relative to the state with the highest level of pre-reform labour productivity within the industry. Pre-reform {0,1} proximity is equal to 0 if a state-industry lies at or below the median of the within-industry pre-reform labour productivity distribution and equals 1 if a state-industry lies above the median. Labour regulation is a measure of state pro-worker labour regulation. Since the labour regulation variable is the same for all industries within a state, standard errors in Columns (1)-(7) are adjusted for clustering on state-year cells as well as heteroscedasticity. Column (8) reports alternative standard errors adjusted for clustering on state-industry cells as well as heteroscedasticity. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3: liberalization, within-industry proximity to the Indian frontier and TFP							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ln TFP	ln TFP	ln TFP	ln TFP	ln TFP	ln TFP	ln TFP
Pre-reform proximity * reform	0.096**	0.084**	0.096***	-	0.087**	0.131***	0.096*
	(0.037)	(0.036)	(0.035)		(0.037)	(0.033)	(0.057)
Pre-reform {0,1} proximity * reform	-	-	-	0.084***	-	-	-
				(0.020)			
Reform	-	-	-	-	-	-0.070***	-
						(0.021)	
Labour regulation	-	-0.071***	-0.038***	-0.036***	-0.032**	-0.026**	-0.038**
		(0.014)	(0.013)	(0.013)	(0.014)	(0.012)	(0.017)
Labour regulation * reform	-	-	-0.041***	-0.042***	-	-0.040***	-0.041***
			(0.005)	(0.006)		(0.006)	(0.009)
State-industry fixed effects	yes	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes		yes
State-reform dummies					yes		
Industry-time trends						yes	
Three-digit industries	yes	yes	yes	yes	yes	yes	yes
Unbalanced Panel	yes	yes	yes	yes	yes	yes	yes
Discrete proximity to frontier				yes			
Observations	18528	18528	18528	18528	18528	18528	18528
R-squared	0.60	0.60	0.61	0.61	0.61	0.63	0.61
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: sample is a three-dimensional unbalanced panel on 3-digit industries in 16 Indian States during 1980-97 (see Data Appendix for further details concerning the data used). ln (TFP) is log total factor productivity constructed as detailed in the data appendix. The slightly smaller sample than in Table 1 reflects missing values for some of the variables used to construct TFP. Reform equals 0 for 1990 and earlier and equals 1 from 1991 onwards. Pre-reform proximity is pre-reform state-industry labour productivity relative to the state with the highest level of pre-reform labour productivity within the industry. Pre-reform {0,1} proximity is equal to 0 if a state-industry lies at or below the median of the within-industry pre-reform labour productivity distribution and equals 1 if a state-industry lies above the median. Labour regulation is a measure of state pro-worker labour regulation.

Since the labour regulation variable is the same for all industries within a state, standard errors in Columns (1)-(7) are adjusted for clustering on state-year cells as well as heteroscedasticity. Column (8) reports alternative standard errors adjusted for clustering on state-industry cells as well as heteroscedasticity. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4: liberalization, within-industry proximity to the Indian frontier, real profitability and real capital stock per employee

	(1)	(2)	(3)	(4)	(5)	(6)
	ln (Rprofit)	ln (Rprofit)	ln (Rprofit)	ln (K/L)	ln (K/L)	ln (K/L)
Pre-reform proximity * reform	0.594***	0.486***	0.573***	0.246***	0.104***	0.265***
	(0.097)	(0.104)	(0.096)	(0.040)	(0.040)	(0.044)
Reform	-	-	-0.335***	-	-	-0.240***
			(0.068)			(0.034)
Labour regulation	-0.092***	-0.101***	-0.077**	0.009	0.013	-0.000
	(0.031)	(0.032)	(0.034)	(0.012)	(0.011)	(0.015)
Labour regulation * reform	-0.040***	-	-0.033**	0.031***	-	0.030***
	(0.013)		(0.014)	(0.006)		(0.006)
State-industry fixed effects	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes		yes	yes	
State-reform dummies		yes			yes	
Industry-time trends			yes			yes
Three-digit industries	yes	yes	yes	yes	yes	yes
Unbalanced Panel	yes	yes	yes	yes	yes	yes
Observations	14052	14052	14052	19623	19623	19623
R-squared	0.76	0.76	0.78	0.79	0.79	0.81
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000

