Three Essays on the Indian Manufacturing:

Wage Inequality, Export and Informality

Manabu Furuta

Abstract

This dissertation investigates the impact of trade liberalization in India on within-plant wage inequality and incumbent exporter's productivity, and the impact of Indian business regulation on economic performance of small firms. Those factors such as wage inequality, export and informality are important for growth of manufacturing sector.

In Chapter 2, we explain two data sets that survey the Indian manufacturing.

Chapter 3 analyzes the effect of reduction in input and output tariffs on the intra-plant wage inequality in India for the period 2000 to 2007. We find that a reduction in output tariff increases the wage inequality, whereas a reduction in input tariff does not have any statistically significant effect on wage inequality. These results suggest that product basket switching from unskilled worker intensive products to skilled worker intensive products occurs in the Indian manufactures because unskilled labor-intensive industries were protected the most prior to trade liberalization. We also examine the effect of the increased demand for skilled workers by the modern service sector, which has been the driving force of recent economic growth in India. The increased demand raises the wage inequality in manufacturing implying that skill-biased technological change in modern service sector has an indirect effect on wage inequality in this sector.

Chapter 4 analyzes the impact of trade liberalization on incumbent exporters benefited from the trade policy change in Indian manufacturing during the period from 1998 to 2007. Our results indicate that the total factor productivity of them increases when export barrier decreases. Their average productivity increases 8 to 12 percentage points for 1 percentage point decrease in export barrier. Another finding is that importers of inputs improve their productivity along with a reduction in input tariff.

Chapter 5 examines the impact of business regulations on the performance of small enterprises in India during the 1994 to 2010 period. Although the enterprises hiring more than 10 workers must register under the Factories Act, however, some entrepreneurs and firms decide not to register in order to avoid the regulations. Our results show that such firms are less productive but more profitable than those that are registered and in the same size class, and educational levels of the owners of those enterprises are very high, suggesting that avoiding the regulations allows them to enjoy profits. Further, the low enforcement of the Act distorts the allocation of resources,

especially human resources.

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Contents

Chapter 1: Introduction

Indian economy has been grown at rapid pace since the late 1980's. In the 2000's, the average GDP growth rate is over 7%. Moreover, India's GDP in the July-September period in 2016 expand by an annual 7.3 percent, and eclipse China's 6.7% growth during the same period. India overtakes China as world's fastest growing major economy. United Nations report titled Economic and Social Survey of Asia and the Pacific 2016 says,

"In India, economic growth is expected to remain at 7.6% in 2017 as investment regains momentum and manufacturing base strengthens on the back of structural reforms" (United Nations, 2016, p.4)

Service sector is the main engine of the rapid growth. This sector's share in GDP is nearly 60% in 2012[1]. Especially, the modern service sector including information technology service is growing at a rapid pace, and the demand for skilled labor in this sector is expanding due to the requirement of computer and English language skills. However, the most of workers are unskilled, and the employment share in service sector is only 30% (National Sample Survey Organization, 2012). The half of workers is employed in agriculture, and the GDP share of agriculture is 14%. Manufacturing accounts for only 20% of GDP share and 20% of employment. Since the employment capacity of service sector is low, the reallocation of labor from agriculture to manufacturing is important for sustainable economic growth. Panagaria (2004) argues, however, that the lackluster performance of manufacturing is growth constrain for economy. In the rest of chapters, we consider the growth factors of the manufacturing: wage inequality, export, and informality.

As mentioned above, Indian economy starts to grow from 1980's, and the growth accelerates from 1991. In 1991, India launches a radical economic reform in the aftermath of a balance-of-payments crisis wherein tariffs are cut dramatically and most

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1 GDP share of each industry is calculated from National Account Statistics (Central Statistical Office).

2 Export-import policy 1997-2002.

3 According to figures by the Department of Heavy Industry, labor productivity measured in terms of gross value added per employee is 1.48 for weaving and spinning, and 1.61 for other textile

quantitative restrictions on import of capital goods and intermediate inputs are removed. Many studies focus on the impact of this reform on the economic performance on Indian manufacturers. For example, the reform affects on productivity (Topalova and Kandewal, 2011; Krishna and Mitra, 1998), output (Aghion et al., 2008) and wage inequality (Chamarbagwara, 2006). Although these studies focus on the reform in 1991, trade liberalization took rapid steps forward and the tariff fell steadily in the 2000's. It is worth to analyze the impact of trade liberalization during the period on the economic performance of manufacturers: wage inequality and productivity.

The impact of trade liberalization on the skilled-unskilled wage gap has attracted a lot of research interest. The traditional trade theory, that is, Heckscher-Ohlin theory predicts that an unskilled labor abundant country specializes in production of unskilled intensive goods after trade liberalization. Resent studies, however, empirically show that trade liberalization in a developing country increases the wage inequality (Goldberg and Pavcnic, 2007). In Indian context, the existing studies on the relationship between trade policy and wage inequality yield mixed conclusions. Sen (2008) suggests that the decline in protection mostly for the unskilled labor-intensive industries leads to a relative fall in the economy-wide return to unskilled labor as compared to skilled labor. In contrast, Kumar and Mishra (2005) suggest that the unskilled workers experience an increasing wage relative to skilled workers because tariff reductions are relatively large in sectors with higher proportion of unskilled workers and these sectors experience an increase in wages.

Chapter 3 analyzes the effect of reduction in input and output tariffs on the intra-plant wage inequality in India for the period 2000 to 2007. We find that a reduction in output tariff increases the wage inequality, whereas a reduction in input tariff does not have any statistically significant effect on wage inequality. These results suggest that product basket switching from unskilled worker intensive products to skilled worker intensive products occurs in the Indian manufactures because unskilled labor-intensive industries were protected the most prior to trade liberalization. We also examine the effect of the increased demand for skilled workers by the modern service sector, which has been the driving force of recent economic growth in India. The increased demand raises the wage inequality in manufacturing implying that skill-biased technological change in modern service sector has an indirect effect on wage inequality in this sector.

Worldwide economic globalization has developed rapidly since the creation of the World Trade Agreement (WTO) in 1995. The Indian trade policy in 1997 proposes with an aim to prepare a framework for globalizations of Indian economy and promote exporters. Chapter 4 analyzes the impact of trade liberalization on incumbent exporters benefited from the trade policy change in Indian manufacturing during the period from 1998 to 2007. Our results indicate that the total factor productivity of them increases when export barrier decreases. Their average productivity increases 8 to 12 percentage points for 1 percentage point decrease in export barrier. Another finding is that importers of inputs improve their productivity along with a reduction in input tariff.

Under the Factories Act, 1948, in India, any enterprises that has more than 10 workers if using the power (more than 20 workers if not using) needs to register as a "Factory" under the Act. The registered enterprises are called as formal enterprises. Enterprises, that do not meet this criterion, need not to register, and are called as informal enterprises. India's informal sector generates 80% of employment in manufacturing and 31.7% of value added, in 2009-2010 (NCEUS, 2010). Kathuria and Sen (2012) compared the productivity between informal and formal enterprises in India during the period from 1989 to 2005, and conclude that formal enterprises are more efficient than informal ones. They, however, disregard the heterogeneity of firms in the informal sectors. They ignore the fact that the informal sector itself comprises of two subsectors: one that consists of those enterprises which under the law can not be formal enterprises and the other, that is populated by enterprises that qualify to be in the formal sector but decide to stay in the informal sector.

Chapter 5 examines the impact of business regulations on the performance of small enterprises in India during the 1994 to 2010 period. Although the enterprises hiring more than 10 workers must register under the Factories Act, however, some entrepreneurs and firms decide not to register in order to avoid the regulations. Our results show that such firms are less productive but more profitable than those that are registered and in the same size class, and educational levels of the owners of those enterprises are very high, suggesting that avoiding the regulations allows them to enjoy profits. Further, the low enforcement of the Act distorts the allocation of resources, especially human resources.

The rest of chapters are organized as follows. Chapter 2 explains the main two data sets: Annual Survey of Industries and National Sample Survey. Chapter 3 discusses the impact of trade liberalization on a within-plant wage inequality. Chapter 4 discusses the impact of trade liberalization on an export enterprise's productivity. Chapter 5 discusses the impact of business regulation on a small enterprise.

Chapter2: Data

As for analysis, we use two sets of data: Annual Survey of industries (hereafter ASI), and National Sample Survey (hereafter NSS). Both ASI and NSS data are plant level data in the Indian manufacturing. The coverage of these data, however, is different. Indian manufacturing is categorized into two groups: informal sector and formal sector. Any enterprise that has more than 10 workers if using the power (more than 20 workers if not using power) needs to register as a “Factory” under the Indian’s Factories Act. The enterprises that are registered under the Act are classified as formal enterprises. The informal sector is organized by the enterprises that hire less than 10 workers with power (or 20 workers without power) and need not register under the Act. ASI investigates the economic activities of formal enterprises, and NSS investigates those of informal enterprises. The rest of this chapter explains the detail of each data set.

2.1 Annual Survey of Industries

Annual Survey of Industries (ASI) data, undertaken by the Central Statistical Organization (CSO), is the annual census-cum-sample survey of the formal manufacturing plants. The ASI data cover two sets of surveys: census and sample. The census survey includes those enterprises, which hire more than 100 workers, and sample survey includes the enterprises, which hire less than 100 workers. Enterprises in sample survey are selected by stratified multi-stage sampling that is, sampling the one third of the enterprises listed.

The ASI data contains the basic information about the economic activity of the formal enterprises, such as the value of products and inputs, the value of fixed assets, emolument for employment, location, established year, ownership type, and so on. The uniqueness of this data is the detailed information about products and inputs. Since the data contains not only total value of sales but also the value of each product, it is possible to analyze the behavior of multi-product enterprises.

The ASI data during the period from 1998 to 2007 contains ID factory code for census sector. Therefore, it is possible to construct a panel data. This panel data allows us to analyze the activity of enterprise after controlling the time-invariant enterprise characteristics.

All rest of chapters use ASI data set. Chapter 3 uses the data during the period from 2000 to 2007. Chapter 4 uses the data during the period from 1997 to 2007. The ASI data of 1997 is cross section data and contains the information about export. The data for 1997 is matched with the panel data during the period from 1998 to 2007. Chapter 5 uses the data of 1994, 2000, 2005, and 2010 in order to compare with the following NSS data.

2.2 National Sample Survey

The NSS survey, conducted by the National Sample Survey Organization, covers the informal manufacturing enterprises not registering under the Factories Act. The survey is undertaken quinquennially using a stratified sampling procedure. The first stage units are the census villages in the rural sector and Urban Frame Survey (UFS) blocks in the urban sector. The ultimate stage units (USU) are informal manufacturing enterprises. Within each district of a state, two basic strata are formed: 1) rural stratum comprising of all rural areas of the district and 2) urban stratum comprising of all the urban areas of the district. However, if there are one or more towns with population 100 thousand or more as per population in a district, each of them also form a separate basic stratum and the remaining urban areas of the district is considered as another basic stratum.

The data from the survey contains the information about the economic activity such as the value of products and inputs, the value of fixed assets, emolument for employment, location, ownership type, and so on, as well as ASI. The difference from the ASI is that the NSS data includes the detailed information about the background of a enterprise such as the educational level of owner, nature of problems faced, registration under any act or authority, and so on.

Chapter 5 uses the NSS data of 1994, 2000, 2005, and 2010. Since the reference period of the data is same as the ASI, it is possible to compare the economic activity between informal and formal enterprises.

Chapter 3: Trade Liberalization and Wage Inequality in the Indian Manufacturing Sector

1. Introduction

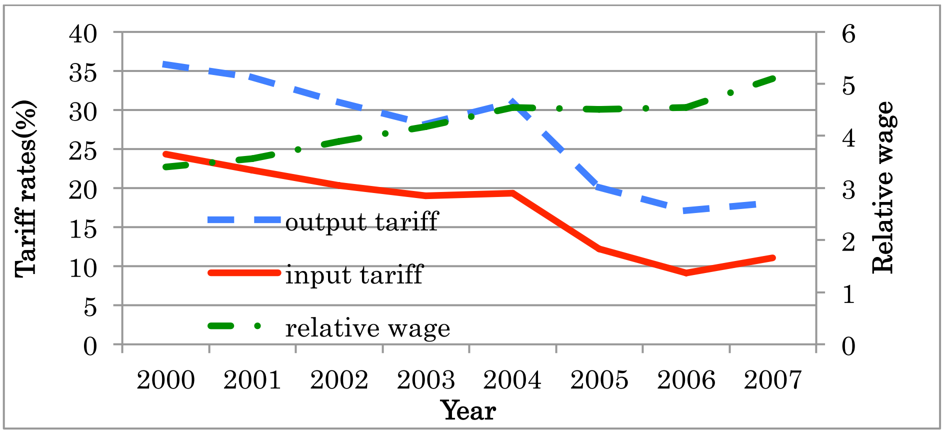
How does trade liberalization affect wage inequality in developing countries? The existing studies on developing countries mainly focuses on middle-income countries such as Brazil, Columbia, and Mexico. (See Goldberg and Pavcnik (2007) and Anderson (2005)). There is evidence that middle-income countries experience skill-biased technical change (hereafter SBTC) (Berman and Machin, 2000) and that trade induced technical change leads to a rise in wage inequality (Caselli, 2014; Gallego, 2012 and Berman, Bound and Machin, 1998). This chapter, by contrast, focuses on India, which is one of the most unskilled-labor abundant countries, and provides evidence that is consistent with a different mechanism that explains the increase in wage inequality in manufacturing after trade liberalization: product basket switching. As the Indian government protected unskilled labor-intensive industries prior to trade liberalization, the product mix in a plant changes to skilled labor-intensive products from unskilled labor-intensive products, relatively, because unskilled labor-intensive industries were protected the most prior to trade liberalization.

Until recently, India's trade regime was among the most restrictive in Asia in terms of nominal tariffs and nontariff barriers. India launched a radical economic reform in 1991 in the aftermath of a balance-of-payments crisis wherein tariffs were cut dramatically and most quantitative restrictions on import of capital goods and intermediate inputs were removed. In the 2000s, trade liberalization took rapid steps forward and the tariff fell steadily. In the early 2000s, the Indian government eased quantitative restrictions on the import of manufactured consumer goods and agricultural products. The trade liberalization period witnessed an increase in the wage inequality between nonproduction and production workers in the Indian manufacturing sector.

Figure 3. 1 illustrates this inverse relationship between tariffs and relative wage for the period between 2000 and 2007.

Figure 3. 1

Average relative wage in plants, output tariffs, and input tariffs between 2000 and 2007.



Note: Based on author's calculation using ASI and WITS data.

Output and input tariffs are simple average of 2-digit industry level tariff rate.

Goldberg and Pavcnik (2007) compiled studies on the relationship between trade liberalization and wage inequality in developing countries, most of which suggest that trade liberalization increases wage inequality, although traditional trade theory, like the S-S effect predicts that trade liberalization decreases wage inequality in an unskilled labor abundant country in a Heckscher-Ohlin (hereafter H-O) world.

The first explanation for the increased wage inequality within a plant after trade liberalization is product basket switching from unskilled labor-intensive products to skilled labor-intensive products occurs in the manufactures if unskilled labor-intensive industries were protected the most prior to trade liberalization. The product basket switching increases the demand for skilled workers and their wage, thus increasing the wage inequality. A model with multi-product firms could generate within-plant wage effects if different final goods are produced with different factor intensities.

The second explanation is skill-biased technical change (SBTC). SBTC arises from the incorporation of new technologies embodied in cheaper imported capital goods, such as machines and office equipment, or intermediate goods that are complementary to skilled workers in unskilled labor-intensive economies. It is relatively easy for firms to import or access imported capital and intermediate goods after trade liberalization. Therefore, SBTC benefits skilled workers, thus increasing the wage inequality.

We analyze how reduction in output and input tariffs affect the intra-plant wage inequality between nonproduction and production workers using plant level data in the Indian manufacturing sector for the period 2000 to 2007. We also discuss if the effects of trade liberalization on wage inequality are consistent with the theoretical predictions of product basket switching and SBTC.

Our estimation results indicate that tariff reduction in final goods increases wage inequality; whereas, tariff reduction in intermediate inputs has statistically insignificant effect on wage inequality even when the plant directly imports the intermediate inputs. These results are consistent with the explanation based on product basket switching.

However, it is possible that SBTCs in other sectors affect increased inequality in manufacturing. In the 2000s, the Indian modern service sector including IT sector grew at a rapid pace. Trade liberalization in this sector was stared in the mid 1980's. The government reduced the tariff rate of computer hardware, its component and software. Due to the requirement of computer and English language skills, most workers in this sector are skilled. The increased demand for skilled worker in the modern service sector may put upward pressure on the wage of skilled labor in manufacturing. We examine this hypothesis and find that this increased demand for skilled worker by the modern service sector does increase the wage inequality in manufacturing. This suggests that SBTC in the modern service sector has an indirect effect on inequality in manufacturing.

