Industrial De-Licensing, Trade Liberalization, and Skill Upgrading in India

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Abstract

We investigate the relationship between industrial de-licensing, trade liberalization, and skill upgrading during the 1980s and 1990s among manufacturing plants in India. We use a unique dataset on India's industrial licensing regime to test whether industrial de-licensing during the 1980s and 1990s played a role in skill upgrading, as measured by the employment and wagebill shares of white-collar workers. In addition, we assess the relative contribution of industrial de-licensing and trade liberalization to skill upgrading. We identify two main channels through which industrial de-licensing affects skill upgrading: capital- and output-skill complementarities. Using both difference-in-differences as well as regression discontinuity techniques, we find two important results. First, after controlling for the size-based exemption rule that determined whether or not a plant faced licensing restrictions, industrial de-licensing during the 1980s appears to have increased the relative demand for skilled workers via capital- and output-skill complementarities. Capital- and output-skill complementarities exist for plants in both licensed and de-licensed industries but were stronger in de-licensed industries during the 1980s, prior to India's massive trade liberalization reforms in 1991. Second, regardless of de-licensing, capital- and output-skill complementarities are generally weaker after trade was liberalized during the early 1990s. Together, capital- and output-skill complementarities contributed 75% (57%) and 31% (29%), respectively, of the growth in the employment and wagebill shares of white-collar workers in de-licensed (licensed) industries before trade was liberalized. After trade liberalization, these contributions were smaller. This suggests that trade liberalization may not have played a major role in raising the relative demand for skilled labor during the early 1990s.

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1 Introduction

During the 1980s and 1990s, the Indian labor market experienced two dramatic changes. First, there was a large increase in the employment of skilled labor. As shown in Figure 1, there was a steady increase in the share of white-collar workers employed by plants as well as in the share of the wagebill going to white-collar workers.[1] After 1991, the wagebill and employment shares of white-collar workers rose sharply. The second change that occurred in the Indian labor market during this period relates to the skill wage gap, as shown in Figure 2. The skill premium, which is defined as the ratio of the average white- and blue-collar wage rates, declined during the early 1980s, remained relatively stable from the mid-1980s until the late 1980s, and rose considerably after 1991.[2]

The 1980s and 1990s also mark a period of widespread economic reforms in India, which consisted of industrial de-licensing from the mid-1980s onwards as well as trade and investment liberalization from 1991 onwards. Since the beginning of industrial de-licensing in 1984-85 coincides with a rising relative employment of skilled labor as well as a relatively constant skill premium, it is reasonable to expect that de-licensing may have increased the relative demand for skilled labor. Moreover, the sharp rise in the relative employment of skilled labor, together with a rising skill premium from 1991 onwards suggests that trade liberalization may have generated greater relative demand for skilled labor as well. In this paper, we investigate whether or not industrial de-licensing and trade liberalization contributed to skill upgrading between 1980-81 and 1994-95 in India.

Industrial de-licensing meant freedom from constraints on output, inputs, technology, and location as well as free entry into de-licensed industries.[3] Freedom from these constraints allowed plants

[1] Figure 1 shows the skill share at the aggregate level not at the plant level. Plant-level data from the Annual Survey of Industries (ASI) are used for all figures and tables. A plant is defined as a production entity whereas a firm is a financial entity. Since the ASI consists of plants and industrial de-licensing pertained to production rather than financial units, we use the term plant throughout this paper. The survey covers all factories registered under the Factories Act of 1948 and only covers the formal sector in Indian manufacturing. White- and blue-collar workers are defined as skilled and unskilled workers, respectively.

[2] An increase in the employment of skilled relative to unskilled labor together with stable relative wages suggests that increases in the relative demand for skilled labor were matched by increases in their relative supply during the 1980s. On the other hand, an increase in the employment of skilled relative to unskilled labor along with rising relative wages indicates increases in the relative demand for skilled labor dominated increases in their relative supply during the first half of the 1990s. Even though our dataset ends in 1994-95, a continuation of the rising trend in the employment and wages of skilled labor relative to unskilled labor has been documented in the literature (Berman et al. forthcoming, Chamarbagwala 2006).

[3] See Sharma (2006*a*) and Sharma (2006*b*) for a detailed description of industrial de-licensing in India.

to take advantage of economies of scale, more efficient input combinations, and new technology. Further, greater domestic competition as a result of free entry into de-licensed industries provided plants with incentives to innovate, increase productivity, and improve product quality. The focus of this paper is to examine whether or not industrial de-licensing generated skill upgrading among manufacturing plants in India via capital- and output-skill complementarities. Capital-skill complementarities may exist if capital is relatively skill-biased. Thus, firms' greater use of capital, as a result of the removal of input constraints, may increase their relative demand for skilled labor. Output-skill complementarities may exist if as firms expand, they require more skilled labor to manage a larger workforce and organize the production and distribution of higher levels of output. Thus, expansion of firms, due to the removal of output constraints, may also increase the relative demand for skilled labor. Industrial de-licensing in India may therefore have resulted in skill upgrading in the presence of capital- and output-skill complementarities.

Besides industrial de-licensing, trade liberalization may have had a similar effect on skilled labor. By increasing foreign competition for domestic plants and providing them with additional incentives to expand, innovate, increase productivity, and improve product quality, trade liberalization may have generated skill upgrading in the presence of capital- and output-skill complementarities. On the other hand, the predictions of the Stolper-Samuelson theorem suggest that trade liberalization should lower the relative demand for and returns to skill in an unskilled labor-intensive country where the most protected sectors were skill-intensive. Given the chronology of Indian reforms – that is, only industrial de-licensing during the 1980s and both trade liberalization and de-licensing from 1991 onwards – as well as trends in the relative demand for and returns to skilled labor during the 1980s and 1990s, it is unclear how both types of reforms contributed to the relative demand for skilled labor. Thus, in this paper, we also investigate the relative contribution of industrial de-licensing and trade liberalization to skill upgrading in manufacturing plants.

A large body of literature has established a link between external sector reforms, skill upgrading, and wage inequality in India and other developing countries (Attanasio et al. 2004, Cragg & Epelbaum 1996, Feenstra & Hanson 1996, 1997, 2003, Goldberg & Pavcnik 2004, Gorg & Strobl 2002, Hanson 2003, Harrison & Hanson 1999, Pavcnik 2003, Verhoogen 2004). For the case of India,

Berman et al. (forthcoming), Chamarbagwala (2006), Kumar & Mishra (2008), Dutta (2005) all examine the relationship between trade liberalization, skill upgrading, and wage inequality during the 1980s and 1990s. While these studies provide valuable insights into the relationship between external sector reforms, skill upgrading, and wage inequality, they don't allow for a relationship between domestic sector reforms, such as industrial de-licensing, and the demand for and returns to skilled labor. Berman et al. (forthcoming) use Indian industry-level data to examine the relationship between output, capital, trade, and skill, but do not investigate the relationship between industrial de-licensing and skill. Sharma (2006*b*) provides evidence that industrial de-licensing contributed to productivity gains among Indian plants, though it does not address the effect of domestic sector reforms on skill upgrading. Our work therefore builds on both Berman et al. (forthcoming) and Sharma (2006*b*) by examining how industrial de-licensing as well as trade liberalization influence skill upgrading using plant-level data for India.

Incorporating industrial de-licensing in an analysis of skill upgrading is particularly important for the case of India and is the major contribution of this paper to the literature. Few of the previous studies on India's labor market control for the changes in the 1980s that were brought about by industrial de-licensing and hence may provide biased estimates of the impact of trade liberalization on skill upgrading. Moreover, by stifling industrial growth and the relative demand for and returns to skilled labor, the licensing regime may have contributed to India's comparative advantage in the service sector during the internet boom in the 1990s. Thus, examining how industrial de-licensing affected skill upgrading during the 1980s may provide a deeper understanding of India's labor market changes post 1991.

Table 1 brings forward three important points that challenge the predictions of other studies on India. First, the chronology of reforms was such that industrial de-licensing began during the mid-1980s and therefore well before the external sector reforms were implemented in July 1991. Thus, industrial de-licensing may have changed the domestic manufacturing environment during the 1980s and 1990s, which may have, in turn, affected the ability and incentives of Indian plants to respond to trade and investment liberalization after 1991. Second, the industrial de-licensing reforms of the 1980s were quite significant with respect to the percentage of manufacturing output

that they affected. Cumulatively, 23% of output and almost 23% of employment had been de-licensed by 1990. These two points suggest that ignoring pre-1991 changes in the licensing regime may provide misleading and biased estimates of the impact of the 1991 reforms. Third, de-licensing in 1991 was not "across the board" as is the common assumption in most studies. In fact, 16% of manufacturing output and 10% of employment were still under compulsory licensing post-1991. Some of these industries were gradually de-licensed in 1993 and 1994. Therefore, studies that ignore the actual chronology of industrial de-licensing post-1991 may overstate the impact of the 1991 reforms.

Here, we highlight our main results from both difference-in-differences and regression discontinuity analyses. First, after controlling for the size-based exemption rule that determined whether or not a plant faced licensing restrictions, industrial de-licensing during the 1980s appears to have increased the relative demand for skilled workers via capital- and output-skill complementarities. Capital- and output-skill complementarities exist for plants in both licensed and de-licensed industries but were stronger in de-licensed industries during the 1980s, prior to India's massive trade liberalization reforms in 1991. Second, regardless of de-licensing, capital- and output-skill complementarities are generally weaker after trade was liberalized during the early 1990s. Together, capital- and output-skill complementarities contributed 75% (57%) and 31% (29%), respectively, of the growth in the employment and wagebill shares of white-collar workers in de-licensed (licensed) industries before trade was liberalized. After trade liberalization, these contributions are 66% (53%) and 29% (25%) in de-licensed (licensed) industries. This suggests that trade liberalization may not have played a major role in raising the relative demand for skilled labor during the early 1990s.

This paper is organized as follows. Section 2 describes the domestic and external sector reforms during the 1980s and 1990s in India. Section 3 summarizes the mechanisms through which skill upgrading may be affected by domestic and external sector reforms. Section 4 describes our data, estimation, and identification strategy. We discuss our results in Section 5 and conclude in Section 6.

2 Domestic and External Sector Reforms

Even though India's mixed economy framework mandated a role for private enterprise, the government believed it was necessary to provide incentives to private establishments to invest in desirable industries and locations. Industrial licensing therefore evolved as a method for the Indian government to control private enterprise in India.[4] A license was a document that permitted a plant to begin or continue production in an industry and was issued by the Ministry of Industry in New Delhi.

The licensing regime controlled entry into an industry and hence the amount of competition faced by a plant. The most important concern for the licensing committee while debating a particular case was the "demand-supply situation" of the good – if it was felt that there was enough existing capacity to satisfy projected demand then the application was rejected, irrespective of the quality of the proposed good and the nature and productivity of the technology that it proposed to use. Another important facet was the type of the good. There was a disdain for variety among policy-makers of the time and competition was thought to be wasteful. Import and foreign exchange requirements were also important considerations and a large number of applications were rejected because they required "too much" foreign exchange. Thus, new projects were not assessed on the merit of their efficiency, productivity, or quality (Das 2000, Marathe 1989).

A license also specified the amount of output that a plant could produce. This was conditional on the proposed location of the project and permission was required to change the location of production. The exact nature of the product was also specified and either permission or a new license was needed to change the product mix. A plant's inputs and technology, though not specified on the license, were also restricted. This is because the most crucial raw materials – steel, cement, coal, fuel, and furnace oil – as well as licenses to import inputs – including machinery and equipment – were controlled by the government with plants receiving annual allotments of these inputs for production. In fact, licensing requirements were implemented primarily through the restricted allocation of these inputs to the plant. Based on the specified output limit on its license, every plant was allotted a fixed amount of these inputs annually. Thus, it was difficult if not impossible

[4] See Sharma (2006*a*) and Sharma (2006*b*) for a detailed description of industrial licensing in India.

for an entrepreneur to produce over the specified output limit on his license.

Policy makers began realizing the crippling effect of the licensing regime on the Indian economy during the 1960s and 1970s and several ad hoc measures were implemented during this period.[5] However, it was only during the 1980s that the government took substantial steps in relaxing the licensing regime by "de-licensing" certain industries. Table 1 shows the percentage of manufacturing output and employment that was de-licensed during the 1980s and 1990s. While this piece-meal approach to reforming industrial policy continued through the 1980s, the Indian economy faced a severe balance of payments crisis in July 1991 and was forced to take loans from international organizations. It was at this time that the biggest de-licensing episode occurred, under pressure from these organizations. Almost all industrial licensing was removed, other than for 16% of manufacturing output.

Along with this, there were massive external sector reforms in 1991, which consisted of trade and investment liberalization. The trade policy reforms aimed at liberalizing and promoting both exports and imports. As a result of lower tariffs, elimination of quotas and import license requirements, and liberalization of technology imports, total exports and imports increased dramatically during the 1990s. Exports were liberalized via the abolition of export subsidies and controls while the liberalization of imports was implemented via a rapid reduction in tariff rates and the abolition of licensing and quantitative restrictions on most imports except consumer goods. The average ad valorem tariff rate fell from 125% in 1990 to 40% in 1999. Besides lower tariffs, non-tariff barriers were reduced by eliminating quantitative restrictions - quotas and import licensing requirements - particularly on capital and intermediate goods. In addition, technology imports were liberalized by eliminating technology license requirements. Foreign direct investment (FDI) was liberalized to a limited extent, resulting in an increase of FDI from $233 million to $3.3 billion during the 1990s. Besides these reforms, the rupee was devalued by 22% (from Rs. 21.20 to Rs. 25.80 per U.S. dollar). The sheer scale and scope of the reforms were so large that this reform episode has been the one that has caught the attention of policy-makers and researchers alike.

[5]The first "de-licensing" of plants occurred in 1966 and by 1969, 41 industries were de-licensed. However in 1973, these industries were licensed again and it was only in 1975 that the second phase of de-licensing began, when 21 four-digit industries accounting for 3% of manufacturing output were de-licensed.

The licensing regime affected plant-level productivity and costs through its control on both the plant's ability and incentives to innovate, reduce costs, use efficient input combinations, adopt new technology, and exploit economies of scale. Direct controls on outputs and inputs affected plants' abilities whereas indirect control of entry affected plants' incentives. Even if direct controls were not fully implemented due to corruption, the effect of indirect controls on incentives was substantial. Licensing restricted entry into most sectors and created artificial monopolies and oligopolies. The average four-firm concentration ratio in Indian manufacturing in 1981 was 54% compared to 32% for the US in 1977. Even among developing countries, India's concentration ratio was closer to Poland's (65% in 1988) rather than Brazil's (32% in 1988).

3 Mechanisms of Skill Upgrading

Given the extent of India's licensing regime, it is reasonable to expect that industrial de-licensing during the 1980s and 1990s may have played a role in raising the demand for and returns to skill in the country. We explore several hypotheses which explain the mechanisms through which domestic and external sector reforms may affect skills in less developed countries (LDCs). Hypotheses I and II relate both domestic and external sector reforms to the demand for and returns to skill in LDCs. Hypotheses III and IV concern only external sector reforms – that is, trade and investment liberalization.

The first hypothesis (Hypothesis I) relates skill-biased technological change to increased demand for skilled labor and a rising skill premium. According to this hypothesis, domestic and external sector reforms increase the degree of competition faced by firms as a result of entry of domestic firms as well as competition from foreign firms. Increased competition provides incentives for firms to become more productive – that is, exploit economies of scale, utilize more efficient input combinations, and adopt new technology. If these changes are *complementary* to skilled labor, economic liberalization should result in skill upgrading and increased wage inequality. In other words, in the presence of output-, capital-, and technology-skill complementarities, we should observe skill upgrading and a widening skill-wage-gap after economic reforms. The existing literature focuses solely on trade liberalization and not on domestic sector reforms. Wood (1995) argues that trade

liberalization results in "defensive innovation" – that is, greater competition from foreign firms may induce domestic firms in LDCs to either engage in R&D or to adopt new and advanced technologies in order to secure their market share in the domestic and international markets. Because of technology-skill complementarities, adoption of modern technologies raises the demand for and returns to skilled labor. Acemoglu (2003) describes how, as the result of trade liberalization in LDCs, increased capital goods imports can lead to greater demand for skilled workers as a result of capital-skill complementarities, thus increasing the skill-premium. Empirical support for this hypothesis is found by Attanasio et al. (2004) for Colombia and by Harrison & Hanson (1999) for the case of Mexico. Gorg & Strobl (2002) find an increase in the relative wages of skilled labor in Ghana, brought about by skill-biased technological change induced through imports of technology-intensive capital goods or export activity. However, Pavcnik (2003) rejects this hypothesis for Chilean plants. Berman et al. (forthcoming) find evidence of output- and capital-skill complementarities in Indian industries during the 1990s, though they exclude any potential effect of industrial de-licensing on skill upgrading.

