ADBI Working Paper Series

TRADE REFORM, MANAGERS, AND SKILL INTENSITY: EVIDENCE FROM INDIA

Pavel Chakraborty

No. 971
June 2019

Asian Development Bank Institute

Pavel Chakraborty is a lecturer and assistant professor at the Department of Economics, Management School of Lancaster University, United Kingdom.

Suggested citation:

Chakraborty, P. 2019. Trade Reform, Managers, and Skill Intensity: Evidence from India. ADBI Working Paper 971. Tokyo: Asian Development Bank Institute. Available: https://www.adb.org/publications/trade-reform-managers-skill-intensity-evidence-india

Please contact the authors for information about this paper.

Email: p.chakraborty1@lancaster.ac.uk

This chapter is based on the article "Input-Trade Liberalization and Demand for Managers: Evidence from India," *Journal of International Economics* 111: 159–176, 2018, co-authored with Ohad Raveh.

Asian Development Bank Institute
Kasumigaseki Building, 8th Floor
3-2-5 Kasumigaseki, Chiyoda-ku
Tokyo 100-6008, Japan

Tel: +81-3-3593-5500
Fax: +81-3-3593-5571
URL: www.adbi.org
E-mail: info@adbi.org

Abstract

India underwent a significant structural transformation through trade liberalization and other reforms (domestic) in the 1990s because of a balance-of-payments crisis. I use this episode to identify the causal effect of a drop in tariffs on wage inequality, measured through managerial and nonmanagerial compensation, between 1990 and 2011. I find that a drop in input tariffs (and not output) significantly increases the share of managerial compensation. In other words, a decline in tariffs on intermediate inputs raised within-firm wage inequality. A 10% drop in tariffs increases the managerial compensation by 0.5%–3.5%. Additionally, I find that this increase in the compensation for managers (or observed increase in wage inequality) can possibly be explained by the rise in skill intensity, but only for firms below halfway in the size distribution. On the other hand, I do not find any evidence of a demand shift from nonmanagers due to a drop in tariffs, leading to inconclusive evidence in favor of skill premium. Additional analysis reveals that it is also the drop in the supply of skilled labor, coupled with demand shifts (toward managerial workers), that led to the rise in the demand for skill for certain categories of workers.

Keywords: trade liberalization, input tariffs, demand for managers, small and medium-sized firms, skill intensity

JEL Classification: F1, F66, F14, M12

Contents

1. INTRODUCTION

International trade economists have long been interested in understanding the distributional implications of globalization or trade liberalization or product market competition. One of the crucial aspects of such distributional effects of competitive pressure, which have received a lot of attention, especially from the 1990s onward, is how such forces divide the labor pie into skilled (or nonproduction) and unskilled (or production) workers. In other words, does an increase in trade participation or exposure to international markets result in an increase in returns for skilled or less skilled workers?

The theoretical underpinning of such an important empirical question originates from the predictions of a well-known theorem in international trade: Stolper-Samuelson. In a model with two factors, it states that "for a rise in the relative price of a good, it will lead to a rise in the return to that factor which is used most intensively in the production of the good, and conversely, to a fall in the return to the other factor." For example, let's denote skilled and unskilled labor as two factors. Now, as countries reduce trade barriers, the Stolper-Samuelson theorem predicts a rise in unskilled-labor wages and a fall in skilled-labor wages in developing countries (as they have a big pool of relatively less skilled workers). The opposite is true in the case of skill-rich countries. In other words, the theorem points out that exposure to international trade or world markets can significantly affect the distribution of resources within the country and can generate substantial distributional conflict.

To investigate whether such is the case, a significant number of studies in the following countries have tried to establish a causal link between the effects of competitive forces (in the form of trade liberalization) and wage inequality (between skilled and unskilled workers) or skill premium: (i) Argentina (Galiani and Sanguinetti 2003; Bustos 2011); (ii) Brazil (Pavcnik et al. 2004; Gonzaga, Menezes-Filho, and Terra 2006; Menezes-Filhoz and Muendler 2011; Araújo and Paz 2014; Krishna, Poole, and Senses 2014); (iii) Chile (Beyer, Rojas, and Vergara 1999); (iv) the People's Republic of China (PRC) (Chen, Yu, and Yu 2017); (v) Colombia (Attanasio, Goldberg, and Pavcnik 2004; Goldberg and Pavcnik 2005); (vi) India (Chamarbagwala 2006; Kumar and Mishra 2008; Chamarbagwala and Sharma 2011; Mehta and Hasan 2012); (vii) Indonesia (Smith et al. 2002; Amiti and Davis 2012; Amiti and Cameron 2012); (viii) Mexico (Feenstra and Hanson 1997; Revenga 1997; Harrison and Hanson 1999; Feliciano 2001; Verhoogen 2008; Frías, Kaplan and Verhoogen, 2009; Frías. Kaplan and Verhoogen, 2012); (ix) Morocco (Currie and Harrison 1997); (x) Turkey (Krishna, Mitra, Chinoy 2001); (xi) Viet Nam (McCaig 2011); and (xii) Latin American countries (Behrman, Birdsall, and Szekely 2000; Haltiwanger et al. 2004).

The primary reason for such an overwhelming number of studies focusing on developing or emerging economies is that during the last three decades or so, many developing countries, most notably Latin American countries in the 1980s and early 1990s, India in the early 1990s, and the PRC joining the WTO in 2001, underwent a significant trade liberalization process that substantially increased their exposure to international markets. The main conclusion that emerges from these studies is that wage inequality or skill premium rose in developing countries due to exposure to international trade. This is puzzling in a Heckscher-Ohlin (H-O) context as developing countries have a comparative advantage in producing low-skill-intensive goods.

A handful of researchers have also investigated the demand for different kinds of workers between exporters and non-exporters in the following developed countries: (i) France (Biscourp and Kramarz 2007); (ii) Germany (Baumgarten 2013); (iii) Hungary (Koren, Csillag, and Kollo 2019); (iv) Portugal (Martins and Opromolla 2010); and (v) the US (Feenstra and Hanson 1996; Bemard and Jensen 1997). Analysis across this set of countries finds strong evidence that an exporter wage gap, conditional on workers' skill levels, contributed to the growth in wage inequality. This finding is consistent with recent heterogeneous-firm trade models that feature an exporter wage premium as well as variability of the premium with respect to increasing trade liberalization.

Given this background, one issue that is currently at the center of economic debates regarding the dynamics of the labor market is how trade reform or exposure to international market(s) or product market competition affects a firm's demand for managers,[1] which in turn affects productivity and performance.[2] The literature on firms' managerial practices or demand for managers originates from a seminal paper by Garicano (2000).

He asks a simple question: What does a firm do? A firm solves problems. Problems arise during different stages of production and managers solve not-so-common problems, whereas nonmanagers take care of routine problems. The demand for managers rises as the ratio of not-so-common problems increases. Garicano (2000) argues that this happens when a firm invests in technological deepening (of the production function). In other words, managerial inputs act as complements to technological inputs. Therefore, with greater adoption of technology (or technological inputs), the demand for skilled labor (or managers) increases. Caliendo and Rossi-Hansberg (2012) use this framework to show that participation in export markets also increases the demand for managers, as firms face a completely new set of not-so-common problems.

In a related context, Acemoglu (2003) develops a model to analyze the impact of international trade on wage premiums. He shows that wage inequality can also happen through skill-biased technical change (SBTC) because of increased international trade. And this may explain the rise in wage inequality without a rise in the relative prices of skill-intensive goods (both in the US and less developed economies), which is the usual intervening mechanism in standard trade models.

Putting these two issues together, I argue that trade reform, or in my case a drop in input tariffs, can induce firms to adopt more technologically intensive inputs. Adoption of high-tech inputs can increase the demand for managers. On the other hand, managers make up a proportion of skilled workers. Therefore, I hypothesize that skill intensity may be a complementary channel through which trade may result in an increase in the demand for managers.

[1] See Chakraborty and Raveh (2018), Chen (2017), Caliendo and Rossi-Hansberg (2012), and Marin and Verdier (2008, 2014).

[2] Studies that link firm organization and managerial practices to firm performance and productivity include Garicano and Rossi-Hansberg (2004, 2006), Bloom and Van Reenen (2007, 2010), Bloom et al. (2013), and Bloom et al. (2014), among others.

Adopting the case of India, I empirically study this nexus in a developing economy, through which we can unravel new dynamics that emphasize the distinctive features of such an economy in this context. All the previous studies investigating similar issues (skill intensity or premium) focus on either/both (i) differential returns for production and nonproduction workers or/and (ii) skilled and unskilled workers, where the workers are sorted according to the number of years of education. I extend and complement the literature by focusing on one niche aspect of the group of skilled workers, the managers. To see whether managers can possibly represent skilled workers or not, I compute a simple correlation between managerial compensation (by aggregating firm-level data to industry) and the ratio of skilled workers or skilled intensity (nonproduction workers/total number of employees). The correlation coefficient is 0.56, suggesting that managers can fairly represent the skilled workers group.