The existing studies on the relationship between trade policy and wage inequality in India yield mixed conclusions. Sen (2008) uses industry level data from Annual Survey of Industries (hereafter ASI) for the period 1973 to 1997 to find that trade liberalization triggers the increase in wage inequality. He suggests that the decline in protection mostly for the unskilled labor-intensive industries leads to a relative fall in the economy-wide return to unskilled labor as compared to skilled labor. Furthermore, he finds that a negative relationship between the degree of protection, which is measured as the effective rate of protection and import penetration ratio, and wage inequality at the industry level, suggesting that trade-induced technological progress leads to an increase in wage inequality within industries. Moreover, Hashim and Banga (2009) use the dynamic industry panel data estimations (GMM) for 58 manufacturing industries for the period from 1998 to 2004 to find that trade liberalization leads to an increase in wage inequality between skilled and unskilled labor. In contrast to these studies, Kumar and Mishra (2005) use individual level data collected by the Indian National Sample Survey Organization (NSSO) to find that trade liberalization leads to a decrease in wage inequalities. They evaluate the impact of the 1991 trade liberalization on the industry wage structure and find that the reduction in trade protection widens differences in wages across industries for similar workers in terms of observable characteristics over time. As different industries employ different proportion of skilled workers, changes in wages across industries translate into changes in relative incomes of skilled and unskilled workers. According to them, tariff reductions are relatively large in sectors with higher proportion of unskilled workers and these sectors experience an increase in wages, which implies that the unskilled workers experience an increasing wage relative to skilled workers.

An important difference of this chapter from other existing studies is that we distinguish output tariffs from input tariffs. This approach allows us to identify how trade liberalization affects wage inequality through increased input or output competition. Sen (2008) suggests that SBTC works in manufacturing based on the finding of a negative and significant relationship between the degree of protection, which is measured as the effective rate of protection and import penetration ratio, and the wage inequality at the sectoral level. However, he does not distinguish the effects of tariff reduction in imported output from imported input on wage inequality because the effective rate of protection, which is a measure of the total effect of output and input tariffs and import penetration ratio, is affected not only by input tariff reduction but also by other factors.

Another important difference from the existing works is the focus on the intra-plant wage inequality. An advantage of the plant level data is that it is possible to control the plant characteristics, such as plant size, skill share, and the proportion of contract labor, that can affect wages. Another benefit of conducting the analysis at the plant level is that we can allow for differential effects between domestically oriented firms and globalized firms. Bernard and Jensen (1997) and Verhoogen (2008) suggest that the wage inequality in globalized firms is much higher than that in domestic firms. However, we do not observe the differences in the intra-plant wage inequality between domestic and globalized plants in our estimation.

Few studies have examined the impact of tariff reduction on intra-plant (or firm) wage inequality using plant (or firm) level unit data in developing countries. Whether tariff reduction widens or shrinks the wage inequality depends on the characteristics of the countries under the analysis. Amiti and Cameron (2012) and Albada (2013) find that reducing tariffs decreases wage inequality within firms in Indonesia and the Philippines respectively. Amiti and Cameron (2012) find that reducing input tariffs decreases the wage inequality within firms importing intermediate goods. Albada (2013) suggests that a firm responds to import competition by shifting to manufacturing of products with lower value, which requires unskilled workers, and substituting self-produced intermediate goods with imported intermediate goods. By contrast, Cacelli (2014) finds that wage inequality increases along with tariff reduction in Mexico, and tariff reduction in machinery and equipment that embody skilled-worker favoring technology increases the wage inequality within plant. The present study is the first to investigate and analyze the channels through which trade liberalization could affect intra-plant wage differentials using plant level data in India.

The remainder of the chapter is organized as follows. Section 2 provides an overview of wage inequality as well as the process of trade liberalization in India. Section 3 provides the theoretical background that could explain the increase in wage inequality after trade liberalization in India. Section 4 describes the estimation strategy. Section 5 describes the data and measurement of key variables. Section 6 presents the estimation results and Section 7 concludes the study.

2. Wage Inequality and Trade Liberalization in India

This section reviews the wage inequality in the Indian manufacturing sector and the historical background of trade policy since its independence.

2.1 Wage Inequality in India

The wage inequality has widened in India since the mid-1980s. Pandey and Shetty (2014) indicate that the share of earnings accounting to production workers in total earnings fell from 65% in 1981 to 47% in 2011, but the proportion of production workers in the total number of workers employed remained unchanged at about 78%. The divergence between white and blue-collar wages began during the mid-1980s and increased over time, especially after 1991 (Chamarbagwala and Sharma, 2007). The present study focuses on the period from 2000 to 2007. Table 3. 1 indicates that nonproduction workers earn 3.4 times higher wage than production workers in 2000, but 5 times higher in 2007 in our sample.

2.2 Trade Liberalization in India

India's experience with trade liberalization through tariff reduction began in the mid-1980s, which was also the period when the wage inequality between nonproduction and production workers started increasing. Prior to the trade liberalization, unskilled labor-intensive industries were heavily protected.

After independence, India adopted import-substituting industrialization. Initially, the government strictly regulated import through quotas rather than tariffs. The regulation was imposed mostly on the import of consumer goods (unskilled labor-intensive goods) and not on capital and intermediate goods (skilled labor-intensive goods). Since the late 1970s, the government began a slow but sustained relaxation of import regulations on capital goods and intermediate goods. In the mid-1980s, under Prime Minister Rajiv Gandhi, India shifted from quantitative import controls to a protective system based on tariffs and took some cautious steps to encourage the import of capital goods, while consumer goods continued to be heavily protected, now by high tariff in place of rigid quotas. Especially, tariff rate of computer hardware, its component and software are reduced in this period.

Trade policy was an important component of the economic reforms of 1991. During the foreign trade policy from 1992 to 1997[2], the average tariffs fell from more than 87% in 1990 to 39% by 1996 (Topalova and Khandelwal, 2011). The 1991 reform removed most of the quantitative restrictions on the import of capital goods and intermediate inputs. As indicated by Kumar and Mishra (2005) and Sen (2008), these dramatic economic reforms affected the unskilled labor-intensive sectors the most. This phenomenon can also be observed in other developing countries, such as Mexico and Colombia, where the unskilled labor-intensive industries experienced the largest tariff

[2] Export-import policy 1997-2002.

reductions (Hanson and Harrison, 1999 and Attanasio et al., 2004).

The foreign trade policy from 1997 to 2002 did not carry forward the tariff reduction further. Quantitative restrictions on imports of manufactured consumer goods and agricultural products were finally removed on April 1, 2001. The subsequent foreign trade policy from 2002 to 2007 was in line with the agenda of trade liberalization. In 2002, the government signaled a return to tariff reduction policy. In our sample period, the average output tariffs in the Indian manufacturing fell from 35% in 2000 to 18% in 2007 and over this same period, the average input tariffs fell from 24% to 11% (See Figure 3. 1 in Introduction).

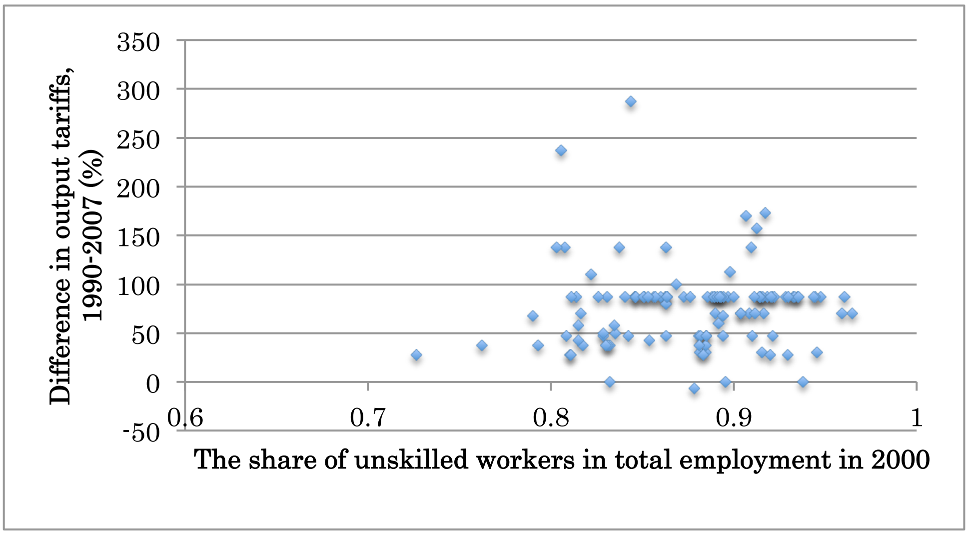
Figure 3. 2 illustrates the relationship between the reduction in output tariff during the period from 1990 to 2007 and the ratio of unskilled workers in each industry in 2000. This indicates that the unskilled labor-intensive industries experienced larger tariff cuts. Table 3. 1 indicates the positive and significant relationship between the reduction in output tariff and the ratio of unskilled workers in an industry.

One of the unskilled labor-intensive industries is textiles and clothing. This industry employs around 35 million people and is the largest manufacturing industry in India in terms of employment. It accounted for 4% of the GDP, 14% of the total industrial production in 2004, and 8.62% of total employment. Labor productivity in the textiles and clothing industry is lower than that in other manufacturing industries[3] (WTO, Trade Policy Review, 2006). The average output tariff in this sector decreased from 100% in 1990 to 12.5% in 2007. The tariff reduction in this sector is 87.5% and this reduction is 10% larger than the average tariff reduction in the other manufacturing industries.

[3] According to figures by the Department of Heavy Industry, labor productivity measured in terms of gross value added per employee is 1.48 for weaving and spinning, and 1.61 for other textile manufacturing, which is lower than that for machinery (3.31), iron and steel (7.45), and automobiles (10.6).

Figure 3. 2

Reduction in output tariffs between 2000 and 2007 and the share of unskilled workers in 2000



Note: Based on author's calculation using WITS and ASI data.

The share of unskilled worker is calculated as the ratio of production worker to total employment in 4-digit industry level.

Table 3. 1

Regression result for reduction in output tariffs between 2000 and 2007 and the share of unskilled workers in 2000

	Tariff reduction, 1990-2007
Share of unskilled workers in 2000	1.638*
	(0.977)
Constant	2.818***
	(0.856)
Observations	110
R-squared	0.025

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%.

3. Theoretical Background

In the previous section, we confirm that the relative wage of nonproduction to production workers increases during the period from 2000 to 2007 period when tariff reduction steps forward. This section reviews the two theoretical perspectives on the positive effects of trade liberalization on wage inequality, product basket switching and skill-biased technical change.

Goldberg and Pavcinik (2007) compiled studies on the relationship between trade liberalization and wage inequality in developing countries such as Mexico, Colombia, Argentina, Brazil, Chile, and India and found that trade liberalization increases wage inequality in most studies. However, in an H-O world with a single cone of diversification, the standard S-S effect predicts that the wage inequality in unskilled labor abundant country decreases under trade liberalization. Previous research indicates that the unskilled labor-intensive sectors are protected the most prior to trade reform in India, and are affected the most by tariff cuts. As trade liberalization decreases the output price in these sectors, the product basket switching from unskilled worker intensive products to skilled worker intensive products may occur in multi-product plants. The product basket switching leads to the increase in within-plant wage inequality because of the increased demand for skilled workers. Bernald et al. (2010) find that product switching to be frequent, widespread, and influential in determining firm outcomes. Although Goldberg et al. (2010a, 2010b) find that the tariff reduction in output does not affect on number of products in Indian manufacturing, firms would change the share of skilled worker intensive products to unskilled worker intensive products in their product mix.

The other line of explanation for the increased demand for skilled labor is SBTC. Wood (1994, 1995, 1997) and Acemoglu (2003) indicate that trade liberalization may well be a driving force of changes in technology. SBTC arises from the incorporation of new technologies embodied in cheaper imported capital goods, such as machines and office equipment, or intermediate goods that are complementary to skilled workers in unskilled labor-intensive countries. It is relatively easy for firms to import or access such imported capital after trade liberalization. Therefore, SBTC benefits skilled workers, thus increasing the wage inequality.

4. Estimation Strategy

This section explains how to estimate the impact of tariff reduction on wage inequality. The results of the estimation are consistent with the theoretical predictions that we discussed in the previous section.

Our estimation strategy involves using the plant level variation in tariffs to identify how reductions in output tariffs and in input tariffs affect the intra-plant wage inequality. The dependent variable is the wage inequality measured by the log of the ratio of the average wage of nonproduction workers to the average wage of production workers. Following Amiti and Cameron (2012), we estimate the reduced form equation[4] as under

$$\ln\left(\frac{w_s}{w_u}\right)_{f,i,t} = \alpha_f + \alpha_{l,t} + \beta_1 * input\ tariff_{f,i,t} + \beta_2 * imp\ input\ tariff_{f,i,t}$$
$$+\beta_3 * output\ tariff_{f,i,t} + Z_{f,i,t}\Gamma + \varepsilon_{f,i,t}\ . \qquad (3.\ 1)$$

In the above equation, $\ln(w_s/w_u)_{f,i,t}$ is the variable representing wage inequality within plant f in industry i in year t. $input\ tariff_{f,i,t}$, $imp\ input\ tariff_{f,i,t}$ and $output\ tariff_{i,t}$ are input tariff, input tariff for importers of input and output tariff that plant f in industry i pay in year t. $input\ tariff_{f,i,t}$ is a weighted average of tariffs, in which the weight is the share of domestically produced inputs used in a plant, while $imp\ input\ tariff_{f,i,t}$ is weighted average of tariffs, in which the weight is share of imported inputs used in a plant. How to construct these tariffs are explained in subsection 5.2. All specifications also include plant fixed effect, α_f, and state-year fixed effect, $\alpha_{l,t}$, to control time-invariant characteristics of the plant and the time-variant shocks affecting states differently respectively[5]. The vector $Z_{f,i,t}$ in the equation controls for the time varying plant-level characteristics such as the plant's size, import share, the skill share (measured as the ratio of the number of nonproduction workers to the total employed), and the share of contract workers in production workers. The plant's import share is included to control the difference in the wage inequality between importers and non-importers because Bernard and Jensen (1997) and Verhoogen (2008) find that the wage inequality in globalized firms is much higher than that in domestic firms. We include the size of the plant because the wage structure may

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4 Although Amiti and Cameron (2012) include the interaction term between the export share of a firm and its output tariff, we could not include it because we were not able to identify from our data if a plant exported or not.

5 The economy wide effects on the wage structures would be absorbed by the year–state dummy. For example, the minimum wage is important for the wage structure. The minimum wage is different among states and changes over time. As we can observe, the number of contract labor increased in the Indian manufacturing sector. Therefore, wage inequality might be affected by the level of minimum wages. Moreover, the labor regulations of each state may affect wage inequality. Besley and Burgess (2004) measure the strength of labor regulation in different states using the amendment in Industrial Dispute Act (IDA) for which the state government has the authority. They indicate that pro-worker amendments of the IDA are associated with lowered investment, employment, productivity, and output in registered manufacturing, and increased urban poverty.

be different between small plants and large plants. The skill share represents the relative supply of skilled workers and a higher share of contract labor in production workers widens the inequality because the wages of contract workers are less than the wages of regular workers and are mostly equal to or less than the minimum wage decided by the state. In recent years, the replacement of regular workers with contract workers has become a common phenomenon in Indian manufacturing (Goldar and Aggarwal, 2012).

First, consider the effect of reducing output tariff. The reduction in output tariffs makes the domestic market for the final goods competitive because the imported final goods become relatively cheap. As mentioned earlier, India protected the unskilled labor-intensive sectors through high tariffs prior to trade liberalization. Prior to trade liberalization, the output price of unskilled labor-intensive industries and the wage of unskilled workers are relatively high. Although India is an unskilled labor abundant country, product basket switching from unskilled worker intensive products to skilled worker intensive products occurs in the multi-product plants. If this is the case, the coefficient of output tariff, β_3, is negative.

Second, consider the effects of reducing input tariffs on the wage inequality. A reduction in input tariffs makes the relatively high quality imported inputs cheaper. If these imported intermediate inputs embody skill-biased technology, then their increased use raises the demand for skilled labor and wage inequality. We call this case trade-induced SBTC. The coefficient of input tariff for importers of input capture the direct impact on importers because import plants directly use these imported inputs. The term input tariff describes the indirect or spillover effect on non-importers. If this effect is present, the coefficient of input tariff, β_1, and the coefficient of the interaction term between input tariff and the plant's input share, β_2, are both negative.

5. Data and Measurement

5.1. Data

We use plant level panel data of the Indian manufacturing sector for the period from 2000 to 2007. The unit level information comes from the Annual Survey of Industries (ASI) data, undertaken by the Central Statistical Organization (CSO), which is the annual census-cum-sample survey of the formal manufacturing plants. The ASI data cover two sets of surveys, census and sample. The census survey captures all enterprises hiring more than 100 workers. To construct the panel data in which it is possible to control the time-invariant plant's fixed effect, we consider only the plants belonging to the census sector.