Quality-upgrading by firms, as a result of greater competition, is the second hypothesis (Hypothesis II). The basic argument is that domestic and external sector liberalization may induce quality upgrading by firms, where quality refers to either firm productivity or product quality. Quality upgrading may be complementary to skilled labor, thereby increasing the relative demand for and returns to skill. Verhoogen (2004) finds strong support for this hypothesis for the case of Mexico where greater exports as a result of the peso crisis resulted in better quality products being produced by exporters. Because higher quality products require a higher proportion of skilled workers, the relative demand for and returns to skilled labor increased. For India, Sharma (2006*b*) finds that plants that were de-licensed also experienced higher productivity both before and after the country's external sector reforms of 1991 but does not examine the relationship between reforms and skills. If productivity is complementary to skilled labor, we would expect that there would also be skill upgrading among Indian plants.

The third hypothesis (Hypothesis III) is based on the Stolper-Samuelson theorem in the Heckscher-Ohlin-Samuelson model and relates solely to external sector reforms in trade. The Stolper-Samuelson

theorem predicts that trade liberalization will lower the demand for and returns to the factor that is used intensively in the production of formerly protected goods. Since India had its highest protection levels – both, tariff and non-tariff barriers – in human- and physical-capital-intensive sectors, the Stolper-Samuelson theorem predicts a decreased demand for skilled labor and a narrowing of the skill-wage-gap in India. The rising relative demand for and returns to skilled labor after 1991 therefore contradicts the predictions of the Stolper-Samuelson theorem for India.[6]

Global production sharing or outsourcing, which relates solely to external sector reforms in investment, is the fourth hypothesis (Hypothesis IV) that has been provided to explain the rising skill premium and demand for skilled labor in LDCs. Feenstra & Hanson (1996) and Feenstra & Hanson (2003) argue that trade and investment liberalization on the part of LDCs allows developed countries (DCs) to transfer the production of intermediate goods and services to LDCs. For LDCs these activities are skill-intensive, which results in a greater demand for and returns to skilled labor. Therefore, external sector reforms that promote trade in manufactures and services and those that attract foreign direct investment can benefit skilled workers in LDCs. Feenstra & Hanson (1997) find empirical support for this hypothesis for the case of Mexico. Since our analysis does not include a measure of outsourcing, we cannot evaluate Hypothesis IV in this study.

Our empirical analysis provides three important results that support Hypotheses I and II. First, we find evidence that capital- and output-skill complementarities exist for plants in both licensed and de-licensed industries but were stronger in de-licensed industries during the 1980s, prior to India's massive trade liberalization reforms in 1991. Second, capital-skill complementarities are stronger for plants that were de-licensed during the 1980s compared to those that were not, once trade was liberalized during the early 1990s. Thus, skilled labor in de-licensed industries benefited more than those in licensed ones. In addition, regardless of trade liberalization, we find stronger output-skill complementarities among plants that were de-licensed in the 1980s compared to those that were not. Third, regardless of de-licensing, capital- and output-skill complementarities are weaker for plants in industries where trade was liberalized during the early 1990s. Thus, the

[6]In many LDCs – namely Colombia, Mexico, Brazil, and Morocco – the most protected sectors were unskilled-labor-intensive, the Stolper-Samuelson theorem predicts that trade liberalization in these countries should lower unskilled wages. Thus, an increased demand for skilled labor and a widening skill-wage-gap support the predictions of the Stolper-Samuelson theorem in these countries.

removal of trade barriers during this period did not play a major role in skill upgrading, at least during the early 1990s. All these results support Hypotheses I and II with respect to domestic sector reforms and indicate that industrial de-licensing played an important role in skill upgrading even before the 1991 trade liberalization reforms were implemented. The lifting of microeconomic constraints for plants in de-licensed industries appears to have brought about greater competition and therefore more incentives to increase productivity and improve product quality. As plants in de-licensed industries took advantage of economies of scale and used more efficient input combinations, both of which may have been complementary to skilled labor, there was skill upgrading as a result of the removal of licensing restrictions.

4 Data and Estimation

4.1 Data

Our data comes from three sources. In order to measure the extent of industrial de-licensing faced by a plant, we have collected a unique and detailed dataset of industrial policy in India from the 1970s onwards. Using this data, we can identify which four-digit industry underwent reform – that is, freedom from licensing requirements – in each year in the 1970s, 1980s, and 1990s. The main source of this data was internal government publications and notifications issued to administrative ministries. Various issues of "Guidelines for Industry", which is a publication by the Ministry of Industry, were used to collect this data. This publication consists of various government orders, notifications, and memos that were compiled for entrepreneurs as well as government officials to use and was obtained from various government and ministry libraries. Some commonly available publications like the Economic Survey were also used to collect and check the de-licensing data. Common publications, however, do not reveal the level of detail about the conditions under which plants were eligible to avail of certain policies, for example, size-based exemption from licensing. Study of government notifications and memos provided insight into the ideology of policy-makers and provided rich detail that we exploit in our identification strategy. Table 2 presents information on the number of industries that were de-licensed in each year from 1980-81 until 1994-95. De-licensing began only in 1984-85 and there was no de-licensing between 1988 and 1991. The biggest

de-licensing episode occurred in 1991-92 along with external sector reforms in trade and investment. After 1991-92, a few more industries were de-licensed and by 1994-95 only 100 four-digit industries remained under licensing.

Data on trade liberalization consist of tariffs in three-digit NIC industries for three sub-periods 1980-84, 1985-90, and 1991-95, obtained from Das (2003).[7] We find that tariffs for an average 3-digit industry declined by 28 percentage points between 1985-90 and 1991-95 and define an industry as trade liberalized if its tariff fell by more than 28 percentage points between these two periods. Table 3 shows the number of industries where trade was liberalized between 1985-90 and 1991-95.

The third source of data are plant-level data for the years 1980-81 until 1994-95 from the Annual Survey of Industries (ASI), conducted by the Central Statistical Organization (CSO), a department in the Indian Government's Ministry of Statistics and Program Implementation. The survey covers all plants registered under the Factories Act of 1948 and only covers the formal sector in Indian manufacturing. The ASI frame can be classified into two sectors – the census sector and the sample sector. Units employing more than 100 workers constitute the census sector. Units in the census sector are covered with a sampling probability of 1 while units in the sample sector are covered with probabilities one-half (until 1987-88) or one-third (after 1987-88). The ASI data consist of a time-series of cross-sections of plants and is not a panel.

The ASI collects data from plants employing more than 20 workers for plants not using electricity and 10 workers if the plant used electricity. However, a plant only came under the purview of the licensing regime if it was defined as a factory, as per the Industries Development & Regulation Act of 1951 (IDRA). According to the IDRA, a factory is defined as a unit that employs 100 or more workers without power or 50 or more workers with power. For our analysis, we use data on all establishments surveyed by the ASI and include an indicator for "factories" as defined by the IDRA since only these plants were the ones that came under the ambit of industrial licensing. In all our analyses, we weight observations using the multiplier or the inverse sampling probability to adjust for sampling frequency.

Production units with assets in plant, machinery, land, and building below a certain defined

[7] The average tariffs in these three periods were 99, 112, and 83 percent, respectively.

threshold were free or "exempt" from industrial licensing requirements. This was part of the government's strategy to promote the growth of smaller plants that would then be the main generation of employment in the manufacturing sector. Moreover, by limiting the number of establishments that fell under the licensing requirement, the administrative burden of the licensing regime was controlled. By granting exemptions to some plants, the volume of applications required for processing by the licensing authority was diminished. As long as exempt plants remained under the threshold asset level, they could enter into and operate in any industry without restrictions on output, inputs, or investment.

The criterion for exemption was based on the original rupee value of plant, machinery, land, and building owned (or proposed to be owned) by the plant and was the same for all industries. From 1980-81 to 1982-83, units with assets in plant, machinery, land, and building worth less than or equal to Rs. 30 million were defined as "small" plants and therefore exempt from licensing requirements. Between 1983-84 and 1989-90, this threshold jumped to Rs. 50 million and after 1990-91 to Rs. 150 million. Thus, a plant's exemption status varied only by plant and year and not by industry.[8]

De-licensing data were merged with plant-level data from the ASI at the four-digit NIC level. Table 4 presents plant characteristics in licensed and de-licensed industries that are used in the empirical analysis. The number of four-digit NIC industries that were de-licensed and under licensing requirements is cumulative and include those in the ASI dataset in each year. Plant characteristics include average values of the employment and wagebill shares of white-collar workers, the capital-output ratio, and real output in each year from 1980-81 until 1994-95. The ASI includes information on an occupational rather than a skill or education measure of employment. The occupational measure differentiates between non-production and production workers, which we define as white- and blue-collar workers, respectively. The employment share of white-collar workers is the number of white-collar workers divided by the total number of workers hired by a plant. The wagebill share of white-collar workers is total wages paid to white-collar workers divided by total wages paid to all workers. The skill premium is defined as the ratio of the average white- and

[8]Inflation did not change a plant's exemption status since the threshold was based on the original or book value rather than the current value of a plant's assets.

blue-collar wage rates. Capital is defined as "the average of the opening and closing book value of assets in plant, machinery, land, and building". This definition does not take account of inflation or the economic value of capital owned by the plant and is similar to the asset level that determined whether or not a plant was exempt from de-licensing or under licensing restrictions. Real output is in 1993-94 Rupees.

As shown in Table 4, the employment and wagebill shares of white-collar workers are slightly higher in de-licensed than in licensed industries until 1991-92, after which the pattern reverses. Also, de-licensed industries generally have higher capital-output ratios compared to licensed ones. Real output is generally higher in de-licensed industries until 1991-92 onwards, when real output in licensed industries is almost double that in de-licensed ones.[9]

4.2 Between- and Within-Industry Decompositions

Before estimating our regressions, we calculate between- and within- industry changes in the employment and wagebill shares of skilled labor using our data aggregated by 4-digit industry and year. We follow the methodology in Berman et al. (1994) and decompose the overall change as:

$$\Delta P_w = \sum_j \Delta S_j \bar{P}_{w_j} + \sum_j \Delta P_{w_j} \bar{S}_j, \tag{1}$$

where $j = 1, ..., J$ 4-digit industries, $P_{w_j} = E_{n_j}/E_j$ is the proportion of white-collar workers in industry j, $S_j = E_j/E$ is the share of employment in industry j, and a bar over a term represents a mean over time. The first term on the right represents the change in the employment or wagebill share of white-collar workers between industries and the second term captures the within-industry change in the share of white-collar workers. The predictions of the Stolper-Samuelson theorem for India would work by shifting the demand for labor away from skilled-labor-intensive to unskilled-labor-intensive industries. Thus, negative between-industry shifts after 1991-92 would support the predictions of the Stolper-Samuelson theorem for India. On the other hand, capital- and output-skill complementarities, either due to de-licensing or trade liberalization, would result in skill upgrading

[9]The rise in output in licensed industries from 1991-92 onwards is associated with a dramatic decline in the number of plants in licensed industries from 1991-92 onwards, making the distribution less skewed and raising average output in these industries.

within industries. Thus, positive within-sector shifts would be indicative of these complementarities in India.

We estimate between- and within-industry changes in the employment and wagebill shares of white-collar workers for three periods – 1980-81 to 1983-84 (no industrial de-licensing or trade liberalization), 1984-85 to 1990-91 (only de-licensing), and 1991-92 to 1994-95 (de-licensing and trade liberalization). For the latter two periods, we further decompose between- and within-industry changes into changes for two groups of industries – those that remained under licensing restrictions and those that were de-licensed during each period. The between-industry term can be decomposed into licensed and de-licensed sectors as:

$$\sum_j \Delta S_j \bar{P}_{w_j} = \sum_{j \in l} \Delta S_j^l \bar{P}_{w_j}^l + \sum_{j \in dl} \Delta S_j^{dl} \bar{P}_{w_j}^{dl}, \tag{2}$$

and the within-industry term can be decomposed as:

$$\sum_j \Delta P_{w_j} \bar{S}_j = \sum_{j \in l} \Delta P_{w_j}^l \bar{S}_j^l + \sum_{j \in dl} \Delta P_{w_j}^{dl} \bar{S}_j^{dl}, \tag{3}$$

where l and dl represent licensed and de-licensed industries, respectively.

Table 5 reports between- and within-industry changes in the employment and wagebill shares of white-collar workers. In all three periods, within-industry changes in the employment and wagebill shares of skilled labor in *all* industries is positive and dominates the between-industry change during the first and last periods. Between 1984-85 and 1990-91, the period during which only industrial de-licensing occurred, within-industry shifts are positive for de-licensed industries but negative for licensed industries. This result suggests that there may have been skill upgrading in plants once their industry was de-licensed and that this may have been due to capital- and/or output-skill complementarities.

Between 1991-92 and 1994-95, during which both industrial de-licensing and trade liberalization occurred, within-industry shifts are positive for both licensed and de-licensed industries, indicating that both these reforms most likely played a role in skill upgrading within industries. Even though between-industry shifts are negative for both licensed and de-licensed industries during the period prior to trade liberalization, the between-industry shifts are negative only for licensed industries

after 1991. This shows that the predictions of the Stolper Samuelson theorem hold only for licensed industries during the period when trade reforms were implemented. Thus, once trade was liberalized, employment and wages shifted away from skilled-labor-intensive and towards unskilled-labor-intensive industries in industries that remained under licensing requirements. On the other hand, positive between-industry shifts for de-licensed industries suggests that the opposite occurred in industries that were no longer under licensing restrictions.

This decomposition shows that a large part of increases in the employment and wagebill shares of skilled labor are due to within-industry shifts. Moreover, since within-industry shifts are positive for de-licensed industries after 1984-85 but not for licensed industries before trade liberalization, this analysis indicates that industrial de-licensing may have played a role in skill upgrading within industries. We therefore turn to exploring the relationship between industrial de-licensing and skill upgrading within industries in more detail.

4.3 Empirical Analysis

4.3.1 Industrial De-licensing and Skill Upgrading: 1980-81 to 1990-91

We begin by investigating the relationship between industrial de-licensing and skill upgrading prior to the 1991 external sector reforms. To focus on the pre-1991 relationship between industrial de-licensing and skills, we restrict our sample to only include the period *before* the external sector reforms of July 1991, that is 1980-81 to 1990-91, and estimate the following equation.

$$Y_{ijts} = \alpha + \beta_1 DL_{jt} + \epsilon_{ijts}, \tag{4}$$

where Y_{ijts} is a measure of the relative demand for skilled labor for plant i producing in industry j located in state s in year t. We use two alternate measures of the relative demand for skilled labor – that is, the proportion of white-collar workers employed by the plant and the plant's wagebill share of white-collar workers. White- and blue-collar workers are non-production and production workers, respectively. The employment share of white-collar workers is defined as $\frac{White-CollarWorkers_{ijts}}{TotalWorkers_{ijts}}$ whereas the wagebill share of white-collar workers is defined as $\frac{White-CollarWages_{ijts}}{TotalWages_{ijts}}$. DL_{jt} is an indicator that takes a value of 1 if industry j was de-licensed in or before year t and 0 otherwise.