Managers are the section of workers who manage or are associated with the production activities of a firm in the data set that I exploit for this article.[3] The primary focus of this article is to investigate the effect of trade liberalization, vis-à-vis changes in tariffs, on the demand for managers relative to nonmanagers, and in addition explore whether skill intensity can act as a complementary channel.[4] While previous studies examined components related exclusively to the managerial side, such as wages and bonuses (e.g., Cunat and Guadalupe 2009), very little attention, if any, has been given to the inclusion of the nonmanagers' side to consider relative terms and within-firm inequality.[5] I study the causal link and try to identify whether skill premium is one of the underlying mechanisms through which it operates.

I start by presenting a simple link between trade and the relative demand for managers in our sample of Indian firms, for the period 1990–2011, in Figure 1.[6] Both measures increase steadily throughout the period, exhibiting a correlation of 0.86. The surge in trade is a consequence of the 1990s trade liberalization exercise in India, which I discuss further below; the increase in the compensation share of managers is what I aim to investigate. I seek to understand whether there is indeed a causal relation between the two. To apprehend further whether such is the case, I divide the sample of firms into importing and nonimporting firms and plot the relative demand measure in Figure 2. The figure indicates that the surge (in the share of managerial compensation) is almost an exclusive feature of the former types. This motivates a focus on tariffs. To test whether, and how, the latter creates a causal effect, I exploit the exogenous nature of India's 1990s trade reform to study a rich data set on Indian manufacturing firms that uniquely disaggregates labor compensation to managers and nonmanagers over a period of one and a half decades.

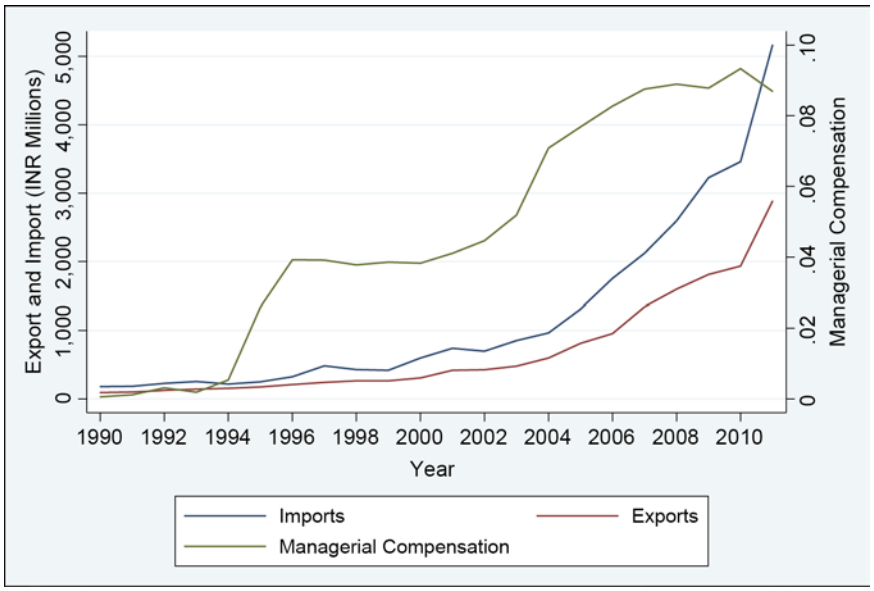
[3] I exclude any manager who is associated with any kind of administrative duties in a firm, such as an HR manager.

[4] Managers are defined as any workers who manage at least one other worker (or who is the sole worker in the firm), with nonmanagers accounting for the remaining balance. I will further discuss this in detail in the empirical part.

[5] An exception is Ma and Ruzic (2018). They study the impact of globalization on executives' income shares in US firms using conditional correlations. In contrast, I try to establish a causal link and empirically identify the underlying channel, while examining a more general definition of managers.

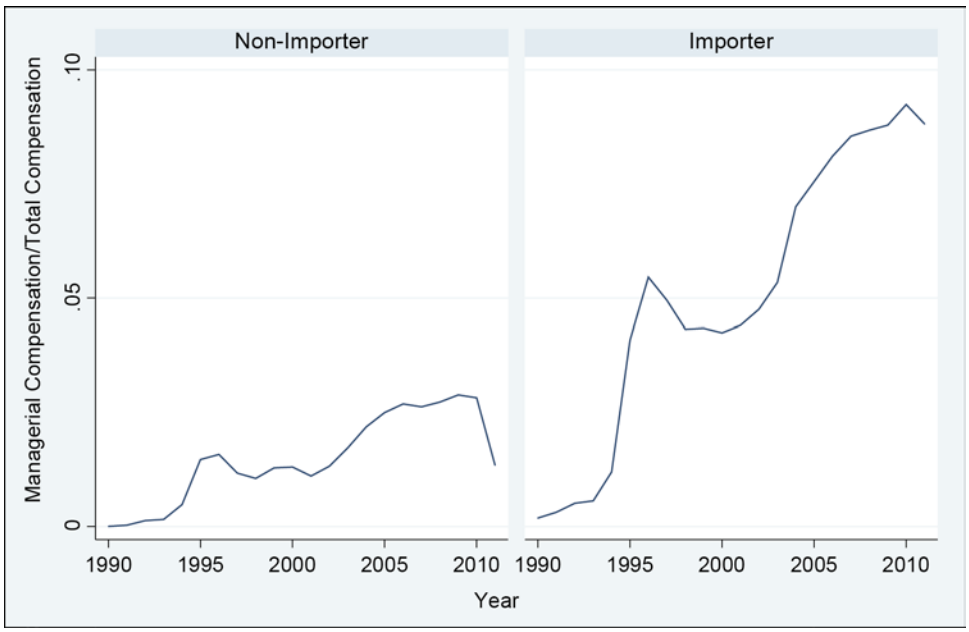
[6] The figure presents the yearly average of the share of total trade (exports plus imports) in gross value added and the share of managerial compensation in total labor compensation for a representative Indian manufacturing firm over the period 1990–2011. I proxy for the relative demand for managers using the latter. I discuss both the measures in more detail in the empirical part.

Figure 1: Trade and Managerial Compensation, 1990–2011



Notes: The figure presents the average trade (exports and imports) values and the average compensation share of managers, 1990–2011 ($\rho = 0.85$).

Figure 2: Managerial Compensation, Importers, and Non-importers, 1990–2011



Notes: The figure presents the average compensation share of managers for importing and nonimporting firms, 1990–2011.

I find a remarkably robust, persistent, and economically meaningful negative effect that, in line with the findings in the initial analysis, is entirely driven by input tariffs. The benchmark estimations indicate that a 10% decrease in input tariffs increases the share of managerial compensation (as well as their number) by approximately 0.5%–3.5%. This effect is robust to considering various controls, specifications, and estimation techniques. These results point to a quality upgrading mechanism reminiscent of Caliendo and Rossi-Hansberg (2012),[7] adjusted to an importing-based economy: Firms import intermediate inputs of higher quality and greater variety; these, together with the products they produce, are embedded with new knowledge that in turn increases the relative demand for workers with skills to manage that.[8]

Next, in investigating whether skill intensity can act as a complementary channel resulting in demand for managers, my results suggest that the phenomenon is particularly significant for firms below the halfway point of the size distribution. In other words, as small and medium-sized firms start to import high-quality intermediate inputs (as a result of the trade reform) without any prior knowledge of how to use them in the production technology, this results in a higher demand for managers (relative to the top half of the size distribution) with suitable knowledge to use them. And this increase in the demand for managers materializes in those sectors where there is a complementary effect of the drop in input tariffs and a higher ratio of skill intensity.

This observation is acute for domestically owned exporting firms, which produce intermediate goods. Though this finding has possible ramifications for the increase in skill premium in India, additional analysis does not find any such evidence. The analysis on nonmanagerial compensation shows no effect of input tariffs on nonmanagerial compensation leading to inconclusive evidence in favor of skill premium in India due to trade reform.

This article is primarily related to the literature on trade liberalization and the demand for skill or skill intensity in developing economies. As discussed before, neoclassical trade theory, via the Stolper-Samuelson theorem, predicts that trade liberalization increases the demand for the abundant factor, which is expected to translate to an increased relative demand for low-skill labor in developing economies. Several studies, however, have documented the opposite (Goldberg and Pavcnik 2007). Various explanations have been offered, including trade-induced skill-biased technical change (Acemoglu 2003), credit constraints (Bonfatti and Ghatak 2013), improved exports (Zhu and Trefler 2005), import composition (Raveh and Reshef 2016), and quality upgrading (Verhoogen 2008). I check whether skill intensity can potentially be cited as one of the channels through which India experiences an increase in the demand for managers due to the trade liberalization episode.

