

# ENTRY LIBERALIZATION AND INEQUALITY IN INDUSTRIAL PERFORMANCE\*

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## Abstract

Industrial delicensing which began in 1985 in India marked a discrete break from a past of centrally planned industrial development. Similar liberalization episodes are taking place across the globe. We develop a simple Schumpeterian growth model to understand how firms respond to the entry threat imposed by liberalization. The model emphasises that firm responses, even within the same industrial sector, are likely to be heterogeneous leading to an increase in within industry inequality. Technologically advanced firms and those located in regions with pro-business institutions are more likely to respond to the threat of entry by investing in new technologies and production processes. Empirical analysis using a panel of 3-digit state-industry data from India for the period 1980-1997 confirms that delicensing led to an increase in within industry inequality in industrial performance.

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## 1. Introduction

Economic liberalization is happening across the globe. Within the same industrial sector, firms which have different technological capabilities or which are located in regions with different types of institutions, may respond in a heterogeneous manner to the competitive pressure imposed by the removal of barriers to entry during liberalization episodes. In short, the effects of liberalization may be unequal – some firms may benefit whilst others suffer, leading to growing within industry inequality in industrial performance. This paper looks directly at this issue from both a theoretical and empirical standpoint. In doing so it departs from much of the recent literature which attempts to evaluate the average effects of economic liberalization on industrial performance.<sup>1</sup>

To guide our research we construct a simple version of a Schumpeterian growth model with entry threat. How firms respond to this entry threat by investing in new technologies and production processes will be determined by two sets of factors, one internal to firms and the other external. Technological capability of firms determines their ability to compete with potential entrants. Firms close to the technological frontier will be incentivised to invest and innovate whilst those far from frontier will be disincentivised. The institutional environment in which firms operate which is captured, for example, by the extent to which labor institutions are pro-employer

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<sup>1</sup>See, for example, Pavcnik (2002), Topalova (2004) and the survey in Tybout (2003). Here we review and highlight aspects of recent research pursued in a companion paper (see Aghion, Burgess, Redding and Zilibotti 2004).

in a given region, will also affect the extent to which they respond to entry threats via investment and innovation. For these reasons, as entry barriers come down with liberalization we expect to observe growing divergence in economic performance across industries within the same industrial sector but located in different regions of a country.

It is this core prediction of entry liberalization leading to rising within industry inequality that we take to the data. To do this we exploit a 3-digit state-industry panel data set gathered by the Annual Survey of Industries in India for the period 1980-1997. In the period since Independence in 1947, India remained a relatively closed economy with an extensive role for central planning of industry via licensing and other instruments. The delicensing reforms of Rajiv Gandhi in 1985 and the more substantial entry liberalization of 1991 marked a discrete break with the past. To capture entry liberalization we construct a delicensing measure which records when a given 3-digit industry was delicensed. We then relate this measure to inequality in economic performance across 3-digit state-industries within the same 3-digit industrial sector. This enables us to examine directly whether the reduction in barriers to entry led to a divergence in industrial performance across Indian states within the same 3-digit industrial sector as is predicted by the model.

The paper is structured as follows. Section 2 presents some theory which enables us to examine how the removal of barriers to entry affects industrial performance depending on the technological capacity of firms and their institutional environment.

Section 3 presents empirical analysis of the link between entry liberalization and within industry inequality using an Indian 3-digit state-industry panel for the period 1980-1997. Section 4 concludes.

## 2. The Model<sup>2</sup>

Consider the following version of the Schumpeterian discrete-time model of Acemoglu, Aghion and Zilibotti (2004). The model economy consists of a set of “states” (or regions) which differ in their factor endowments, distribution of productivities across firms and labor market regulations.

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

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

$x_{s,t}(\nu)$  is the quantity of intermediate input produced in sector  $\nu$ , state  $s$  and date  $t$ ,  $A_{s,t}(\nu)$  is a productivity parameter that measures the quality of the intermediate input  $\nu$  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.

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<sup>2</sup>This model was first developed in Aghion, Burgess, Redding and Zilibotti (2004).

In each intermediate sector  $\nu$  only one firm (a monopolist) is active in each period, and property rights over intermediate firms are transmitted within dynasties. A firm consists of an entrepreneur, who has the power to take decisions concerning production and investments, workers that for simplicity we assume to be in a fixed number, and a technology to transform one unit of the final good into one unit of intermediate good of productivity  $A_t(\nu)$ .