Notes: sample is a three-dimensional unbalanced panel on 3-digit industries from 16 Indian States during 1980-97 (see Data Appendix for further details concerning the data used). ln (Rprofit) is log real registered manufacturing profits. ln (K/L) is log real registered manufacturing capital stock per employee. The smaller sample than in Table 1 reflects missing or negative values for real profits. Reform equals 0 for 1990 and earlier and equals 1 from 1991 onwards. Pre-reform proximity is pre-reform state-industry labour productivity relative to the state with the highest level of pre-reform labour productivity within the industry. Pre-reform {0,1} proximity is equal to 0 if a state-industry lies at or below the median of the within-industry pre-reform labour productivity distribution and equals 1 if a state-industry lies above the median. Labour regulation is a measure of state pro-worker labour regulation.

Since the labour regulation variable is the same for all industries within a state, standard errors in Columns (1)-(7) are adjusted for clustering on state-year cells as well as heteroscedasticity. Column (8) reports alternative standard errors adjusted for clustering on state-industry cells as well as heteroscedasticity. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5: liberalization, within-industry proximity to the Indian frontier, real manufacturing output and employment

	(1)	(2)	(3)	(4)	(5)	(6)
	ln Y	ln Y	ln Y	ln L	ln L	ln L
Pre-reform proximity * reform	0.574***	0.517***	0.461***	0.412***	0.435***	0.357***
	(0.070)	(0.076)	(0.063)	(0.044)	(0.047)	(0.043)
Pre-reform {0,1} proximity * reform	-	-	-	-	-	-
Reform	-	-	-0.280***	-	-	-0.127***
			(0.037)			(0.027)
Labour regulation	-0.076***	-0.083***	-0.060***	-0.044***	-0.069***	-0.033*
	(0.020)	(0.021)	(0.021)	(0.016)	(0.014)	(0.018)
Labour regulation * reform	-0.066***	-	-0.062***	-0.054***	-	-0.049***
	(0.009)		(0.008)	(0.007)		(0.007)
State-industry fixed effects	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes		yes	yes	
State-reform dummies		yes			yes	
Industry-time trends			yes			yes
Three-digit industries	yes	yes	yes	yes	yes	yes
Unbalanced Panel	yes	yes	yes	yes	yes	yes
Observations	19623	19623	19623	19623	19623	19623
R-squared	0.88	0.88	0.90	0.86	0.86	0.89
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000

Notes: sample is a three-dimensional unbalanced panel on 3-digit industries from 16 Indian States during 1980-97 (see Data Appendix for further details concerning the data used). ln (Y) is log real registered manufacturing output. ln (L) is log registered manufacturing employees. Reform equals 0 for 1990 and earlier and equals 1 from 1991 onwards. Pre-reform proximity is pre-reform state-industry labour productivity relative to the state with the highest level of pre-reform labour productivity within the industry. Pre-reform {0,1} proximity is equal to 0 if a state-industry lies at or below the median of the within-industry pre-reform labour productivity distribution and equals 1 if a state-industry lies above the median. Labour regulation is a measure of state pro-worker labour regulation.

Since the labour regulation variable is the same for all industries within a state, standard errors in Columns (1)-(7) are adjusted for clustering on state-year cells as well as heteroscedasticity. Column (8) reports alternative standard errors adjusted for clustering on state-industry cells as well as heteroscedasticity. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6: robustness, balanced panel

	(1)	(2)	(3)	(4)	(5)	(6)
	ln (Y/L)	ln TFP	ln (Rprofit)	ln (K/L)	ln Y	ln L
Pre-reform proximity * reform	0.126**	0.131***	0.598***	0.230***	0.409***	0.283***
	(0.051)	(0.050)	(0.114)	(0.047)	(0.050)	(0.044)
Labour regulation	-0.026***	-0.021**	-0.095**	-0.021	-0.121***	-0.096***
	(0.009)	(0.010)	(0.037)	(0.014)	(0.018)	(0.014)
Labour regulation * reform	-0.007*	-0.027***	-0.037**	0.032***	-0.043***	-0.036***
	(0.004)	(0.005)	(0.014)	(0.007)	(0.009)	(0.007)
State-industry fixed effects	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes	yes
Three-digit industries	yes	yes	yes	yes	yes	yes
Balanced panel	yes	yes	yes	yes	yes	yes
Observations	10259	9658	7852	10259	10259	10259
R-squared	0.86	0.64	0.77	0.84	0.91	0.90
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000