There are two potential sources of endogeneity of industry de-licensing which may provide biased and inconsistent estimates of β_1 in Equation 4. The first potential source of endogeneity is unobserved heterogeneity or omitted variable bias at the industry level. Our main explanatory variable, DL_{jt}, varies at the four-digit industry-level of the National Industrial Classification (NIC). Political economy factors, like political affiliation and lobbying power, also vary at the industry-level and may determine whether or not industry j gets de-licensed in any given year t. If political power is also concentrated among highly skilled industries, then there may be a spurious correlation between industrial de-licensing and the relative demand for skilled labor, which would bias our estimate of β_1. In order to control for unobservable heterogeneity at the industry-level, we include four-digit industry fixed effects, δ_j, which allows us to estimate skill upgrading *within* industries. We also include year (γ_t) and state (λ_s) fixed effects to control for year- and state-specific unobservables that may influence labor market conditions, such as labor laws.[10] Equation 5 includes industry, year, and state fixed effects.

$$Y_{ijts} = \alpha + \beta_1 DL_{jt} + \delta_j + \gamma_t + \lambda_s + \epsilon_{ijts} \tag{5}$$

The nature of industrial de-licensing in India provides yet another potential source of bias of β_1: there may be a reverse causation between skill upgrading and industrial de-licensing. The reforms of the 1980s have been characterized by some as "reforms by stealth". There was no consensus for economic reforms in the 1980s. More importantly, it is clear from policy documents that the government was eager to portray the changes of the 1980s as a continuation of the existing system even though these reforms introduced dramatic changes that veered away from the high-regulation, socialist paradigm that had been operating since the 1950s. Under these circumstances, it is possible that the Indian government chose industries for de-licensing based on certain industry-specific characteristics that either raised the chances of success of the reforms or that minimized social costs in case of failure. For example, the government may have chosen to de-license more skill-intensive industries if government officials expected skill-intensity to enhance the success of the reforms or to minimize the employment effects of de-licensing. In this case, β_1 will not measure

[10] Since labor laws regarding hiring and firing of labor vary across states, which may affect the relative demand for skilled labor, it is necessary to include state fixed effects.

the effect of industrial de-licensing on skills. Rather, it will capture the *selection* of skill-intensive industries into de-licensing and will be biased upwards. While industry fixed effects control for some industry-specific characteristics that may have determined selection into de-licensing, we need plant-level variation in our de-licensing measure in order to get reliable estimates.

To correct for this potential bias, we use an important institutional feature of the licensing regime in India. As discussed in Section 4.1, there was an important size-based difference in the application of licensing provisions. In particular, units that had assets in plant, machinery, land, and building less than a threshold value were exempt from industrial licensing requirements. Units with assets above the threshold level were subject to micro-economic constraints and were protected from free entry. Even though exempt plants were not directly subject to licensing requirements, they were constrained in size since increasing their assets may have pushed them over the threshold, thereby making them subject to licensing requirements indirectly. Thus, both types of plants were affected differently by the licensing regime. Exempt plants were constrained in size whereas nonexempt plants were constrained in output and protected from competition. We therefore expect exempt and nonexempt plants to be affected differently by de-licensing of their industry.

In order to identify the effect of industrial de-licensing on skill upgrading, we include an indicator for a plant's nonexemption status (NE_{ijts}) and interact this indicator with the de-licensing dummy ($DL_{jt} * NE_{ijts}$) in Equation 6.

$$Y_{ijts} = \alpha + \beta_1 DL_{jt} + \beta_2 NE_{ijts} + \beta_3 DL_{jt} * NE_{ijts} + \delta_j + \gamma_t + \lambda_s + \epsilon_{ijts} \tag{6}$$

The specification in Equation 6 is a difference-in-differences (DD) estimation where NE_{ijts} is an indicator that takes the value of 1 if plant i in industry j, year t, and state s had assets in plant, machinery, land, and building that were equal to or more than the threshold asset level – and 0 otherwise. Assets in plant, machinery, land, and building are the plant's fixed capital in a given year.[11] The difference-in-differences specification in Equation 6 captures whether or not the difference in skill upgrading between nonexempt (large) and exempt (small) plants was different for plants in industries that were de-licensed compared to those that remained under licensing

[11]Fixed capital is defined as the "book value of assets in plant, machinery, land, and building". This definition does not take account of inflation or the economic value of capital owned by the plant.

requirements.

One potential concern with the identification strategy in Equation 6 is that de-licensing may result in a change in the size distribution of plants in an industry, which could affect the results. For example, after the removal of licensing requirements, plants that previously limited their size in order to remain exempt from licensing may have expanded production. We investigate this claim in great detail and find no evidence of any major change in the size distribution of plants after de-licensing. In industries that were de-licensed between 1984-85 and 1990-91, the proportion of exempt plants was 0.95 during 1980-81 to 1983-84 – that is, the period before de-licensing. Once these industries were de-licensed, the proportion of exempt plants fell to 0.93. This pattern was similar to that for plants in industries that were not de-licensed during the 1980s, where the proportion of exempt plants fell from 0.97 to 0.95 from the pre-reform period (1980-81 to 1983-84) to the de-licensing period (1984-85 to 1990-91). Thus, there was no sudden inexplicable decline in the proportion of exempt plants following reforms. Similarly, the average annual rate of growth of the number of exempt plants also maintained its pattern across licensed and de-licensed industries between 1980-81 and 1983-84 and between 1984-85 and 1990-91. It rose from 1.6% to 2.4% in de-licensed industries and from -1.5% to 0.5% in industries that remained under licensing requirements.

We also find no sudden or major shift in the size distribution of small plants in de-licensed industries when compared to small plants in licensed industries. In Figure 3, we plot the distribution of exempt plants' assets in 1983 (pre-reform) and 1988 (after de-licensing reforms) in licensed and de-licensed industries. In each graph the solid line represents the year 1988 and the dashed line represents the year 1983. We see that the distribution is very similar in de-licensed industries as compared to licensed industries. This is especially true towards the end of the distribution, that is, nearer to the threshold asset level of Rs. 50 million for exemption from licensing requirements.

Hypothesis I in Section 3 discusses two important mechanisms through which domestic reforms, such as industrial de-licensing, are expected to affect skill upgrading – namely, capital- and output-skill complementarities. In order to investigate this hypothesis, we add the natural log of a plant's capital-output ratio ($ln\left(\frac{K_{ijts}}{O_{ijts}}\right)$) and the natural log of a plant's output level ($ln\left(O_{ijts}\right)$) as well as

their interactions with the de-licensing indicator in Equation 7.[12]

$$Y_{ijts} = \alpha + \beta_1 DL_{jt} + \beta_2 NE_{ijts} + \beta_3 ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_4 ln\left(O_{ijts}\right) + \beta_5 DL_{jt} * NE_{ijts} \\ + \beta_6 DLjt * ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_7 DL_{jt} * ln\left(O_{ijts}\right) + \delta_j + \gamma_t + \lambda_s + \epsilon_{ijts}, \tag{7}$$

K_{ijts} is measured as the plant's assets in plant, machinery, land, and building in year t and is identical to the measure used to calculate a plant's exemption status. Output is measured as plant j's real output in year t, which is calculated using industry-specific deflators.

The rationale for including the capital-output ratio and output level of a plant is the following. First, as mentioned above, capital- and output-skill complementarities are two important mechanisms through which industrial de-licensing is expected to affect skill upgrading. Including a plant's capital-output ratio and it's output level allow us to see whether or not there is evidence of capital- and output-skill complementarities for manufacturing plants in India. Second, the capital-output ratio and output level of a plant may be correlated with it's exemption status and it's demand for skilled labor. Thus, omitting these important plant characteristics may generate a spurious correlation between a plant's exemption status and it's demand for skill in Equation 6 due to omitted variable bias. The correlation between a plant's exemption status and it's capital-output ratio and output level is evident in Table 6, which presents summary statistics of our key variables for plants that were not exempt from industrial licensing (columns (2) and (3)) and for plants that were exempt from licensing requirements (columns (4) and (5)) for three periods.[13] In all three periods, plants that were not exempt from licensing had approximately twice the average natural log of the capital-output ratio and roughly 1.5 times the average natural log of output of plants that were exempt from licensing. If a plant's capital-output ratio and output level are also correlated with it's demand for skilled labor as a result of capital- and output-skill complementarities, then omitting these plant characteristics from our explanatory variables may provide biased coefficient estimates. Third, the specification in Equation 7 allows us to examine whether or not *all* plants

[12]We also estimate a regression that includes all possible interactions. In the fully interacted model, we include $NE * ln(K/O)$ and $NE * ln(O)$ as well as two triple interactions, $DL * NE * ln(K/O)$ and $DL * NE * ln(O)$, in Equation 7. The results of this specification are very similar to those presented here and are available from the authors upon request.

[13]The period 1980-81 to 1983-84 is pre-reform with no industrial de-licensing or external sector policy changes. During 1984-85 and 1990-91 there was only industrial de-licensing and the 1991-92 to 1994-95 period was characterized by both industrial de-licensing and external sector reforms.

in an industry – that is, both exempt and nonexempt ones – are affected by de-licensing, based on continuous measures of their capital-output ratio and output level rather than simply comparing plants above and below the threshold asset level.[14]

All regressions are weighted with plant-level multipliers or the inverse sampling probability to adjust for sampling frequency and winsorized at the 1% level.[15] In all regressions we include an indicator for whether the plant is a factory or not, as defined by the IDRA.[16] We also include indicators for the type of ownership and organization of a plant. For ownership structure, we include two indicators – one for a joint sector plant (that is, joint private-public ownership) and the other for a plant in the private sector. The omitted group consists of plants in the public sector. We include two indicators to capture overall differences in organization structure – one for a public or private limited company and the other for a co-operative society. The omitted group consists of plants that are individual proprietorships or partnerships.[17] In all regressions, we estimate robust standard errors, clustered at the four-digit-industry level.

Even though we include four-digit industry, state, and year fixed effects, in addition to indicators for the type of ownership and organization of a plant, the existence of plant-level unobserved heterogeneity may still provide biased estimates of capital- and output-skill complementarities in licensed and de-licensed industries. This may happen if, for example, plant-level productivity is correlated with a plant's size, capital-output ratio, output level, as well as it's relative demand for skilled labor. While the inclusion of plant-level fixed effects would solve this problem, the ASI data

[14] An equation that uses changes in the share of skilled labor as the dependent variable and changes in the capital-output ratio and output level of a plant as explanatory variables can be derived from a translog cost function of a plant that uses capital as well as skilled and unskilled labor as inputs. This has been used by Berman et al. (1993) and Berman et al. (forthcoming). Since the ASI dataset does not consist of a panel of plants, we cannot estimate such an equation at the plant level.

[15] We also estimate all regressions using (plant size * plant-level multipliers) as weights, which provide qualitatively similar results and are available from the authors upon request. In order to winsorize our data at the 1% level, we sort our data by the employment (wagebill) share of white-collar workers and replace the bottom and top 1% of plants with the observations closest to them, which makes our regression estimates less influenced by outliers. As an alternative to winsorizing, we also estimate all regressions after dropping the lowest and highest 1% of plants in the sample. These results are qualitatively similar to the ones presented here and are available from the authors upon request.

[16] A factory is a plant that employs 50 or more workers and uses power in the production process or one that employs 100 or more workers without using power in the production process.

[17] The four major choices for organizing a business in India are individual proprietorships, partnerships, companies (private or public limited), and co-operative societies. The individual proprietorship form consists of entrepreneurs who have sole ownership of the establishment. Establishments with multiple owners or shareholders may be partnerships, companies, or co-operative societies. See Chapter 3 of Ramani et al. (2004) for a detailed discussion of alternative business forms.

do not include a panel of plants. Therefore, we cannot include plant fixed effects in any of our regressions and this should be considered in evaluating the results.

4.3.2 Regression Discontinuity Design

There are some aspects of the licensing regime in India – in particular, the size-based exemption from licensing provisions – that allow us to investigate the impact of de-licensing on the demand for skilled workers among plants that are immediately above or below the threshold asset level for exemption. That is, rather than comparing the average plant above and below the threshold, we compare plants just above and below the threshold. Given that the average exempt plant may be very different from the average nonexempt plant, due to size differences, the regression discontinuity analysis allows us to compare plants that are very similar but not equally treated in terms of licensing restrictions.

To do this, we apply standard regression discontinuity (RD) design techniques for the estimation of Equation 7 and estimate Equation 8:

$$\begin{aligned} Y_{ijts} = \alpha &+ \beta_1 DL_{jt} + \beta_2 NE_{ijts} + \beta_3 ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_4 ln\left(O_{ijts}\right) + \beta_5 DL_{jt} * NE_{ijts} \\ &+ \beta_6 DL_{jt} * ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_7 DL_{jt} * ln\left(O_{ijts}\right) + \sum_k \phi_k Z^k_{ijts} + \sum_k \varphi_k DL_{jt} * Z^k_{ijts} \\ &+ \delta_j + \gamma_t + \lambda_s + \epsilon_{ijts}. \end{aligned} \tag{8}$$

The control function, Z^k_{ijts} consists of the kth degree polynomial of a plant's asset level (K_{ijts}) relative to the threshold asset level (K^T_τ), that is, $Z_{ijts} = \ln\left(K_{ijts}/K^T_\tau\right)$, which is greater than zero for plants with capital above the threshold asset level and less than zero for plants with capital below this threshold.[18]

[18]Note that K^T_τ varies across three different periods, that is τ represents the periods 1980-81 to 1982-83, 1983-84 to 1989-90, and 1990-91 onwards, during which the threshold asset level changed. There are two important features in Equation 8 that need to be noted. First, Z_{ijts} is a measure of a plant's level of capital *relative* to the threshold asset level and is calculated by rescaling a plant's capital (that is, by dividing it by K^T_τ). Thus, Z_{ijts} varies at the plant level, which allows us to identify ϕ_k from variation at the plant level. Also note that since we are constraining the coefficient on $ln\left(K_{ijts}\right)$ to be the same as the coefficient on $ln\left(K^T_\tau\right)$ (that is, $\phi_k \ln\left(\frac{K_{ijts}}{K^T_\tau}\right) = \phi_k lnK_{ijts} - \phi_k lnK^T_\tau$), ϕ_k is not perfectly collinear with the coefficients on the year fixed effects, γ_t. Thus, we can include year fixed effects in Equation 8. Second, the specification in Equation 8 does not allow us to identify the effect of a plant's capital on it's demand for skilled labor, that is $\partial Y_{ijts}/\partial \ln\left(K_{ijts}\right)$, since a plant's level of capital is also in the control function. However, we can still identify the effect of a plant's capital-output ratio on it's demand for skill, that is $\partial Y_{ijts}/\partial \ln\left(K_{ijts}/O_{ijts}\right)$, which is the comparative static that is of interest to us.

Given that exempt and nonexempt plants were affected differently by the licensing regime, it is reasonable to expect that they might respond differently to de-licensing. After de-licensing, nonexempt plants could take advantage of economies of scale and faced more competition. According to Hypotheses I and II, improvements in their productivity or product quality may have increased their demand for skill. On the other hand, once their industry was de-licensed, exempt plants could increase their size, which in turn may have affected their demand for skilled labor. While Equation 7 allows us to measure differences in the demand for skill based on a plant's exemption status as well as an industry's licensing status, it does so for the average exempt and nonexempt plants. Since the average exempt plant may be very different from the average nonexempt plant, unobserved plant-level heterogeneity may bias our results. By controlling for a plant's distance from the threshold asset level, Equation 8 essentially allows us to measure differences in the demand for skill among plants near the threshold asset level. That is, it focuses on plants that are very similar in terms of their asset levels and therefore have similar characteristics that are related to their size, but are differently treated in terms of licensing requirements due to their exemption status.