Standard analysis (see Acemoglu, Aghion and Zilibotti, 2004) shows that the surplus generated by this firm is equal to  $\alpha^{\frac{1}{1-\alpha}} (\frac{1-\alpha}{\alpha}) A_t(\nu)$ . Entrepreneurs and workers split this surplus according to the Nash rule. The share appropriated by each of the parties, say  $\beta$  and  $(1 - \beta)$ , depend on their bargaining strengths, which is assumed to depend on institutional features (state-specific labor legislation). Let  $\delta \equiv \beta \cdot \alpha^{\frac{1}{1-\alpha}} (1 - \alpha) / \alpha$ . The equilibrium profit appropriated by the entrepreneur is, then:

$$\pi_t(\nu) = \delta A_t(\nu).$$

Also, substituting for the equilibrium production level of each intermediate good,  $x_t(\nu)$ , in the production function for final output, we obtain the total output level  $y_t = \alpha^{\frac{2\alpha-1}{1-\alpha}} A_t$  where  $A_t \equiv \int_0^1 A_t(\nu) d\nu$  is the average productivity in the state.

### 2.1. Technological states, innovation, and entry

In every period, and within each state, intermediate firms 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  $\bar{A}_t$  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  $t - 1$ ), the leading firm in the production of a particular intermediate input can be in two states: (i) "high-productivity" firms have a productivity level  $A_{t-1}(\nu) = \bar{A}_{t-1}$ , namely, are at the current frontier; (ii) "low-productivity" firms have a productivity level  $A_{t-1}(\nu) = \bar{A}_{t-2}$ , namely, are one step behind it.

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

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

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

We make the following assumptions about firms' dynamics. If an advanced firm is successful at  $t$ , it starts as an advanced firm at  $t+1$ . All other firms start as backward firms (note that this implies that firms with a realized productivity equal to  $A_{t-2}$  at  $t$  automatically upgrade their initial productivity due to some spillover effect). However, in this case, with an exogenous probability  $h$ , the leader is replaced by a new firm starting as advanced at  $t+1$ . Let  $a_t$  denote the proportion of "advanced" firms at  $t$ , and  $z_A$  denote the innovative investment of advanced firms. Then the productivity distribution is characterized by the following dynamics:

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

implying the steady-state proportion of advanced firms being equal to  $a^* = \frac{h}{1 - z_A(1 - h)}$ .

Intermediate firms are subject to competition from outsiders. In particular, we assume that, in every period, an outsider can operate a hit-and-run entry in the local market for a particular intermediate good.<sup>3</sup> Outside firms observe the outcome of the innovative investment of the local firm, and face the following decision. They can either stay out of the market, or pay a small fixed cost,  $\zeta$ , and be granted permission to sell in the local market with probability  $\mu$ .<sup>4</sup> Outsiders are assumed have the frontier productivity,  $\bar{A}_t$ .

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<sup>3</sup>A variant of this model with permanent entry is developed by Aghion, Blundell, Griffith, Howitt and Brantl (2004) who then confront it with UK firm level data on entry threat, actual entry, patenting and productivity growth.

<sup>4</sup>We can interpret  $\mu$  as the probability of success of an application for a license or in overcoming other legal barriers to starting production.

If an outsider enters and competes with a low productivity firm, it steals all the market. If it competes with a high-productivity firm, however, Bertrand competition drives the profits of both firms to zero. We assume the parameters to be such that the outside firm will always find it profitable to try to enter if the market is controlled by a low-productivity firm. However, the outsider will not try to enter if there is a high-productivity incumbent. Therefore, the probability of entry in the market for input  $\nu$  will be zero, if the local firm  $\nu$  was initially “advanced” and has undertaken a successful innovative investment. Else, the probability is  $\mu$ .

## 2.2. *Equilibrium innovation investments*

We now consider the decisions of incumbent producers in each of the 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  $t$ . This is a useful simplification that avoids the need to solve more complicated dynamic problems.