Notes: sample is a three-dimensional balanced panel on 3-digit industries in 16 Indian States during 1980-97 (see Data Appendix for further details concerning the data used). ln (Y) is log real registered manufacturing output; ln L is log registered manufacturing employees; ln (Y/L) is log real registered manufacturing output per employee; ln (Rprofit) is log real registered manufacturing profitability; ln (K/L) is log real registered manufacturing capital stock per employee. The smaller sample in Column (2) reflects missing values for variables used to construct TFP. The smaller sample in Column (3) reflects missing or negative values for profitability. Reform equals 0 for 1990 and earlier and equals 1 from 1991 onwards. Pre-reform proximity is pre-reform state-industry labour productivity relative to the state with the highest level of pre-reform labour productivity within the industry. Pre-reform {0,1} proximity is equal to 0 if a state-industry lies at or below the median of the within-industry pre-reform labour productivity distribution and equals 1 if a state-industry lies above the median.

Since the labour regulation variable is the same for all industries within a state, standard errors in Columns (1)-(7) are adjusted for clustering on state-year cells as well as heteroscedasticity. Column (8) reports alternative standard errors adjusted for clustering on state-industry cells as well as heteroscedasticity. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 7: robustness, political controls and high versus low reform industries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	ln (Y/L)	ln TFP	ln (Rprofit)	ln (K/L)	ln Y	ln L	ln (Y/L)	ln TFP	ln (Rprofit)	ln (K/L)	ln Y	ln L
							Effect in Low-reform industries					
Pre-reform proximity * reform	0.205***	0.141***	0.575***	0.218***	0.528***	0.323***	0.109**	0.075**	0.486***	0.280***	0.437***	0.328***
	(0.052)	(0.040)	(0.107)	(0.045)	(0.081)	(0.049)	(0.042)	(0.036)	(0.109)	(0.040)	(0.070)	(0.045)
Labour regulation	-0.007	-0.034***	-0.072**	0.041***	-0.062***	-0.055***	-0.053***	-0.050***	-0.094***	-0.004	-0.079***	-0.026
	(0.008)	(0.013)	(0.034)	(0.013)	(0.019)	(0.015)	(0.011)	(0.013)	(0.035)	(0.013)	(0.022)	(0.018)
Labour regulation * reform	-0.008*	-0.027***	-0.043**	0.029***	-0.051***	-0.043***	-0.004	-0.043***	-0.055***	0.035***	-0.053***	-0.049***
	(0.005)	(0.005)	(0.017)	(0.007)	(0.011)	(0.008)	(0.004)	(0.006)	(0.017)	(0.007)	(0.010)	(0.008)
							Additional Effect in High-reform industries					
Pre-reform proximity * reform * high reform industry	-	-	-	-	-	-	0.108*	0.041	0.173	-0.122*	0.342***	0.234***
							(0.062)	(0.061)	(0.148)	(0.069)	(0.072)	(0.058)
Labour regulation * high reform industry	-	-	-	-	-	-	0.060***	0.038***	-0.001	0.036**	0.002	-0.058***
							(0.009)	(0.011)	(0.035)	(0.016)	(0.017)	(0.018)
Labour regulation * reform * high reform industry	-	-	-	-	-	-	-0.026***	0.000	0.040	-0.011	-0.039***	-0.013
							(0.007)	(0.009)	(0.029)	(0.012)	(0.013)	(0.010)
Proportion Congress	-0.311***	-0.276***	-0.188	-0.289*	-0.533***	-0.222**	-	-	-	-	-	-
	(0.105)	(0.090)	(0.324)	(0.157)	(0.177)	(0.108)						
Proportion hard left	-0.916***	-0.611***	-1.145*	-1.263***	-1.009***	-0.093	-	-	-	-	-	-
	(0.177)	(0.234)	(0.657)	(0.276)	(0.321)	(0.230)						
Proportion soft left	0.268	0.721***	-0.778	-0.213	-0.287	-0.555	-	-	-	-	-	-
	(0.492)	(0.214)	(1.040)	(0.688)	(0.794)	(0.392)						
Proportion Janata	-0.310***	-0.253**	-0.170	-0.285*	-0.520***	-0.210*	-	-	-	-	-	-
	(0.108)	(0.104)	(0.330)	(0.154)	(0.177)	(0.113)						
Proportion Hindu Nationalist	-0.057	-0.255**	0.374	0.077	-0.034	0.023	-	-	-	-	-	-
	(0.121)	(0.110)	(0.359)	(0.183)	(0.210)	(0.128)						
Proportion regional parties	-0.174**	-0.324***	-0.038	-0.117	-0.493***	-0.319***	-	-	-	-	-	-
	(0.086)	(0.082)	(0.273)	(0.129)	(0.150)	(0.102)						
State-industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes	yes						
High/low reform industry-year dummies							yes	yes	yes	yes	yes	yes
Three-digit industries	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Unbalanced panel	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Labour productivity proximity	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	16608	15735	11897	16608	16608	16608	19396	18306	13858	19396	19396	19396
R-squared	0.84	0.63	0.77	0.79	0.88	0.87	0.83	0.61	0.77	0.79	0.88	0.87
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: sample is a three-dimensional unbalanced panel on 3-digit industries in 16 Indian States during 1980-97 (see Data Appendix for further details concerning the data used). ln (Y) is log real registered manufacturing output; ln L is log registered manufacturing employees; ln (Y/L) is log real registered manufacturing output per employee; ln (Rprofit) is log real registered manufacturing profitability; ln (K/L) is log real registered manufacturing capital stock per employee. Reform equals 0 for 1990 and earlier and equals 1 from 1991 onwards. Pre-reform proximity is pre-reform state-industry labour productivity relative to the state with the highest level of pre-reform labour productivity within the industry. Pre-reform {0,1} proximity is equal to 0 if a state-industry lies at or below the median of the within-industry pre-reform labour productivity distribution and equals 1 if a state-industry lies above the median. High reform industry is equal to 1 if an industry experiences an above median proportional fall in tariffs during 1991-7, has no compulsory industrial licensing restrictions post-1991 and has no restriction to public sector activity post-1991. High reform industry is equal to 0 otherwise.