5.2. Measurement of main variables

The main variables we use for the estimations are as follows. The wage inequality between nonproduction and production workers is the ratio of the wage rate of the supervisory and managerial staff to the wage of floor-level workers. Each wage rate is calculated as the average daily wage per worker, derived from a division of total emolument paid by the plant to the nonproduction (production) workers by the number of nonproduction (production) workers counted as man days. The total emolument includes not only wages but also bonus, contribution to provident and other funds, and workman and staff welfare expenses. As is the standard in the literature, we define skilled workers to be nonproduction workers and unskilled workers to be production workers.

We construct a database of annual output tariff data from 2000 to 2007 based on the World Integrated Trade Solution (WITS) data. Tariff data for India are drawn at the four-digit of the Harmonized System (HS) classification, which are converted to the International Standard Industrial Classification of All Economic Activities, Revision 3 (ISIC Rev.3) by using the appropriate concordance table available from the WITS. Four-digit level National Industrial Classification (NIC) 98 set by the Indian government in 1998 has a one to one correspondence with ISIC Rev.3. The product codes are also able to convert to four-digit level NIC code. Therefore, output tariff for plant f is constructed as

$$output\ tariff_{f,i,t} = \sum_{s} \gamma_{f,s,i,t} \cdot output\ tariff_{st}$$

$$where\ \gamma_{f,s,i,t} = \frac{product_{f,s,i,t}}{\sum_s product_{f,s,i,t}}. \qquad (3.\ 2)$$

$\gamma_{f,s,i,t}$ is the share of product s in the value of total output in plant f in industry i. $output\ tariff_{st}$ is output tariff for product s. Output data includes the value of 10 main products in each year.

We construct two types of input tariff: $input\ tariff_{f,i,t}$ and $imp\ input\ tariff_{fit}$. The tariff for domestically produced inputs for plant f is constructed as

$$input\ tariff_{f,i,t} = \sum_{i} \delta_{f,s,i,t} \cdot output\ tariff_{s,t}$$

$$where\ \delta_{f,s,i,t} = \frac{input_{f,s,i,t}}{\sum_s input_{f,s,i,t}}. \quad (3.\ 3)$$

$\delta_{f,s,i,t}$ is the share of input s in the value of total input in plant f in industry i. $output\ tariff_{s,t}$ is output tariff for intermediate good s. Input data includes the value of 10 main inputs in each year. The tariff for imported inputs, $imp\ input\ tariff_{fit}$, is constructed as same as $input\ tariff_{fit}$, although we could identify 5 main imported inputs. In the estimation, the coefficient of $imp\ input\ tariff_{fit}$ captures the direct impact of tariff on importers because import plants directly use these imported inputs. The term $input\ tariff_{fit}$ describes the indirect or spillover effect on non-importers.

The relationship between wage inequality and tariffs would be affected by the time varying plant-level characteristics. In order to control for those effects, we include the skill share measured as the ratio of the number of nonproduction workers to the total employment, the size of the plant measured by the log of the plant's total labor force counted as man days, and the ratio of the number of contract labor to the total number of production workers as control variables (See Table 3. A. 1 in Appendix for summary of definition of main variables).

5.3 Descriptive Statistics

Table 3. 2 indicates the descriptive statistics of the main variables (the variable named the share of modern service sector in the State Domestic Product (hereafter SDP) is used in section 6.2). The sample size is 88,827 for the period from 2000 to 2007. The dependent variable of the regression, log of wage inequality, has a sample average of 1.208. This implies that the wage of nonproduction is 335% of the wage of production worker on an average.

Output tariff and input tariff imposed on the sample plants are on an average 28% and 18% respectively. Output tariff is higher than input tariff by about 10% point. The average import share (the share of imported intermediate goods in total intermediate goods used in production) is only 9%, reflecting that two third of the plants are non-importers. Input tariff for importers are on average 6%.

The average size of the plant measured as the log of the plant's total labor force counted as man-days is 10, which implies that a plant employs, on annual average, about 22,000 man-days. The average skill share is 10% and this ratio ranges from about 0 to 94%. The average ratio of contract labor is 21%. As mentioned earlier, this ratio increased from 15% in 2000 to 22% in 2007 and peaked at 23% in 2004.

Table 3. 2

Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
$\ln(w_s/w_u)_{f,i,t}$	88,827	1.208	0.688	−4.607	8.291
w_s	88,827	718.591	1231.387	1.654	159973.800
w_u	88,827	182.629	159.984	1.045	8609.266
output tariff$_{f,i,t}$	88,827	0.283	0.252	0	2.1
input tariff$_{f,i,t}$	88,827	0.185	0.207	0	1.82
impshare$_{f,i,t}$	88,827	0.097	0.213	0	1
imp input tariff$_{f,i,t}$	88,827	0.061	0.125	0	2.1
$\ln(\text{labor})_{f,i,t}$	88,827	10.736	1.422	3.738	16.483
skill share$_{f,i,t}$	88,827	0.105	0.095	0	0.942
ratio of contract labor$_{f,i,t}$	88,827	0.212	0.329	0	1
share of skilled worker intensive products	88,827	0.654	0.630	0.00000215	14.94516
number of producs	88,827	2.308	1.953	1	10
sdp share of service$_{l,t}$	86,747	0.178	0.070	0.051	0.466

Note: Based on author's calculation using ASI and WITS data.

6. Results

This section presents the estimation results and provides the theoretical interpretation of the results.

6.1 Baseline Results

Table 3. 3 shows the baseline results. We include only output tariff in column 1 and input tariff in column 2. In the former case, the coefficient is negative and significant indicating that a fall in output tariff is associated with an increase in the wage inequality between nonproduction and production workers, whereas in the latter case the coefficient is negative but insignificant. These results suggest that increased wage

inequality after trade liberalization coincides with product basket switching wherein the unskilled labor-intensive sectors are protected the most prior to a trade reform. In column 4 where we include both output tariffs and input tariffs, the coefficient of output tariff remains negative and significant, and the coefficient of input tariff is positive but insignificant.

We further explore whether the effect of input tariff reduction is different between importers and non-importers of intermediate goods. In column 4, we include input tariff for importers and the plant's input share. The coefficient of the term and that of the input tariff are both insignificant. This suggests that imported inputs do not have any effect on the wage inequality, and implies that SBTC in manufacturing does not affect wage inequality. Amiti and Cameron (2011) find that reduction in input tariff decreases the within-plant wage inequality in Indonesia because intermediate goods are more skilled labor-intensive than final goods and reduction in input tariff decreases the demand for the skilled workers. In India, the tariff of unskilled labor-intensive products reduced most. Even if intermediate goods are more skilled labor-intensive than manufacturing, the reduction in input tariff seems not to decrease the demand for skilled workers in intermediate goods.

Above-mentioned results might be biased because of some omitted variables such as time varying plant-level characteristics. Therefore, we add the skill share in column 5, the size of plant measured by the log of the plant's total labor force in column 6, and the ratio of contract labor within production workers in column 7. Even after controlling those variables, the coefficient of output tariff is significant and negative. The coefficient on the skill share is negative and significant indicating that an increase in the share of nonproduction workers within a plant is associated with lower wage inequality. Although the size of plant does not matter for the wage inequality, the coefficient of the ratio of contract labor is positive and significant indicating that replacing regular workers with contract workers is cost cutting and widens the wage inequality between nonproduction and production workers.

Table 3. 3

Baseline Results

Dependent variable	$\ln(w_s/w_u)_{f,i,t}$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
output tariff$_{i,t}$	-0.0430***			-0.0467***	-0.0421***	-0.0424***	-0.0407**
	(0.016)			(0.017)	(0.016)	(0.016)	(0.016)
input tariff$_{i,t}$		0.000	-0.001	0.009	0.006	0.006	0.008
		(0.015)	(0.015)	(0.016)	(0.015)	(0.015)	(0.015)
impshare$_{f,i,t}$			0.011	0.013	0.021	0.021	0.023
			(0.020)	(0.021)	(0.020)	(0.020)	(0.020)
impshare$_{f,i,t}$ * input tariff$_{i,t}$				0.009	0.003	0.002	0.002
				(0.019)	(0.018)	(0.018)	(0.018)
skill share$_{f,i,t}$					-2.243***	-2.227***	-2.181***
					(0.034)	(0.036)	(0.036)
ln(labor)$_{f,i,t}$						0.007	-0.005
						(0.005)	(0.005)
ratio of contract labor$_{f,i,t}$							0.153***
							(0.012)
Plant FE	YES	YES	YES	YES	YES	YES	YES
State$_l$ * Year$_t$	YES	YES	YES	YES	YES	YES	YES
Constant	1.152***	1.137***	1.136***	1.150***	1.383***	1.307***	1.398***
	(0.007)	(0.006)	(0.006)	(0.008)	(0.008)	(0.050)	(0.051)
Observations	100,304	100,304	100,304	100,304	100,304	100,304	100,304
R-squared	0.032	0.032	0.032	0.032	0.097	0.097	0.1
Number of panelid	40,002	40,002	40,002	40,002	40,002	40,002	40,002

Notes: Robust standard errors in parentheses are clustered at 5-digit industry-year level. * significant at 10%; ** significant at 5%; *** significant at 1%.

6.2 Product Basket Switching

Although baseline results show that a reduction in output tariff increases the within-wage inequality, how does a plant change their product mixture along with output tariff reduction? Table 3. 2 in subsection 5.3 shows that plant produce on average 2.3 products. Goldberge et al. (2010a, 2010b) shows that output tariff does not affect on number of products. Column (1) in Table 3. 4 shows the result of impact of 4-digit industry level output tariff ($ind\ output\ tariff_{jt}$) on number of products. The result is consistent result with Goldberge et al. (2010a, 2010b), and 4-digit industry level output tariff does not effect on number of products. Since industry level output tariff implies that output tariff of each product is same with that of the main product, we use the plant specific output tariff, explained in subsection 5.2, as an explanatory variable in column (2), and the coefficient of output tariff is negative and significant. The reduction in the plant specific output tariff increases number of products.

We also analyze the relationship between the share of skilled labor-intensive products and output tariff. The share is constructed as follows:

$$Skilled\ product\ share_{f,i,t} = \sum_{s} \gamma_{f,s,i,t} \cdot skilled\ worker\ intensity_{s,t}$$

$$\text{where } \gamma_{f,s,i,t} = \frac{product_{f,s,i,t}}{\sum_s product_{f,s,i,t}}$$

$$\text{and } skilled\ worker\ intensity_{s,t} = \frac{\sum_f total\ wage\ of\ skilled\ workers_{f,s,t}}{\sum_f total\ wage\ of\ unskilled\ workers_{f,s,t}}. \quad (3.\ 4)$$

$skilled\ worker\ intensity_{s,t}$ is the skilled labor-intensity measured by the ratio of total wage of skilled workers to that of unskilled workers in products s at 4 digit NIC categories.

We estimate the reduced form equation as under,

$$Skilled\ product\ share_{f,i,t} = \alpha_f + \alpha_{l,t} + \beta_1 output\ tariff_{f,i,t} + Z_{f,i,t}\Gamma + \varepsilon_{f,i,t}. \quad (3.\ 5)$$

All specifications include plant fixed effect, α_f, and state-year fixed effect, $\alpha_{l,t}$, to control time-invariant characteristics of the plant and the time-variant shocks affecting states differently respectively[6]. The vector $Z_{f,i,t}$ in the equation controls for the time varying plant-level characteristics such as the plant's size, import share, the skill share and the share of contract workers in production workers.

Column (3) in Table 3. 4 shows the results of the impact of reduction in output tariff on product mixture. The coefficient of output tariff is negative and significant, indicating that product basket switching from unskilled labor-intensive products to skilled labor- intensive products after trade liberalization. After control for time-invariant plant characteristics in column (4), the output tariff is still negative and

6 The economy wide effects on the wage structures would be absorbed by the year–state dummy. For example, the minimum wage is important for the wage structure. The minimum wage is different among states and changes over time. As we can observe, the number of contract labor increased in the Indian manufacturing sector. Therefore, wage inequality might be affected by the level of minimum wages. Moreover, the labor regulations of each state may affect wage inequality. Besley and Burgess (2004) measure the strength of labor regulation in different states using the amendment in Industrial Dispute Act (IDA) for which the state government has the authority. They indicate that pro-worker amendments of the IDA are associated with lowered investment, employment, productivity, and output in registered manufacturing, and increased urban poverty.

significant.

These results suggest that reduction in output tariff increases the scope of production, and plant switch product mix from unskilled labor-intensive products to skilled labor- intensive products because the tariff reduction on former products was larger than that on latter products after trade liberalization.

Table 3. 4

Impact of reduction in output tariff on scope of production and product mix

	(1)	(2)	(3)	(4)
Dependent variable	number of products	number of products	skilled product share	skilled product share
output tariff$_{f,i,t}$		-0.164***	-0.291***	-0.235***
		(0.050)	(0.054)	(0.044)
ind_output tariff$_{i,t}$	0.065			
	(0.055)			
impshare$_{f,i,t}$				0.222***
				(0.044)
skill share$_{f,i,t}$				0.792***
				(0.089)
ln(labor)$_{f,i,t}$				-0.0205**
				(0.009)
ratio of contract labor$_{f,i,t}$				0.0822**
				(0.039)
Plant FE	YES	YES	YES	YES
State$_l$ * Year$_t$	YES	YES	YES	YES
Constant	2.273***	2.356***	0.549***	0.650***
	(0.022)	(0.019)	(0.064)	(0.101)
Observations	88,827	88,827	88,827	88,827
R-squared	0.008	0.008	0.163	0.188
Number of panelid	35,185	35,185	35,185	35,185

Notes: Robust standard errors in parentheses are clustered at 5-digit industry-year level. * significant at 10%; ** significant at 5%; *** significant at 1%.

Skilled product share is a weighted average of skilled worker intensity, in which a weight is product share. Skilled worker intensity is measured by the ratio of total wage of skilled workers to that of unskilled workers in products *s* at 4 digit NIC categories.

6.3 Effect of SBTC in the Modern Service sector

The modern service sector in India is growing at a rapid pace and the demand for skilled labor in this sector is expanding along with it. Trade liberalization in this sector was stared in the mid 1980's. The government reduced the tariff rate of computer hardware, its component and software. The modern service sector includes communication, banking and insurance, and real estate, ownership of dwellings and business services. It is relatively easy for a skilled worker than an unskilled worker employed in the manufacturing sector to move to this sector. In other words, the labor market for skilled worker is integrated, while that for unskilled worker is fragmented between the manufacturing sector and the modern service sector. Therefore, the demand for skilled workers in the modern service sector is important for the demand for skilled workers in the manufacturing sector. In the baseline specification, we try to absorb the effect of the demand in modern service sector on wage inequality in manufacturing by the year-state dummy variable. However, in order to distinguish the effect of the increased demand of the modern service sector on wage inequality in manufacturing from other factors included in the year-state dummy variable, we include the share of the modern service sector in SDP as a proxy for the demand for skilled workers in that sector. Table 3. 5 shows that the output tariff reduction still increases the wage inequality. More importantly, the increase in the modern service sector's share in SDP contributes to increased wage inequality in manufacturing. This suggests that SBTC in modern service sector affects wage inequality in manufacturing.

Table 3. 5

Effect of SBTC in the Modern Service sector

Dependent variable	$\ln(w_s/w_u)_{f,i,t}$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
output tariff$_{i,t}$	-0.0534**		-0.0507**	-0.0507**	-0.0508**	-0.0507**	-0.0472**
	(0.022)		(0.023)	(0.023)	(0.022)	(0.022)	(0.022)
input tariff$_{i,t}$		-0.175	-0.094	-0.084	-0.168	-0.171	-0.154
		(0.171)	(0.174)	(0.179)	(0.172)	(0.172)	(0.172)
impshare$_{f,i,t}$				0.012	-0.009	-0.013	-0.015
				(0.042)	(0.041)	(0.042)	(0.041)
impshare$_{f,i,t}$ * input tariff$_{i,t}$				-0.046	0.063	0.075	0.093
				(0.218)	(0.213)	(0.214)	(0.212)
skill share$_{f,i,t}$					-2.265***	-2.251***	-2.206***
					(0.055)	(0.058)	(0.058)
ln(labor)$_{f,i,t}$						0.006	-0.006
						(0.007)	(0.007)
ratio of contract labor$_{f,i,t}$							0.150***
							(0.016)
sdp share of service$_{l,t}$	0.801***	0.811***	0.798***	0.796***	0.810***	0.813***	0.791***
	(0.242)	(0.242)	(0.242)	(0.242)	(0.233)	(0.233)	(0.233)
Plant FE	YES	YES	YES	YES	YES	YES	YES
Year$_t$	YES	YES	YES	YES	YES	YES	YES
Constant	0.958***	0.978***	0.979***	0.977***	1.224***	1.153***	1.248***
	(0.039)	(0.054)	(0.054)	(0.055)	(0.053)	(0.096)	(0.096)
Observations	98,118	98,118	98,118	98,118	98,118	98,118	98,118
R-squared	0.023	0.023	0.023	0.023	0.09	0.09	0.092
Number of panelid	39,018	39,018	39,018	39,018	39,018	39,018	39,018

Notes: Robust standard errors in parentheses are clustered at 5-digit industry-year level. * significant at 10%; ** significant at 5%; *** significant at 1%.