4.3.3 Industrial De-licensing, Trade Liberalization, and Skill Upgrading: 1980-81 to 1994-95

In order to examine how industrial de-licensing during the 1980s and trade liberalization from 1991 onwards affected the relative demand for skills, we use data for the entire period and estimate Equation 9. Given the chronology of reforms, the main objective of this analysis is to understand how plants that were de-licensed during the 1980s performed with respect to skill upgrading after trade reforms were implemented from 1991 onwards. We use data on tariffs (T_{jt}) in three-digit NIC industries from Das (2003) for three sub-periods 1980-84, 1985-90, and 1991-95 in order to estimate

Equation 9 for the period 1980-81 to 1994-95.[19]

$$
\begin{aligned}
Y_{ijts} = \alpha &+ \beta_1 DL80_{jt} + \beta_2 ln\left(T_{jt}\right) + \beta_3 NE_{ijts} + \beta_4 ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_5 ln\left(O_{ijts}\right) + \beta_6 DL80_{jt} * ln\left(T_{jt}\right) \\
&+ \beta_7 DL80_{jt} * NE_{ijts} + \beta_8 DL80_{jt} * ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_9 DL80_{jt} * ln\left(O_{ijts}\right) + \beta_{10} ln\left(T_{jt}\right) * NE_{ijts} \\
&+ \beta_{11} ln\left(T_{jt}\right) * ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_{12} ln\left(T_{jt}\right) * ln\left(O_{ijts}\right) + \beta_{13} DL80_{jt} * ln\left(T_{jt}\right) * NE_{ijts} \\
&+ \beta_{14} DL80_{jt} * ln\left(T_{jt}\right) * ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_{15} DL80_{jt} * ln\left(T_{jt}\right) * ln\left(O_{ijts}\right) + \delta_j + \gamma_t + \lambda_s + \epsilon_{ijts}.
\end{aligned}
\tag{9}
$$

In Equation 9, we use a different measure of industrial de-licensing that only incorporates de-licensing during the 1980s. $DL80_{jt}$ is an indicator that takes a value of 1 if industry j was de-licensed in or before year t and 0 otherwise, provided it was de-licensed during the 1980s. Thus, if industry a was de-licensed in 1984-85, $DL80_{at}$ will be 1 from 1984-85 until 1994-95 for all plants in industry a and 0 from 1980-81 until 1983-84. On the other hand, if industry b was only de-licensed in 1991-92, $DL80_{bt}$ will be 0 from 1980-81 until 1994-95. We use this alternate measure of industrial de-licensing in order to isolate the impact of de-licensing during the 1980s from the effects of the 1991 reforms. As described in Section 2, the 1991 reforms consisted of industrial de-licensing as well as trade and investment liberalization and Table 2 shows that the largest de-licensing episode occurred in 1991, along with trade and investment liberalization. Equation 9 therefore allows us to examine the effect of pre-1991 industrial de-licensing on skill upgrading with and without trade liberalization.

As shown in Table 2, the most dramatic reduction in licensing occurred in 1991-92, together with trade liberalization. Since there was a considerable overlap in the industries that were de-licensed and those that were trade liberalized (Table 3), the trade liberalization measure may be capturing not only trade liberalization but also industrial de-licensing in 1991-92. To isolate the effect of trade liberalization and de-licensing in 1991-92 on skill upgrading, we estimate Equation 10 where $DL91_{jt}$ is 1 if industry j was de-licensed in or after 1991-92 and 0 otherwise.

[19] Since tariffs in industry j and year t are non-zero for all j and t, we use the natural log of tariffs ($ln(T_{jt})$) in Equation 9.

$$
\begin{aligned}
Y_{ijts} = {} & \alpha + \beta_1 DL80_{jt} + \beta_2 DL91_{jt} + \beta_3 ln\left(T_{jt}\right) + \beta_4 NE_{ijts} + \beta_5 ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_6 ln\left(O_{ijts}\right) \\
& + \beta_7 DL80_{jt} * ln\left(T_{jt}\right) + \beta_8 DL91_{jt} * ln\left(T_{jt}\right) + \beta_9 DL80_{jt} * NE_{ijts} + \beta_{10} DL91_{jt} * NE_{ijts} \\
& + \beta_{11} DL80_{jt} * ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_{12} DL91_{jt} * ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_{13} DL80_{jt} * ln\left(O_{ijts}\right) + \beta_{14} DL91_{jt} * ln\left(O_{ijts}\right) \\
& + \beta_{15} ln\left(T_{jt}\right) * NE_{ijts} + \beta_{16} ln\left(T_{jt}\right) * ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_{17} ln\left(T_{jt}\right) * ln\left(O_{ijts}\right) + \beta_{18} DL80_{jt} * ln\left(T_{jt}\right) * NE_{ijts} \\
& + \beta_{19} DL91_{jt} * ln\left(T_{jt}\right) * NE_{ijts} + \beta_{20} DL80_{jt} * ln\left(T_{jt}\right) * ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_{21} DL91_{jt} * ln\left(T_{jt}\right) * ln\left(\frac{K_{ijts}}{O_{ijts}}\right) \\
& + \beta_{22} DL80_{jt} * ln\left(T_{jt}\right) * ln\left(O_{ijts}\right) + \beta_{23} DL91_{jt} * ln\left(T_{jt}\right) * ln\left(O_{ijts}\right) + \delta_j + \gamma_t + \lambda_s + \epsilon_{ijts}
\end{aligned}
\tag{10}
$$

4.3.4 Non-Panel Structure of ASI Data

The richness of the ASI data makes it a good data source for the empirical analysis conducted in this paper. However, the absence of panel data introduces several limitations to this dataset and our results should therefore be interpreted keeping this in mind.

Ideally, we would like to observe each plant over time. However, we can only observe different cross-sections of plants over time. A major issue with repeated cross-sections rather than panel data is that being exempt or nonexempt may be ex-post characteristics in that plants may deliberately change their asset levels in order to become exempt from licensing requirements. This would introduce a correlation between a plant's nonexemption status (NE) and de-licensing (DL). Thus, we may not be capturing the effect of de-licensing on the demand for skilled labor by plants that were originally exempt from licensing requirements.

Another drawback of using non-panel data for this study is that we cannot include plant fixed effects in order to control for unobserved plant-specific characteristics that may be correlated with the plant's nonexemption status, capital-output ratio, output level as well as it's demand for skilled labor. This may generate a spurious correlation between a plant's demand for skilled labor and the right-hand-side variables in our regressions. Since a plant's capital may be a quasi-fixed factor, being difficult to change in the short run, the relationship between a plant's capital and skilled

labor may indeed be causal, even in the absence of plant fixed effects. However, output-skill complementarities in our analysis must be interpreted with caution since there is a possibility of reverse causation.

The non-panel structure of the ASI data introduces possible biases in both the difference-in-differences regressions as well as those using the regression discontinuity design technique. Unlike the usual RDD technique, we cannot observe the same plant before and after the reform but instead observe similar plants pre- and post-reform. Thus, comparing units based on possibly ex-post characteristics may generate biased results.

5 Results

5.1 Industrial De-Licensing and Skill Upgrading: 1980-81 to 1990-91

We present results of estimating Equation 6 in Table 8.[20] The bottom panel presents coefficients and F-test statistics for four hypotheses. The coefficient β_1 captures the impact of de-licensing on the demand for skilled labor in exempt plants ($\bar{Y}_{DL=1} - \bar{Y}_{DL=0} = \beta_1$ for $NE = 0$). It is small and statistically significant only for the employment share of skilled labor using data for the period 1980-81 to 1990-91. That is, the employment share of skilled labor is 0.5 percentage points (pp) higher in de-licensed exempt plants than in licensed exempt plants. The impact of de-licensing on skilled labor in nonexempt plants is given by $\beta_1 + \beta_3$ ($\bar{Y}_{DL=1} - \bar{Y}_{DL=0} = \beta_1 + \beta_3$ for $NE = 1$), showing that the employment share of skilled labor is 2.7 pp higher in de-licensed nonexempt plants than in licensed nonexempt plants using data for the 1980s.

While β_1 and $\beta_1 + \beta_3$ capture between-industry differences, within-industry differences are measured by β_2 and $\beta_2 + \beta_3$. The difference between exempt and nonexempt plants in licensed industries is captured by β_2 ($\bar{Y}_{NE=1} - \bar{Y}_{NE=0} = \beta_2$ for $DL = 0$), showing that nonexempt plants demand more skilled labor than exempt plants. This is true for both dependent variables and for both periods. A larger difference is found between exempt and nonexempt plants in de-licensed industries ($\bar{Y}_{NE=1} - \bar{Y}_{NE=0} = \beta_2 + \beta_3$ for $DL = 1$). These results are not surprising since larger plants may require more skilled labor, such as managers and technicians, than smaller ones. Moreover, once

[20] In all tables, we present regression results with and without interaction terms. Adding interaction terms do not substantially change the magnitude or significance of non-interaction terms in all regressions.

licensing requirements are removed, larger plants demand even more skilled labor compared to smaller plants since they are free from input and output constraints.

In Table 9, results of Equation 7 are presented. Once we include plant-level characteristics, namely $ln\left(\frac{K_{ijts}}{O_{ijts}}\right)$ and $ln\left(O_{ijts}\right)$, our coefficient estimates are quite different.[21] Using data for the 1980s, the employment and wagebill shares of skilled labor are generally not different in de-licensed exempt plants than in licensed exempt plants. A similar result is found for nonexempt plants in de-licensed compared to licensed industries. Moreover, in both licensed and de-licensed industries, nonexempt plants demand less skilled labor than exempt plants. That is, once we control for the capital-intensity and output of a plant, it is the exempt plants that exhibit a larger demand for skill in all industries. In addition, using data for the 1980s, the difference between exempt and nonexempt plants in skill demand is greater in de-licensed than in licensed industries.

While these results are unexpected and appear to contradict the findings in Table 8, their intuition is evident on closer examination. Since we control for a plant's capital-output ratio and output level, we are essentially comparing the skill shares of two plants that have the same capital-output ratio and output level though one plant is nonexempt and the other is exempt from licensing requirements due to different asset levels. One way in which an exempt plant can produce the same output as a nonexempt plant is by hiring more skilled workers. Moreover. since nonexempt plants in de-licensed industries have no restrictions on expansion and are therefore presumably larger than nonexempt plants in licensed industries, for an exempt plant to be producing the same output as a nonexempt plant in a de-licensed industry, it must be hiring even more skilled labor.

In order to compare capital- and output-skill complementarities for plants in licensed and de-licensed industries, Table 10 presents coefficients and F-test statistics in Panel A.[22] In Panel B,

[21] The difference between exempt plants in licensed and de-licensed industries is now given by $\bar{Y}_{DL=1} - \bar{Y}_{DL=0} = \beta_1 + \beta_6 * ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_7 * ln\left(O_{ijts}\right)$ for $NE = 0$. For nonexempt plants, this difference is $\bar{Y}_{DL=1} - \bar{Y}_{DL=0} = \beta_1 + \beta_5 + \beta_6 * ln\left(\frac{K_{ijts}}{O_{ijts}}\right) + \beta_7 * ln\left(O_{ijts}\right)$ for $NE = 1$. We evaluate both these differences at the average values of $ln\left(\frac{K_{ijts}}{O_{ijts}}\right)$ and $ln\left(O_{ijts}\right)$.

[22] The coefficients in Panel A are obtained by taking the derivative of the employment and wagebill shares of white-collar workers with respect to $(ln\left(\frac{K_{ijts}}{O_{ijts}}\right))$ and $(ln\left(O_{ijts}\right))$, respectively, separately for plants in licensed and de-licensed industries from columns (5) and (6) in Table 9. For $DL = 0$, $\partial Y_{ijts}/\partial ln\left(\frac{K_{ijts}}{O_{ijts}}\right) = \beta_3$ and $\partial Y_{ijts}/\partial ln\left(O_{ijts}\right) = \beta_4$. For $DL = 1$, $\partial Y_{ijts}/\partial ln\left(\frac{K_{ijts}}{O_{ijts}}\right) = \beta_3 + \beta_6$ and $\partial Y_{ijts}/\partial ln\left(O_{ijts}\right) = \beta_4 + \beta_7$.

elasticities are calculated using the coefficient estimates in Panel A and the average employment and wagebill shares of white-collar workers from Table 7 (0.19 and 0.26 respectively).[23] The elasticity of the employment share of white-collar workers with respect to the capital-output ratio is larger in de-licensed industries (0.058) than in licensed ones (0.047). A similar pattern is found for the elasticity of the wagebill share of white-collar workers with respect to the capital-output ratio, which is 0.058 in de-licensed industries and 0.050 in licensed ones. Elasticities of the employment and wagebill shares of white-collar workers with respect to the output level are more than double those with respect to the capital-output ratio and are also larger in de-licensed than in licensed industries.

Panel C summarizes the degree of capital- and output-skill complementarities in terms of elasticities, based on the rate of growth of the capital-output ratio (127.50%) and output level (66.57%) for the average plant during the period 1980-81 to 1990-91. Panel C shows that an increase of 127.50% in the capital-output ratio for the average plant between 1980-81 and 1990-91 is associated with a 6.04% and 7.38% rise in the employment share of white-collar workers for plants in licensed and de-licensed industries, respectively. For the wagebill share of white-collar workers, these figures are 6.38% and 7.36% for plants in licensed and de-licensed industries, respectively. The magnitude of these complementarities suggest that industrial de-licensing strengthened capital-skill complementarities with respect to the employment and wagebill shares of white-collar workers during the 1980s in India.

With respect to output-skill complementarities, an increase of 66.57% in the output level for the average plant between 1980-81 and 1990-91 is associated with a 6.66% and 9.11% rise in the employment share of white-collar workers for plants in licensed and de-licensed industries, respectively. For the wagebill share of white-collar workers, there is a 7.17% and 8.71% increase for plants in licensed and de-licensed industries, respectively. Thus, industrial de-licensing during the 1980s also strengthened output-skill complementarities with respect to the relative demand for skilled labor. Our results are qualitatively similar to Berman et al. (forthcoming), who find that output-skill complementarities are substantially larger than capital-skill complementarities in

[23] Elasticities are calculated as the coefficient (from Panel A of Table 10) divided by the average employment or wagebill share of white-collar workers in the period 1980-81 to 1990-91.

Indian industries.

5.2 Regression Discontinuity Design

Even though the results of Equation 7 provide evidence that skill upgrading as a result of de-licensing occurred through capital- and output-skill complementarities, unobserved differences in the average exempt and nonexempt plant (other than the capital-output ratio and the output level) may bias the coefficient estimates. While we cannot include plant fixed effects (due to the lack of panel data), we can compare very similar plants near the threshold asset level that were treated differently in terms of exemption from licensing requirements. In Tables 11 and 12, we present RD results from estimating Equation 8 for the periods 1980-81 to 1990-91 (columns (1) to (3)) and 1980-81 to 1994-95 (columns (4) to (6)) for the employment and wagebill shares of skilled workers, respectively.[24]

The lower panel of Tables 11 and 12 present four hypotheses based on a plant's exemption status and an industry's licensing status for plants close to the threshold asset level, that is with $Z_{ijts} = \ln\left(K_{ijts}/K_{\tau}^{T}\right) \approx 0$. The effect of de-licensing on skill demand is negative for both exempt and nonexempt plants near the threshold (top two rows of bottom panel), which contrasts with the results reported in Table 9 for the average plant. However, similar to the results reported in Table 9, we find that exempt plants near the threshold demand more skill than nonexempt plants near the threshold in both licensed and de-licensed industries (bottom two rows of bottom panel), though the difference is not always larger in de-licensed industries and depends on the polynomial order of the control function.

It is interesting to note that the magnitude of the coefficients from the RD analysis are not very sensitive to the degree of polynomial of the control function and that most remain statistically significant in all specifications. However, the magnitude of the coefficients from the RD analysis vary for the two sets of data – that is, 1980-81 to 1990-91 compared to 1980-81 to 1994-95. This is not surprising since a large number of industries were de-licensed in 1991, making a plant's exemption status less relevant after 1991.

[24] We also estimate these regressions for subsamples of plants at different distances from the threshold, the results of which are available from the authors upon request.