Labour regulation is a measure of state pro-worker labour regulation. Since the labour regulation variable is the same for all industries within a state, standard errors in Columns (1)-(7) are adjusted for clustering on state-year cells as well as heteroscedasticity. Column (8) reports alternative standard errors adjusted for clustering on state-industry cells as well as heteroscedasticity. * significant at 10%; ** significant at 5%; *** significant at 1%.

Figure 1: Total Manufacturing Imports/Gross Output

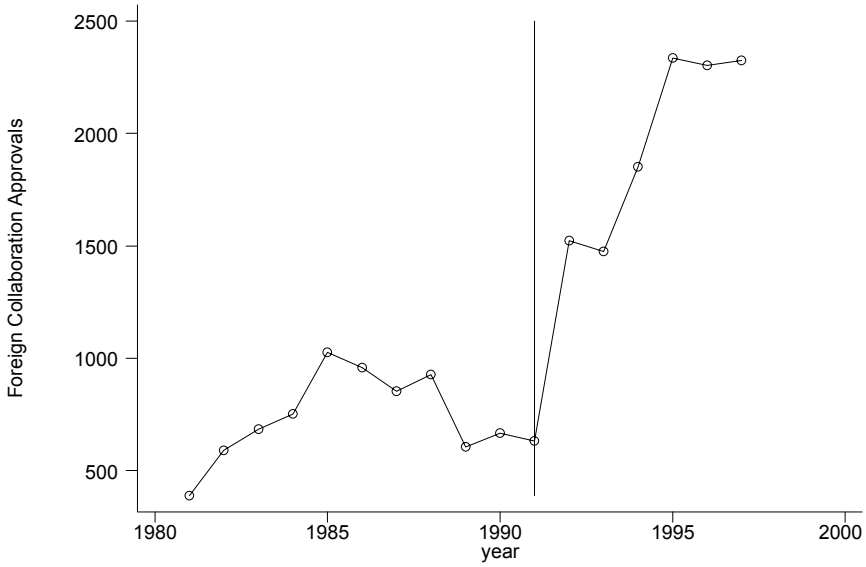

Figure 2: Foreign Collaboration Approvals (Investment and Technology)