Secondly, the article also contributes to literature regarding offshoring and wage inequality. Feenstra and Hanson (1996, 1997) show that purchasing an input from a foreign source can replace a task previously done by a worker and therefore can lower wages. On the other hand, the ability to use foreign inputs can raise wages (Grossman and Rossi-Hansberg 2008). Autor, Levy and Murnane (2003) and Ebenstein et al. (2014) in the case of the US and Hummels et al. (2014) for Danish firms show that workers

[7] Studying a model of heterogeneous firms with knowledge-based hierarchies, they show that trade liberalization increases the number of management layers in exporting firms, as managers can solve more efficiently problems arising from increasing output than workers for whom costly knowledge needs to be acquired.

[8] Interestingly, this is in contrast to previous studies that examined developed economies, pointing to a product market competition mechanism (e.g., Cunat and Guadalupe 2009; Bloom, Sadun, and Van Reenen 2010), and hence emphasizing the extent to which the case of a developing economy may present different dynamics and provide new insights.

whose occupations involve routine tasks experience large wage drops with offshoring. I also find a similar result: Increased use of foreign inputs results in a demand for managerial workers, but in the case of a developing country.

Lastly, the article is also closely related to the literature on how the adoption of technologically intensive inputs induces a skill wage gap between and within firms. However, as pointed out by Card and DiNardo (2002), a central issue regarding such an association is the problem of identifying a causal link between the adoption of new technology and a rise in skilled workers' wage. I use the drop in tariffs on intermediate inputs because of the trade liberalization exercise in India in the 1990s to identify a causal effect of technology adoption (in terms of adoption of high-quality technologically intensive intermediate inputs) on wage inequality.

The article is structured as follows. The next section discusses the previous studies investigating the effect of trade reform on skill premium or intensity in India. Section 3 describes the firm-level data. Section 4 undertakes the main exercise, examining the effects of trade liberalization on the relative demand for managers, and checks whether skill intensity is one of the channels. Section 5 discusses the results and relates them with some policy perspectives. Section 6 concludes.

2. LITERATURE REVIEW

As discussed above, a growing body of academic and policy debates on the merits and demerits of liberalization have centered on the internal distributional consequences and how they affect labor markets. This section presents all the other evidence from India on the impact of trade reform on wages. India offers an interesting case for studying the effects of trade reform for a couple of reasons: (a) the magnitude of trade liberalization was very big (Kumar and Mishra 2008). The average tariff drop in manufacturing was more drastic than trade liberalization episodes in Latin American countries (e.g., Mexico, Colombia, and Brazil). In addition to tariffs, India has also reduced nontariff barriers (NTBs) since 1991; (b) trade reforms in India were exogenous and were in response to a severe balance-of-payments (BOP) crisis in 1991. The objective of reducing trade barriers was based on the IMF's conditionalities for assistance. Therefore, policy makers had less room to cater to special lobby interests.

The first paper to investigate the issue of wage inequality in India was by Chamarbagwala (2006). She uses data from the Employment and Unemployment Schedule of the National Sample Survey Organization (NSSO) for four rounds, 1983–84, 1987–88, 1993–94, and 1999–2000 to investigate India's skill wage gap and gender wage differential during the two decades that coincide with the economic liberalization in India. Using nonparametric methodology, she argues that economic liberalization contributed to the widening of the skill wage gap. In other words, there was an increase in the demand for skilled labor and that was mostly due to skill upgrading within industries. On the other hand, the paper shows that international trade in manufacturing goods benefitted skilled men, but hurt skilled women, whereas outsourcing of services generated a demand for both male and female skilled workers. Dutta (2007) uses the same data set for the same time period as above but estimates wage regression models using the augmented Mincer earnings equation controlling for human capital, industry affiliation, and various other characteristics. She also concludes that trade reforms have substantially increased wage inequality as the relative wages of the unskilled workers fell considerably.

Kumar and Mishra (2008) use household survey data from the Employment and Unemployment Schedule of the NSSO for four rounds, 1983–1984, 1987–1988,

1993–1994, and 1999–2000, to estimate the effect of a drop in tariffs on industry wage structure. However, the authors argue that since the manufacturing is largely located in urban areas, they focus their attention on workers only in urban areas. In contrast to the above-mentioned studies on India, they find that trade liberalization has led to a decrease in wage inequality between skilled and unskilled workers in India. This is because the magnitude of tariff reductions was relatively larger in sectors with a higher proportion of unskilled workers.

Azam (2010), using microdata for the period 1983 to 2005, investigates the role of the demand and supply of skilled workers in explaining the rise in skill premium in India. The paper finds: (a) the tertiary (college)-secondary (high school) wage premium increased in India during the 1990s and 2000s and this increase differs across age groups. Increases in wage premiums have been driven mostly by younger age groups, while older age groups did not experience any significant increase; (b) the increase in wage premium was due to demand shifts in favor of workers with a tertiary education, mainly between 1993 and 2004. He argues that the growth rate of the demand for tertiary-educated workers relative to secondary-educated workers was fairly stable in the 1980s and the 1990s. This is due to the increase in the relative supply of tertiary workers during the period 1983–1993, which negated the demand shift and as a result the wage premium did not increase much. However, between 1993 and 1999, the growth rate of the relative supply of tertiary workers decelerated and became virtually stagnant between 1999 and 2004. This resulted in an increase in the wage premium.

Chamarbagwala and Sharma (2011) investigate the relationship between industrial delicensing, trade liberalization, and skill upgrading during the 1980s and 1990s among manufacturing plants in India. They use Annual Survey of Industries (ASI) data to test whether industrial delicensing during the 1980s and 1990s played a role in skill upgrading (as measured by the employment and wage bill shares of white-collar workers). Using both difference-in-differences as well as regression discontinuity techniques, they find two important results: (a) industrial delicensing during the 1980s increased the relative demand for skilled workers via capital- and output-skill complementarities; (b) trade liberalization did not play a major role in raising the relative demand for skilled labor during the 1990s.

Lastly, Mehta and Hasan (2012) examine the effects of trade and services liberalization on wage inequality in India. Their main finding is that labor reallocations and wage shifts due to services reforms are many times larger than those of trade liberalization. Additionally, the paper also highlights that: (a) a large proportion (30%–66%) of the increase in wage inequality is due to changes in industry wages and skill premiums that cannot be empirically linked to trade liberalization; and (b) the bulk of the effects of trade liberalization do not remain in interindustry wage shifts and skill premiums but are subsumed by general equilibrium effects.

Overall, the evidence is mixed. The majority of the studies find trade liberalization to have increased skill premium, whereas others ascertain no effect. This article does not make any effort to investigate the direct effect of trade reform on skill premium but looks at whether trade reform affects the demand for managerial workers, where skill intensity acts as an intermediary channel. In doing so, I find that even if skill intensity can possibly be termed a complementary channel (in increasing the demand for managerial workers) for firms below the halfway point of the size distribution, I do not find any conclusive evidence that trade reform has led to an increase in skill premium.

3. FIRM-LEVEL DATA

The firm-level data that I primarily use are based on the PROWESS database, constructed by the Centre for Monitoring the Indian Economy (CMIE). The PROWESS database contains information on approximately 27,400 publicly listed companies, all within the organized sector, of which almost 11,500 are in the manufacturing sector. I examine firms belonging to the Indian manufacturing sector. Firms are placed according to the five-digit 2008 National Industrial Classification (NIC) level and are reclassified to the 2004 NIC level to facilitate matching with the industry-level tariffs. The database reports direct measures on a vast array of firm-level characteristics, including sales, disaggregated trade components (imports and exports), R&D expenditures, technology transfers, production factors employed, gross value added, assets, ownership, and others. In addition, it covers both large and small enterprises; data for the former types are collected from balance sheets, whereas the latter is based on the CMIE's periodic surveys of smaller companies.

PROWESS presents several features that make it particularly appealing for the purposes of this study. It is in effect a panel of firms, enabling their behavior to be studied over time. The (unbalanced) sample covers up to 8,000 firms, across 108 (4-digit NIC) manufacturing industries that belong to 22 (2-digit NIC) larger ones,[9] over the period 1990–2011, thereby covering the 1990s trade reform.

The unique feature of the data set upon which the analysis is mainly based is that it disaggregates compensation data to those received by managers and nonmanagers, with a further disaggregation of compensation to wages and bonuses. Specifically, the division is done at three levels: nonmanagers, directors, and executives, with the last two comprising the managers group. While the definition of the former is that they do not manage other employees, directors are defined as managers without executive powers, as opposed to executives, who do possess such responsibilities. Executives include, for instance, the CEO, CFO, and chairman, whereas directors cover positions such as divisional managers. In effect, directors are considered middle management, whereas executives are the top management. While there may be scope for subjective interpretation of this distinction by firms, it does not affect the main analysis where I aggregate executives and directors. These features enable me to study the relative demand for managers and through that trace down the underlying channel that affects it.