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

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

whose solution yields:

$$z = \delta (1 - \mu) g = z_B. \quad (1)$$

Recall that backward firms can only make profits if there is no entry (probability  $1 - \mu$ ). The productivity is  $\bar{A}_{t-1}$  if the investment is successful (probability  $z$ ) and  $\bar{A}_{t-2}$  if the investment is not successful (probability  $1 - z$ ).<sup>5</sup>

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

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

whose solution yields:

$$z = \delta (g + \mu) = z_A. \quad (2)$$

In this case, incumbent firms can prevent entry by successfully adopting the last technology, which occurs with probability  $z$ . In this case, the local firm has a productivity level  $\bar{A}_t$ . The firm also retains the market if the investment is not successful, but there is no entry. This event occurs with probability  $(1 - \mu) (1 - z)$ . In this case the firm's productivity is  $\bar{A}_{t-1}$ .

We interpret an increase of the entry threat,  $\mu$ , as a liberalization reform.

Straightforward differentiation of equilibrium innovation intensities with respect to

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<sup>5</sup>One could generalize the model to allow for the possibility that through aggressive innovative investments backward firms can catch-up with the frontier. This would create scope for defensive innovation from backward firms when the probability of entry increases. As long as the probability that backward firms can make large jumps is sufficiently low, this extension would not change qualitatively the comparative statics of the model.

$\mu$  yields:

$$\frac{\partial z_A}{\partial \mu} = \delta > 0 \text{ and } \frac{\partial z_B}{\partial \mu} = -\delta g < 0. \quad (3)$$

In other words, *increasing the entry threat (e.g., through slashing barriers to entry via delicensing) encourages innovation in advanced firms and discourages it in backward firms.* The intuition for these comparative statics is immediate. The higher the threat of entry, the more important 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 the incentive for the incumbent to invest in innovation.

Next, consider the effects of changes in labor market regulations on innovative investments. “Pro-worker” regulations are captured by smaller  $\delta'$ s, as discussed above. It is immediate that

$$\frac{\partial z_A}{\partial \delta} = g + \mu > 0 \text{ and } \frac{\partial z_B}{\partial \delta} = (1 - \mu) g > 0.$$

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

### 2.3. Predictions for state-industries

We have so far assumed, for simplicity, that there is only one sector of activity. The stylized model presented above can be reinterpreted as describing a single industry rather than the economy as a whole. Each state-industry should then be viewed as an "island" populated by a set of competitive final producers and a set of non-competitive differentiated intermediated producers. The products of different industries are perfect substitutes in consumption, and the price of all final goods is set equal to unity. Thus, the equilibrium described in this section, as well as its comparative statics, can be regarded as the equilibrium of a state-industry. The average productivity of firms in state-industry is  $A_{i,s,t} = \int_0^1 A_{i,s,t}(\nu) d\nu$ .

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

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

where  $h_{i,s} = h + \varepsilon_{i,s}$ . This representation allows us to introduce in a parsimonious way steady-state productivity differences across state-industries: more advanced state-industries (conditional on labor market regulations) are those with high  $h_{i,s}$ 's. The model's predictions for firm behavior now hold at the level of state-industries (see Aghion, Burgess, Redding and Zilibotti, 2004).

### 3. The Unequal Effects of Liberalization<sup>6</sup>

State control of Indian industry was enshrined in the Industries (Development and Regulation) Act of 1951 whereby firms required a licence in order to establish a new factory, to expand capacity by more than 25% of existing levels, or to manufacture a new product. These controls were supplemented with state controls on financial intermediation, imports, foreign direct investment and high tariff and non-tariff barriers as part of an overall strategy of centrally planned industrial development. Licensing enabled the state to control the pattern of industrial development across Indian states and to address regional disparities. India lived under this “License Raj” for the bulk of its post-colonial history, however, slow growth in the late-1960s and 1970s (see Table 1) generated pressure for change culminating in Rajiv Gandhi’s reforms of the mid-1980s where one third of Indian 3-digit manufacturing industries were exempted from industrial licensing. A growing fiscal and balance of payment crisis (which necessitated intervention by the IMF) and the assassination of Rajiv Gandhi which led to the appointment of Narasimha Rao to Prime Minister and of Manmohan Singh to Finance Minister precipitated more dramatic internal and external liberalization in 1991. Compulsory industrial licensing was abolished in all but a few industries so that as of 1991 85% of all 3-digit manufacturing industries were delicensed. There was also significant reductions in tariff and non-tariff barriers and a loosening of controls on imports and foreign investment.