SDP share of service is the share of the modern service sector in State Domestic Products (SDP).

7. Concluding Remarks

In this Chapter, we analyze the relationship between trade liberalization and intra-plant wage inequality between nonproduction and production workers using plant level data in the Indian manufacturing sector. We also discuss if the effects of trade liberalization on wage inequality are consistent with product basket switching and SBTC. Our estimation results indicate that tariff reduction in final goods increases wage inequality, but tariff reduction in intermediate inputs does not have a statistically significant effect on wage inequality. These results suggest that product switching occurs by multi product plants in India manufacturing where unskilled labor-intensive industries are protected the most prior to trade liberalization. We also conform that the share of skilled labor-intensive goods in production increases when output tariff decreases.

We also consider the increased demand for skilled worker by the modern service sector including the IT sector, liberalized in the mid 1980. Due to the requirements of computer and English language skills, the modern service sector, which is growing at a rapid pace, demands larger number of skilled workers. This increased demand for skilled workers would widen the wage inequality in the manufacturing sector because it is relatively easy for the skilled workers in the manufacturing sector to move to the modern service sector. Moreover, a manufacturing plant needs to offer a higher wage to skilled workers. Our results indicate that the increase in the share of modern service sector in SDP contributes to an increase in wage inequality in manufacturing. This suggests that SBTC in modern service sector affects wage inequality in manufacturing.

In future studies, we plan to include variables indicating labor market conditions, such as the minimum wage, the Besley and Burguss index, and unionization rate, in our estimation in order to confirm the robustness of our results. In addition, we plan to deal with possible endogeneity of tariff rates that might have a bias on the results. For example, it could be the case that politically powerful industries are able to successfully lobby the government for trade protection. However, no such analysis is undertaken in this chapter; this area will be an interesting subject for future research.

Appendix

A. 1 Main variables

Table 3. A. 1

Definition of main variables

Variables	Definition
$\ln(w_s/w_u)_{f,i,t}$	Log of (wage of non-production worker/wage of production worker) within factory f in industry i at year t
w_s	Daliry wage of supervisory and managerial staff
w_u	Daliry wage of factory-floor level workers counted as man days.
output $\text{tariff}_{i,t}$	Output tariff or final good tariff of plant f in industry I at year t.
input $\text{tariff}_{f,i,t}$	Input tariff or intermidiate good tariff of plant f in industry I at year t. .
$\text{impshare}_{f,i,t}$	The ratio of value of imported inputs to value of all inputs invested by a factory f in industry I at year t
imp input tarif $_{f,i,t}$	Input tariff of importer f in industry I at year t. .
$\ln(\text{labor})_{f,i,t}$	Log of total employment including supervisory and managerial staffs and
skill $\text{share}_{f,i,t}$	The ratio of the number of supervisory and managerial staffs to the total number of empoyment.
skill product sharef,i,t	The share of skiled labor-intensive products in total products.
number of producs	Number of products.
ratio of contract $\text{labor}_{f,i,t}$	The ratio of the number of contract labor to the total number of factory-floor level workers
sdp share of $\text{service}_{l,t}$	The state domestic products share of modern service sector. Modern service sector includes communication, banking and insurance, and real estate, ownership of dwellings and business services.

Chapter 4: The Impact of Trade Liberalization on Productivity in the Indian Manufacturing Sector

1. Introduction

The 1995 establishment of the World Trade Organization (WTO) is the capstone of a gradual process of global liberalization of trade that started after the Second World War. Although average tariffs for many countries are in the 20-30 percent range with wide variety of non-tariff barriers in 1950, the average tariff rates drop to the 5-10 percent rage in most countries in 2010 (Hoekman (2014)). The value of global trade in goods and services increases from US$5 trillion in 1995 to US$16 trillion in 2010[7]. In such a circumstances, the Indian trade policy in 1997 is proposed with an aim to prepare a framework for globalizations of Indian economy and promote exporters. In this chapter, we analyze the impact of reduction in export barrier on productivity of incumbent exporters, who are benefited from the export-oriented trade policy, during the period 1998 to 2007. Since India reduces the import tariffs in final goods and intermediate goods in the same period, we also analyze the impact of reduction in those tariffs on the productivity of plants.

Exporters had relatively easy access to imported inputs and machinery due to reduction in tariffs on those goods imported to produce export goods under the trade policy in 1997. Moreover, exporters who export entire products are promoted by the tax holiday. The exporters benefited from the policy could improve their economic performance when export barrier is reduced. Our results reveal that trade liberalization increases incumbent exporters' productivity by 8 to 11 percentage points for each 1-percentage decrease in export barrier.

Many theoretical works studies the within-plant productivity growth after trade reform (Atkeson and Burstein, 2011; Burstein and Melitz, 2012; Bustos, 2011; Costantini and Melitz, 2008; Yeaple, 2005). Recent research empirically provides

[7] Source data is World Integrated Trade Solution data.

evidence that exporters improve their productivity or upgrade their technology. Bustos (2011) shows that Argentinian exporters increased investments in technology with tariff reduction under the Mercado Comun del Sur (MERCOSUR) trade agreement. Lileeva and Trefler (2010) and Aw et al. (2011) also show that exporters engaged in more productive innovation and increased their productivity in Canada and Taiwan, respectively.

How do incumbent exporters improve their productivity? Bustos (2011) proposes that the within-plant productivity growth is caused by adoption of more advanced technologies. Trade liberalization[8] reduces trade costs and exporters then upgrade their technologies using the profit from reduced trade costs. That particular model allows the most efficient exporters to invest in additional fixed costs to adopt more advanced technology to reduce their marginal cost. There are other possible channels through which trade reforms increase within-firm productivity: intensifying competition may force firms to improve their efficiency by reducing average costs (Helpman & Krugman, 1985), force firms to focus on their core competency products or product innovation (Bernard, Redding & Schott, 2006), reduce managerial slack and generate x-efficiency gains (Hicks, 1935), or raise innovation incentives among domestic firms due to the threat of foreign entrants (Aghion et al., 2005). We assume that the increase in IT investment reflects technology upgrades, especially in the late 1990s and early 2000s, and find that reduction in export barrier increases the investment. This result suggests that exporters invest on technology and improve their productivity.

Many empirical studies show that reduction in import tariffs improves on firm-level productivity in developing countries (Pavcnik, 2002; Muendler, 2004; Amiti and Konings, 2007; Fernandes, 2007). In India, trade liberalization began in the late 1980s, though advanced after the economic reform in 1991. Many studies focus on this economic reform, though early studies of the relationship between liberalization and productivity reach mixed conclusions. Krishna and Mitra (1998) use firm-level data in the manufacturing sector from 1986 to 1993 and find some evidence of an increase in the growth rate of productivity in the years following the 1991 reform, while Balakrishnan et al. (2000) using similar data sets, do not. Resent studies show the consistent findings with Krishna and Mitra (1998). Sivadasan (2009) finds the reduction

[8] Bustos (2011)'s model assumes the bilateral trade liberalization with an identical partner.

in final goods tariffs and FDI liberalization increased productivity using a pooled cross-sectional dataset for the early years of the reforms (1986 – 1994). Topalova and Khandelwal (2011) find that reduction in final good and input tariffs increased productivity among large manufacturing firms during the period 1987 to 2001. Our results suggest that tariff reduction in input tariff increases the productivity of importers of inputs, but reduction in output tariff does not have significant effect on productivity.

This is the first work analyzing the growth of incumbent exporters' productivity using plant-level data in India. Export revenue data became available from surveys only in 1997. We uniquely match the cross-sectional data in 1997, which includes the information about export, with panel data for 1998 to 2007. Plant level panel data provides the advantage of making it possible to control plant characteristics such as size, age, and type of ownership, as well as time-invariant plant fixed effect.

The chapter proceeds as follows. Section 2 overviews the process of trade liberalization in India. Section 3 discusses the empirical methodology and Section 4 describes the data. Section 5 presents the results and Section 6 concludes.

2. Indian export-oriented trade policy and trade liberalization

Worldwide economic globalization has developed rapidly since the creation of the World Trade Agreement (WTO). The world average Most Favored Nation (MFN) tariff drops from 13% in 1995 to 9% in 2010. The value of global trade in goods and services increases from US$5 trillion in 1995 to US$16 trillion in 2010[9].

India's top 10 export partners[10] in 2007 with export shares of 50% from India are members of the WTO. Moreover, India has trade agreements with many trading partners.[11] These factors have decreased Indian exporters' export barriers. Figure 4. 1 shows the decreasing trend during the period from 1998 to 2007. It is worth noting that

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9 Source data is World Integrated Trade Solution data.

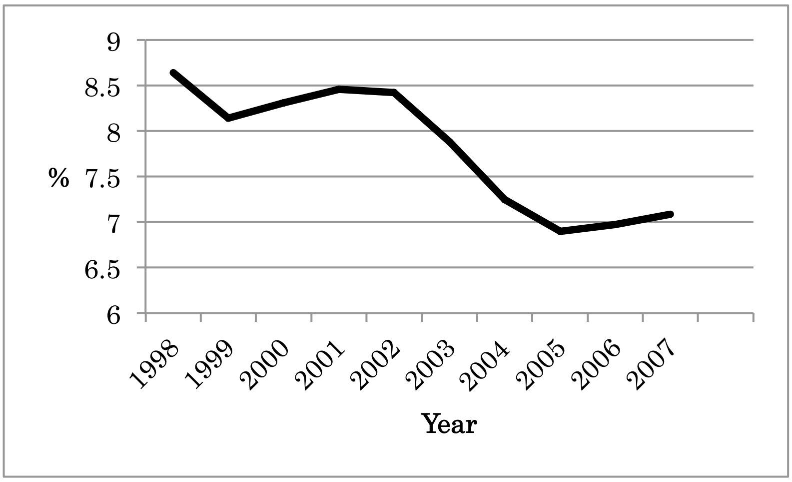
10 The U.S.A, United Arab Emirates, China, Singapore, the U.K., Hong Kong, Netherland, Germany, Belgium, and Italy in 2007. (Ministry of Commerce and Industry, Export Import Data Bank, http://commerce.nic.in/eidb/default.asp)

11 In the 2000's, India concluded bilateral trade agreements with Sri Lanka, Afghanistan, Chile, Singapore, Nepal, Korea, Bhutan, and Bangladesh. India concluded the CEPA with Malaysia and Japan in 2011, and a multilateral trade agreement with Association of South-East Asian Nations (ASEAN), Mercado Comun del Sur (MERCOSUR), South Asian Free Trade Area (SAFTA), Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), and American Public Transportation Association (APTA). Other bilateral or multilateral trade agreements are still under negotiation.

the export barrier is exogenously determined because the tariff rate depends on the trade partners. We take the weighted average of per-country tariffs, in which the weight is the share of export volume from India to a specific country.

Figure 4. 1

Average Export barriers



Source: Calculations based on WITs data.

Note: Export barrier is a weighted average of average tariff imposed on Indian exporters by a trade partner, in which a weight is the share of export to a trade partner from India.

Before 1991, trade policy was characterized by high tariffs and pervasive import restrictions. However, India launched a dramatic economic reform as a part of an IMF adjustment program in 1991. The first generation of trade liberalization from 1991 to 1996 reduced import tariffs, eliminated and quantitative restrictions.

The new 5-year trade policy announced in 1997 was export-oriented. Exporter has relatively easy access to imported inputs and machinery due to reduction in tariffs on imports of capital goods such as machinery and machinery parts, and import raw materials and intermediate goods under the trade policy[12]. The trade policy also simplified procedures for export. In addition, Export Oriented Unions (EOUs), which

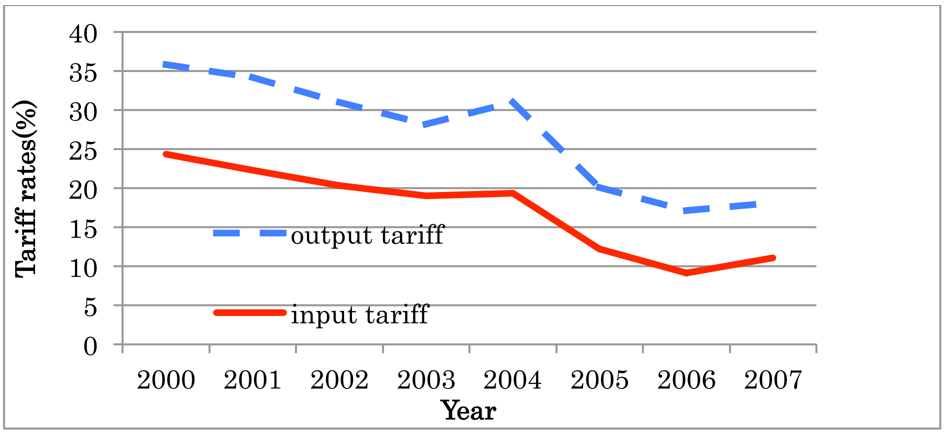
[12] The Duty Entitlement Pass Book (DEPB) scheme began in1997, and under the DEPB scheme, the credit of amount as a specified percentage of FOB value of exports is given to the exporter after the export of goods. Firms can then use this credit to import raw materials and intermediate goods for export purpose. The Export Promotion of Capital Goods (EPCG) scheme benefits exporters by reducing tariffs on imports of capital goods such as machinery and machinery parts.

are organizations aiming to export their entire products have more benefits and facilitates, such as an extended tax holiday. A scheme to establish Special Economic Zones (SEZs) in the country to promote exports is announced in 2000. The SEZs aim to provide an internationally competitive and hassle-free environment for exports and are expected to boost the country's exports. The tariff reduction on imports does not carry forward in the period, although quantitative restrictions on imports of manufactured consumer goods and agricultural products were finally removed in 2001.

The subsequent foreign trade policy from 2002 to 2007 continues to incentivize exporters. For example, quantitative restrictions on exports were withdrawn, except for some items related to national security. In addition, the government reduced the average output tariffs in Indian manufacturing from 35% in 2000 to 18% in 2007 and the average input tariffs from 24% in 2000 to 11% in 2007 (See Figure 4. 2).

Figure 4. 2

Average Output and Input Tariff in Manufacturing



Note: Based on author's calculation using ASI and WITS data.

Output and input tariffs are simple average of 2-digit industry level tariff rate.

3. Methodology

3.1 Measuring TFP

We first measure plant-level total factor productivity (TFP) following Levinsohn and Petrin (2003). As detailed below, they use a plant's raw material inputs as a proxy for the unobservable productivity shocks to correct for the simultaneity problem in estimation of the firm's production function. Including a proxy that controls for the part of the error correlated with inputs eliminates the variation in inputs related to the productivity term.

Following Petrin et al. (2004) and assuming a Cobb-Douglas production function, the estimation equation is

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \eta_{it} \quad (4.\ 1)$$

where y_{it} is the log of plant i's output at time t; k_{it} is the log of plant i's capital assets; and l_{it} is the log of labor. While η_{it} is an error term that is uncorrelated with input choice, the simultaneity problem arises from the ω_{it} term, an unobservable plant-specific time-varying productivity shock that may be correlated with the plant's choice of variable inputs. Assuming that intermediate input m_{it} depend on the variables k_{it} and ω_{it}, and increases monotonically in ω_{it}, ω_{it} can be written as a function of k_{it} and m_{it}: $\omega_{it}(m_{it}, k_{it})$. Thus, equation (4.1) can be rewritten as

$$y_{it} = \beta_l l_{it} + \phi_{it}(m_{it}, k_{it}) + \eta_{it} \quad (4.\ 2),$$

where $\phi_{it}(m_{it}, k_{it}) = \beta_0 + \beta_k k_{it} + \omega_{it}(m_{it}, k_{it})$. Substituting a third-order polynomial approximation in k_{it} and m_{it} in place of ϕ_{it}, we estimate $\widehat{\beta_l}$, $\widehat{\phi}_{it}$ and $\widehat{\beta_0}$ using OLS. In the second stage, for any candidate value β_k^*, we compute a prediction for ω_{it}: $\widehat{\omega}_{it} = \widehat{\phi}_{it} - \beta_k^* k_{it} - \widehat{\beta_0}$. Using these values, a consistent approximation to $E[\omega_{it}|\omega_{it-1}]$ is given by the predicted values from the regression

$$\widehat{\omega}_{it} = \gamma_0 + \gamma_1\omega_{it-1} + \gamma_2\omega_{it-1}^2 + \gamma_3\omega_{it-1}^3 + \epsilon_{it} \quad (4.\ 3)$$

assuming that productivity follows a Markov process. The estimate of $\widehat{\beta_k}$ is the solution to following process

$$min_{\beta_k^*} \textstyle\sum_t (y_{it} - \beta_l l_{it} - \beta_k^* k_{it} - E[\widehat{\omega_{it}|\omega_{it-1}}])^2. \quad (4.\ 4)$$

The bootstrap approach is used to construct standard errors for the estimates $\widehat{\beta_l}$ and $\widehat{\beta_k}$. Plant-level TFP is measured by substituting the estimated output elasticity of capital, $\widehat{\beta_k}$ and of labor, $\widehat{\beta_l}$ into the Cobb-Douglas production function as follows.

$$TFP_{it} = \frac{y_{it}}{{k_{it}}^{\beta_k}{l_{it}}^{\beta_l}}. \quad (4.\ 5)$$

3.2 Empirical Strategy

The following equation is used to identify the impact of tariff liberalization on within-plant productivity:

$$\ln tfp_{ijt} = \alpha + \alpha_i + \beta(Export\ barrier_t \times ExporterD_{ij,1997}) + \gamma Output\ tariff_{jt} + \delta ImporterD_{ijt} + \eta Input\ tariff_{jt} + \lambda(Input\ tariff_{jt} \times ImporterD_{ijt}) + X_{ijt}\theta + \varepsilon_{ijt} \quad (4.\ 6)$$

where $\ln tfp_{ijt}$ is log of total factor productivity of factory i in industry *j* at time *t*; $ExporterD_{ij1997}$ is the exporter dummy, which takes the value of 1 if a factory is an exporter in 1997; and $ImporterD_{ijt}$ is importer dummy, which takes the value of 1 if a factory is an importer of inputs. $Export\ barrier_t$ is the export barrier for exporters, $Output\ tariff_{jt}$ is tariff for final good at 4-digit industry level[13], and $Input\ tariff_{jt}$ is tariff for intermediate goods at 3-digit industry level at year t. These tariffs are at valorem tariff and measured as percentage based on World Integrated Trade Solution (WITS) database. The detailed construction process for $Export\ barrier_t$ and $Input\ tariff_{jt}$ is discussed in subsection 4.1. X_{ijt} is a vector of factory characteristics including type of ownership, and size[14]. All specifications also include plant fixed effect, α_i, to control time-invariant characteristics of the plant.