Table 1 presents a conditional correlation matrix between the share of managerial compensation with exports and imports (with imports also divided into four different categories – import of raw materials, import of capital goods, import of stores and spares, and import of finished goods). Column (1) shows that the total imports of a firm and share of managerial compensation are significantly correlated at the 5% level. Columns (2)–(5) divide total imports into the categories outlined above. The numbers indicate that the correlation is strongest in the case of import of capital goods (0.03) followed by import of raw materials (0.01), with no significance in the case of import of stores and spares and finished goods. I also do not find any significant correlation between the exports of a firm (column (6)) and managerial compensation. Nonetheless, these numbers are merely suggestive and not conclusive, unless we control for any other policy effects and firm- and industry-level attributes.

[9] In terms of composition, approximately 20% of the firms in the data set are registered as Chemical and Pharmaceutical industries, followed by Food Products and Beverages (13.74%), Textiles (10.99%), and Basic Metals (10.46%).

Table 1: Descriptive Statistics

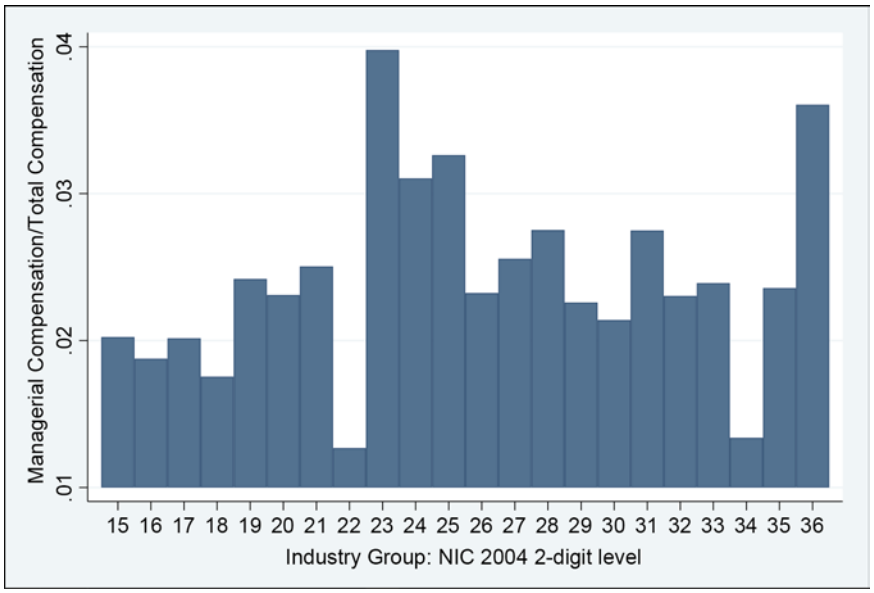
	Mean	Median	Std Dev.	Min.	Max.
Panel A: Dependent Variables					
Managerial Compensation/Total Compensation	0.02	0	0.07	0	1
Managerial Compensation	1.31	0	169.65	0	66,315.1
Nonmanagerial Compensation	95.53	14.4	631.83	0	47,619.5
Managers	1.56	1	0.72	1	7
Panel B: Firm-/Industry-level Determinants – Explanatory Variables					
Total Imports/GVA	0.89	0.04	39.63	0	7,323.5
Import of Raw Materials/GVA	0.68	0.15	10.25	0	1,142.67
Import of Capital Goods/GVA	0.40	0.02	12.66	0	1,192
Import of Stores and Spares/GVA	0.059	0.01	0.58	0	40.45
Import of Finished Goods/GVA	5.65	0.04	149.59	0	7,323.5
Technology Adoption/GVA	0.07	0	9.77	0	2,163
Capital Employed	8.82	1.76	128.57	0	16,789
Productivity	0.48	0.42	0.34	0	5.50
GVA	1,181.05	127.48	16,000.95	0.086	1,031,605
Skill Intensity	0.26	0.25	0.07	0.04	0.71
Factories	3,870.49	3,304	3,021.15	15	13,893
Management Technology	2.49	2.48	0.42	0	3.17
Input Tariffs	73.02	48.83	49.40	17.34	202.02
Output Tariffs	75.93	50	57.14	14.5	298.07

Notes: Annual data at the firm level, covering the period 1990–2011. Monetary values are in real INR millions. "Mcomp/Tcomp" is the share of managerial compensation in total labor compensation. Compensation is the sum of "Wages" and "Bonuses." With regard to managers, it is the sum of Executives (top management) and Directors (middle management), whereas for nonmanagers, it is all the other employees. "Managers" is the total number of managers. "Total Imports" = Imports of Raw Materials + Imports of Capital Goods + Imports of Stores and Spares + Imports of Finished Goods. "Technology Adoption" = R&D expenditure + Royalty payments for technical know-how. "Capital Employed" is the amount of capital employed. "Productivity" is a measure for firm productivity computed following the Levinsohn and Petrin (2003) methodology. "GVA" is gross value added, defined as total sales - total raw material expenditure. "Skill intensity" is the ratio of nonproduction workers to total employees at the 3-digit level NIC 2004. "Factories" is the number of factories at the 3-digit level of NIC 2004. "Management technology" is the management quality score obtained from Bloom and Van Reenen (2010) at the 2-digit level of NIC 2004. "Tariffs (input and output)" are at the industry level (4-digit NIC 2004).

The data set provides much variation across firms and industries in the compensation characteristics of managers compared to nonmanagers. For instance, Figure 3 plots the average share of managerial compensation in total labor compensation across two-digit industries for the period 1990–2011.[10] It goes from a low of approximately 0.5% to a high of around 4%, and the difference across industries is clearly observed. This is also noted when measuring changes over time: Averaging annual changes over the same period, I observe that while in some industries the average annual rate of change is around 10%, in others it can get higher than 200%, thereby providing quite large differences. When this translates to firm level, such variation will be even more prominent.

[10] Note that all industry-level categorizations done throughout the paper are based on the 2004 NIC classification.

Figure 3: Managerial Compensation, Across Industries, 1990–2011



Notes: The figure presents the average compensation share of managers across NIC 2004 2-digit level industries, 1990–2011.

Lastly, it has a relatively wide coverage, accounting for more than 70% of the economic activity in the organized industrial sector, and 75% (95%) of the corporate (excise duty) taxes collected by the Indian government (Goldberg et al. 2010). In terms of trade, it covers approximately 40%–45% of India's total export and import activity, presenting a reasonably good aggregate picture of India's trade position. In addition, it has been used in previous similar studies, providing some reassurance of its relevance and applicability to the particular issues studied.[11] All variables are measured in millions of Indian rupees (INR), deflated to 2005 using the industry-specific Wholesale Price Index (WPI), and are outlined in Appendix A. Table 2 presents descriptive statistics for all variables.[12]

Before proceeding to the regression analysis, it is imperative to clear up an important initial implication of the patterns outlined in Figure 2. It could be possible that the trend observed in terms of the increase in managerial compensation is simply due to an administrative reclassification of workers. To show that this is not the case, I divide the sample of firms into four different quartiles by size (assets) and plot the share of managerial compensation for both importing and nonimporting firms across these four quartiles in Figure 4. A similar trend is observed across firms of all sizes: It is the importing firms for which the share is rising significantly. There is no plausible reason to argue that the firms across the size distribution are reclassifying their workers from nonmanagers to managers as the trade liberalization kicks in in India. This encourages me to look for an effect of trade reform where I use both firm-level import ratios and industry-level tariffs.

[11] See, for example, Goldberg et al. (2010), Topalova and Khandelwal (2011), Ahsan (2013), Ahsan and Mitra (2014), and De Loecker et al. (2016).