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<sup>6</sup>This section is based on Aghion, Burgess, Redding and Zilibotti (2004).

State panel data for the period 1960-1997 from Besley and Burgess (2004) suggests that economic liberalization was associated with rising economic growth, particularly in the manufacturing sector (see Table 1).<sup>7</sup> Figure 1 examines the evolution of cross-state inequality by graphing out the standard deviation of log registered and unregistered manufacturing output per capita for the years 1960 to 1997. The distinction between these two sectors is germane as the unregistered (informal) sector of small firms is not subject to licensing controls whereas the registered (formal) sector of larger firms is.<sup>8</sup> Inequality in registered manufacturing output declines from 1960 until 1985 and then increases up to 1997. In line with the predictions of the model we see that delicensing post-1985 is associated with rising inequality in the regulated manufacturing sector.<sup>9</sup> In contrast, inequality in the unregulated manufacturing sector rises across the whole period.

Using Indian Annual Survey of Industries data we can carry out a similar exercise looking at inequality across states within 3-digit registered manufacturing industries. To do this we calculate the standard deviation across states of log gross output and output per employee within a 3-digit manufacturing industry for each year between 1980 and 1997. Figure 2 graphs the three-year moving average of the median of these within-industry standard deviations across this period. Consistent with the model we observe growing inequality following the 1985 delicensing reforms, with

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<sup>7</sup>See Rodrik and Subramanian (2004) and Topalova (2004).

<sup>8</sup>Manufacturing firms with more than ten employees with power or with more than twenty without are classified as registered whereas firms below these cut-offs are classified as unregistered.

<sup>9</sup>The falling trend pre-1985 reflects the use of licensing and other state controls to reduce regional disparities in industrial development.

the within industry inequalizing effects of liberalization becoming particularly strong post-1991.<sup>10</sup>

To directly link within 3-digit industry inequality to industrial delicensing we run regressions of the form:

$$y_{it} = delic_{it} + d_t + \eta_i + u_{it}$$

where  $i$  denotes a 3-digit registered manufacturing industry and  $t$  year,  $y_{it}$  is an economic outcome of interest,  $delic_{it}$  is a 0/1 dummy which switches on when a 3-digit industry is delicensed,  $d_t$  is a year dummy that controls for common macro-economic shocks and will capture the overall effects of the 1985 and 1991 liberalizations across all 3-digit industries,  $\eta_i$  is an industry fixed effect that controls for unobserved heterogeneity across 3-digit industries, and  $u_{it}$  is a stochastic error. To allow for heteroscedasticity and serial correlation in the error term over time, the standard errors are corrected for clustering at the 3-digit industry level. This is a “differences in differences” specification, where the effect of delicensing is identified from the differential change over time in the economic outcome in industries which delicense relative to industries where compulsory industrial licensing is retained.

The  $delic_{it}$  measure corresponds to the probability of entry measure  $u$  in the

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<sup>10</sup>These findings concerning aggregate and within-industry inequality are robust to considering alternative measures of dispersion such as the coefficient of variation or the difference in log output, log output per capita, or log output per worker at the 90th and 10th percentiles of the cross-state distribution.

model. We would therefore expect industrial delicensing to encourage entry.<sup>11</sup> Column (1) of Table 2 confirms this where we see that delicensing increases the number of factories in a 3-digit industry. We are now in a position to link entry liberalization to inequality in industrial performance within 3-digit industries across states. Columns (2) and (3) shows that delicensing leads to an increase in within industry inequality in output and output per employee. Columns (4) and (5) show a similar pattern for two superlative index measures of total factor productivity.

This finding of rising inequality following entry liberalization is consistent with the theoretical model which emphasizes how a common reform may have uneven effects on the performance of state-industries within a given industrial sector. In Aghion, Burgess, Redding and Zilibotti (2004) we explore how a state-industry's distance to the Indian technological frontier and state specific labor market institutions can help us understand rising within 3-digit industry inequality across the 1980-1997 period.<sup>12</sup>

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<sup>11</sup>This view is confirmed in the Government of India's own official reports (e.g. Reports of the 1969 Industrial Licencing Policy Enquiry Committee and the 1985 Narasimhan Committee on Replacement of Physical by Financial Controls).