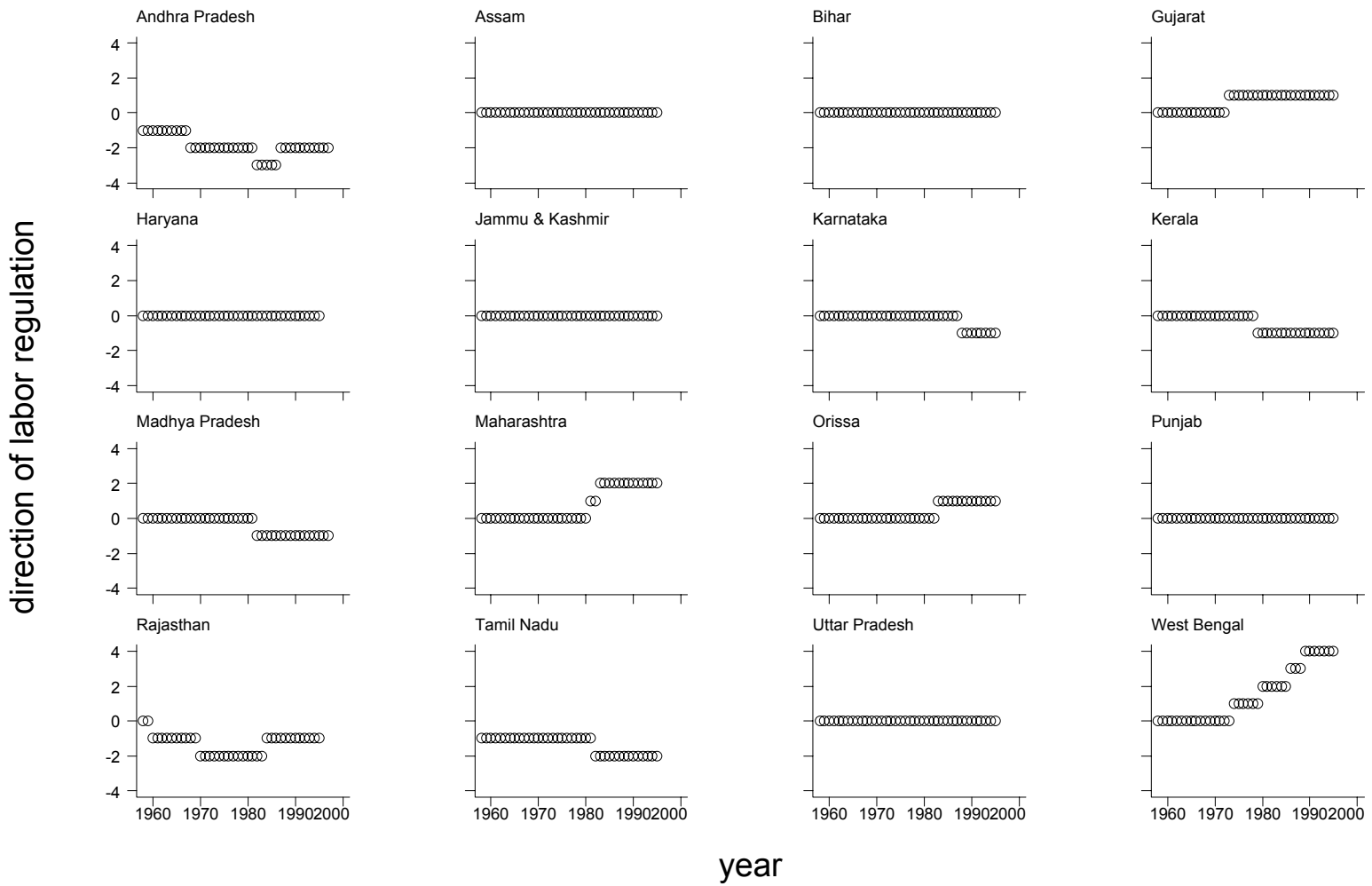

Figure 3: Labour Regulation in India: 1958-2000

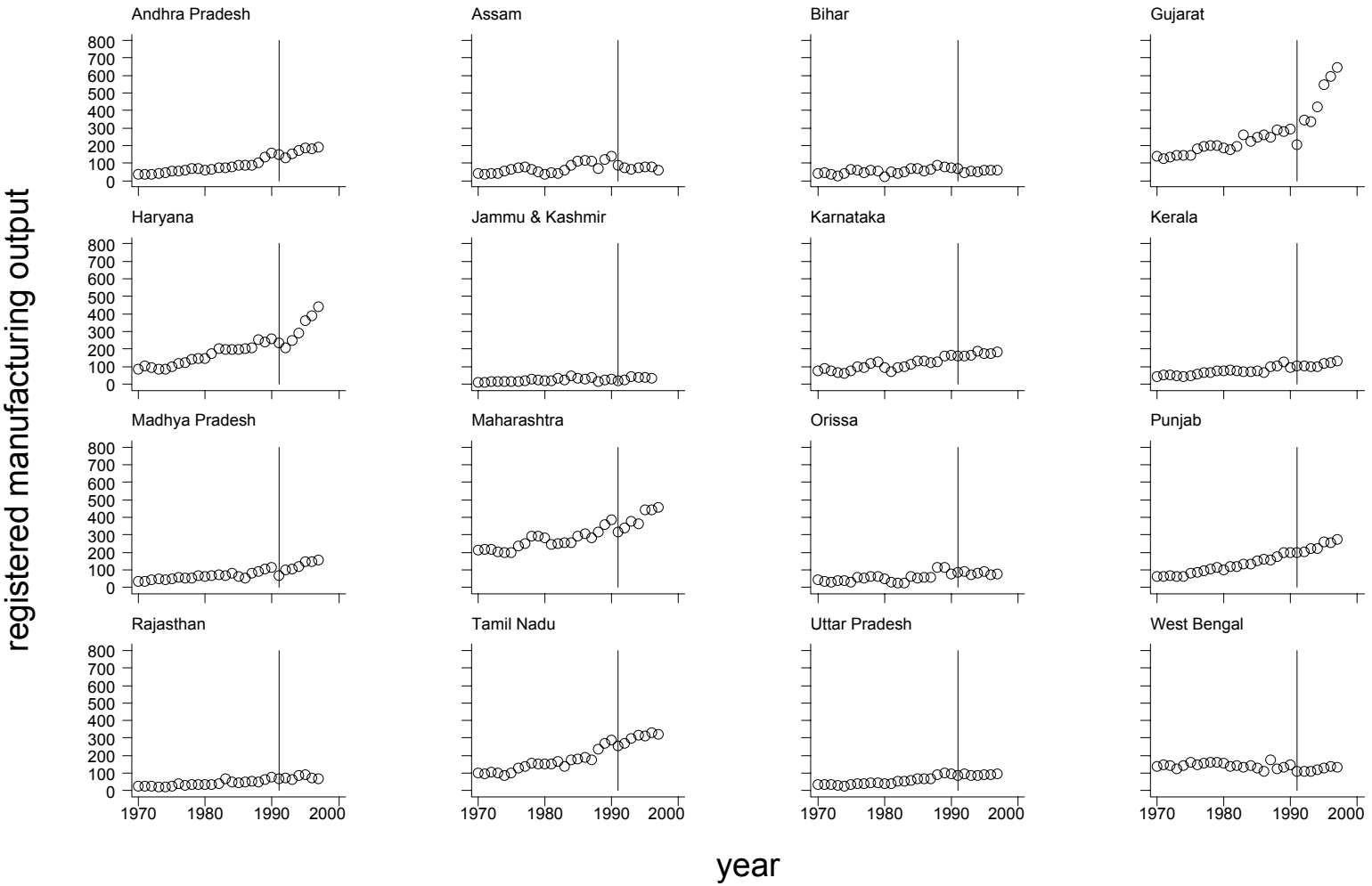

Figure 4: Registered Manufacturing Output Per Capita: 1970-2000

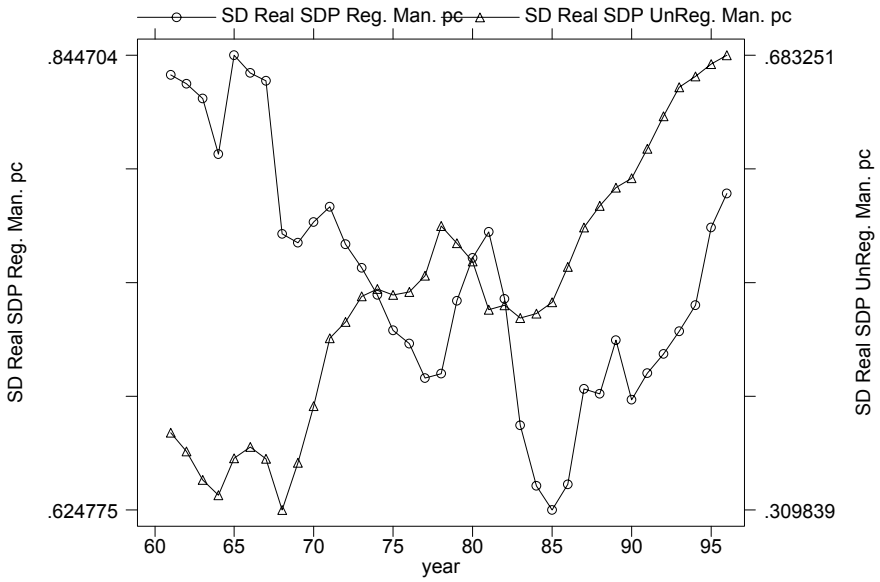

Figure 5: Standard Deviation Manufacturing Output per Capita

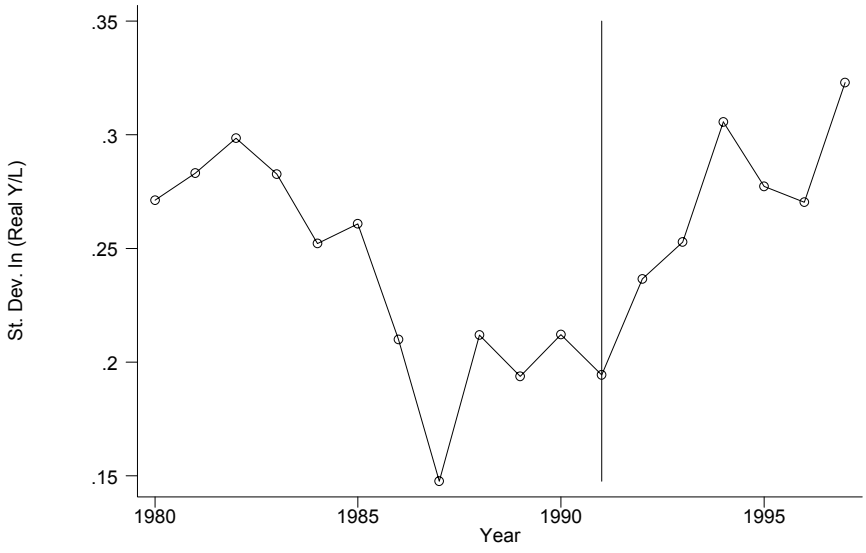

Figure 6: Standard Deviation Registered Manufacturing Output per Worker