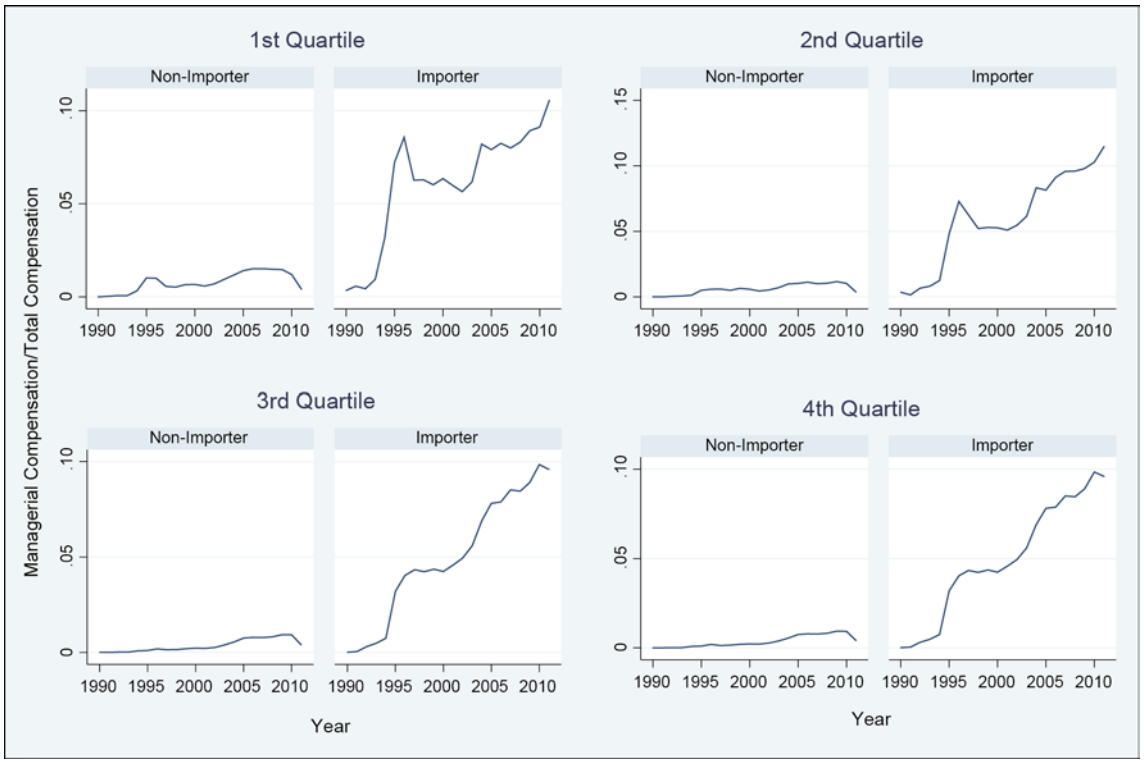
[12] One pattern described in Table 1 deserves further comment. As reported, the maximum figures of various GVA-normalized measures can reach relatively high values; this is a feature of the definition of GVA (see Appendix A), and occurs in cases of high purchases and low sales, such as in initial investments, for instance. All results are robust to omitting observations with GVA-normalized figures higher than one; nonetheless, we maintain the full sample in the main analyses for the purposes of exploiting its full extent.

Table 2: Correlation Matrix – Imports, Exports, and Managerial Compensation

	Total Imports	Import of Capital Goods	Import of Raw Materials	Import of Stores and Spares	Import of Finished Goods	Total Exports	MComp/ TComp
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total Imports	1.00						
Import of Capital Goods	0.14*	1.00					
Import of Raw Materials	0.70*	0.02*	1.00				
Import of Stores and Spares	0.12*	0.02*	0.16*	1.00			
Import of Finished Goods	0.71*	0.00	0.008*	0.00	1.00		
Total Exports	0.97*	0.009*	0.75*	0.11*	0.63*	1.00	
Managerial Compensation/ Total Compensation	0.01*	0.03*	0.01*	0.002	–0.002	0.001	1.00

Notes: Numbers denote correlation coefficients. * denotes significance at 5% level.

Figure 4: Managerial Compensation, Across Size Distribution, 1990–2011



Notes: The figure presents the average compensation share of managers for importing and nonimporting firms across size distribution, 1990–2011.

4. TRADE REFORM AND THE RELATIVE DEMAND FOR MANAGERS

4.1 Preliminary Analysis

I start by testing the general association between trade and demand for managers through a firm-level analysis, using the data described above. Specifically, I use direct firm-level measures of trade, via import and export penetration, to see which form of trade flow is associated with demand for managerial workers. I consider the following equation for firm i, at time t:

$$\left(\frac{Mcomp}{Tcomp}\right)_{ijt} = \delta_i + \beta_T \ln(Trade/GVA)_{ijt-1} + firmcontrols_{it-1} + \eta_t + \theta_t^j + \varepsilon_{it} \quad (1)$$

where $Mcomp$ is the managers' total compensation, $Tcomp$ is total labor compensation, $Trade$ is either total imports or exports, and GVA is the gross value added of a firm i at industry j in year t. $firmcontrols$ is a vector of firm-level characteristics. It includes firm age, age squared, R&D intensity [(R&D expenditure + Royalty payment for technical knowhow)/GVA]. δ_i and η_t are firm and time fixed effects. θ_t^j refers to interactions between industry and year fixed effects. It controls for other types of shocks (such as a change in labor policy or availability of more finance, etc.) at the industry level, which vary over time and may affect the compensation share of managers. I cluster standard errors at the firm level.

β_T is our coefficient of interest. It is the empirical association between normalized imports, or exports, and the relative demand for managers. In effect, the equation examines the determinants of the relative demand for managers, measured through the wage bill share of managers. Results appear in Table 3.

Starting with imports (Imp/GVA), column (1) presents the benchmark setting. As can be seen, the coefficient of interest is positive and significant. In addition, the magnitude is economically meaningful: A 1% increase in the GVA share of total imports increases the compensation share of managers by approximately 0.1%. In column (2), as I replace imports with exports (Exp/GVA), the effect vanishes. In other words, I do not find any effect of exports on the relative demand for managers. Column (3) uses both exports and imports. The significant effect of imports on the demand for managerial workers continues, with no effect from exports. Interestingly, this particular result depicts different dynamics than those presented in previous studies that emphasize the role of exports in developed economies (e.g., Caliendo and Rossi-Hansberg 2012), implying that the case of a developing economy may provide a new perspective on this.

Next, I exploit the classification of imports into several categories in columns (4) and (5). In column (4), I put together import of capital goods and raw materials to denote it as "import of inputs" ($ImpInput/GVA$), whereas I sum import of stores and spares and finished goods to classify it as "import of non-inputs" ($ImpNInput/GVA$). The estimates show that the aggregate effect of imports on managerial compensation is completely driven by import of inputs. Column (5) regresses managerial compensation on exports and all the separate components of imports: import of capital goods ($ImpCap/GVA$), import of raw materials ($ImpRaw/GVA$), import of stores and spares ($ImpStoSpa/GVA$), and import of finished goods ($ImpFin/GVA$). Estimates demonstrate that the import of capital goods and import of raw materials are significantly and positively correlated with the share of managerial compensation, with the effect being higher in the case of capital goods.

Table 3: Imports, Exports, and Relative Demand for Managers

	$MComp/TComp$				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
$(Imp/GVA)_{t-1}$	0.010*** (0.001)		0.010*** (0.001)		
$(Exp/GVA)_{t-1}$		0.002 (0.001)	0.0002 (0.001)	0.0003 (0.002)	0.001 (0.002)
$(ImpInput/GVA)_{t-1}$				0.008*** (0.001)	
$(ImpNInput/GVA)_{t-1}$				0.001 (0.003)	
$(ImpRaw/GVA)_{t-1}$					0.006*** (0.002)
$(ImpCap/GVA)_{t-1}$					0.010*** (0.003)
$(ImpStoSpa/GVA)_{t-1}$					0.002 (0.006)
$(ImpFin/GVA)_{t-1}$					0.001 (0.003)
$Firm\ Controls_{t-1}$	Yes	Yes	Yes	Yes	Yes
R-Square	0.16	0.16	0.17	0.19	0.42
N	73,045	73,045	73,045	73,045	73,045
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE (4-digit)*Year Trend	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1)–(5) use the share of managerial compensation in the total compensation ($MComp/TComp$) of a firm as the dependent variable. Total Compensation = Compensation to Nonmanagers + Compensation to Managers. Compensation to Managers is the sum of compensation of all the management levels. Compensation to Nonmanagers is the compensation to all other employees. "Imp/GVA" is the GVA share of total imports (Import of Raw Materials + Import of Capital Goods + Import of Stores and Spares + Import of Finished Goods) of a firm. "Exp/GVA" is the GVA share of total exports of a firm. "$ImpInput/GVA$" is the GVA share of imports of capital goods and raw materials of a firm. "$ImpNInput/GVA$" is the GVA share of imports of stores and spares and finished goods of a firm. "$ImpRaw,$" "$ImpCap,$" "$ImpStoSpa,$" and "$ImpFin$" are import of raw materials, capital goods, stores and spares, and finished goods. "GVA" is the Gross Value Added (GVA) of a firm. It is defined as Total Sales - Total Raw Material Expenditure. "$Firm\ Controls$" include age of a firm, age squared, "$\frac{TechAdop}{GVA}$," and size of a firm. "$TechAdop/GVA$" measures the level of technology adoption, defined as the sum of R&D expenditure and royalty payments for technical know-how normalized by GVA. I use "Assets" as the size indicator. All the dependent variables are in natural logarithm, measured in millions of rupees, deflated to 2005 using the industry-specific WPI. Numbers in parenthesis are robust clustered standard errors at the firm level. Intercepts are not reported. *, **, and *** denote 10%, 5%, and 1% level of significance, respectively.

To understand whether skill intensity can be termed one of the complementary channels for the increase in demand for managers, I interact the skill intensity ratio with the several import penetration ratios in Table 4. I define skill intensity as the ratio of nonproduction workers to total employees of an industry. This ratio is constructed at the three-digit level 2004 NIC. Columns (1) – (3) interact the skill intensity ratio with (Imp/GVA), ($ImpInput/GVA$) and ($ImpNInput/GVA$), and ($ImpCap/GVA$), ($ImpRaw/GVA$), ($ImpStoSpa/GVA$), and ($ImpFin/GVA$), respectively. The estimates do not show any evidence of the interaction effect of import ratios and skill intensity on the increase in the demand for managers.