This Chapter predicts that incumbent exporters increase their productivity along with the reduction in export barrier and thus expects $\beta < 0$. According to Amiti and Knonigs (2007), input and output tariffs increase firms' productivity. In the Indian context, Topalova and Khandelwal (2011) and Harrison et al. (2011) find that reduced input tariffs rather than reduced output tariffs increase productivity. The interaction term between input tariff and the importer dummy reflects the direct effect of the decline in input tariff on importers' productivity. A negative and significant coefficient on the interaction term λ would imply that importers benefit more from lower input tariffs than non-importers. Thus, this chapter hypothesizes that δ is positive, indicating that imported inputs embody advanced technology. Note that we do not include the exporter dummy, as detailed next, due to a data limitation in which exporters' status does not change during the period.

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[13] Tariff data for India are drawn at the four-digit level of the Harmonized System classification, which are converted to International Standard Industrial Classification of All Economic Activities (ISIC) Revision 3 using the concordance table available from WITS. National Industrial Classification (NIC) in 1998 at the four-digit level has a one to one correspondence with ISIC Rev 3 at the four-digit level.

[14] Topalova and Khandelwal (2011) categorize firms as small if the average sales during the sample period are below the median, medium if sales are above the median but less than the 99th percentile, and large if sales exceed the 99th percentile.

4. Data

4.1 Data

Plant Information

This Chapter uses plant-level panel data for Indian manufacturing firms during 1998 to 2007. The unit-level information comes from the Annual Survey of Industries (ASI) undertaken by the Central Statistical Organization (CSO). This is an annual survey of all formal manufacturing factories across all the states. The ASI data covers two sets of surveys: a census and a sample. The former includes enterprises with more than 200 workers and the latter includes enterprises with less than 200 workers.[15] The balanced panel data is constructed using data from the census sector. The data set contains information about 665 individual manufacturing enterprises for each year.

Unfortunately, the panel data from ASI during 1998 to 2007 does not contain the information about exports. Therefore, the cross section ASI data for 1997, which contains information about factories' exporting revenue, are matched with the panel data. However, since there are no factory IDs in the 1997 data, the same factory for 1997 and 1998 is identified by matching the following variables: state, type of ownership, type of organization, rural or urban, and net fixed asset. In accounting, the net fixed asset at the end of last financial year must coincide with the net fixed asset at the beginning of the current financial year. There is, however, a within-plant deviation of around 30% on average, even in the panel data. Therefore, the factories are presumed to be the same if the deviation between the 1997 and 1998 data is less than 30% and the other time-invariant variables are same. Fortunately, there is a deviation of about 2% on average in the matched balanced panel set. The matched data set contains information about 170 individual manufacturing enterprises with information about exports.

Export barrier

We construct a database of annual export barrier data from 1998 to 2007 using World Integrated Trade Solution (WITS) data and Import and Export data from the Ministry of Commerce and Industry. The export barrier for year t is constructed as

$$export\ barrier_t = \sum_k \gamma_{kt} \cdot Average\ import\ tariff_{kt} \qquad (4.\ 7)$$

[15] The threshold changed from 200 workers to 100 workers in 2000. However, this chapter uses the previous threshold in order to create balanced panel data.

where γ_{kt} is country k's share of the amount of export value from India and $Average\ import\ tariff_{kt}$ is country k's average Most Favored Nation (MFN) import tariff in year t except for the countries whose bilateral or multilateral trade agreements with India are in force in the sample period[16]. Preferential tariffs are applied for these countries. Number of trade partner is 142. Figure 4. 1 shows that the average export barrier falls from more than 8.6% in 1998 to 7.1% in 2007.

Input tariff

We construct a data of annual input tariff data for 1998 to 2007 as follows. The input tariff for industry j is constructed as

$$input\ tariff_{jt} = \sum_s \alpha_{jst} \cdot output\ tariff_{jst} \qquad (4.\ 8)$$

where α_{jst} is the share of input s in industry j. The share of input of each industry is calculated from the 1998 Input Output (IO) table. The industrial classification of the IO table is at the three-digit NIC level. Therefore, input tariff for the industry is at three-digit industry level.

4.2. Descriptive Statistics

Table 4. 1 reports the descriptive statistics for the main variables, including real value added as output, real fixed asset as capital, and total person-days as labor. Value added is deflated by double deflation method, in which real value added is measured as the difference between real gross output and real intermediate inputs[17]. This table shows that a plant's average value added and fixed assets are INR443 million and INR869 million, respectively. Plants employ an average of 260,000 person-days. Export barriers range from 6.9% to 8.6%. Output tariffs range from 0% to 260% with an average of 28.2%, which is much larger than that of input tariffs, which range from 6.2% to 30.2% with an average of 16.9%. . Most plants are privately owned, and 46% of enterprises are exporters. Plants operated for an average of 29 years.

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[16] FTA with Sri Lanka, Singapore, Bhutan, and Chile are in force in 2000, 2005, 2006 and 2007, respectively. MFA in South Asian Free Area (including Bangladesh, Pakistan, Nepal, and Maldives) is in force in 2006.

[17] Gross output is deflated by wholesale price index (WPI) at 3-digit NIC industry level. Intermediate inputs are deflated by a weighted average of WPI, in which a weight is input share calculated from Input Output table.

Table 4. 1

Descriptive statistics for the main variables

Variables		NOB	Mean	SD	Minimum	Maximum
Real Value Added	(milion Rs.)	1675	443	1,420	11,507	23,500
Real Fixed Asset	(milion Rs.)	1697	869	4,430	583	90,500
Man-days employed	(mandays)	1695	262,634	762,718	26	11,800,000
Real Computer Investment	(milion Rs.)	1640	492	3,987	0	83,772
Export barrier	(%)	1700	7.81	0.65	6.90	8.64
Output tariff	(%)	1640	28.20	18.74	0.00	260.00
Input tariff	(%)	1696	16.91	5.34	6.21	30.15
ExportD	(Indicater)	1700	0.46	0.50	0	1
ImportD	(Indicater)	1700	0.54	0.50	0	1
Private Alone	(Indicater)	1700	0.97	0.17	0	1
Private joint	(Indicater)	1700	0.01	0.11	0	1
Government owned	(Indicater)	1700	0.02	0.13	0	1
Medium	(Indicater)	1700	0.48	0.50	0	1
Small	(Indicater)	1700	0.51	0.50	0	1
Large	(Indicater)	1700	0.02	0.13	0	1
Age	(Year)	1700	29	17	2	112
Age sq	(Year sq)	1700	1,118	1,425	4	12,544

Source: Calculations using ASI data.

5. Results

Table 4. 2 shows the estimated output elasticity of capital or labor. The production function is constant return to scale since the estimation fails to reject $\beta_l + \beta_k = 1$ statistically.

Table 4. 2

Output elasticity

l	0.562***
	(0.066)
k	0.353***
	(0.114)
Observations	1672
Adj R-squared	0.8572

Source: Calculations using ASI data

*Note: * significant at 10%; ** significant at 5%; *** significant at 1%.*

Before analyzing the relationship between a tariff reduction and productivity growth, we confirm Bernard and Jensen's (1999) finding that exporters are more efficient, larger in terms of employment, and pay higher wages. For confirmation, we estimate following equation for 1998:

$$v_{ij,1998} = \alpha + \gamma Export_{ij,1997} + \varepsilon_{ij,1998} \qquad (4.\ 9)$$

where v_{ijt} is log of TFP, log of employment, or log of labor cost of factory i in industry j at time t; $Export_{ij,1997}$ is the export dummy, which takes a value of 1 if a factory is an exporter in 1997. Table 4. 3 shows the result of these estimations, which indicate that exporters are more efficient, larger in terms of employment, and pay higher wages initially.

Table 4. 3

Exporters' characteristics

Dependent	Log of TFP	Log of Employment	Log of Wage
Export-dummy	0.252**	0.856***	1.445***
	(0.120)	(0.209)	(0.267)
Constant	5.038***	11.346***	16.941***
	(0.082)	(0.140)	(0.183)
Observations	164	169	169
R-squared	0.020	0.089	0.144

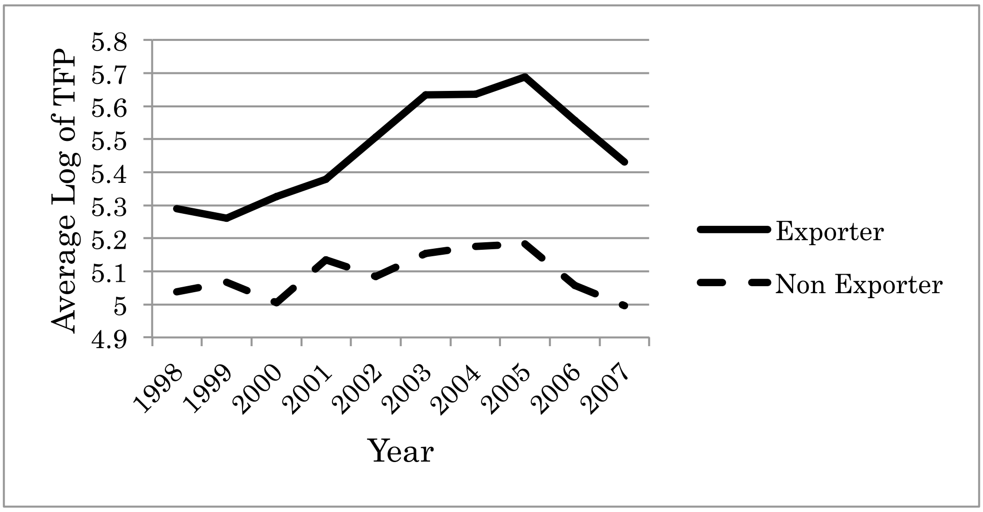
Source: Calculations using ASI data

*Note: * significant at 10%; ** significant at 5%; *** significant at 1%.*

Comparing the average TFP growth between exporters and non-exporters for 1998 to 2007, Figure 4. 3 shows that Average TFP of exporters dominate that of non-exporters in every year. Moreover, the average TFP growth of incumbent exporters are higher than that of non-exporters from 2000 until 2005. In this period, the export and import tariffs decreased drastically, suggesting that tariff reductions might have different impacts on the average TFP growth of exporters and non-exporters.

Figure 4. 3

Comparison of exporters' and non-exporters' log of TFP



Source: Calculations using ASI data.

Note: Total Factor Productivity (TFP) is estimated by Levinsohn and Petrin (2003)'s approach.

Table 4. 4 reports the results from equation (4.6) for 1998 to 2007. Column (1) indicates that exporters react to export barrier reductions: their average TFP increases by 11 percentage points for each 1 percentage point decrease in export barriers. The regression in column (2) includes the output tariff and shows results quantitatively similar to those in column (1). Column (3) adds the input tariff and importer dummy and column (4) adds the interaction term of input tariff and importer dummy. These results suggest that, in addition to the exporter's productivity growth with a reduced export barrier, importers improved their productivity with a reduction in the input tariff. Topalova and Khandelwal (2011) also shows that reduced input tariffs rather than reduced output tariffs increase productivity, but output tariff has moderate but significant effect on productivity. Sivadasan (2009) also shows the similar result. The difference from those literatures might be due to the exclusion of exit and entry effects of plant. The results in column (5) include the control variables of ownership, size, state, and industry dummies and indicate that productivity for exporters and importers increase with reduced export and input tariffs, respectively. In addition, larger factories are more productive than smaller factories.

The results indicate that incumbent exporters improve their productivity, consistent with findings from previous studies (Bustos, 2011; Lileeva & Trefler, 2010; Aw et al., 2011). Although the TFP growth may not directly reflect technology upgrades (See Foster et al., 2008; Hsieh and Klenow, 2009; and Bernard et al., 2010), the process that exporters increase investments in technology using the profit from reduced trade costs may occur in Indian manufacturing. The increase in IT investment may reflect technology upgrades, especially in the late 1990s and early 2000s. Therefore, we estimate equation (4.6) using computer investment as a dependent variable. Table 4. 5 indicates that a reduction in export barrier leads to an increase in exporters' computer investments in any specification. Thus, exporters might upgrade their technology along with export barrier reduction.

Table 4. 4

Impact of trade liberalization on productivity

Dependent variable	Log of TFP				
	(1)	(2)	(3)	(4)	(5)
Export tariff × ExportD	−0.115***	−0.125***	−0.122***	−0.0795**	−0.0801**
	(0.034)	(0.036)	(0.036)	(0.038)	(0.037)
Output tariff		−0.0006	−0.00001	−0.0002	0.0001
		(0.00181)	(0.00184)	(0.00184)	(0.00155)
Input tariff			−0.011	0.004	0.011
			(0.009)	(0.010)	(0.011)
ImportD			0.0895*	0.372***	0.234**
			(0.047)	(0.098)	(0.095)
Input tariff × ImportD				−0.0173***	−0.0112**
				(0.005)	(0.005)
Private joint					0.621
					(0.434)
Government owned					−0.084
					(0.389)
Medium					−0.842***
					(0.125)
Small					−1.374***
					(0.135)
Age					0.003
					(0.006)
Age sq					−0.0001
					(0.0001)
Factory FE	YES	YES	YES	YES	
Year FE	YES	YES	YES	YES	YES
State FE					YES
Industry FE					YES
Constant	5.588***	5.653***	5.776***	5.367***	6.210***
	(0.144)	(0.153)	(0.213)	(0.245)	(0.652)
Observations	1,672	1,612	1,608	1,608	1,608
R-squared	0.068	0.068	0.069	0.076	0.153
Number of panelid	170	164	164	164	164

Source: Calculations using ASI data

*Note: * significant at 10%; ** significant at 5%; *** significant at 1%.*

Table 4. 5

Impact of trade liberalization on computer investment

Dependent variable	Computer investment				
	(1)	(2)	(3)	(4)	(5)
Export tariff × ExportD	−771.9***	−791.6***	−806.4***	−630.2***	−658.4***
	(211.4)	(220.7)	(222.8)	(236.4)	(237.6)
Output tariff		−8.284	−8.922	−9.672	−3.029
		(11.26)	(11.54)	(11.53)	(7.11)
Input tariff			10.39	72.02	65.95
			(58.38)	(64.69)	(64.98)
ImportD			108.60	1,281**	901.10
			(291.30)	(607.40)	(581.00)
Input tariff × ImportD				−71.89**	−41.73
				(32.69)	(31.75)
Private joint					15,729***
					(1281.00)
Government owned					476.30
					(1128.00)
Medium					−7,290***
					(742.40)
Small					−7,320***
					(782.70)
Age					5.00
					(23.54)
Age sq					−0.114
					(0.28)
Factory FE	YES	YES	YES	YES	
Year FE	YES	YES	YES	YES	YES
State FE					YES
Industry FE					YES
Constant	3,108***	3,423***	3,229**	1,528	6,473***
	(876.4)	(941.9)	(1318.0)	(1526.0)	(2366.0)
Observations	1,697	1,637	1,633	1,633	1,633
R-squared	0.026	0.028	0.028	0.031	0.045
Number of panelid	170	164	164	164	164

Source: Calculations using ASI data.

*Note: * significant at 10%; ** significant at 5%; *** significant at 1%.*

Computer investment is calculated as the investment in fixed asset for computer and in units of million INR.