In Table 13, we present capital- and output-skill complementarities from the RD analysis for plants at the threshold asset level. That is, we evaluate the partial derivatives $\partial Y_{ijts}/\partial ln\left(\frac{K_{ijts}}{O_{ijts}}\right)$ and $\partial Y_{ijts}/\partial ln\left(O_{ijts}\right)$ at $Z_{ijts} = \ln\left(K_{ijts}/K_{\tau}^{T}\right) = 0$. These results support the findings from Table 10, namely that de-licensing increased demand for skill through capital- and output-skill complementarities. Since Table 10 presents complementarities for the average plant in licensed and de-licensed industries and Table 13 shows complementarities for plants near the threshold asset level, we can compare the strength of these complementarities for the average plant and for plants close to the threshold. Comparing complementarities in Panel C in Tables 10 and 13, we see that in licensed industries, capital- and output-skill complementarities are much smaller for plants close to the threshold than they are for the average plant. In de-licensed industries, however, there are larger complementarities for plants close to the threshold compared to the average plant. Thus, de-licensing appears to have benefited skilled labor via capital-intensity and output more among plants close to the threshold asset level.

5.3 Industrial De-Licensing, Trade Liberalization, and Skill Upgrading: 1980-81 to 1994-95

We next turn to examining how plants that were de-licensed during the 1980s performed in terms of skill upgrading after trade liberalization from 1991 onwards. Results of estimating Equation 9 are presented in Table 14. In Table 15, we present 4 hypothesis tests for the 1980s trade regime (Panel A) and the trade regime of the early 1990s (Panel B).

Under the 1980s trade regime, the employment and wagebill shares of skilled labor are generally not different in de-licensed exempt plants than in licensed exempt plants. Under the trade regime of the early 1990s, however, exempt plants in de-licensed industries demanded more skilled labor. There is no difference between nonexempt plants in licensed and de-licensed industries under both trade regimes.

Comparing exempt and nonexempt plants, we find that nonexempt plants demand less skilled labor than exempt plants in both licensed and de-licensed industries but particularly so in de-licensed industries. This is true for both trade regimes though the difference between exempt and nonexempt plants are slightly greater during the trade regime of the early 1990s. The only

exception is that the employment shares in exempt and nonexempt plants in licensed industries are similar. These results closely parallel the results presented in Table 9.

Given the results of Equation 7, where we found evidence that skill upgrading occurred via capital- and output-skill complementarities, we now focus on differences in capital- and output-skill complementarities between plants in licensed and de-licensed industries using mean tariff levels for two periods – that is, the 1980s and the first half of the 1990s.

In order to compare capital- and output-skill complementarities for plants in licensed and de-licensed industries, Table 16 presents linear combinations of coefficients and t-test statistics in Panel A, elasticities in Panel B, and capital- and output-skill complementarities in Panel C. Linear combinations of coefficients using mean tariff levels during the 1980s (105.64) are presented in the left panel whereas those using mean tariff levels during the first half of the 1990s (83.10) are presented in the right panel. Three observations are striking in comparing capital- and output-skill complementarities in Panel C by licensing status and mean tariff levels.

First, there are stronger capital-skill complementarities for plants in de-licensed than in licensed industries. This is true for both trade regimes, namely the more protected trade environment with high tariff levels during the 1980s as well as the trade liberalized regime with lower tariff levels during the early 1990s. Thus, plants in de-licensed industries fared better than those in licensed industries irrespective of trade liberalization, with respect to capital-skill complementarities.

Second, output-skill complementarities are stronger in de-licensed than in licensed industries and this is also true for both trade regimes. The exception is output-skill complementarities with respect to the wagebill share, before trade liberalization occurred, where there is no difference between plants in licensed and de-licensed industries. Since trade liberalization did not magnify the difference in output-skill complementarities between de-licensed and licensed industries, the ability of plants in de-licensed industries to take advantage of economies of scale appears to have benefited skilled labor regardless of trade liberalization.

The third interesting result in Table 16 is that regardless of de-licensing, capital- and output-skill complementarities (Panel C) are generally stronger before trade liberalization (left panel) than after trade was liberalized (right panel). There are two exceptions. First, output-skill complementarities

with respect to the employment share of skilled labor among plants in licensed industries are the same (7.18) before and after trade liberalization. Second, output-skill complementarities with respect to the wagebill share of skilled labor among plants in de-licensed industries are larger after trade liberalization (10.04) than before (8.86). This result suggests that trade liberalization may not have played a major role in raising the relative demand for skilled labor at least via capital-skill complementarities during the early 1990s.

5.4 Industrial De-Licensing During the 1980s and 1990s

Tables 17 and 18 present results of estimating Equation 10. Comparing plants in industries that were de-licensed during the 1980s to those that remained licensed during the 1980s, the degree of capital-skill complementarities in Table 18 are different from those in Table 16. Capital-skill complementarities are either the same or weaker among plants in industries that were de-licensed during the 1980s compared to those that remained licensed during the 1980s. This is true for both the protected trade regime during the 1980s as well as the trade liberalized one during the early 1990s. Output-skill complementarities are stronger among plants in industries that were de-licensed during the 1980s than in licensed industries for both trade regimes, but more so after trade liberalization. Thus, jointly, de-licensing during the 1980s and trade liberalization in 1991 onwards appears to have benefited skilled labor via output-skill complementarities.

For plants in industries that were de-licensed during the 1990s, capital-skill complementarities are substantially weaker than those in both licensed as well as 1980s de-licensed industries. Again, this is true for both types of trade regimes. Output-skill complementarities, however, are stronger for plants in industries that were de-licensed during the 1990s compared to licensed ones, but only before trade was liberalized.

This analysis indicates that it was primarily the 1980s de-licensing that benefited skilled labor via output-skill complementarities. As discussed in Section 3, Berman et al. (forthcoming) find evidence of output- and capital-skill complementarities in Indian industries during the 1990s, though they exclude any potential effect of industrial de-licensing on skill upgrading. Our results are similar to Berman et al. (forthcoming), who find that skill upgrading occurred mostly through output-skill

complementarities in Indian industries.

The results presented in this paper also complement those of Berman et al. (forthcoming) by showing that industrial de-licensing during the 1980s contributed to skill upgrading in India even before trade was liberalized in 1991. We find that skill upgrading was greater among plants that had time to adjust to the removal of output constraints due to de-licensing prior to trade liberalization. De-licensing during the 1990s did, however, benefit skilled labor after trade liberalization with respect to output-skill complementarities.[25]

6 Conclusion

In this paper we use disaggregated data on plant-level characteristics, industrial de-licensing, and tariffs to examine how industrial de-licensing and trade liberalization affected the relative demand for skilled labor in India. The chronology of Indian reforms, with piece-meal industrial de-licensing in the 1980s and external sector reforms in the 1990s, allows us to separate the effects of domestic and external sector reforms.

Both DD and RD analyses show that after controlling for the size-based exemption rule that determined whether or not a plant faced licensing restrictions, industrial de-licensing during the 1980s appears to have increased the relative demand for skilled workers via capital- and output-skill complementarities.

We find that during the 1980s, capital- and output-skill complementarities exist for plants in all industries but are stronger in industries that were de-licensed. Thus, freedom from output, input, and technology constraints as well as increased entry and competition in de-licensed industries appears to have increased the relative demand for skilled labor before India liberalized trade from 1991 onwards. Using data for the 1980s and early 1990s, greater capital intensity and output for plants in de-licensed industries generated greater demand for skilled labor compared to those in licensed industries. This is true both for both periods, that is, pre- and post- trade liberalization.

With respect to trade liberalization, we find that capital- and output-skill complementarities

[25]The papers that are the closest to our analysis are Berman et al. (forthcoming) and Kumar & Mishra (2008). Our results are supported by the findings of these papers. Note, however, that direct comparisons between our results and theirs are not feasible since their specifications investigate the determinants of the rate of growth of the demand for skill while our analysis focuses on the determinants of the level of the demand for skill.

are generally weaker after trade liberalization in both licensed and de-licensed industries. This, together with the finding that complementarities are stronger in de-licensed industries, suggests that trade liberalization during the early 1990s did not play a major role in skill upgrading whereas industrial de-licensing did. Since our de-licensing indicator captures de-licensing during the 1980s, our results indicate that plants that had time to adjust to de-licensing before trade was liberalized experienced greater skill upgrading. Isolating the 1980s de-licensing episode from de-licensing and trade liberalization in 1991-92, we find that it was primarily the 1980s de-licensing that benefited skilled labor via output-skill complementarities.

Our regression results as well as Figure 1 confirm that an increasing trend in the relative demand for skilled workers preceded the external sector reforms of 1991 and that industrial de-licensing in India played a role in this. Before trade was liberalized, capital- and output-skill complementarities jointly contributed 75% and 31%, respectively of the growth in the employment and wagebill shares of white-collar workers in de-licensed industries. In licensed industries capital- and output-skill complementarities contributed less – 57% and 29%, respectively.[26] Similar evidence is found for the post-1991 period, when trade was liberalized, though the magnitudes are slightly smaller. Together, capital- and output-skill complementarities contributed 66% (53%) and 29% (25%) of the growth in the employment and wagebill shares of white-collar workers in de-licensed (licensed) industries after trade was liberalized during the early 1990s.

Our results support Hypotheses I and II, described in Section 3. Once microeconomic constraints were lifted from plants, they could invest in more capital as well as produce more output and take advantage of economies of scale. Thus, it is not surprising that both capital intensity and output play important roles in skill upgrading. Increased competition, brought about by industrial de-licensing during the 1980s, appears to have provided plants with greater incentives to increase productivity and product quality. As plants adopted more efficient input combinations

[26]From Table 16, before trade liberalization (left panel) the predicted growth rate in the employment share of skilled labor in de-licensed industries is 24.04% (12.48 + 11.56), which is 75% of the actual growth rate of 32.07% in the employment share of white-collar workers during the 1980s. For the wagebill share of white-collar workers, the predicted growth rate due to capital- and output-skill complementarities in de-licensed industries is 22.21% (13.35 + 8.86), which is 31% of the actual growth rate of 72.81% during the 1980s. In licensed industries, the predicted growth rates are 18.27% (11.09 + 7.18) and 21.18% (12.32 + 8.86) in the employment and wagebill shares of white-collar workers, which are 57% and 29% of the actual growth rates of 32.07% and 72.81%, respectively.

and exploited economies of scale, skill upgrading occurred as a result of capital- and output-skill complementarities.

The results of this paper underscore the importance of incorporating domestic industrial policy changes in economic research since these changes may lead to distortions in optimal resource use. Including external sector reforms in such analyses is also important since trade reforms may reduce these distortions. This paper also provides some evidence that there may have been some unexpected positive consequences of India's industrial policy distortions. By keeping the relative demand for and returns to skilled labor low, the licensing regime may have contributed to the cost advantage faced by the skilled service sector in India during the 1990s. The success of the Indian software industry as well as the growth of business process outsourcing activities may therefore be partly due to decades of industrial licensing restrictions under the License Raj.

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Figure 1: Trends in the Wagebill and Employment Shares of White-Collar Workers: India, 1980-81 to 1994-95

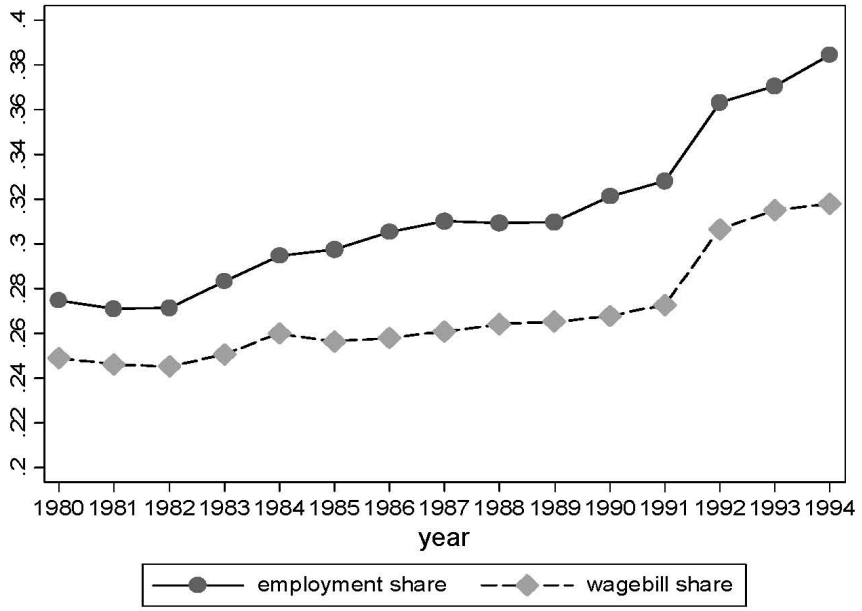

Figure 2: Trends in the Skill Premium: India, 1980-81 to 1994-95

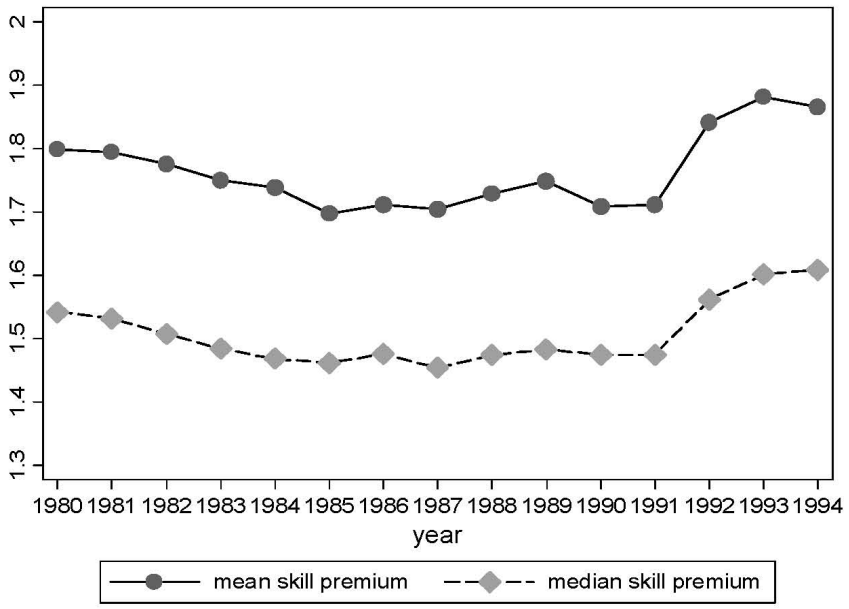

Figure 3: Distribution of Assets of Exempt Plants in Licensed and De-licensed Industries

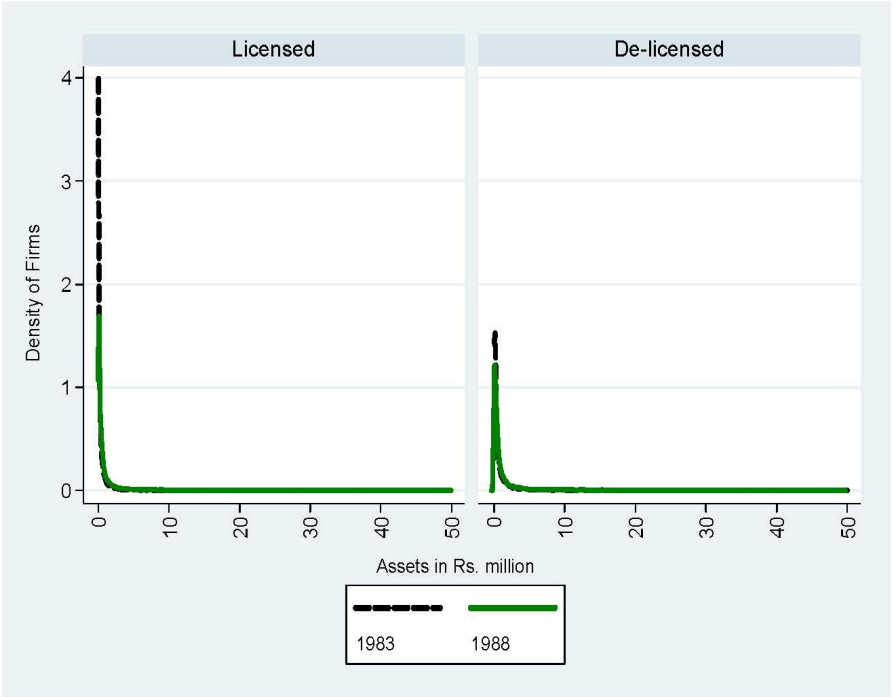

Table 1: Percentage of Cumulative Output and Employment in De-Licensed Industries

Year	**% Output**	**% Employment**
1980-81	0.000	0.000
1981-82	0.000	0.000
1982-83	0.000	0.000
1983-84	0.000	0.000
1984-85	6.807	7.627
1985-86	13.933	15.040
1986-87	19.994	17.885
1987-88	24.957	23.477
1988-89	25.028	23.395
1989-90	22.774	22.378
1990-91	23.174	22.820
1991-92	84.123	89.972
1992-93	83.612	90.198
1993-94	84.765	90.881
1994-95	84.412	91.078

To compute these figures we use de-licensing and plant-level data at the four-digit level of the National Industrial Classification (NIC).