Table 4: Imports, Exports, Relative Demand for Managers, and Skill Premium

	$MComp/TComp$		
	(1)	**(2)**	**(3)**
$(Imp/GVA)_{t-1} \times SkillInt_{t-1}$	0.003		
	(0.005)		
$(ImpInput/GVA)_{t-1} \times SkillInt_{t-1}$		–0.002	
		(0.007)	
$(ImpNInput/GVA)_{t-1} \times SkillInt_{t-1}$		–0.016	
		(0.021)	
$(ImpRaw/GVA)_{t-1} \times SkillInt_{t-1}$			0.006
			(0.013)
$(ImpCap/GVA)_{t-1} \times SkillInt_{t-1}$			0.013
			(0.029)
$(ImpStoSpa/GVA)_{t-1} \times SkillInt_{t-1}$			0.003
			(0.006)
$(ImpFin/GVA)_{t-1} \times SkillInt_{t-1}$			0.002
			(0.006)
$Firm\ Controls_{t-1}$	Yes	Yes	Yes
R-Square	0.61	0.61	0.61
N	73,045	73,045	73,045
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE (4-digit)*Year Trend	Yes	Yes	Yes

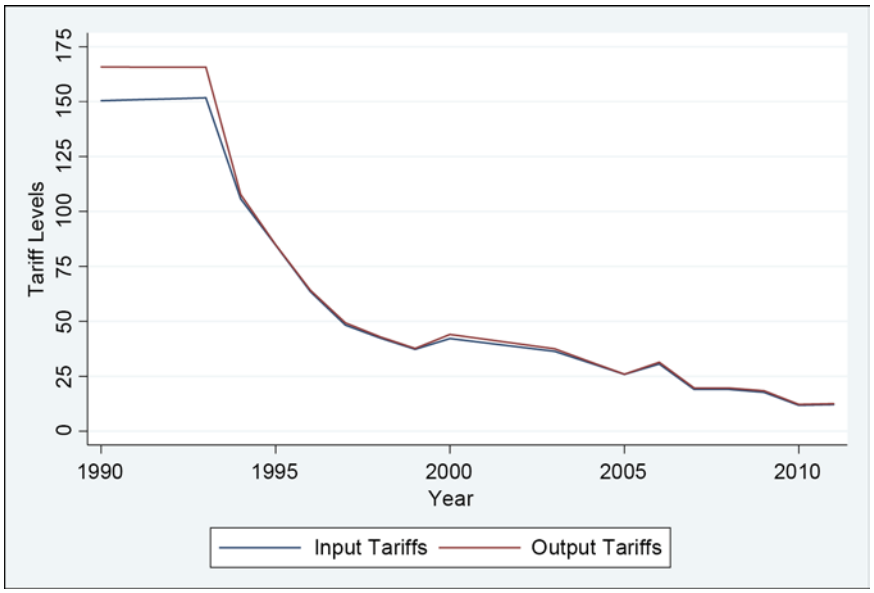
Notes: Columns (1)–(3) use the share of managerial compensation in the total compensation ($MComp/TComp$) of a firm as the dependent variable. Total Compensation = Compensation to Nonmanagers + Compensation to Managers. Compensation to Managers is the sum of compensation of all the management levels. Compensation to Nonmanagers is the compensation to all other employees. "Imp/GVA" is the GVA share of total imports (Import of Raw Materials + Import of Capital Goods + Import of Stores and Spares + Import of Finished Goods) of a firm. "$ImpInput/GVA$" is the GVA share of imports of capital goods and raw materials of a firm. "$ImpNInput/GVA$" is the GVA share of imports of stores and spares and finished goods of a firm. "$ImpRaw,$" "$ImpCap,$" "$ImpStoSpa,$"and "$ImpFin$" are import of raw materials, capital goods, stores and spares, and finished goods. "GVA" is the Gross Value Added (GVA) of a firm. It is defined as Total Sales - Total Raw Material Expenditure. "$SkillInt$" is the skill intensity of an industry. It is defined as the ratio of nonproduction workers to total employees of an industry at 3-digit 2004 NIC. "$Firm\ Controls$" include age of a firm, age squared, "$\frac{TechAdop}{GVA}$," and size of a firm. "$TechAdop/GVA$" measures the level of technology adoption, defined as the sum of R&D expenditure and royalty payments for technical know-how normalized by GVA. I use "Assets" as the size indicator. All the dependent variables are in natural logarithm, measured in millions of rupees, deflated to 2005 using the industry-specific WPI. Numbers in parenthesis are robust clustered standard errors at the firm level. Intercepts are not reported. *, **, and *** denote 10%, 5%, and 1% level of significance, respectively.

4.2 Causal Inference

4.2.1 India's Trade Reform

Prior to 1990, India was one of the most trade-restrictive economies in Asia, with high tariff and nontariff barriers. In 1991, following a balance-of-payments crisis, India turned to the IMF for assistance. The latter conditioned such assistance on the implementation of a major adjustment program. A major part of the adjustment program was to abandon the restrictive trade policies. As a result, average tariffs fell by more than half between 1990 and 1996 (Topalova and Khandelwal 2011). Nontariff barriers experienced a similar drop between the late 1980s and the mid-1990s (Goldberg et al. 2010). Figure 5 plots average tariff levels (both input and output) across manufacturing industries. Starting at around 150 in 1990, the average tariff level dropped to less than a tenth of that by 2011. These major tariff changes form the key policy measure I plan to exploit.

Figure 5: Tariff Reform in India, Manufacturing Industries, 1990–2011



Notes: The figure presents the average output and input tariffs across 2004 NIC 4-digit level, 1990–2011.

One major advantage with the tariff liberalization program is that it did not seem to have targeted industries within the manufacturing sector in a way that was related to pre-reform conditions (Goldberg et al. 2010). This establishes the plausibly exogenous nature of the reform. Next, there is much variation in the tariff changes across industries. The four-digit industry-level average annual decreases in tariffs range from as low as 2% to as high as 25%, with a mean of 6% and a standard deviation of approximately 2.5% (Chakraborty and Raveh 2018).

The tariff data are derived from the TRAINS-WITS tariff database, at the HS six-digit level. These output tariffs are passed through India's input-output (I-O) matrix for 1993–1994 to construct input tariffs. Next, both the input and output tariffs are then concorded to the four-digit 2004 NIC level using the Debroy and Santhanam (1993) concordance table. The tariffs are then matched with the firm-level data.

4.2.2 Empirical Strategy and Results

I estimate the following reduced-form equation to understand the effect of changes in tariffs on the relative demand for managers:

$$\left(\frac{Mcomp}{Tcomp}\right)_{ijt} = \delta_i + \beta_T \ln(Tariff)_{jt-1} + firmcontrols_{it-1} + \eta_t + \theta_t^j + \varepsilon_{jt} \qquad (2)$$

where, $\ln(Tariff)_{jt-1}$ is the natural logarithm of tariff levels corresponding to industry j at period $t-1$. I use both output and input tariffs. The remaining notation follows that described previously, except for θ_t^j. In this case, θ_t^j denotes interactions of industry fixed effects and year trends instead of industry-year fixed effects. Since the tariff data vary by industry-time, using industry-year fixed effects will absorb all the variations. I follow Moulton (1990) to cluster standard errors at the industry level.

I start by using both input and output tariffs; results are reported in Table 5. Column (1) regresses the share of managerial compensation on lagged output tariffs, a number of firm controls (firm age, age squared, R&D intensity, and assets of a firm), firm fixed effects, year fixed effects, and interactions of industry fixed effects and year trends. The estimate shows that a drop in output tariffs or increase in product market competition significantly increases the share of managerial compensation. I additionally use lagged value of dependent variable in column (2); output tariffs continue to significantly affect managerial compensation. In column (3), I use both input and output tariffs. Including both input and output tariffs concurrently, the results show that: (a) the effect of output tariffs drops to zero; and (b) a drop in tariffs on intermediate inputs now explains the rise in managerial compensation. Column (4) adds the lagged value of the share of managerial compensation. The previous finding continues: no effect of output tariffs and drop in tariffs on intermediate inputs explain the demand for managers.