6. Conclusion

We construct unique, balanced plant-level panel data for Indian manufacturing firms by matching cross sectional data in 1997, including information about exports, for 1998 to 2007. Based on the data, we estimate TFP and examine the differing trends in TFP growth between exporters and non-exporters and the impact of export barrier reductions on incumbent exporter's productivity. The results show that trade liberalization improves incumbent exporters' productivity and computer investment: their productivity increases by 8 to 12 percentage points for each 1 percentage decrease in export barriers. This may suggest that incumbent exporters increase investments to upgrade technology using the profit from reduced tariffs, as Bustos (2011) suggests. Another possibility is that "learning by exporting" increases exporters' productivity after entering the export market (Van Biesebroeck, 2005; De Loecker, 2007), though the chapter's data could not identify when a firm enters the export market. Another finding is that importers improved their productivity as input tariffs declined. This result is consistent with that of Topalova and Khandelwal (2011).

In the wave of globalization after the creation of the World Trade Agreement (WTO), the Indian government adopted an export-oriented trade policy with subsidies to exporters. The results from this chapter suggest that this policy change benefited incumbent exporters during the period in which the trade partner reduced the export barrier. The improved economic performance among exporters led the government's targeted growth in the Indian economy.

One limitation in the data is that exporter status does not change during the sample period because the data only contains initially this information. Moreover, the method of identifying factories from the 1997 data in the post-1998 data suffers from sample selection bias because this favor plants with good accounting systems and drop some samples with insufficient systems. Therefore, future research could use other methods for matching, such as propensity score matching. Future studies could also construct the export barrier at the industry level.

Chapter 5: The Impact of Business Regulations on Economic Performance of Small Firms: Empirical Evidence from Indian Manufacturing[18]

1. Introduction

Since the mid-1980s, many theoretical studies have examined the relationship between institutional quality and economic outcomes. The links between institutions and performance have also been analyzed in a large and growing body of empirical literature. According to the World Bank (2014, p.30), "since 2003, 1,578 research articles using *Doing Business* data alone have been published in peer-reviewed academic journals, and another 4,464 have been posted online." In addition, studies based on the country rating have been produced by Transparency International, Political Risk Services, and the Heritage Foundation (Economic Freedom). This large body of research supports the view that cumbersome, poorly functioning regulatory business environments undermine entrepreneurship and economic performance.

However, most such research relies on country-level proxy indicators of regulations, such as institutional quality (Dall'Olio et al., 2013; Dutz et al., 2011; Djankov et al., 2002, 2006; Botero et al., 2004), governance (Kaufmann et al., 1999, 2002, 2006), strength of the legal system (Houston et al., 2010; Durnev and Kim, 2005), and labor market rigidities (Dreher and Grassebner, 2013; Amin, 2009; Besley and Burgess, 2004). Economic outcomes are measured by total factor productivity (TFP; Barseghyan, 2008), labor productivity (Dall'Olio et al., 2013), entry rate (Dreher and Gassebner, 2013), income per capita (Djankov, McLiesh, and Ramalho, 2006), corporate growth (Litov and Yeung, 2008), exports (Portugal-Perez and Wilson, 2011),

[18] This chapter is a joint work with Aradhna Aggarwal.

or innovations (Dutz et al., 2011). A feature common to most of these studies is that selected country-level aggregate proxies are used to assess their association with country, industry, or firm-level performance after controlling country and/or industry-specific effects.

However, the cross-country regression based methodology has several limitations (Levine and Renelt, 1992; Levine and Zarvos, 1993). According to Maddala (1999, p. 432), "One should not expect to draw too many policy conclusions from these cross-country regressions." Hence, some studies have used natural experiments, in the spirit of randomized evaluations (e.g., Amiti and Khandelwal; Bruhn, 2013, 2011). This methodology can yield more convincing results than pure cross-sectional studies. In many cases, though, given the complexity of economic settings this methodology may not establish causality between regulation and outcomes of interest (World Bank, 2014, p.30).

Against that background, the present study adopts a novel approach. With a focus on India, we examine the effect of regulations on firms' performance by assessing the difference in economic performance between firms in the informal[19]sector, which qualify for the formal sector but do not register with the formal sector, and their counterpart firms (i.e., those in the same size class that choose to register) in the formal sector. We measure a firm's performance using its TFP and profitability.

Under the Factories Act, 1948, in India, any enterprise that has more than 10 workers and uses power (or more than 20 workers if it does not use power) must register as a "factory." Enterprises that do not meet these criteria need not register.[20] If an enterprise crosses the threshold level of employment and does not register under the law, it remains in the informal sector "unlawfully." Since the Factories Act requires formal enterprises to comply with the employment and other regulations, by not registering under the Act, an enterprise avoids compliance with the regulatory mechanism. The present study adopts the novel approach of focusing on the

[19]In India, the formal sector defined is called the "organized" sector, and the informal sector is called the "unorganized" sector.

[20] This does not mean that enterprises of a lower scale cannot register themselves as a "factory" in the Factories Act.

performance of uniquely sampled firms in the formal and informal sectors that face very different regulatory institutions at a given point in time, and conducts a comparative analysis of their performance. Econometric exercises in this chapter reveal that the firms that choose not to register are less efficient but more profitable (except for 1994) than their counterpart firms in the formal sector. In economic terms, the difference between the formal and informal sectors is a matter of regulation. Business regulations define the rules of the game and thereby influence the ease with which transactions can take place in product and factor markets in the formal economy. On the other hand, informal-sector entrepreneurs tend not to be directly affected by formal business laws. Specifically, the informal sector refers to parts of the economy that are not taxed, regulated, or monitored. Because barriers to doing business vary widely across formal and informal sectors, it is expected that the difference in performance of the two sets of selected firms across these sectors is attributable to the quality of business regulations, after controlling for other firm-specific factors.

The remainder of this chapter is organized as follows. Section 2 describes the theoretical framework and reviews the existing literature. Section 3 explains the methodology and data. The results of a comparison of TFP and profitability between formal and informal sectors are provided in Section 4, while the robustness checks of these results are presented in Section 5. Section 6 describes the impact of owners' educational level on informal enterprises. Section 7 concludes.

2. Theoretical framework and existing literature

Conventionally, business regulations are expected to facilitate business. They shape the incentives of key economic actors in society and are created to reduce uncertainty about exchanges (Coase, 1937; Shubik, 1975; Williamson, 1975, 1985) and enhance predictability. They also reduce transaction costs that arise in economic activities from the separation of buyers and sellers and ensuing information problems. Moreover, the formal firms can benefit from regulations through access to public goods and enforcement of property rights and contracts, which could cut their transaction costs in inefficient contractual relations. In addition, the firms can benefit from access to formal credit, and then afford to purchase and maintain equipment and physical capital. This may have a positive impact on the firms' productivity. Productivity also hinges on the quality of inputs found in the local market. Since business regulation reduces transaction costs, as noted above, it is easy to negotiate with suppliers and access good-quality inputs. Business regulation, and especially labor regulation, guarantees health, safety, and appropriate working hours. These guarantees are attractive for workers, and formal firms may easily recruit high-skilled workers and improve their productivity. These benefits on productivity from business regulation suggest the following hypothesis:

Hypothesis 1.

Enterprises that cross the formal sector threshold but avoid formal regulations by not registering themselves under the Factories Act are less efficient than their counterpart enterprises in the same size class in the formal sector.

On the other hand, formal firms are those registered under the Factories Act; as many as 43 registrations are required with various agencies related to labor, tax,[21] health, safety, and others (see Garg, 2001) for details of the regulations).[22] In addition, several approvals and licenses must be acquired, including approval for the building plan and environmental clearance. Not only does this delay a startup's business, but compliance with these rules and regulations may also impose a heavy burden on entrepreneurs. For instance, if an employee works over 48 hours per week, his/her employer must pay twice the normal wage for time exceeding the 48 hours. Furthermore, this law specifies rules regarding work-time for women and children. The owner must improve facilities for safety, sanitation, and welfare. When an enterprise does not obey the law, the owner must pay a fine of Rs. 100,000 or less or serve a sentence of two years' penal servitude. Lack of transparency in rules, weak governance, and corruption increase the costs of entry and compliance several fold. An annual registration fee, as determined by the number of workers and horsepower used, increases the cost further. Finally, there is little flexibility to withdraw once an investment is undertaken in a venture (Aggarwal and Sato, 2011).

The heavy burden of the registration would depress the profitability of small formal firms. In the line with Amirapu and Gechter (2014)'s model, which allow the

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[21] If an enterprise registers as a corporate firm, it should pay income tax as per the Income Tax Act of 1961.

[22] http://www.citehr.com/409015-all-form-under-factories-act-1948-application.html

misreport to inspectors, the impact of the Factories Act on the profitability can be expressed as follows. Firms choose not only their true employment (n), but also their reported employment (l). Let output Y be a function of labor n and productivity α. The wage is w. The registration cost per worker (extra labor cost) is τ. The fine (F) if caught is fixed, and probability of caught p is an increasing and convex function of degree of misreporting $(n-l)$. Then Firms solve following profit maximization problem:

$$\pi(\alpha) = max_{n,l}\ \alpha f(n) - wn - \tau l * 1(l > 9) - F * p(n-l). \qquad (5.\ 1)$$

The solution of this problem is follows. The lowest productivity firms (those with α below some threshold, α_1) will be unconstrained, choosing $n < 9$ and reporting truthfully ($l = n$). Higher productivity firms, with $\alpha \in (\alpha_1, \alpha_2)$, will choose $n > 9$, exceeding the regulatory threshold, but will find it profitable to misreport their employment, setting $l = 9$. The highest productive firms are with $\alpha > \alpha_2$, which are productive enough to warrant hiring work forces so large that they cannot avoid detection with reasonable probability and must report $l > 9$.

If the regulation cost per worker is too high, the profitability of registered firm will decrease. Amirapu and Gechter (2014) shows that registered firm must pay additional labor cost of 35% of the wage per worker. This high additional labor cost suggests us the hypothesis as follows:

Hypothesis 2.

Enterprises that cross the formal sector threshold but avoid formal regulations by not registering themselves under the Factories Act are, in fact, more profitable than their counterpart enterprises in the same size class in the formal sector.

We test these hypotheses by matching the informal sector firms that qualify for the formal sector but avoid formal sector registration with their counterpart firms in the formal sector.

A few studies have analyzed the productivity difference between formal and informal sector firms. La Porta and Shleifer (2008, 2014), for instance, discuss the impact of firms in the informal sector on economic growth using cross-country data, including India. Using data from World Bank firm-level surveys, they find that informal firms are small and extremely unproductive, even when compared to small formal firms, and especially so relative to larger formal firms. They conclude that informal firms do not contribute to economic growth, which is driven by the efficient formal firms and disappears over time. Kathuria and Sen (2013) compare the productivity of informal and formal enterprises in India using data from the Annual Survey of Industry (ASI) and National Sample Survey (NSS) during the period from 1989 to 2005. They use the stochastic frontier approach to measure TFP and conclude that formal enterprises are more efficient than informal ones. Those papers, however, disregard the heterogeneity of firms in the informal sectors. They ignore the fact that the informal sector itself comprises two subsectors: one consisting of enterprises that under the law cannot be formal enterprises and the other, of enterprises that qualify to be in the formal sector but decide to stay in the informal sector.

Similarly, the formal sector comprises enterprises that range from those employing as few as 10 workers to those with more than 1,000 workers. Thus, by combining large representative surveys of informal firms (which essentially comprise microenterprises) with the census of formal firms, these studies are likely to give an upward bias to the efficiency of the formal sector firms. We match the informal sector firms that are eligible to be in the formal sector but choose not to register with their counterpart firms in the registered sector and compare their performance. Chatterjee and Kanbur (2015) classify enterprises in Indian manufacturing into four types: Compliers, Evaders, Avoiders, and Outsiders. Compliers are those that have registered under the Factories Act and are included in the ASI data. Evaders are those covered by the NSS survey that have 10 workers or more; these firms should have registered but have not done so. Avoiders hire just below 10—in other words, nine workers. Outsiders hire fewer than eight workers. They compare labor productivity between Compliers and Evaders and find that the labor productivity of the former is higher than that of the latter by 2.5 times. Although this result is similar to ours, it might not reflect the pure effect of registration under the Indian Factories Act because enterprises hiring more than 50 workers are regulated by other acts, such as the Industrial Dispute Act. Therefore, we set the upper limit for the number of workers hired by enterprises and identify the enterprises regulated only by the Factories Act.[23]

[23] Chatterjee and Kanbur (2015) use data derived from ASI 2009-10 and NSS 2010-11. Although the period of both surveys conducted overlap and their main focus is the number of enterprises, the reference period for many variables, such as fixed capital and gross value added, are different between the two sets of data. Therefore, the present study uses ASI 2010-11 and NSS 2010-11 for analysis. For the same reason, we use the ASI and NSS data for 1994-95, 2000-01, and 2005-06.

3.Methodology

3.1. Total Factor Productivity

Our methodology to compare the TFP of "unlawful" informal enterprises and formal enterprises in the same size class that choose to register involves four steps.

Step 1: Measuring TFP

In step 1, we estimate the TFP of a firm using two approaches. One approach is to measure TFP by estimating a production function. The other is the TFP index developed by Caves et al. (1982).

Measuring TFP by estimatiing a production function: We use the Cobb-Douglas production function to estimate TFP, which is described by the following equation,

$$\mathrm{TFP}_{j,i,t} = \frac{y_{j,i,t}}{{k_{j,i,t}}^{\alpha}{l_{j,i,t}}^{\beta}} \qquad (5.\ 2)$$

where $y_{j,i,t}$ is gross value added, $k_{j,i,t}$ is gross fixed assets, and $l_{j,i,t}$ is total number of workers produced or input by factory j in industry i at year t. α and β, which represent the output elasticity of capital or labor, are estimated by the following estimation equation,

$$\ln y_{j,i,t} = \rho + \alpha \ln k_{j,i,t} + \beta \ln l_{j,i,t} + \mu_{j,i,t} \quad (5.\ 3)$$

where ρ is a constant term, and μ is a stochastic error term. Column 1 of the appendix table 5.A.1 shows the estimated output elasticity of capital, α, and of labor, β.

Measuring TFP using the TFP index: The TFP index was developed by Caves et al. (1982) and improved by Good et al. (1998). It is measured using the following equation:

$$\text{TFP INDEX}_{j,i,t} = lny_{j,i,t} - \overline{lny} - \left[\frac{1}{2}\left(w_{k\,j,i,t} + \overline{w_k}\right)\left(lnk_{j,i,t} - \overline{lnk}\right) + \frac{1}{2}\left(w_{L\,j,i,t} + \overline{w_L}\right)\left(lnl_{j,i,t} - \overline{lnl}\right)\right] \quad (5.\ 4)$$

where w_k or w_L is the cost shares of capital or labor, respectively. $\overline{lny}$, $\overline{lnk}$, $\overline{lnl}$, $\overline{w_k}$ and $\overline{w_L}$ are the means of each variable. This equation assumes the constant return to scale, because w_k is caluculated by $1 - w_L$. To justify the accuracy of the comparisons between any two enterprises, each enterprise's inputs and outputs are expressed as deviations from a single reference point. As a reference point, the Caves, Christensen, and Diewert multilateral index uses the hypothetical average enterprises with input revenue shares that are equal to the arithmetic mean revenue shares over all observations, and output and input levels that are equal to the geometric mean of output and the inputs over all observations. Each enterprise's output, inputs, and, thus, productivity is measured relative to this hypothetical enterprise (Aw et al., 2000).

Step 2: Comparison of TFP between informal and formal enterprises by Kernel density estimation

In step 2, the TFP measured by the above approach is compared between the two selected sets of enterprises in the formal and informal sectors by Kernel density estimation. This approach shows the difference in TFP distributions between two groups.

Step 3: Comparison of TFP between informal and formal enterprises using OLS estimation

In this step, we regress a firm-specific productivity measure on a dummy variable that captures whether the firm belongs to the formal or informal sector after controlling for industry, type of ownership, and so forth. More specifically, we use the following specification

$$lnTFP_{j,i,t}(or\ TFP\ \mathrm{INDEX}_{j,i,t}) = a + bFormal_{j,i,t} + cYear_t + dFormal_{j,i,t} * Year_t + X'_{j,i,t}g + e_{j,i,t} \quad (5.5)$$

where a is a constant term, and $e_{j,i,t}$ is a stochastic error, while $Formal_{j,i,t}$ is a formal dummy. The vector of control variables, $X_{j,i,t}$, includes the ownership dummy, urban dummy, state dummy, and industry dummy. Table 5. 1 summarizes the definition of the explanatory variables used in the OLS estimation.