Table 2: Industrial De-Licensing By Industry and Year

Two-Digit NIC Industries	**Industry**	**No. of Four-Digit NIC Industries**	**Number of Four-Digit NIC Industries de-licensed in:**								
			1984	1985	1986	1987	1991	1992	1993	1994	All Years
20	Food products	20	2	1	1	0	9	0	0	1	14
21	Food products	22	0	0	0	1	9	0	0	2	12
22	Beverages, tobacco, and related products	17	0	0	0	0	10	0	0	1	11
23	Cotton textiles	7	0	0	0	0	7	0	0	0	7
24	Wool, silk, and man-made fibre textiles	15	0	0	0	0	12	0	0	0	12
25	Jute and other vegetable fibre textiles	9	0	0	0	0	8	1	0	0	9
26	Textile products and wearing apparel	30	0	0	0	0	23	1	0	3	27
27	Wood, wood products, furniture, and fixtures	11	0	0	0	0	8	0	0	0	8
28	Paper, printing, publishing, and allied industries	24	2	0	0	14	3	0	0	2	21
29	Leather, fur, and leather products	10	3	0	0	1	0	0	0	0	4
30	Chemicals and chemical products	53	1	1	5	0	30	0	0	1	38
31	Rubber, plastic, petroleum, and coal products	18	1	0	0	0	12	0	0	4	17
32	Non-metallic mineral products	41	10	1	1	0	19	0	0	1	32
33	Basic metals and alloy industries	14	0	0	0	0	11	0	0	1	12
34	Metal products and parts	26	4	1	1	0	12	1	0	3	22
35	Machinery and equipment	55	6	8	0	17	18	0	0	1	50
36	Machinery and equipment	43	5	5	1	4	18	0	0	1	34
37	Transport equipment and parts	18	1	3	0	0	9	0	1	0	14
38	Other manufacturing industries	30	4	1	1	2	10	0	0	0	18
All		463	39	21	10	39	228	3	1	21	362

To compute these figures we use de-licensing data at the two- and four-digit levels of the National Industrial Classification (NIC).

Table 3: Trade Liberalization By Industry Between 1985-90 and 1991-95

Two-Digit NIC Industries	**Industry**	**No. of Four-Digit NIC Industries**	**No. of Four-Digit NIC Industries Trade Liberalized Between 1985-90 and 1991-95**
20	Food products	20	4
21	Food products	22	3
22	Beverages, tobacco, and related products	17	0
23	Cotton textiles	7	7
24	Wool, silk, and man-made fibre textiles	15	3
25	Jute and other vegetable fibre textiles	9	4
26	Textile products and wearing apparel	30	21
27	Wood, wood products, furniture, and fixtures	11	1
28	Paper, printing, publishing, and allied industries	24	2
29	Leather, fur, and leather products	10	5
30	Chemicals and chemical products	53	11
31	Rubber, plastic, petroleum, and coal products	18	6
32	Non-metallic mineral products	41	8
33	Basic metals and alloy industries	14	4
34	Metal products and parts	26	6
35	Machinery and equipment	55	10
36	Machinery and equipment	43	23
37	Transport equipment and parts	18	3
38	Other manufacturing industries	30	3
All		463	124

Source: Das (2003). An industry is defined as trade liberalized if its tariff fell by more than 22 percentage points (the average tariff decline) between 1985-90 and 1991-95.

Table 4: Characteristics of Plants in De-Licensed and Licensed Industries – Average Values

De-Licensed Industries

Year	No. of Four-Digit NIC Industries	No. of Observations	Employment Share	Wagebill Share	Capital-Output Ratio	Real Output
1980-81	0	0	0	0	0	0
1981-82	0	0	0	0	0	0
1982-83	0	0	0	0	0	0
1983-84	0	0	0	0	0	0
1984-85	39	6,156	0.21	0.27	20.26	168,579
1985-86	62	11,072	0.22	0.29	22.09	183,766
1986-87	65	13,181	0.24	0.32	24.18	233,597
1987-88	129	17,886	0.23	0.31	25.64	245,203
1988-89	88	18,107	0.23	0.31	25.69	257,600
1989-90	121	20,782	0.23	0.31	25.94	256,668
1990-91	120	21,259	0.24	0.31	27.16	271,596
1991-92	349	79,406	0.21	0.28	28.14	243,913
1992-93	355	82,646	0.23	0.31	31.96	246,192
1993-94	351	84,474	0.23	0.32	34.95	258,213
1994-95	415	87,566	0.23	0.32	38.11	274,361

Licensed Industries

Year	No. of Four-Digit NIC Industries	No. of Observations	Employment Share	Wagebill Share	Capital-Output Ratio	Real Output
1980-81	316	66,115	0.18	0.25	14.06	140,401
1981-82	317	70,012	0.18	0.25	14.62	142,960
1982-83	314	71,904	0.18	0.25	15.60	173,753
1983-84	331	74,586	0.19	0.25	21.19	173,285
1984-85	289	63,413	0.19	0.26	21.38	193,105
1985-86	276	63,690	0.19	0.25	21.91	195,469
1986-87	256	60,264	0.19	0.25	21.86	197,818
1987-88	302	55,011	0.19	0.25	23.94	218,565
1988-89	206	56,669	0.19	0.25	24.93	230,794
1989-90	262	60,516	0.19	0.25	23.00	249,061
1990-91	263	62,651	0.19	0.26	24.44	250,907
1991-92	31	6,157	0.22	0.29	22.61	467,145
1992-93	31	6,511	0.24	0.33	28.37	461,221
1993-94	33	6,503	0.25	0.34	30.99	469,239
1994-95	39	6,747	0.25	0.34	35.76	487,758

To compute these figures we use de-licensing and plant-level data at the four-digit level of the National Industrial Classification (NIC). The number of four-digit NIC industries that were de-licensed and under licensing requirements is cumulative and include those in the ASI dataset in each year. The number of observations are the number of plants surveyed in each year of the ASI data. All variables are weighted with plant-level multipliers and winsorized at the 1% level. Real output is in 1993-94 Rupees.

Table 5: Between- and Within-Industry Decomposition of Changes in Employment and Wagebill Shares of Skilled Labor

		Employment Share			**Wagebill Share**		
Time Period	**Industries**	**Between**	**Within**	**Total**	**Between**	**Within**	**Total**
1980-81 to 1983-84	All	0.0024	0.0061	0.0086	0.0079	0.0039	0.0118
1984-85 to 1990-91	All	-0.0160	0.0001	-0.0158	-0.0274	0.0033	-0.0242
	Licensed	-0.0071	-0.0050	-0.0121	-0.0077	-0.0057	-0.0134
	De-licensed	-0.0089	0.0051	-0.0037	-0.0197	0.0090	-0.0107
1991-92 to 1994-95	All	0.0023	0.0063	0.0086	0.0109	0.0134	0.0244
	Licensed	-0.0015	0.0010	-0.0005	-0.0025	0.0022	-0.0003
	De-licensed	0.0039	0.0052	0.0091	0.0134	0.0112	0.0246

To compute these figures we aggregate plant-level data into a panel of four-digit industries for the years 1980-81 to 1994-95. In aggregating our data, all variables are weighted with plant-level multipliers.

Table 6: Summary Statistics for Nonexempt and Exempt Plants

Variable	**Nonexempt Plants**		**Exempt Plants**	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**
(1)	(2)	(3)	(4)	(5)
1980-81 to 1983-84				
Employment Share	0.29	0.13	0.18	0.16
Wagebill Share	0.39	0.15	0.25	0.21
Ln Skill Premium	0.47	0.36	0.43	0.53
Ln Capital-Output Ratio	3.00	1.12	1.37	2.11
Ln Real Output	15.32	1.31	10.04	1.87
Number of Observations	2542		206062	
1984-85 to 1990-91				
Employment Share	0.30	0.14	0.19	0.16
Wagebill Share	0.41	0.17	0.26	0.21
Ln Skill Premium	0.52	0.43	0.40	0.53
Ln Capital-Output Ratio	3.47	1.11	1.95	1.87
Ln Real Output	15.35	1.36	10.38	1.83
Number of Observations	6339		317892	
1991-92 to 1994-95				
Employment Share	0.32	0.14	0.22	0.17
Wagebill Share	0.44	0.17	0.30	0.22
Ln Skill Premium	0.56	0.46	0.46	0.53
Ln Capital-Output Ratio	4.14	1.12	2.39	1.83
Ln Real Output	15.68	1.34	10.56	1.89
Number of Observations	3638		187119	

Source: Annual Survey of Industries (1980-81 to 1994-95) and industrial de-licensing data collected by the authors. The number of observations are the number of plants surveyed in each of the three time periods in the ASI data. All variables are weighted with plant-level multipliers and winsorized at the 1% level. Real output is in 1993-94 Rupees.

Table 7: Summary Statistics

Variable (1)	**Mean** (2)	**Std. Dev.** (3)
1980-81 to 1983-84		
Employment Share	0.18	0.16
Wagebill Share	0.25	0.21
Ln Skill Premium	0.43	0.53
Ln Capital-Output Ratio	1.38	2.11
Ln Real Output	10.08	1.92
Number of Observations	194056	
1984-85 to 1990-91		
Employment Share	0.20	0.16
Wagebill Share	0.26	0.21
Ln Skill Premium	0.40	0.53
Ln Capital-Output Ratio	1.97	1.87
Ln Real Output	10.44	1.90
Number of Observations	321814	
1991-92 to 1994-95		
Employment Share	0.22	0.17
Wagebill Share	0.30	0.22
Ln Skill Premium	0.46	0.53
Ln Capital-Output Ratio	2.41	1.83
Ln Real Output	10.61	1.95
Number of Observations	189851	
1980-81 to 1990-91		
Employment Share	0.19	0.16
Wagebill Share	0.26	0.21
Ln Skill Premium	0.41	0.53
Ln Capital-Output Ratio	1.77	1.98
Ln Real Output	10.32	1.92
Number of Observations	515870	
1980-81 to 1994-95		
Employment Share	0.20	0.16
Wagebill Share	0.27	0.21
Ln Skill Premium	0.43	0.53
Ln Capital-Output Ratio	1.96	1.96
Ln Real Output	10.40	1.93
Number of Observations	705721	

Source: Annual Survey of Industries (1980-81 to 1994-95) and industrial deregulation data collected by the authors. The number of observations are the number of plants surveyed in each of the three time periods in the ASI data. All variables are weighted with plant-level multipliers and winsorized at the 1% level. Real output is in 1993-94 Rupees.

Table 8: OLS Results of Equation 6 – Industrial De-Licensing and Skill Upgrading

		1980s Sample						Full Sample	
Variable	**Coeff**	**Employment Share**	**Wagebill Share**	**Employment Share**	**Wagebill Share**	**Employment Share**	**Wagebill Share**	**Employment Share**	**Wagebill Share**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
DL	β_1	0.005**	0.004	0.005**	0.004	0.005**	0.004	0.001	0.000
		[0.002]	[0.003]	[0.002]	[0.003]	[0.002]	[0.003]	[0.002]	[0.003]
NE	β_2			0.028***	0.018***	0.024***	0.015**	0.027***	0.021***
				[0.006]	[0.007]	[0.007]	[0.008]	[0.006]	[0.007]
$DL * NE$	β_3					0.022**	0.014	0.009	0.007
						[0.011]	[0.013]	[0.006]	[0.010]
$Constant$	α	0.145***	0.191***	0.145***	0.191***	0.145***	0.191***	0.157***	0.208***
		[0.008]	[0.010]	[0.008]	[0.010]	[0.008]	[0.010]	[0.007]	[0.008]
Industry FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations		498,582	498,286	498,582	498,286	498,582	498,286	687,292	686,455
R-squared		0.23	0.28	0.23	0.28	0.23	0.28	0.23	0.27
Difference between Exempt Plants in Licensed and De-licensed Industries						0.005**	0.004	0.001	0.000
$H_0 : \beta_1 = 0$						[4.22]	[1.57]	[0.21]	[0.02]
Difference between Nonexempt Plants in Licensed and De-licensed Industries						0.027**	0.018	0.010	0.007
$H_0 : \beta_1 + \beta_3 = 0$						[5.71]	[1.54]	[2.32]	[0.50]
Difference between Exempt and Nonexempt Plants in Licensed Industries						0.024***	0.015**	0.027***	0.021***
$H_0 : \beta_2 = 0$						[13.25]	[3.97]	[20.30]	[8.20]
Difference between Exempt and Nonexempt Plants in De-licensed Industries						0.046***	0.029**	0.036***	0.028***
$H_0 : \beta_2 + \beta_3 = 0$						[28.74]	[6.60]	[39.19]	[14.35]

Source: Annual Survey of Industries (1980-81 to 1994-95) and industrial de-licensing data collected by the authors. Industry fixed effects are at the four-digit industry level. All regressions include indicators for whether or not the plant is a factory and for the type of ownership and organization. The omitted ownership structure is public sector plants and the omitted organization consists of individual proprietorship and partnership plants. Robust standard errors, clustered at the four-digit-industry level, are in parentheses in the top panel. F-statistics are presented in parentheses in the bottom panel. A *, **, and *** represent significance at the 10%, 5%, and 1% levels respectively.

Table 9: OLS Results of Equation 7 – Industrial De-Licensing and Skill Upgrading

		1980s Sample				Full Sample	
Variable	**Coeff**	**Employment Share**	**Wagebill Share**	**Employment Share**	**Wagebill Share**	**Employment Share**	**Wagebill Share**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DL	β_1	0.006***	0.005*	-0.072***	-0.066**	-0.006	0.003
		[0.002]	[0.003]	[0.024]	[0.029]	[0.011]	[0.014]
NE	β_2	-0.030***	-0.068***	-0.029***	-0.066***	-0.027***	-0.062***
		[0.007]	[0.010]	[0.008]	[0.011]	[0.008]	[0.012]
$ln(K/O)$	β_3	0.009***	0.013***	0.009***	0.013***	0.009***	0.013***
		[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
$ln(O)$	β_4	0.019***	0.029***	0.019***	0.028***	0.019***	0.029***
		[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
$DL * NE$	β_5			-0.015	-0.022	0.000	0.001
				[0.011]	[0.014]	[0.007]	[0.012]
$DL * ln(K/O)$	β_6			0.002	0.002	-0.003***	-0.004***
				[0.001]	[0.002]	[0.001]	[0.001]
$DL * ln(O)$	β_7			0.007***	0.006**	0.001	0.001
				[0.002]	[0.003]	[0.001]	[0.001]
$Constant$	α	-0.042*	-0.084***	-0.033	-0.076***	-0.025	-0.068***
		[0.022]	[0.023]	[0.024]	[0.025]	[0.023]	[0.024]
Industry FE		Yes	Yes	Yes	Yes	Yes	Yes
State FE		Yes	Yes	Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations		479,207	478,869	479,207	478,869	661,648	660,793
R-squared		0.26	0.31	0.26	0.31	0.25	0.3
Difference between Exempt Plants in Licensed and De-licensed Industries				0.004*	0.003	0.002	0.001
$H_0 : \beta_1 + \beta_6 * ln(K/O) + \beta_7 * ln(O) = 0$				[1.94]	[1.11]	[0.99]	[0.32]
Difference between Nonexempt Plants in Licensed and De-licensed Industries				-0.010	-0.018	0.002	0.002
$H_0 : \beta_1 + \beta_5 + \beta_6 * ln(K/O) + \beta_7 * ln(O) = 0$				[1.01]	[1.32]	[0.37]	[0.17]
Difference between Exempt and Nonexempt Plants in Licensed Industries				-0.029***	-0.066***	-0.026***	-0.061***
$H_0 : \beta_2 = 0$				[3.56]	[5.90]	[3.34]	[5.31]
Difference between Exempt and Nonexempt Plants in De-licensed Industries				-0.044***	-0.088***	-0.026***	-0.060***
$H_0 : \beta_2 + \beta_5 = 0$				[5.89]	[9.00]	[3.71]	[6.20]

Source: Annual Survey of Industries (1980-81 to 1994-95) and industrial de-licensing data collected by the authors. Industry fixed effects are at the four-digit industry level. All regressions include indicators for whether or not the plant is a factory and for the type of ownership and organization. The omitted ownership structure is public sector plants and the omitted organization consists of individual proprietorship and partnership plants. Robust standard errors, clustered at the four-digit-industry level, are in parentheses in the top panel. Linear combinations of coefficients are presented in the bottom panel, with t-statistics (in absolute value) in parentheses. An average $ln(K/O)$ of 1.81 for the 1980s sample and 1.99 for the full sample and an average $ln(O)$ of 10.58 for the 1980s sample and 10.68 for the full sample are used to calculate linear combinations of coefficients. A *, **, and *** represent significance at the 10%, 5%, and 1% levels respectively.