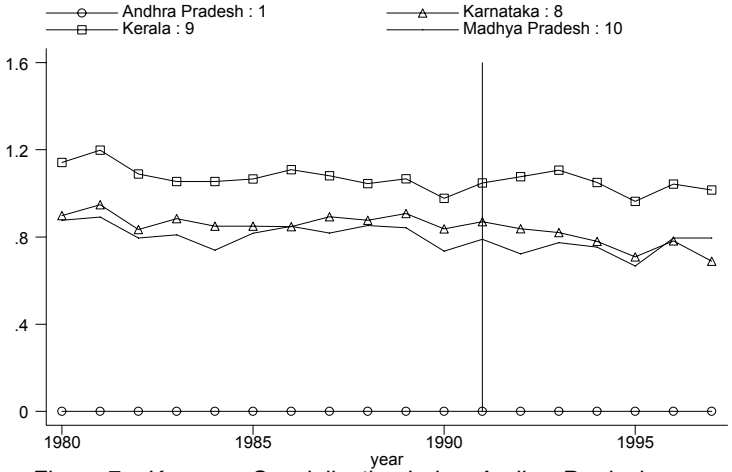

Figure 7a: Krugman Specialization Index, Andhra Pradesh

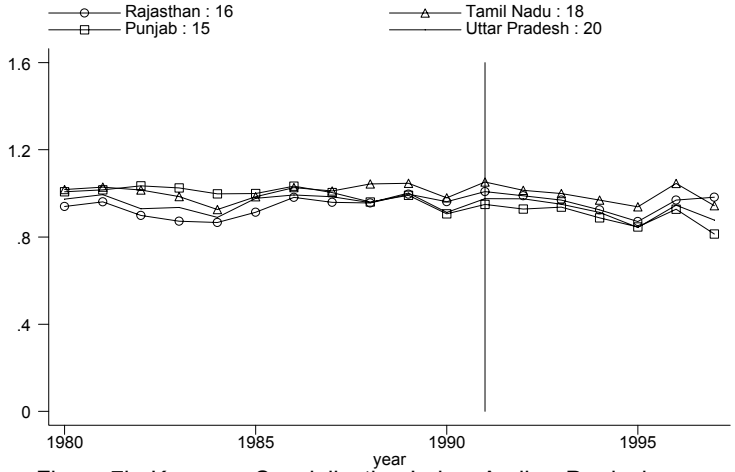

Figure 7b: Krugman Specialization Index, Andhra Pradesh

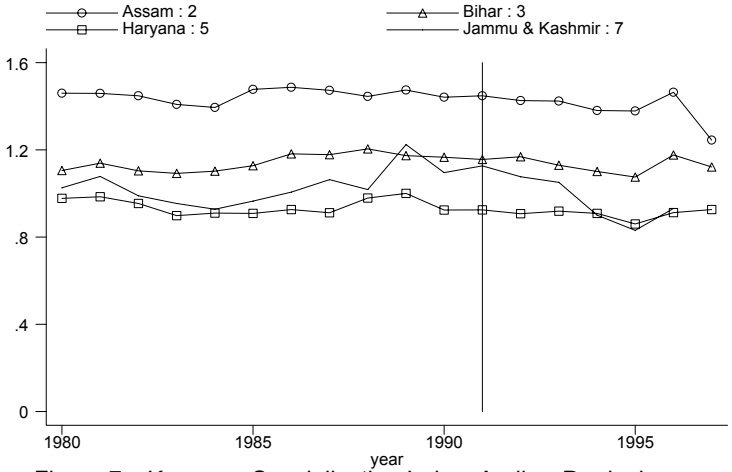

Figure 7c: Krugman Specialization Index, Andhra Pradesh

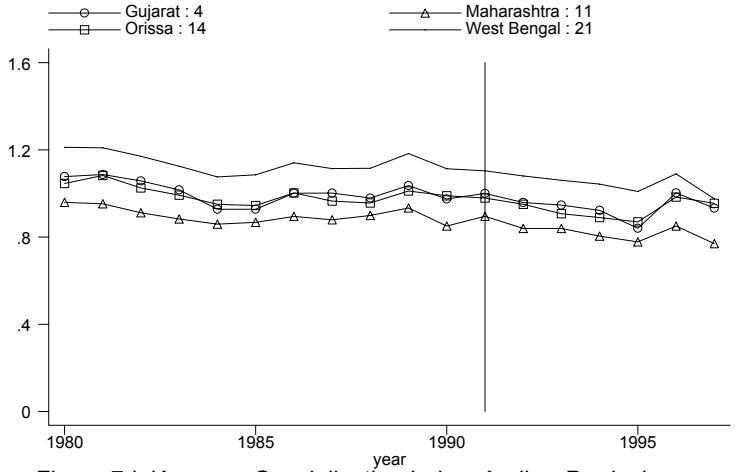

Figure 7d: Krugman Specialization Index, Andhra Pradesh

Table A1: States of India	
State code	**State Name**
1	Andra Pradesh
2	Assam
3	Bihar
4	Gujarat
5	Haryana
7	Jammu & Kashmir
8	Karnataka
9	Kerala
10	Madhya Pradesh
11	Maharashtra
14	Orissa
15	Punjab
16	Rajasthan
18	Tamil Nadu
20	Uttar Pradesh
21	West Bengal

Table A2: distribution of observations across states, industries and time in the unbalanced panel		
Number of industries per state		
	Number of Obs	**Cumulative Percentage of Sample**
< 10	0	0
< 25	292	1.49
< 50	1455	7.41
<100	15459	78.78
<110	19623	100.00
Minimum number of states per industry across time		
	Number of Obs	**Cumulative Percentage of Sample**
< 5	4875	24.84
< 10	15145	77.18
< 15	19623	100.00
Number of years per state-industry		
	Number of Obs	**Cumulative Percentage of Sample**
< 10	0	0
< 15	1293	6.59
<=18	19623	100.00