Table 5. 1

Definition of Dependent Variables Used in OLS estimation

Variable	Description
Formal	1 = formal, 0 = informal
Industry	1 = concerned industry, 0 = otherwise
District	1 = concerned district, 0 = otherwise
Urban	1 = urban area, 0 = rural area
Individual	1 = individual proprietorship, 0 = otherwise
Family	1 = joint family or partnership, 0 = otherwise
Co-operative	1 = co-operative society, 0 = otherwise
Others	1 = others(including enterprises owned by government or state), 0 = otherwise

Source: Author

If an enterprise operates in a different location, the TFP may vary because of the difference of infrastructure, the degree of firm agglomeration, or the economic situation. The difference of TFP caused by location is controlled for by the state dummy. Since the production technology may be different between industries, this aspect is controlled by the industry dummy. According to the NIC 2-digit code, 22 industries are classified. The reference group is the food production industry. The urban dummy controls for the difference of infrastructure or production market. Type of ownership (*Individual, Family, Cooperative, Others*) may affect TFP because the incentive of the owner differs for individually owned, government owned, cooperative society owned, and market-based enterprises. The reference group is public limited enterprises.

Step 4: Robustness check:

For the robustness check, in step 4 we assume that production technology is different between industries. To consider the technological difference between industries, we use three approaches.

The first approach is that we categorize sample enterprises into two types:

labor-intensive and capital-intensive. We assume that they possess different production technology and compare the TFP of the informal and formal enterprises obtained by estimating their production functions separately. Following Hassan and Jandoc (2010), the Beverages and Tobacco, Textile Products, Wood/Wood Products, Leather/Leather Products, and Nonmetallic Products industries are classified as labor intensive, and the Machinery, Electrical Machinery, Transport, Metals and Alloys, Rubber/Plastic/Petroleum/Coal, and Paper/Paper Products industries are classified as capital intensive.[24] Columns (2) and (3) of appendix Table 5. A. 1 show each industry's estimated output elasticity of capital, α, and of labor, β.

The second approach assumes that each industry (22 NIC 2-digit industries) has a different production function. Here we assume that all 22 industries have different technologies. Under this assumption, we estimate the following equation,

$$lny_{j,i,t} = \rho + \alpha \ln k_{j,i,t} + \beta \ln l_{j,i,t} + \sum_{i=1}^{21} \gamma_i D_{industry,i} + \sum_{i=1}^{21} \delta_i D_{industry,i} \times \ln k_{j,i,t}$$

$$+ \sum_{i=1}^{21} \theta_i \, D_{industry,i} \times \ln l_{j,i,t} + \mu_{j,i,t}. \qquad (5.6)$$

$D_{industry,i}$ is a dummy variable of industry i. We use $\alpha + \delta_i D_{industry,i}$ as the elasticity of capital and $\beta + \theta_i D_{industry,i}$ as the elasticity of labor. If δ_i or θ_i is accepted under a 5% t-test significance level, the value is regarded as 0.[25] The reference group is food product industry in OLS estimation. Table 5.A. 2 shows each industry's the output elasticity of capital and labor.

The third approach is that the production functions of the informal and formal enterprises are estimated separately to estimate their productivity. Columns 4 and 5 of appendix Table 5. A. 1 show each sector's estimated output elasticity of capital, α, and of labor, β.

[24]The other industries we deem too ambiguous to classify are Food Products, Textiles, Basic Chemicals, Metal Products, and Other Manufacturing.

[25] This method avoids the distortion caused by insignificant large values of coefficients. However, the estimation result is not different.

3.2. Profitability

We also analyze the impact of the Factories Act on the profit. The (operating) profitability is defined as follows,

$$profitability = \frac{Gross\ Value\ Added - Labor\ cost}{Sales}. \qquad (5.7)$$

This equation suggests that improvement in TFP increases profitability but increased labor cost yields less profitability. If the regulation of the Factories Act affects productivity and labor cost, the impact of the Act on profitability is mixed. If the negative effect from increased labor cost is large enough and decreases profitability, the regulation is too strict for small firms to register as formal firms. We compare the profitability of "unlawful" informal enterprises and formal enterprises in the same size class but choose to register using OLS estimation, using profitability as the dependent variable in equation (5.5).

3. Data

We use plant-level data for the formal and informal manufacturing sectors for 1994, 2000, 2005, and 2010. For the informal sector, we use the National Sample Survey (NSS) Organization firm-level surveys on the informal manufacturing sector (that is, those firms that are not registered under the Indian Factories Act of 1948). Data on the formal manufacturing sector is drawn from the Annual Survey of Industries (ASI), undertaken by the Central Statistical Organization (CSO), which is the annual census-cum-sample survey of all the formal manufacturing units for all industries across all states. The two sets of data are described as follows.

- The NSS survey is undertaken quinquennially using a stratified sampling procedure. This chapter uses the data of 1994, 2000, 2005, and 2010 (51st, 56th, 62nd, and 67th rounds). Conceptually, NSS should include enterprises hiring fewer than 10 workers (or 20 if power is not used) because, as mentioned above, enterprises that cross this threshold are required to register under the Factories Act and are covered by ASI. However, in reality, NSS is found to contain enterprises hiring more than 10 workers (or 20 workers if not using power) and up to 50 workers. Those enterprises stay in the informal sector "unlawfully." This chapter focuses on enterprises that "unlawfully" stay in the informal sector. The subsample from NSS is composed of enterprises that hire more than 10 workers with power (or 20 workers if not using power) and fewer than 50 workers.[26] We call this subsample IE (Informal Enterprises). Seasonal enterprises, which operate in only the specific season, are dropped from the analysis because ASI consists of those enterprises that are not seasonal.

- The ASI data cover two sets of surveys: census and sample. The census survey, which captures all enterprises, includes those enterprises that hire more than 100 workers, and the sample survey includes enterprises that hire fewer than 100 workers. Enterprises in a sample survey are selected by stratified multi-stage sampling (i.e., sampling one-third of the enterprises listed). We select a subsample from the sample survey of ASI that comprises enterprises with fewer than 50 workers and more than 10 workers if using power (or 20 workers if not), the same size as IE. We call this subsample FE (Formal Enterprises).

Table 5. 2 shows the characteristics of the two sets of enterprises in terms of output, capital, labor, and capital intensity. We use real gross value added (GVA) at the 1993 price as output, real gross fixed assets at the 1993 price as capital, and total average hiring worker in a day as labor. Capital intensity is defined as the deflated gross fixed asset divided by total average worker in a day. Labor cost is the sum of wages, bonus, and welfare. From this table, it is evident that the GVA of FE is, on average, 2.86 times higher than that of IE. Moreover, the gross fixed asset of FE is, on average, 4.09 times higher than IE. Although the number of workers of FE is, on average, slightly higher than IE, it has almost the same size because we make a sub-sample to control the firm size between two groups. The capital intensity of FE is apparently higher than that of IE; FE is 3.82 times higher than that of IE, on average.

[26] To identify an enterprise that does not use power and hires more than 10 workers but less than 20 workers, we use the value of electricity consumption. We regard an enterprise using less than Rs. 10,000, which is double the average consumption in Delhi, as one with no power.

Table 5. 2

Descriptive Statistics of Main Variables

	Informal enterprise					Formal enterprises				
	NOB	Mean	SD	Minimum	Maximum	NOB	Mean	SD	Minimum	Maximum
Real Gross Value Added based 1993 price (Rs.)	6,792	1,101,425	2,546,235	-1,124,007	343,000,000	55,768	3,145,895	29,100,000	-1,850,000,000	7,070,000,000
Real Gross Fixed Asset based 1993 price (Rs.)	6,824	1,165,884	3,921,664	3	1,530,000,000	57,883	4,771,655	25,200,000	0	2,760,000,000
No. of workers (man)	6,824	19	9	10	49	57,883	24	11	10	49
Capital intensity (Rs./man)	6,824	20,279	57,994	0.1	765,182	57,883	77,458	303,133	0.03	16,400,000
Year 1994	6,824	0.11	0.31	0	1	57,883	0.28	0.45	0	1
Year 2000	6,824	0.22	0.42	0	1	57,883	0.18	0.39	0	1
Year 2005	6,824	0.42	0.49	0	1	57,883	0.26	0.44	0	1
Year 2010	6,824	0.25	0.43	0	1	57,883	0.27	0.44	0	1

Source: Authors calculations based on ASI and NSS data.

4. Results

Average productivity comparisons

Table 5.3 shows the statistical comparison of TFP and the TFP index between the selected groups of informal and formal enterprises. This result suggests that the TFP of the latter group is, on average, 1.07 times higher than the former. This table also indicates that the FE's TFP index is, on average, much higher than that of the IE.

Table 5. 3

Statistical comparison of TFP & TFP index

Statistical comparison of TFP					
	NOB	Mean	SD	Minimum	Maximum
IE's log of TFP	6769	10.01439	1.103744	1.579191	15.20785
FE's log of TFP	49371	10.75428	1.206356	2.492265	17.75833
Statistical comparison of TFP index					
	NOB	Mean	SD	Minimum	Maximum
IE's TFP index	5147	0.2119889	1.096515	-8.071443	5.511344
FE's TFP index	46007	0.530963	2.924786	-503.5998	36.07987

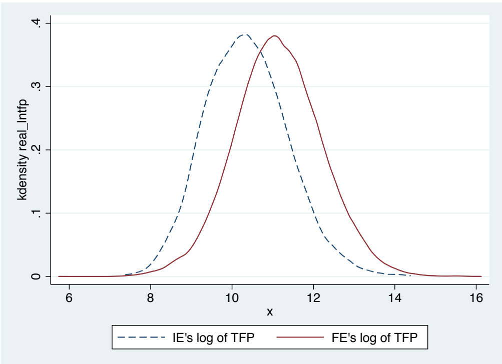
Source: Authors' calculations.

Comparison of TFP: Kernel density estimation

Measuring TFP by estimating a production function: Figure 5.1 shows the distributions of the log of TFP. The solid line is the density of formal enterprises, and the dotted line is the density of informal enterprises. This figure indicates that IE's TFP distribution is on the left side of FE's.

Figure 5. 1

Kernel density estimation of log of TFP



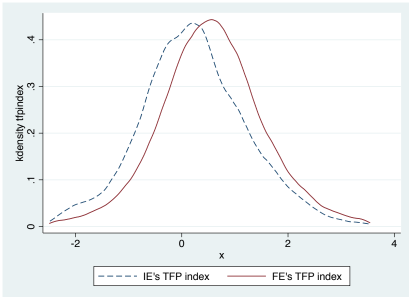
Source: Authors' estimation based on ASI and NSS data

Note: TFP is mesured by estimating Cobb-Douglas production function.

TFP index: Figure 5.2 shows the distributions of IE’s TFP index and FE’s TFP index. The solid line is the density of FE, and the dotted line is the density of IE. Like the distribution of TFP measured by the production function in Figure 5.1, this figure also indicates that IE’s TFP distribution is on the left side of that of FE.

Figure 5. 2

Kernel density estimation of TFP index



Source: Authors’ estimation based on ASI and NSS data

Note: TFP index is measured by Caves et al. (1982)’s approach.

Comparisons of productivity: The OLS approach

TFP as the dependent variable: The above results suggest that firms that stay “unlawfully” in the informal sector are less efficient than those that choose to register. Since that approach does not, however, account for other factors affecting TFP (e.g., location and industry), we applied OLS estimation in order to control for those factors. Table 5.4 shows the results of OLS estimation when the log of TFP obtained by estimating the production function is used as a dependent variable.[27] All specification controls the effects of state and industry. In column (1), the formal dummy is included as an explanatory variable. In other words, other factors affecting TFP are not controlled.

[27]We also measured TFP by estimation of the translog production function. TFP is the residual from following the equation, $\ln y = \alpha + \beta \ln k + \gamma \ln l + \frac{1}{2}\delta(\ln k)^2 + \frac{1}{2}\vartheta(\ln l)^2 + \rho(\ln k \times \ln l) + \epsilon$. OLS estimation is then conducted. The results are consistent with the results that TFPs measured by estimation of the Cobb-Douglas production function or TFP index are used as dependent variables.

This estimation indicates that the coefficient of the formal dummy is significantly positive. In column (2), we include the year dummy and the interaction terms between the formal dummy and year dummy, identifying the time difference of average TFP and the difference between FE's TFP and IE's TFP in each year. FE's TFP is 2.3, 3.6, 3, and 3 times higher than IE's TFP in 1994, 2000, 2005, and 2010, respectively. When we focus on the change in IE's TFP in the sample period, the TFP has decreased since 1994. To the contrary, FE's TFP in latter year is higher than that in 1994, although the peak year is 2000. From those results, we see that the firms that decide not to register themselves to avoid regulations are less efficient than those that are registered and in the same size class.

To control for the firms' characteristics, the ownership dummy and urban dummy are added in column (3). The coefficient of the formal dummy and the interaction terms with year dummies are significant and have the same sign as those in column (2). Most of the ownership dummies (Individual, Family, and Co-operative) are significantly negative, indicating that those firms are less efficient than private limited companies. Moreover, firms set in an urban area are more efficient than those in a rural area. Even if we control for the firms' characteristics, FE is more efficient than IE.

TFP index as the dependent variable: Table 5. 4 (Columns (4)-(6)) also shows the results of OLS estimation using TFP index as the dependent variable. The formal dummy and the interaction terms between the formal dummy and year dummies are significantly positive (except in 2000) under any specification. Those results indicate that, even after controlling other factors affecting TFP, FE is more efficient than IE in the sample period. Moreover, the difference in TFP index between IE and FE has increased.

Table 5. 4

OLS estimation using log of TFP as dependent variable and OLS estimation using log of TFP index as dependent variable

	OLS estimation using log of TFP as dependent variable			OLS estimation using log of TFP index as dependent variable		
	(1)	(2)	(3)	(4)	(5)	(6)
Formal	1.037***	0.834***	0.764***	0.580***	0.288***	0.229***
	(0.003)	(0.012)	(0.012)	(0.006)	(0.014)	(0.014)
Year 2000		-0.239***	-0.248***		0.560***	0.534***
		(0.010)	(0.010)		(0.034)	(0.035)
Formal * Year 2000		0.441***	0.408***		-0.203***	-0.135***
		(0.013)	(0.013)		(0.036)	(0.036)
Year 2005		-0.139***	-0.107***		-0.0477***	-0.0729***
		(0.010)	(0.010)		(0.012)	(0.012)
Formal * Year 2005		0.276***	0.217***		0.327***	0.398***
		(0.013)	(0.013)		(0.014)	(0.016)
Year 2010		-0.251***	-0.179***		-0.319***	-0.335***
		(0.010)	(0.010)		(0.012)	(0.012)
Formal * Year 2010		0.266***	0.176***		0.365***	0.424***
		(0.013)	(0.013)		(0.020)	(0.020)
Individual			-0.363***			0.0993***
			(0.006)			(0.014)
Family			-0.182***			0.189***
			(0.006)			(0.014)
Co-operative			-0.680***			0.029
			(0.025)			(0.037)
Others			0.242***			0.037
			(0.017)			(0.037)
Urban			0.0488***			0.158***
			(0.004)			(0.006)
Industry	YES	YES	YES	YES	YES	YES
State	YES	YES	YES	YES	YES	YES
Constant	9.713***	9.239***	9.496***	-0.00447**	-0.436***	-0.599***
	(0.002)	(0.033)	(0.033)	(0.002)	(0.046)	(0.047)
Observations	56,140	55,936	55,936	51,154	50,962	50,962
R-squared	0.184	0.27	0.281	0.032	0.065	0.068

*Note: Robust Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.*

Source: Authors estimation based on ASI and NSS data.

Comparison of TFP: Robustness Check

Table 5. 5 shows the result of OLS estimation taking account of technology gap between industries or sectors with all the control variables. This figure indicates that "unlawful" informal enterprises are less efficient than formal enterprises with the same size in any point, even though, in the specifications, different production technologies are assumed between capital and labor intensive industries (Column (1)); each NIC industry (Column (2)); and IEs and FEs, as discussed above (Column (3)).

These show that our findings that "unlawful" informal enterprises are less efficient than formal enterprises with the same size are robust even if we consider the different production technologies between industries or between informal and formal sectors.

Table 5. 5

OLS estimation taking account of technology gap

	OLS estimation using log of TFP as dependent variable		
	Between capital and labor intensive industries	Each NIC industry	IEs and FEs
	(1)	(2)	(3)
Formal	0.906***	0.926***	1.598***
	(0.011)	(0.011)	(0.011)
Year 2000	-0.155***	-0.128***	-0.0420***
	(0.010)	(0.010)	(0.010)
*Formal * Year 2000*	0.293***	0.272***	0.261***
	(0.013)	(0.013)	(0.013)
Year 2005	0.001	0.013	0.126***
	(0.009)	(0.009)	(0.009)
*Formal * Year 2005*	0.0979***	0.0849***	0.0540***
	(0.013)	(0.013)	(0.012)
Year 2010	-0.0792***	-0.0290***	0.0494***
	(0.010)	(0.009)	(0.009)
*Formal * Year 2010*	0.0503***	0.0246*	0.0384***
	(0.013)	(0.013)	(0.013)
Individual	-0.360***	-0.418***	-0.434***
	(0.006)	(0.006)	(0.006)
Family	-0.160***	-0.221***	-0.235***
	(0.006)	(0.006)	(0.006)
Co-operative	-0.756***	-0.820***	-0.813***
	(0.024)	(0.024)	(0.024)
Others	0.278***	0.242***	0.153***
	(0.017)	(0.018)	(0.017)
Urban	0.0413***	0.0500***	0.0958***
	(0.004)	(0.004)	(0.004)
Industry	YES	YES	YES
State	YES	YES	YES
Constant	10.28***	9.405***	9.224***
	(0.034)	(0.033)	(0.031)
Observations	55,936	55,936	55,936
R-squared	0.784	0.547	0.491

Note: Robust Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

In column (1), we assume that the production function is different between capital and labor intensive industries classified by Hassan and Jandoc (2010). In column (2), we assume that each industry (22 NIC 2-digit industries) has a different production function. In column (3), we assume that formal and informal sector have the different production functions.