Table 10: Complementarities from Equation 7

Null Hypothesis	1980s Sample	
	Employment Share	Wagebill Share
Panel A: Coefficients and Test Statistics		
Plants in Licensed Industries		
$H_0 : \beta_3 = 0$	0.009***	0.013***
	[259.83]	[232.46]
$H_0 : \beta_4 = 0$	0.019***	0.028***
	[74.95]	[131.11]
Plants in De-licensed Industries		
$H_0 : \beta_3 + \beta_6 = 0$	0.011***	0.015***
	[240.80]	[130.68]
$H_0 : \beta_4 + \beta_7 = 0$	0.026***	0.034***
	[240.80]	[344.76]
Panel B: Elasticities		
Plants in Licensed Industries		
Elasticity wrt capital-output ratio	0.047	0.050
Elasticity wrt output	0.100	0.108
Plants in De-licensed Industries		
Elasticity wrt capital-output ratio	0.058	0.058
Elasticity wrt output	0.137	0.131
Panel C: Complementarities		
Plants in Licensed Industries		
Capital-skill complementarities	6.04	6.38
Output-skill complementarities	6.66	7.17
Plants in De-licensed Industries		
Capital-skill complementarities	7.38	7.36
Output-skill complementarities	9.11	8.71

Source: Annual Survey of Industries (1980-81 to 1990-91) and industrial de-licensing data collected by the authors. Coefficients from columns (5) and (6) of Table 9 are presented in Panel A. F-statistics are presented in parentheses in Panel A. The F-critical value with 1 restriction at the 1% level of significance is 6.63. Average employment and wagebill shares of 0.19 and 0.26 are used to calculate elasticities in Panel B. An increase of 127.50% and 66.57% in the capital-output ratio and output level for the average plant between 1980-81 and 1990-91 are used to calculate complementarities in Panel C.

Table 11: Regression Discontinuity Results (Equation 8) – Employment Share of White-Collar Workers

Variable	Coeff	1980-81 to 1990-91			1980-81 to 1994-95		
		Polynomial of Degree			Polynomial of Degree		
		1	2	3	1	2	3
		(1)	(2)	(3)	(4)	(5)	(6)
DL	β_1	-0.298***	-0.316***	-0.317***	-0.142***	-0.164***	-0.169***
		[0.048]	[0.052]	[0.055]	[0.036]	[0.037]	[0.038]
NE	β_2	-0.015	-0.048***	-0.036**	-0.017*	-0.048***	-0.035**
		[0.011]	[0.011]	[0.016]	[0.010]	[0.011]	[0.016]
$ln(K/O)$	β_3	0.002	0.002	0.001	0.001	0.001	0.001
		[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
$ln(O)$	β_4	0.007***	0.005***	0.005***	0.006***	0.005***	0.005**
		[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
$DL * NE$	β_5	-0.026*	-0.008	0.002	-0.006	0.012	0.015
		[0.014]	[0.016]	[0.021]	[0.008]	[0.008]	[0.010]
$DL * ln(K/O)$	β_6	0.016***	0.015***	0.015***	0.006**	0.005**	0.005**
		[0.003]	[0.003]	[0.003]	[0.002]	[0.002]	[0.002]
$DL * ln(O)$	β_7	0.020***	0.021***	0.021***	0.009***	0.010***	0.010***
		[0.003]	[0.003]	[0.003]	[0.002]	[0.002]	[0.002]
$Constant$	α	-0.058***	0.001	-0.005	-0.039*	0.000	-0.007
		[0.022]	[0.024]	[0.027]	[0.023]	[0.026]	[0.030]
Industry FE		Yes	Yes	Yes	Yes	Yes	Yes
State FE		Yes	Yes	Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations		430,941	430,941	430,941	655,304	655,304	655,304
R-squared		0.02	0.03	0.03	0.02	0.02	0.02
Difference between Exempt Plants in Licensed and De-licensed Industries		-0.050***	-0.064***	-0.067***	-0.025**	-0.025**	-0.042***
$H_0 : \beta_1 + \beta_6 * ln(K/O) + \beta_7 * ln(O) = 0$		[4.01]	[3.52]	[3.03]	[2.56]	[2.56]	[3.11]
Difference between Nonexempt Plants in Licensed and De-licensed Industries		-0.075***	-0.072***	-0.066***	-0.030**	-0.030**	-0.028**
$H_0 : \beta_1 + \beta_5 + \beta_6 * ln(K/O) + \beta_7 * ln(O) = 0$		[4.45]	[4.26]	[4.15]	[2.37]	[2.37]	[2.40]
Difference between Exempt and Nonexempt Plants in Licensed Industries		-0.014	-0.048***	-0.035**	-0.017*	-0.017*	-0.034**
$H_0 : \beta_2 = 0$		[1.43]	[4.39]	[2.19]	[1.70]	[1.70]	[2.16]
Difference between Exempt and Nonexempt Plants in De-licensed Industries		-0.040***	-0.056***	-0.033**	-0.022***	-0.022***	-0.020
$H_0 : \beta_2 + \beta_5 = 0$		[4.12]	[4.68]	[2.30]	[2.67]	[2.67]	[1.50]

Source: Annual Survey of Industries (1980-81 to 1994-95) and industrial de-licensing data collected by the authors. Industry fixed effects are at the four-digit industry level. All regressions include indicators for whether or not the plant is a factory and for the type of ownership and organization. The omitted ownership structure is public sector plants and the omitted organization consists of individual proprietorship and partnership plants. Robust standard errors, clustered at the four-digit-industry level, are in parentheses in the top panel. Linear combinations of coefficients are presented in the bottom panel, with t-statistics (in absolute value) in parentheses. An average $ln(K/O)$ of 1.81 for the 1980s sample and 1.99 for the full sample and an average $ln(O)$ of 10.58 for the 1980s sample and 10.68 for the full sample are used to calculate linear combinations of coefficients. A *, **, and *** represent significance at the 10%, 5%, and 1% levels respectively. All rgeressions include the control function, Z^k_{ijts}, which consists of the kth degree polynomial of a plant's asset level (K_{ijts}) relative to the threshold asset level (K^T_t), that is, $Z_{ijts} = \ln\left(K_{ijts}/K^T_t\right)$.

Table 12: Regression Discontinuity Results (Equation 8) – Wagebill Share of White-Collar Workers

		1980-81 to 1990-91			1980-81 to 1994-95		
Variable	Coeff	Polynomial of Degree			Polynomial of Degree		
		1	2	3	1	2	3
		(1)	(2)	(3)	(4)	(5)	(6)
DL	β_1	-0.441***	-0.490***	-0.489***	-0.223***	-0.261***	-0.274***
		[0.072]	[0.081]	[0.089]	[0.058]	[0.059]	[0.063]
NE	β_2	-0.038**	-0.098***	-0.069**	-0.041***	-0.096***	-0.066**
		[0.016]	[0.018]	[0.030]	[0.015]	[0.018]	[0.029]
$ln(K/O)$	β_3	0.006*	0.006**	0.006*	0.003	0.004	0.004
		[0.004]	[0.003]	[0.003]	[0.004]	[0.003]	[0.003]
$ln(O)$	β_4	0.016***	0.012***	0.012***	0.013***	0.010***	0.010***
		[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
$DL * NE$	β_5	-0.042**	-0.004	0.017	-0.011	0.020	0.030
		[0.020]	[0.023]	[0.035]	[0.011]	[0.012]	[0.019]
$DL * ln(K/O)$	β_6	0.026***	0.025***	0.024***	0.009**	0.008**	0.009**
		[0.005]	[0.005]	[0.005]	[0.004]	[0.004]	[0.004]
$DL * ln(O)$	β_7	0.029***	0.030***	0.030***	0.014***	0.015***	0.016***
		[0.005]	[0.005]	[0.005]	[0.003]	[0.003]	[0.004]
$Constant$	α	-0.167***	-0.064	-0.076	-0.110***	-0.04	-0.058
		[0.038]	[0.041]	[0.050]	[0.040]	[0.043]	[0.053]
Industry FE		Yes	Yes	Yes	Yes	Yes	Yes
State FE		Yes	Yes	Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations		430,661	430,661	430,661	654,530	654,530	654,530
R-squared		0.04	0.04	0.04	0.04	0.04	0.04
Difference between Exempt Plants in Licensed and De-licensed Industries		-0.091***	-0.126***	-0.134***	-0.055**	-0.081***	-0.081***
$H_0 : \beta_1 + \beta_6 * ln(K/O) + \beta_7 * ln(O) = 0$		[4.96]	[4.47]	[3.64]	[3.62]	[4.57]	[4.57]
Difference between Nonexempt Plants in Licensed and De-licensed Industries		-0.133***	-0.129***	-0.114***	-0.066***	-0.062***	-0.062***
$H_0 : \beta_1 + \beta_5 + \beta_6 * ln(K/O) + \beta_7 * ln(O) = 0$		[4.99]	[4.82]	[4.75]	[3.12]	[2.93]	[2.93]
Difference between Exempt and Nonexempt Plants in Licensed Industries		-0.038**	-0.097***	-0.070**	-0.041***	-0.096***	-0.096***
$H_0 : \beta_2 = 0$		[2.45]	[5.52]	[2.35]	[2.74]	[5.46]	[5.46]
Difference between Exempt and Nonexempt Plants in De-licensed Industries		-0.080***	-0.100***	-0.049***	-0.053***	-0.076***	-0.076***
$H_0 : \beta_2 + \beta_5 = 0$		[5.97]	[6.62]	[2.64]	[4.10]	[4.86]	[4.86]

Source: Annual Survey of Industries (1980-81 to 1994-95) and industrial de-licensing data collected by the authors. Industry fixed effects are at the four-digit industry level. All regressions include indicators for whether or not the plant is a factory and for the type of ownership and organization. The omitted ownership structure is public sector plants and the omitted organization consists of individual proprietorship and partnership plants. Robust standard errors, clustered at the four-digit-industry level, are in parentheses in the top panel. Linear combinations of coefficients are presented in the bottom panel, with t-statistics (in absolute value) in parentheses. An average $ln(K/O)$ of 1.81 for the 1980s sample and 1.99 for the full sample and an average $ln(O)$ of 10.58 for the 1980s sample and 10.68 for the full sample are used to calculate linear combinations of coefficients. A *, **, and *** represent significance at the 10%, 5%, and 1% levels respectively. All rgeressions include the control function, Z^k_{ijts}, which consists of the kth degree polynomial of a plant's asset level (K_{ijts}) relative to the threshold asset level (K^T_t), that is, $Z_{ijts} = \ln\left(K_{ijts}/K^T_t\right)$.

Table 13: Complementarities from Equation 8 with Third Degree Polynomial of Z_{ijts}

Null Hypothesis	1980s Sample	
	Employment Share	Wagebill Share
Panel A: Coefficients and Test Statistics		
Plants in Licensed Industries		
$H_0 : \beta_3 = 0$	0.001	0.006*
	[0.63]	[3.62]
$H_0 : \beta_4 = 0$	0.005***	0.012***
	[6.95]	[18.30]
Plants in De-licensed Industries		
$H_0 : \beta_3 + \beta_6 = 0$	0.016***	0.030***
	[35.35]	[45.02]
$H_0 : \beta_4 + \beta_7 = 0$	0.026***	0.042***
	[68.53]	[89.63]
Panel B: Elasticities		
Plants in Licensed Industries		
Elasticity wrt capital-output ratio	0.005	0.023
Elasticity wrt output	0.026	0.046
Plants in De-licensed Industries		
Elasticity wrt capital-output ratio	0.084	0.115
Elasticity wrt output	0.137	0.162
Panel C: Complementarities		
Plants in Licensed Industries		
Capital-skill complementarities	0.67	2.94
Output-skill complementarities	1.75	3.07
Plants in De-licensed Industries		
Capital-skill complementarities	10.74	14.71
Output-skill complementarities	9.11	10.75

Source: Annual Survey of Industries (1980-81 to 1990-91) and industrial de-licensing data collected by the authors. Coefficients from column (3) of Tables 11 and 12 are presented in Panel A. F-statistics are presented in parentheses in Panel A. The F-critical value with 1 restriction at the 1% level of significance is 6.63. Average employment and wagebill shares of 0.19 and 0.26 are used to calculate elasticities in Panel B. An increase of 127.50% and 66.57% in the capital-output ratio and output level for the average plant between 1980-81 and 1990-91 are used to calculate complementarities in Panel C.

Table 14: OLS Results of Equation 9 – Industrial De-Licensing, Trade Liberalization, and Skill Upgrading

		Full Sample			
Variable	**Coeff**	**Employment Share**	**Wagebill Share**	**Employment Share**	**Wagebill Share**
(1)	(2)	(3)	(4)	(5)	(6)
$DL80$	β_1	0.007**	0.006*	-0.413	-0.549*
		[0.003]	[0.003]	[0.285]	[0.326]
$ln(T)$	β_2	-0.011	-0.023*	-0.03	-0.081
		[0.010]	[0.013]	[0.046]	[0.061]
NE	β_3	-0.026***	-0.062***	-0.021	-0.198
		[0.007]	[0.009]	[0.108]	[0.161]
$ln(K/O)$	β_4	0.008***	0.012***	-0.013	-0.033**
		[0.000]	[0.001]	[0.009]	[0.013]
$ln(O)$	β_5	0.019***	0.029***	0.014	0.011
		[0.002]	[0.002]	[0.018]	[0.024]
$DL80 * ln(T)$	β_6			0.079	0.111
				[0.063]	[0.072]
$DL80 * NE$	β_7			-0.149	-0.128
				[0.154]	[0.223]
$DL80 * ln(K/O)$	β_8			0.007	0.01
				[0.016]	[0.019]
$DL80 * ln(O)$	β_9			0.044*	0.058*
				[0.025]	[0.029]
$ln(T) * NE$	β_{10}			-0.001	0.031
				[0.024]	[0.035]
$ln(T) * ln(K/O)$	β_{11}			0.005**	0.010***
				[0.002]	[0.003]
$ln(T) * ln(O)$	β_{12}			0.001	0.004
				[0.004]	[0.005]
$DL80 * ln(T) * NE$	β_{13}			0.03	0.024
				[0.034]	[0.049]
$DL80 * ln(T) * ln(K/O)$	β_{14}			-0.001	-0.002
				[0.004]	[0.004]
$DL80 * ln(T) * ln(O)$	β_{15}			-0.008	-0.012*
				[0.006]	[0.007]
$Constant$	α	0.022	0.036	0.119	0.313
		[0.052]	[0.065]	[0.210]	[0.279]
Industry FE		Yes	Yes	Yes	Yes
State FE		Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes
No. of Observations		677,733	676,870	677,733	676,870
R-squared		0.25	0.30	0.25	0.30

Source: Annual Survey of Industries (1980-81 to 1994-95) and industrial de-licensing data collected by the authors. Industry fixed effects are at the four-digit industry level. All regressions include indicators for whether or not the plant is a factory and for the type of ownership and organization. The omitted ownership structure is public sector plants and the omitted organization consists of individual proprietorship and partnership plants. Robust standard errors, clustered at the four-digit-industry level, are in parentheses. A *, **, and *** represent significance at the 10%, 5%, and 1% levels respectively.