<sup>12</sup>The paper is contribution to the growing literature which emphasises that a firms distance from the technological frontier will determine the extent to which it benefits from entry. Sabirianova, Svenjar and Terrell (2004), for example, find that greater presence of foreign firms in a given industry has a negative average effect on the productive efficiency of Czech and Russian domestic firms but the effect is positive on the efficiency of other foreign owned firms.

#### 4. Conclusions

The world has tended to divide between those who are for or against liberalization. Reality it turns out is more nuanced – there can no *a priori* assumption that industry in a particular region of a country will benefit from or be harmed by liberalization. Consistent with our theoretical model we find that entry deregulation elicited heterogeneous responses from industries in the same 3-digit sector but located in different states of India. This is an important finding as it suggests that actions by firms to upgrade technological capability or by policy makers to improve the institutional environment will have a central bearing on whether industry in a given sector and state benefits from or is harmed by the process of economic liberalization. Identification of policies which enable local industry to benefit from economic liberalization is where the research frontier now lies. The combination of economic theory and microeconomic data sources, together with an emphasis on incentives and technology, provides a fruitful avenue for further research on the microeconomics of industrial development.

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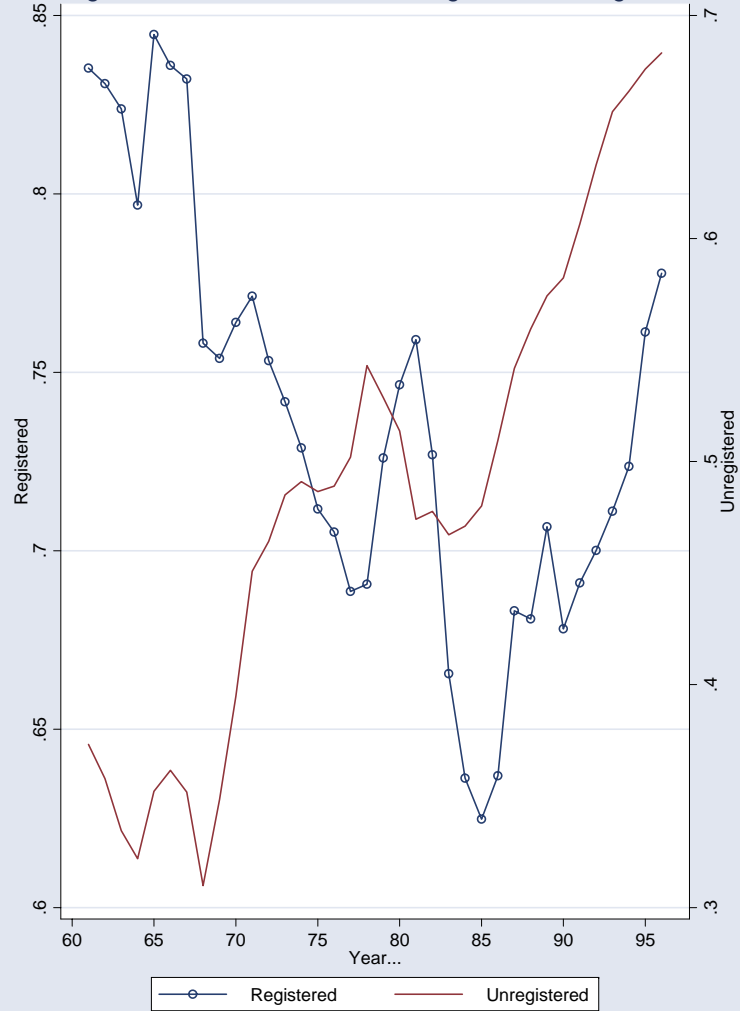
Table 1 : Economic Growth in India, 1960-97			
	Annual Growth SDP per capita	Annual Growth Manufacturing SDP per capita	Annual Growth Registered Manufacturing SDP per capita
1960-70	2.82%	1.89%	2.58%
1970-80	1.53%	3.90%	3.39%
1980-85	2.90%	4.17%	5.78%
1985-90	3.76%	5.68%	6.92%
1991-97	4.06%	6.90%	8.19%

*Notes:* SDP denotes real state domestic product. Nominal domestic product in each state is deflated using a rural-urban population weighted average of the consumer price indices for industrial workers and agricultural laborers. Registered manufacturing corresponds to all factories with more than 10 employees with power or more than 20 employees without power. The data source is Besley and Burgess (2004).