Source: Authors estimation based on ASI and NSS data.

Comparison of Profitability

Table 5. 6 shows the results of OLS estimation using profitability as dependent variables. The control variables are the same as in the estimation using TFP and the TFP index as dependent variables. All specification controls the effects of state and industry. In column (1), the formal dummy is included as an explanatory variable. This estimation indicates that the coefficient of the formal dummy is significantly negative. The result indicates that the profitability of IE is 1.04 times higher than that of FE, suggesting that registering under the Factories Act increases labor cost. In column (2), we include the year dummy and the interaction terms between the formal dummy and year dummy, identifying the time difference of average profitability and the difference between FE and IE profitability in each year. While the formal dummy is positive, the coefficient of the interaction terms between the formal dummy and year dummy are negative and larger than the coefficient of the formal dummy. IE's profitability is 1.04, 1.07, and 1.07 times higher than FE's profitability in 2000, 2005, and 2010, respectively, although FE's profitability is 1.03 times higher than IE's profitability in 1994.These results suggest that following the Factories Act decreases the profitability of the enterprises in 2000, 2005, and 2010 except in 1994. The exception in 1994 might reflect that formal enterprises dominate the market because of industrial licenses. De-licensing began in 1985 and accelerated in 1991, but the licensing system remained until the late 1990s (see Agion et al., 2008). In column (3), after controlling for the firms' characteristics, the ownership dummy and urban dummy, the coefficient of the formal dummy, and the interaction terms with year dummies are significant and have the same sign as column (2).

Table 5. 6

OLS estimation using profitability as dependent variable

	(1)	(2)	(3)
Formal	-0.0421***	0.0399***	0.0459***
	(0.00045)	(0.00152)	(0.00152)
Year 2000		-0.0249***	-0.0237***
		(0.00109)	(0.00110)
*Formal * Year 2000*		-0.0815***	-0.0839***
		(0.00165)	(0.00166)
Year 2005		-0.0222***	-0.0232***
		(0.00105)	(0.00105)
*Formal * Year 2005*		-0.108***	-0.109***
		(0.00162)	(0.00162)
Year 2010		-0.00253**	-0.00540***
		(0.00105)	(0.00105)
*Formal * Year 2010*		-0.113***	-0.112***
		(0.00162)	(0.00162)
Urban			-0.0100***
			(0.00047)
Individual			0.00842***
			(0.00068)
Family			-0.00961***
			(0.00065)
Co-operative			-0.0261***
			(0.00280)
Others			0.0128***
			(0.00175)
Industry	YES	YES	YES
State	YES	YES	YES
Constant	0.0984***	0.119***	0.122***
	(0.00248)	(0.00271)	(0.00274)
Observations	54,682	54,682	54,682
R-squared	0.077	0.137	0.142

*Note: Robust Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.*

Source: Authors estimation based on ASI and NSS data.

Propensity Score Matching

Although we compare the “unlawful” informal enterprises (IE) and the formal enterprises (FE) that are in the same size class but choose to register assuming that they possess indifferent characteristics except for registration, one may contend that comparison between IE and FE is inappropriate because each group possesses different characteristics that lead to different registration choice. We would like to know the difference in an enterprise's economic performance with and without registration in the Factories Act. Clearly, we cannot observe both economic performances for the same enterprise at once. Taking the mean outcome of the informal enterprise as an approximation is not advisable, since formal and informal enterprises usually differ even in the absence of registration. This problem is known as selection bias.

The matching approach is one possible solution to the selection problem. Its basic idea is to find in a large group of informal enterprises that are similar to formal enterprises in all relevant pre-registration characteristics X. That being done, differences in outcomes of this well-selected informal enterprises and formal enterprises can be attributed to the registration. Since conditioning on all relevant covariates is limited in the case of a high dimensional vector X (the so-called "curse of dimensionality"), Rosenbaum and Rubin (1983) developed the balancing score b(X) (i.e., functions of the relevant observed covariates X such that the conditional distribution of X given by b(X) is independent of assignment into treatment). One of the well-known balancing scores is the propensity score (i.e., the probability of participating in a program given observed characteristics X).

Therefore, for another robustness check, we apply propensity score matching (PSM). PSM is a method for matching registered and non-registered enterprises based on propensity score. This approach allows us to compare the productivity and profitability of enterprises that have a similar possibility of being formal after controlling for the observable characteristics. We compare TFP and profitability between the "unlawful" informal enterprise and the formal enterprise possessing a similar possibility to be formal with the former. The possibility of being formal is estimated by Probit using firm characteristics X, such as labor costs, the value of the outstanding loan, the value of fixed assets, number of labor, ownership values of fuels consumed, state, and industry. Table 5.A. 3 in Appendix shows the result of probit estimation.

Table 5. 7 shows consistent results with OLS estimation results. The table indicates

that the "unlawful" enterprises are less efficient and more profitable than formal enterprises, even after we control for the difference of characteristics between the two groups.

Table 5. 7

Propensity Score Matching

	(1)	(2)
Dependent variable	TFP	Profitability
Formal	2.927	-1.352
S.E.	0.248	0.654
p-value	0.000	0.019
Observations	34058	34058

Source: Authors estimation based on ASI and NSS data.

6. The educational level of owner running the informal enterprises

Although La Porta and Shleifer (2008, 2014) show that the owner's educational level of informal enterprises is very low and the educational level is the same as that of workers, what is the educational level of the "unlawful" enterprises? La Porta and Shleifer (2014) show that the percentage of the college educated owners of informal firms ranges from 0 to 19, although that of formal firms ranges from 33 to 100 in 15 developing countries[28] including India. As for India, they show that almost none of the owners of informal firms have college degrees, while this number is 89 percent for the formal firm in India. However, we find to the contrary that the owners running "unlawful" informal enterprises are highly educated. Fortunately, we can access the educational information of the owners running informal enterprises in 2005. Table 5. 8 shows that the owner's educational level is different between "unlawful" informal enterprises and "lawful" enterprises. The striking fact, however, is that the owner's educational level of "unlawful" informal enterprises is very high. 50% of those owners take college educated or higher, while only 6% of the owners of "lawful" enterprises take higher

[28] The sample countries are India, Indonesia, Tanzania, Cambodia, Burkina Faso, Cape Verde, Bangladesh, Niger, Kenya, Pakistan, Guatemala, Cameroon, Brazil, Senegal, and Uganda. The line up in increasing order of ratio of college educated owners of informal firms.

educated. This might suggest that highly educated people "unlawfully" run the enterprises and enjoy the profit from avoiding the regulation.

Table 5. 8

Owner's Educational Level of Informal Enterprises in 2005

	"Lawful" Informal	"Unlawful" Informal
not literate	15.06%	1.50%
literate without formal school	1.37%	0.16%
literate but below primary	9.09%	1.86%
primary	20.14%	5.13%
middle	25.63%	10.15%
secondary	14.84%	16.62%
higher secondary	6.18%	10.38%
diploma/ certificate course	1.32%	3.67%
graduate	5.43%	41.06%
post-graduate or above	0.94%	9.47%

Source: Authors' calculations based on NSS in 2005.

Note: "Lawful" informal enterprises hire less than 9 workers if using power (or 19 if not using power). "Unlawful" informal enterprises hire more than 10 (or 20) workers and do not register under Factory Act.

We compare TFP between "unlawful" informal enterprises run by a highly educated person, those run by a low educated person, and formal enterprises. In Table 5.9, columns (1) and (2) show the comparisons of TFP and profitability between the "unlawful" informal enterprises and formal enterprises in 2005, respectively. The results are consistent with the results in section 5, indicating that the former are less productive and more profitable. In columns (3) and (4), TFP and profitability are compared between "unlawful" informal enterprises run by a highly educated owner and those run by a low educated one. These results show that the TFP of the former is 1.4 times higher than the latter, but the profitability of the latter is 1.02 times higher than the former. These results suggest that the educational level of an owner is related to productivity, but the labor costs increase to achieve high profitability. The increased labor costs may relate to hiring skilled workers, even though the Factories Act does not regulate those enterprises. Although profitability of "unlawful" informal enterprises run by a highly educated owner is lower than those run by a low educated one, Column (5) shows that profit per worker of the former is higher than that of the latter. In columns (6) and (7), we compare TFP and profitability between the “unlawful” informal enterprises run by a highly educated owner and formal enterprises, respectively. These results show that formal enterprises are more efficient and less profitable than “unlawful” informal enterprises, but the TFP difference is smaller than the difference between the “unlawful” informal enterprises and formal enterprises in column 1. These results suggest that the heterogeneity in the educational level of “unlawful” informal enterprises’ owners makes the difference in productivity.

Table 5. 9

OLS estimation with Owner’s Educational Level in 2005

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Between IE and FE		Between IE run by highly educated owner and IE run by Lowly educated owner			Between IE run by highly educated owner and FE	
Dependent variable	log of TFP	profitability	log of TFP	profitability	profit	log of TFP	profitability
Formal	0.760***	-0.0750***				0.543***	-0.0660***
	(0.007)	(0.001)				(0.008)	(0.001)
high education			0.395***	-0.0153***	34,987***		
			(0.007)	(0.001)	(1081)		
Individual	-0.651***	0.00979***	-1.409***	-0.0501***	-148,301***	-0.544***	0.00982***
	(0.011)	(0.001)	(0.022)	(0.005)	(8235)	(0.011)	(0.001)
Family	-0.347***	-0.0267***	-1.143***	-0.0937***	-147,161***	-0.307***	-0.0337***
	(0.011)	(0.001)	(0.023)	(0.005)	(8320)	(0.011)	(0.001)
Co-operative	-0.088	-0.0233***	-1.260***	-0.0673***	-138,288***	0.082	-0.0247***
	(0.057)	(0.006)	(0.069)	(0.011)	(9652)	(0.060)	(0.006)
Others	-0.231***	-0.0409***	-1.188***	-0.107***	52,788***	-0.175***	-0.0497***
	(0.040)	(0.012)	(0.047)	(0.010)	(12865)	(0.040)	(0.012)
Urban	0.0394***	-0.00833***	0.002	-0.00702***	2,766**	0.0836***	0.00460***
	(0.006)	(0.001)	(0.007)	(0.001)	(1248)	(0.009)	(0.001)
Industry	YES	YES	YES	YES	YES	YES	YES
State	YES	YES	YES	YES	YES	YES	YES
Constant	9.725***	0.0833***	10.22***	0.127***	125,699***	9.962***	0.0827***
	(0.045)	(0.020)	(0.045)	(0.008)	(19178)	(0.049)	(0.024)
Observations	18156	19557	2848	2843	2843	16996	18397
R-squared	0.287	0.170	0.322	0.240	0.226	0.223	0.128

*Note: Robust Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.*

Highly educated owners are the owners of informal firms take college education or higher, while lowly educated owners take less than college education.

Source: Authors estimation based on ASI and NSS data.

The informal sector includes not only those enterprises that under the law cannot be formal enterprises, but also those enterprises with highly educated owners that qualify to be in the formal sector but decide to stay in the informal sector. An enterprise run by a highly educated owner might be a start-up enterprise and register in the Factories Act if it could improve productivity enough to recover the loss from increased the registration costs including labor costs.

7. Conclusion

This chapter measures the TFP and profitability of "unlawful" informal enterprises and formal enterprises in the same size class. A comparison of TFP between the two groups is conducted with non-parametric and parametric approaches. The results show that the TFP of "unlawful" informal enterprises is, on average, lower than that of formal enterprises, even after controlling for the effects of location, industry, and type of ownership. A robustness check, conducted by assuming technological differences between industries or between informal and formal enterprises, also confirms our results. In contrast, the profitability of the "unlawful" informal enterprise is higher than that of the counterpart enterprises. Another finding is that the owners' educational levels of "unlawful" informal enterprises are high, and half of those owners have college educations or higher. These results suggest that entry costs, including labor costs, to the formal sector are too high for small enterprises, and the low enforcement of the act motivates small enterprises to "unlawfully" stay in the informal sector even if their human resources are abundant.

The policy implication is that regulatory costs should be lowered. If the entry costs are lowered, "unlawful" informal enterprises may be incentivized to enter the formal sector. Earlier studies also indicate that firms can be incentivized to register by the relaxation of business restrictions. For instance, Bruhn (2013) finds that business registration reform caused 14.9% of informal business owners with characteristics similar to those of formal business owners to shift to the formal economy in Mexico. Kaplan, Piedra, and Seira (2011) also show that simplified entry regulations led 5% of informal firms to shift to the formal economy in Mexico. Bruhn (2011) shows that a reform that simplified business regulations in Mexico municipalities increased registration by 5%. Providing information about registration or paying for it does not necessarily increase formalization, particularly when there are other barriers (De Mal, McKenzie, and Woodruff, 2013). Branstetter et al. (2014) offer further evidence that simpler business registration helps create formal firms. There is also evidence that the lowering of business regulations increases new firm entry (For instance, Branstetter et al., 2013)

A very significant percentage of the economy in developing countries comes from the informal sector. For instance, India's informal sector is rather large despite a high rate of economic growth and modernization. It generated 80% of employment in manufacturing and 31.7% of value added, in 2009–2010 (NCEUS, 2010). A key input to development would be to bring businesses operating in the informal sector into the formal sector, especially those with high levels of human resources. Reducing entry costs could enhance the growth of manufacturing, and, moreover, increase the country's economic growth.

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APPENDIX

A.1. Output elasticity for robustness estimations

Table 5. A. 1

Output elasticity

	All Samples	Capital-intensive	Labor-intensive	IE	FE
k	0.420***	0.344***	0.291***	0.363***	0.358***
	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)
l	0.655***	0.880***	0.643***	0.317***	0.548***
	(0.003)	(0.008)	(0.007)	(0.004)	(0.006)
Constant	6.283***	6.994***	7.780***	7.707***	7.891***
	(0.016)	(0.040)	(0.027)	(0.021)	(0.024)
NOB	56,140	16,696	11,284	6,769	49,167
R^2	0.379	0.323	0.321	0.301	0.318

*Note: Robust Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.*

Column (2) and (3) describe the estimated output elasticity assuming that capital and labor intensive industries, classified by Hassan and Jandoc (2010), have different production functions. In column (3) and (4), we assume that formal and informal sector have the different production functions.

Source: Authors' estimation based on ASI and NSS data.

Table 5.A. 2

Output elasticity by 2-digit industry level

	nic code	cofficient of k	cofficient of l
Food Products and Beverages	15	0.377***	0.790***
Tobacco Products	16	0.128***	0.822***
Textiles	17	0.503***	0.630***
Apparel	18	0.377***	0.450***
Leather Products	19	0.548***	0.375***
Wood and Wood Products	20	0.397***	0.278***
Paper and Paper Products	21	0.403***	0.691***
Publishing and Printing	22	0.300***	0.670***
Coke and Petrolem Products	23	0.380***	1.340***
Chemical Products	24	0.605***	0.455***
Rubber and Plastic Products	25	0.377***	0.830***
Non-Metallic Mineral Products	26	0.268***	0.675***
Basic Metals	27	0.371***	0.656***
Fabricated Metal Products	28	0.343***	1.048***
Machinery and Equipment	29	0.227***	1.133***
Office, Accounting and Computing Machinery	30	0.500***	0.641***
Electrical Machinery and Apparatus	31	0.476***	0.579***
Radio, TV and Communication Equipment	32	0.311***	0.588***
Medical , Precison and Optical Instrumentsm Watches and Clocks	33	0.367***	0.629***
Motor Vehicles	34	0.459***	0.834***
Other Transport Equipment	35	0.387***	0.539***
Furniture	36	0.492***	0.039***

*Note: Robust Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.*

Source: Authors' estimation based on ASI and NSS data.

Table 5.A. 3

The result of Probit estimation

	(1)
Dependent Variable	*Formal*
Labor	*0.327****
	(0.012)
Fixed asset	*-0.0350****
	(0.008)
Labor cost	*3.79e-09****
	(0.000)
Log of value of fuel	*-0.186****
	(0.007)
Individual	*-0.859****
	(0.030)
Family	*-0.623****
	(0.028)
Co-operative	*-0.756****
	(0.083)
Others	*-0.829****
	(0.075)
Urban	*-0.205****
	(0.021)
Log of outstanding loan	*0.147****
	(0.006)
Industry	*YES*
State	*YES*
Constant	*1.816****
	(0.133)
Observations	*94493*
Pseudo-R-squared	*0.222*

*Note: Note: Robust Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.*

Source: Authors' estimation based on ASI and NSS data.

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