Table 15: Linear Combinations and T-Statistics from Equation 9

Panel A: 1980s Trade Regime	**Employment Share**	**Wagebill Share**
Difference between Exempt Plants in Licensed and De-licensed Industries		
$H_0 : \beta_1 + \beta_6 * ln(T) + \beta_8 * ln(K/O) + \beta_9 * ln(O) + \beta_{14} * ln(T) * ln(K/O) + \beta_{15} * ln(T) * ln(O) = 0$	0.004	0.003
	[1.42]	[0.71]
Difference between Nonexempt Plants in Licensed and De-licensed Industries		
$H_0 : \beta_1 + \beta_7 + \beta_6 * ln(T) + \beta_{13} * ln(T) + \beta_8 * ln(K/O) + \beta_9 * ln(O) + \beta_{14} * ln(T) * ln(K/O) + \beta_{15} * ln(T) * ln(O) = 0$	-0.005	-0.013
	[0.43]	[0.90]
Difference between Exempt and Nonexempt Plants in Licensed Industries		
$H_0 : \beta_3 + \beta_{10} * ln(T) = 0$	-0.011	-0.040***
	[1.57]	[4.54]
Difference between Exempt and Nonexempt Plants in De-licensed Industries		
$H_0 : \beta_3 + \beta_7 + \beta_{10} * ln(T) + \beta_{13} * ln(T) = 0$	-0.020**	-0.056***
	[2.28]	[4.87]

Panel B: Early 1990s Trade Regime	**Employment Share**	**Wagebill Share**
Difference between Exempt Plants in Licensed and De-licensed Industries		
$H_0 : \beta_1 + \beta_6 * ln(T) + \beta_8 * ln(K/O) + \beta_9 * ln(O) + \beta_{14} * ln(T) * ln(K/O) + \beta_{15} * ln(T) * ln(O) = 0$	0.007**	0.007*
	[2.42]	[1.83]
Difference between Nonexempt Plants in Licensed and De-licensed Industries		
$H_0 : \beta_1 + \beta_7 + \beta_6 * ln(T) + \beta_{13} * ln(T) + \beta_8 * ln(K/O) + \beta_9 * ln(O) + \beta_{14} * ln(T) * ln(K/O) + \beta_{15} * ln(T) * ln(O) = 0$	-0.007	-0.012
	[0.67]	[0.86]
Difference between Exempt and Nonexempt Plants in Licensed Industries		
$H_0 : \beta_3 + \beta_{10} * ln(T) = 0$	-0.011	-0.047***
	[1.43]	[4.56]
Difference between Exempt and Nonexempt Plants in De-licensed Industries		
$H_0 : \beta_3 + \beta_7 + \beta_{10} * ln(T) + \beta_{13} * ln(T) = 0$	-0.025***	-0.067***
	[2.99]	[6.11]

Source: Annual Survey of Industries (1980-81 to 1994-95) and industrial de-licensing data collected by the authors. Linear combinations of coefficients from columns (5) and (6) of Table 14 are presented with t-statistics in parentheses. An average tariff level of 105.64 in the 1980s and 83.10 in the 1990s are used to calculate linear combinations of coefficients.

Table 16: Complementarities from Equation 9

1980s Trade Regime			1990s Trade Regime		
Null Hypothesis	**Employment Share**	**Wagebill Share**	**Null Hypothesis**	**Employment Share**	**Wagebill Share**
Panel A: Coefficients and Test Statistics			**Panel A: Coefficients and Test Statistics**		
Plants in Licensed Industries			Plants in Licensed Industries		
$H_0 : \beta_4 + \beta_{11} * ln(T) = 0$	0.008***	0.012***	$H_0 : \beta_4 + \beta_{11} * ln(T) = 0$	0.007***	0.010***
	[16.31]	[15.06]		[10.7]	[10.84]
$H_0 : \beta_5 + \beta_{12} * ln(T) = 0$	0.018***	0.030***	$H_0 : \beta_5 + \beta_{12} * ln(T) = 0$	0.018***	0.027***
	[9.16]	[12.23]		[9.66]	[13.27]
Plants in De-licensed Industries			Plants in De-licensed Industries		
$H_0 : \beta_4 + \beta_8 + \beta_{11} * ln(T) + \beta_{14} * ln(T) = 0$	0.009***	0.013***	$H_0 : \beta_4 + \beta_8 + \beta_{11} * ln(T) + \beta_{14} * ln(T) = 0$	0.008***	0.011***
	[7.99]	[10.48]		[7.16]	[8.98]
$H_0 : \beta_5 + \beta_9 + \beta_{12} * ln(T) + \beta_{15} * ln(T) = 0$	0.229***	0.030***	$H_0 : \beta_5 + \beta_9 + \beta_{12} * ln(T) + \beta_{15} * ln(T) = 0$	0.025***	0.034***
	[13.77]	[16.57]		[15.64]	[18.79]
Panel B: Elasticities			**Panel B: Elasticities**		
Plants in Licensed Industries			Plants in Licensed Industries		
Elasticity wrt capital-output ratio	0.040	0.044	Elasticity wrt capital-output ratio	0.035	0.037
Elasticity wrt output	0.090	0.111	Elasticity wrt output	0.090	0.100
Plants in De-licensed Industries			Plants in De-licensed Industries		
Elasticity wrt capital-output ratio	0.045	0.048	Elasticity wrt capital-output ratio	0.040	0.041
Elasticity wrt output	0.145	0.111	Elasticity wrt output	0.125	0.126
Panel C: Complementarities			**Panel C: Complementarities**		
Plants in Licensed Industries			Plants in Licensed Industries		
Capital-skill complementarities	11.09	12.32	Capital-skill complementarities	9.70	10.27
Output-skill complementarities	7.18	8.86	Output-skill complementarities	7.18	7.97
Plants in De-licensed Industries			Plants in De-licensed Industries		
Capital-skill complementarities	12.48	13.35	Capital-skill complementarities	11.09	11.30
Output-skill complementarities	11.56	8.86	Output-skill complementarities	9.97	10.04

Source: Annual Survey of Industries (1980-81 to 1994-95) and industrial de-licensing data collected by the authors. Linear combinations of coefficients from columns (5) and (6) of Table 14 are presented in Panel A, with t-statistics in parentheses. An average tariff level of 105.64 in the 1980s and 83.10 in the 1990s are used to calculate linear combinations of coefficients in Panel A. Average employment and wagebill shares of 0.20 and 0.27 are used to calculate elasticities in Panel B. An increase of 277.25% and 79.75% in the capital-output ratio and output level for the average plant between 1980-81 and 1994-95 are used to calculate complementarities in Panel C.

Table 17: OLS Results of Equation 10 – Industrial De-Licensing, Trade Liberalization, and Skill Upgrading

		Full Sample			
Variable	**Coeff**	**Employment Share**	**Wagebill Share**	**Employment Share**	**Wagebill Share**
(1)	(2)	(3)	(4)	(5)	(6)
$DL80$	β_1	0.006**	0.004	-0.097	-0.18
		[0.003]	[0.004]	[0.356]	[0.444]
$DL91$	β_2	-0.003	-0.005	0.823	1.309*
		[0.003]	[0.004]	[0.550]	[0.756]
$ln(T)$	β_3	-0.013	-0.027**	0.036	-0.002
		[0.010]	[0.013]	[0.071]	[0.096]
NE	β_4	-0.027***	-0.062***	-0.152	-0.449**
		[0.007]	[0.009]	[0.132]	[0.180]
$ln(K/O)$	β_5	0.008***	0.012***	0.022*	0.019
		[0.000]	[0.001]	[0.013]	[0.019]
$ln(O)$	β_6	0.019***	0.029***	0.037	0.037
		[0.002]	[0.002]	[0.028]	[0.038]
$DL80 * ln(T)$	β_7			0.013	0.033
				[0.078]	[0.098]
$DL91 * ln(T)$	β_8			-0.178	-0.288*
				[0.123]	[0.169]
$DL80 * NE$	β_9			-0.018	0.121
				[0.163]	[0.230]
$DL91 * NE$	β_{10}			0.352	0.562
				[0.289]	[0.408]
$DL80 * ln(K/O)$	β_{11}			-0.028	-0.042*
				[0.018]	[0.022]
$DL91 * ln(K/O)$	β_{12}			0.002	-0.034
				[0.030]	[0.036]
$DL80 * ln(O)$	β_{13}			0.022	0.032
				[0.031]	[0.040]
$DL91 * ln(O)$	β_{14}			-0.074	-0.11
				[0.048]	[0.067]
$ln(T) * NE$	β_{15}			0.027	0.083**
				[0.028]	[0.039]
$ln(T) * ln(K/O)$	β_{16}			-0.003	-0.001
				[0.003]	[0.004]
$ln(T) * ln(O)$	β_{17}			-0.004	-0.002
				[0.006]	[0.008]
$DL80 * ln(T) * NE$	β_{18}			0.002	-0.029
				[0.036]	[0.050]
$DL91 * ln(T) * NE$	β_{19}			-0.076	-0.119
				[0.065]	[0.091]
$DL80 * ln(T) * Ln(K/O)$	β_{20}			0.006	0.009*
				[0.004]	[0.005]
$DL91 * ln(T) * Ln(K/O)$	β_{21}			-0.001	0.006
				[0.007]	[0.008]
$DL80 * ln(T) * Ln(O)$	β_{22}			-0.004	-0.006
				[0.007]	[0.009]
$DL91 * ln(T) * Ln(O)$	β_{23}			0.016	0.024
				[0.011]	[0.015]
$Constant$	α	0.032	0.053	-0.191	-0.057
		[0.053]	[0.068]	[0.328]	[0.441]
Industry FE		Yes	Yes	Yes	Yes
State FE		Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes
No. of Observations		661,648	660,793	661,648	660,793
R-squared		0.25	0.30	0.25	0.30

Source: Annual Survey of Industries (1980-81 to 1994-95) and industrial de-licensing data collected by the authors. Industry fixed effects are at the four-digit industry level. All regressions include indicators for whether or not the plant is a factory and for the type of ownership and organization. The omitted ownership structure is public sector plants and the omitted organization consists of individual proprietorship and partnership plants. Robust standard errors, clustered at the four-digit-industry level, are in parentheses. A *, **, and *** represent significance at the 10%, 5%, and 1% levels respectively.

Table 18: Complementarities from Equation 10

1980s Trade Regime			1990s Trade Regime		
Null Hypothesis	**Employment Share**	**Wagebill Share**	**Null Hypothesis**	**Employment Share**	**Wagebill Share**
Panel A: Coefficients and Test Statistics			**Panel A: Coefficients and Test Statistics**		
Plants in Licensed Industries			Plants in Licensed Industries		
$H_0 : \beta_5 + \beta_{16} * ln(T) = 0$	0.009***	0.013***	$H_0 : \beta_5 + \beta_{16} * ln(T) = 0$	0.009***	0.014***
	[16.22]	[13.05]		[11.19]	[9.52]
$H_0 : \beta_6 + \beta_{17} * ln(T) = 0$	0.019***	0.030***	$H_0 : \beta_6 + \beta_{17} * ln(T) = 0$	0.020***	0.029***
	[9.29]	[12.45]		[8.91]	[11.77]
Plants in Industries De-licensed in 1980s			Plants in Industries De-licensed in 1980s		
$H_0 : \beta_5 + \beta_{11} + \beta_{16} * ln(T) + \beta_{20} * ln(T) = 0$	0.009***	0.013***	$H_0 : \beta_5 + \beta_{11} + \beta_{16} * ln(T) + \beta_{20} * ln(T) = 0$	0.008***	0.011**
	[8.00]	[10.41]		[7.05]	[8.72]
$H_0 : \beta_6 + \beta_{13} + \beta_{17} * ln(T) + \beta_{22} * ln(T) = 0$	0.023***	0.032***	$H_0 : \beta_6 + \beta_{13} + \beta_{17} * ln(T) + \beta_{22} * ln(T) = 0$	0.025***	0.034***
	[13.79]	[16.55]		[15.57]	[18.60]
Plants in Industries De-licensed in 1991			Plants in Industries De-licensed in 1991		
$H_0 : \beta_5 + \beta_{12} + \beta_{16} * ln(T) + \beta_{21} * ln(T) = 0$	0.004**	0.008***	$H_0 : \beta_5 + \beta_{12} + \beta_{16} * ln(T) + \beta_{21} * ln(T) = 0$	0.005***	0.007***
	[2.25]	[4.33]		[4.86]	[5.20]
$H_0 : \beta_6 + \beta_{14} + \beta_{17} * ln(T) + \beta_{23} * ln(T) = 0$	0.020***	0.032***	$H_0 : \beta_6 + \beta_{14} + \beta_{17} * ln(T) + \beta_{23} * ln(T) = 0$	0.017***	0.027***
	[6.74]	[8.80]		[8.91]	[11.77]
Panel B: Elasticities			**Panel B: Elasticities**		
Plants in Licensed Industries			Plants in Licensed Industries		
Elasticity wrt capital-output ratio	0.045	0.048	Elasticity wrt capital-output ratio	0.045	0.052
Elasticity wrt output	0.095	0.111	Elasticity wrt output	0.100	0.107
Plants in Industries De-licensed in 1980s			Plants in Industries De-licensed in 1980s		
Elasticity wrt capital-output ratio	0.045	0.048	Elasticity wrt capital-output ratio	0.040	0.041
Elasticity wrt output	0.115	0.119	Elasticity wrt output	0.125	0.126
Plants in Industries De-licensed in 1991			Plants in Industries De-licensed in 1991		
Elasticity wrt capital-output ratio	0.020	0.030	Elasticity wrt capital-output ratio	0.025	0.026
Elasticity wrt output	0.100	0.119	Elasticity wrt output	0.085	0.100
Panel C: Complementarities			**Panel C: Complementarities**		
Plants in Licensed Industries			Plants in Licensed Industries		
Capital-skill complementarities	12.48	13.35	Capital-skill complementarities	12.48	14.38
Output-skill complementarities	7.58	8.86	Output-skill complementarities	7.97	8.57
Plants in Industries De-licensed in 1980s			Plants in Industries De-licensed in 1980s		
Capital-skill complementarities	12.48	13.35	Capital-skill complementarities	11.09	11.30
Output-skill complementarities	9.17	9.45	Output-skill complementarities	9.97	10.04
Plants in Industries De-licensed in 1991			Plants in Industries De-licensed in 1991		
Capital-skill complementarities	5.55	8.21	Capital-skill complementarities	6.93	7.19
Output-skill complementarities	7.97	9.45	Output-skill complementarities	6.78	7.97

Source: Annual Survey of Industries (1980-81 to 1994-95) and industrial de-licensing data collected by the authors. Linear combinations of coefficients from columns (5) and (6) of Table 17 are presented in Panel A, with t-statistics in parentheses. An average tariff level of 105.64 in the 1980s and 83.10 in the 1990s are used to calculate linear combinations of coefficients in Panel A. Average employment and wagebill shares of 0.20 and 0.27 are used to calculate elasticities in Panel B. An increase of 277.25% and 79.75% in the capital-output ratio and output level for the average plant between 1980-81 and 1994-95 are used to calculate complementarities in Panel C.