Table 2: Delicensing, Entry and Within-industry Inequality					
	(1)	(2)	(3)	(4)	(5)
	Number of Factories	St Dev ln(Y)	St Dev ln(Y/L)	St Dev ln(TFP1)	St Dev ln(TFP2)
Industry delicensed	87.581** (36.311)	0.131*** (0.040)	0.066*** (0.021)	0.051** (0.024)	0.052** (0.025)
Observations	1764	1764	1764	1764	1764
R-squared	0.97	0.65	0.64	0.37	0.37
Industry fixed effects	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES

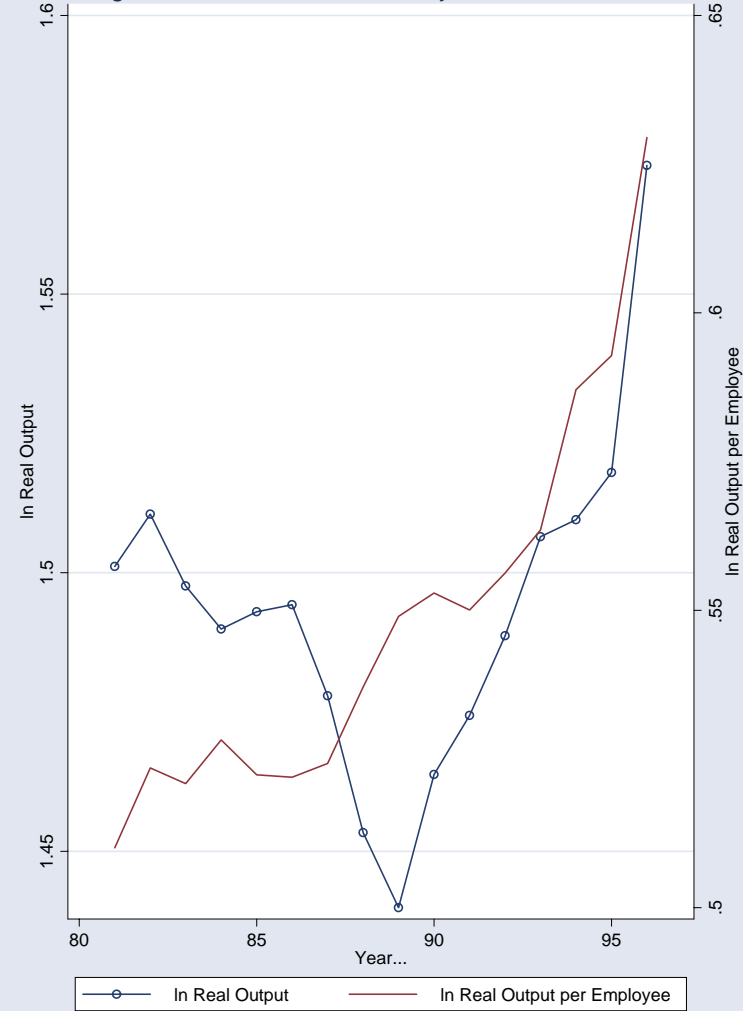
*Notes:* sample is an industry-time panel on three-digit manufacturing industries during 1980-97 from the Indian Annual Survey of Industries (ASI). See Aghion, Burgess, Zilibotti and Redding (2004). Industry delicensed is an industry-time measure of delicensing, which takes the value 1 if the industry is delicensed in a particular year and 0 otherwise. Number of factories is the number of factories active in an industry and year. St Dev denotes the standard deviation across states within an industry and year. ln(Y) is log real gross output. ln(Y/L) is log real gross output per employee. ln(TFP1) is log superlative index Total Factor Productivity. ln(TFP2) is log superlative index Total Factor Productivity, including non-production and production workers as separate factors of production. Output, employees and other factor inputs are from the ASI. Price deflators are from the Handbook of Industrial Statistics. Standard errors in parentheses are heteroscedasticity robust and adjusted for clustering on industry. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

Figure 1: Standard Deviation in Log Manufacturing SDP



State Domestic Product (SDP) National Accounts data from Besley and Burgess (2004)

Figure 2: Median Within Industry Standard Deviation



Annual Survey of Industries (ASI) data from Aghion et al. (2004)