Table 5: Output Tariffs, Input Tariffs, and Relative Demand for Managers

	$MComp/TComp$			
	(1)	**(2)**	**(3)**	**(4)**
$OutTariffs_{t-1}$	–0.006**	–0.005**	–0.00002	–0.00006
	(0.003)	(0.002)	(0.003)	(0.003)
$InpTariffs_{t-1}$			–0.010**	–0.008**
			(0.005)	(0.004)
$(MComp/TComp)_{t-1}$		0.260***		0.263***
		(0.020)		(0.021)
$Firm\ Controls_{t-1}$	Yes	Yes	Yes	Yes
R-Square	0.15	0.18	0.14	0.18
N	70,369	70,369	70,369	70,369
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE (4-digit)* Year Trend	Yes	Yes	Yes	Yes

Notes: Columns (1)–(4) use the share of managerial compensation in the total compensation ($MComp/TComp$) of a firm as the dependent variable. "$InpTariffs/OutTariffs$" is input (output) tariffs at the 4-digit NIC 2004 level. "$Firm\ Controls$" include age of a firm, age squared, "$\frac{TechAdop}{GVA}$," and size of a firm. "$TechAdop/GVA$" measures the level of technology adoption, defined as the sum of R&D expenditure and royalty payments for technical know-how normalized by GVA. I use "Assets" as the size indicator. All the dependent variables are in natural logarithm, measured in millions of rupees, deflated to 2005 using the industry-specific WPI. Numbers in parenthesis are robust clustered standard errors at the firm level. Intercepts are not reported. *, **, and *** denote 10%, 5%, and 1% level of significance, respectively.

This result (when using the input and output tariffs concurrently) also provides some insights into the potential underlying mechanism. While a decrease in output tariffs may stiffen product market (import) competition (Amiti and Konings 2007), a decrease in input tariffs increases the technological complexity of the production process. The latter is a feature of the higher quality and variety of imported inputs (Acemoglu and Zilibotti 2001; Eaton and Kortum 1996; Goldberg et al. 2010). The dominating effect of input tariffs suggests that the observed increase in the relative demand of managers is triggered by changes in the production technologies rather than by a stronger competition in the final goods market. I continue my following analysis focusing on input tariffs.

Benchmark results: The benchmark results are presented in Table 6. In this table, I look at both intensive (price of managers or compensation of managers) and extensive (number of managers) margins of managerial demand in a firm. I start with the former. Columns (1)–(4) show that a 10% drop in input tariffs increases the relative managerial compensation of a firm by 0.8%–2.3%. In other words, the higher the usage of imported foreign inputs, the higher the demand for managers. Column (2) presents a dynamic version of Equation (2), providing a similar result.

Table 6: Input Tariffs, Relative Demand for Managers, and Skill Premium: Benchmark Results

	$MComp/TComp$					No. of Managers	MComp/ GVA	Non-MComp/ GVA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$InpTariffs_{t-1}$	–0.015*** (0.003)	–0.023** (0.010)	–0.007 (0.005)	–0.0002 (0.003)	–0.014*** (0.005)	–0.312*** (0.104)	–0.010*** (0.002)	–0.004 (0.004)
$(MComp/TComp)_{t-1}$		0.657*** (0.031)						
$InpTariffs_{t-1} \times Importer$			–0.008*** (0.003)					
$InpTariffs_{t-1} \times Importer\ Input$				–0.013*** (0.001)				
$Importer\ Input$				0.067*** (0.006)				
$InpTariffs_{t-1} \times SkillInt_{t-1}$					–0.005+ (0.003)			
$SkillInt_{t-1}$					0.013 (0.013)			
$Firm\ Controls_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.12	n/a	0.12	0.62	0.61	0.58	0.31	0.43
N	70,369	70,369	70,369	70,369	70,369	27,975	70,369	70,369
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE (4-digit)* Year Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1)–(5) use share of managerial compensation ($MComp/TComp$) as the dependent variable. Columns (6), (7), and (8) use number of managers, GVA share of managerial compensation, and GVA share of nonmanagerial compensation as the dependent variables, respectively. "$InpTariffs$" is input tariffs at the 4-digit NIC 2004 level. "$Importer$" is a dummy variable that takes a value of 1 if a firm imports (either import of raw materials, capital goods, stores and spares, or finished goods). "$ImporterInput$" is a dummy variable if a firm imports either capital goods or raw materials. "$SkillInt$" is the skill intensity of an industry. It is defined as the ratio of nonproduction workers to total employees of an industry at 3-digit 2004 NIC. "$Firm\ Controls$" include age of a firm, age squared, "$\frac{TechAdop}{GVA}$," and size of a firm. "$TechAdop/GVA$" measures the level of technology adoption, defined as the sum of R&D expenditure and royalty payments for technical know-how normalized by GVA. I use "Assets" as the size indicator. All the dependent variables are in natural logarithm, measured in millions of rupees, deflated to 2005 using the industry-specific WPI. Numbers in parenthesis are robust clustered standard errors at the firm level. Intercepts are not reported. +, *, **, and *** denote 12%, 10%, 5%, and 1% level of significance, respectively.

Column (3) introduces an interaction term of input tariffs and an importer dummy (it takes a value of 1 for a firm that is importing). The estimates show that the entire effect is concentrated for firms that are importing. In column (4), to understand the source of the previous effect according to the type of importing firm, I create an additional dummy where it takes a value of 1 if an individual firm is importing production units (capital goods and raw materials) and interacts with input tariffs. Likewise, in column (3), the results demonstrate that the magnitude of the effect increases by more than 1.5 times and the interaction term is significant at the 1% level. This gives additional

support to the results shown in Table 3. Firms importing more intermediate inputs as a result of a drop in input tariffs (due to trade reform) require more managers to manage those inputs in order to utilize them in their production processes.

Column (5) introduces our key variable: skill intensity.[13] As before, I measure skill intensity through the three-digit industry-level ratio of nonproduction workers to all employees, with the standard skill intensity measure being used in the literature.[14] This measure is obtained from Ghosh (2014) (1990–2000) and the Indian Annual Survey of Industries (2001–2011). Previous studies indicate that globalization increases the demand for skill in developing economies (Goldberg and Pavcnik 2007). This, in turn, may affect the demand for managers. The main coefficient of interest, β_T, remains stable. Unlike the interaction terms between import ratios and skill intensity, the interacted effect of input tariffs and skill intensity explains the increase in demand for managers, but only at the 12% level of significance. In other words, $InpTariffs \times SkillInt$ indicates that there is an apparent differential effect across industries' benchmark skill intensity levels: The higher the drop in input tariffs, the higher the increase in the demand for skills, and thus the rise in managerial compensation. In other words, the demand for managers tends to rise in those sectors where there is a complementary effect of a drop in input tariffs and a higher ratio of skill intensity. This particular finding gives some possible indication of skill premium through the import of high-quality intermediate goods by firms, which we investigate in column (8). On the other hand, the skill intensity variable is positively correlated with the demand for managers, but not significantly.

Column (6) uses the number of managers as the dependent variable. A drop in input tariffs also significantly affects the extensive margin of managers. I use the GVA share of managerial compensation in column (7). The benchmark result continues to be the same: A drop in tariffs increases the price of managers.

Lastly, column (8) exploits compensation of the other category of workers, i.e., nonmanagers, as the dependent variable. The reason to look at the other category (of workers) is to understand whether there is an opposite or differential effect of trade reform across different categories of workers. This is crucial in order to understand whether there is any evidence of skill premium in India. The point estimate shows that trade reform (or drop in input tariffs) has no effect on the demand for nonmanagers. In other words, the effect of tariff liberalization on nonmanagerial compensation is indistinguishable from zero. Based on these results, it is difficult to conclusively claim that the demand for managers (as a result of trade reform) led to an increase in skill premium in India (although we find some evidence of skill intensity being one of the complementary channels).

[13] At first glance, it may suggest that skill and managers might be correlated through the standard definition of skill in the literature, which considers nonproduction workers or otherwise those in white-collar occupations. Note, however, that this definition, while also covering managers, includes various additional occupations that do not necessarily hold managerial positions. For instance, in the cases of Berman, Bound and Griliches (1994) and Zhu and Trefler (2005), skilled workers are defined as holding the following positions within the manufacturing sector: manager, professional, technician, and clerical worker; indeed managers represent a subset of that, though the other professions can fall under the nonmanagers classification.

[14] Proxying skill intensity by "nonproduction" is nontrivial, though this is common practice by necessity, given data limitations. Indeed, this measure is adopted by various studies on trade liberalization and skill in developing countries (e.g., Raveh and Reshef 2016; Zhu and Trefler 2005). In addition, Berman et al. (1994) show that the production/nonproduction worker classification is a good proxy for skilled and unskilled workers.

Additional channels: Having identified the main effect, I now consider other possible complementary channels that may affect the demand for managers in Table 7. In each case, I focus on two points: first, the role of the additional control as an intermediate channel, by examining its direct effect, and second, via its effect through the main variable of interest (input tariffs).

Table 7: Input Tariffs, Relative Demand for Managers, and Skill Premium: Additional Channels

	$MComp/TComp$				
	Capital Employed	**Total Factor Productivity**	**Factories**	**Management Technology**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
$InpTariffs_{t-1}$	–0.003* (0.002)	–0.00004 (0.004)	–0.009* (0.005)	–0.013*** (0.004)	–0.035*** (0.010)
$InpTariffs_{t-1} \times CapEmp_{t-1}$	0.001 (0.001)				0.005** (0.002)
$InpTariffs_{t-1} \times TFP_{t-1}$		–0.002 (0.003)			0.014*** (0.004)
$InpTariffs_{t-1} \times Factories_{t-1}$			–0.001** (0.000)		–0.002** (0.001)
$InpTariffs_{t-1} \times MT_{t-1}$				0.004 (0.004)	–0.029 (0.019)
$CapEmp_{t-1}$	0.003 (0.004)				0.007 (0.008)
TFP_{t-1}		0.016* (0.009)			0.042*** (0.016)
$Factories_{t-1}$			0.014*** (0.005)		0.019*** (0.006)
$Firm\ Controls_{t-1}$	Yes	Yes	Yes	Yes	Yes
R-Square	0.58	0.63	0.12	0.12	0.08
N	69,704	46,286	70,369	68,856	45,337
Firm FE	Yes	Yes	No	No	No
Industry FE	No	No	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE (4-digit)*Year Trend	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1)–(7) use share of managerial compensation ($MComp/TComp$) as the dependent variable. "$InpTariffs$" is input tariffs at the 4-digit NIC 2004 level. "$CapEmp$" is the amount of capital employed by a firm. "TFP" is total factor productivity at firm level estimated using Levinshon and Petrin (2003). "$Factories$" is the number of factories at 3-digit level of NIC 2004. "MT" is an index of Management Quality at 2004 NIC 2-digit level and has been sourced from Bloom and Van Reenen (2010). "$Firm\ Controls$" include age of a firm, age squared, "$\frac{TechAdop}{GVA}$," and size of a firm. "$TechAdop/GVA$" measures the level of technology adoption, defined as the sum of R&D expenditure and royalty payments for technical know-how normalized by GVA. I use "Assets" as the size indicator. All the dependent variables are in natural logarithm, measured in millions of rupees, deflated to 2005 using the industry-specific WPI. Numbers in parenthesis are robust clustered standard errors at the firm level. Intercepts are not reported. *, **, and *** denote 10%, 5%, and 1% level of significance, respectively.

I start with the potential connection between managers and capital employed. The key variable, intermediate inputs, is a flow measure of incoming equipment. The stock value of capital, which includes non-equipment stock as well, may also affect the demand for managers. For instance, capital-intensive production processes may involve automation and hence less problem solving and less demand for managers than labor-intensive production technologies. To test the role of capital intensity, I add firms' GVA share of capital employed in column (1). Its direct effect is indistinguishable from zero, providing

no evidence that the stock of capital is correlated with the compensation share of managers. Importantly, β_T does not change relative to the benchmark case, indicating that the effect of the incoming flow of equipment on the relative demand for managers holds regardless of whether the firm is relatively capital intensive. Notably, the interaction of this measure with input tariffs does not point to any kind of systematic differential effects across capital intensity levels.

Next, I test for the effect of productivity. Previous research shows that trade liberalization increases firm productivity (e.g., Topalova and Khandelwal 2011). Higher productivity may increase the demand for managers due, for instance, to its potential effects on organizational design (Garicano 2000). To test whether it also acts as a complementary channel, I add a measure of productivity in column (2). I adopt the Levinsohn and Petrin (2003) methodology to construct firm-level TFP.[15] The estimated coefficients indicate that the interaction effect of input tariffs and productivity is also not associated with the relative demand for managers.

Third, despite controlling for firm assets, I follow Acemoglu et al. (2007) and Bloom et al. (2010) to dig deeper into the potentially important effect of size on the demand for managers, by testing an additional related measure: the number of factories and plants at the three-digit industry level. I add this measure in column (3); the estimated β_T indicates that the main result is robust to this addition. The estimate also shows that a drop in input tariffs induced the establishment of more factories, which consequently led to an increase in managerial compensation, as local knowledge is important.

Lastly, an additional potential determinant relates to management technology. In a recent study, Chen (2017) makes a connection between trade liberalization and management technology. If better management technology requires a higher volume and quality of managers, it may represent a viable channel. To potentially test for this, I proxy management technology through the cross-country-industry management survey carried out by Bloom and Van Reenen (2010). Surveying a large number of firms in various manufacturing industries in India (among other countries) throughout 2004, Bloom and Van Reenen (2010) construct a measure for management quality in different sectors. This index is a number between 1 and 5, with 5 representing the best quality. Estimates in column (4) indicate that input-trade liberalization does not have any systematically different effect on the relative demand for managers across industries' level of management technology.

In column (5), I include all the additional controls and their interactions with the input tariffs. This is a relatively demanding specification in terms of potential multicollinearity. However, the primary coefficient of interest remains negative and significant, similarly to the benchmark estimates.

Firm characteristics: I now take a step further and look into several other firm- and industry-level characteristics to investigate which type(s) of firm or industry characteristic(s) is(are) driving the main result. An additional purpose is to check whether there is any kind of stronger evidence of skill intensity as a complementary channel for any subsample of firms that got masked in the aggregate results. The results are presented in Table 8.

[15] The method controls for the potential simultaneity in the production function by using firms' raw material inputs as a proxy for the unobservable productivity shocks.

Table 8: Input Tariffs, Relative Demand for Managers, and Skill Premium: Firm Characteristics

	$MComp/TComp$						
		Export Orientation		End Use		Ownership	
	Size	Exporters	Non-exporters	Final Goods	Intermediate Goods	Domestic	Foreign
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$InpTariffs_{t-1}$		–0.021** (0.008)	–0.009+ (0.006)	–0.007 (0.006)	–0.017** (0.007)	–0.022*** (0.007)	–0.018 (0.019)
$InpTariffs_{t-1} \times SkillInt_{t-1}$		–0.012** (0.005)	–0.007* (0.004)	–0.004 (0.004)	–0.008+ (0.005)	–0.013*** (0.004)	–0.010 (0.013)
$InpTariffs_{t-1} \times Qr_1 \times SkillInt_{t-1}$	–0.020*** (0.007)						
$InpTariffs_{t-1} \times Qr_2 \times SkillInt_{t-1}$	–0.015** (0.007)						
$InpTariffs_{t-1} \times Qr_3 \times SkillInt_{t-1}$	–0.018*** (0.006)						
$InpTariffs_{t-1} \times Qr_4 \times SkillInt_{t-1}$	–0.007 (0.006)						
$InpTariffs_{t-1} \times Qr_1$	–0.054*** (0.010)						
$InpTariffs_{t-1} \times Qr_2$	–0.052*** (0.009)						
$InpTariffs_{t-1} \times Qr_3$	–0.054*** (0.010)						
$InpTariffs_{t-1} \times Qr_4$	–0.039*** (0.009)						
$Firm\ Controls_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.17	0.20	0.08	0.10	0.12	0.12	0.22
N	70,369	37,325	33,044	31,815	38,554	65,777	4,592
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE (4-digit)* Year Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1)–(7) use share of managerial compensation ($MComp/TComp$) as the dependent variable. "$InpTariffs$" is input tariffs at the 4-digit NIC 2004 level. "$SkillInt$" is the skill intensity of an industry. It is defined as the ratio of nonproduction workers to total employees of an industry at 3-digit 2004 NIC. Quartiles (Qr_i) are defined according to the total assets of a firm. A firm belongs to the 1st quartile (Qr_1) if the assets of that firm are below the 25th percentile of the total assets of that industry to which the firm belongs and so on. "$Firm\ Controls$" include age of a firm, age squared, "$\frac{TechAdop}{GVA}$," and size of a firm. "$TechAdop/GVA$" measures the level of technology adoption, defined as the sum of R&D expenditure and royalty payments for technical know-how normalized by GVA. I use "Assets" as the size indicator. All the dependent variables are in natural logarithm, measured in millions of rupees, deflated to 2005 using the industry-specific WPI. Numbers in parenthesis are robust clustered standard errors at the firm level. Intercepts are not reported. +, *, **, and *** denote 12%, 10%, 5%, and 1% level of significance, respectively.

I start by investigating the role of the size of a firm in column (1). More specifically, is the increase in the relative demand for managers concentrated in one section of firms or does it differ across the size distribution? I divide the firms according to their size. I use the total assets of a firm as the size indicator. I use the following method: If the total asset of a firm is below the 25th percentile of the total assets of that industry, that firm belongs to the 1st quartile. Likewise, if a firm's total asset falls between the 25th and 50th, 50th, and 75th, or is greater than the 75th percentile, it falls into the category of the 2nd, 3rd, or 4th quartile, respectively. Since firms could move across quartiles over time. I use the average rank of the firms for the period of analysis. In order to find out the required effect, I interact the input tariffs with the respective quartiles.

The estimates reveal some interesting facts: All firms, except the big ones, show significant evidence of skill intensity as an additional channel due to a drop in input tariffs, with the effect being highest for the smallest firms. This is intuitive: As firms import more high-quality intermediate goods, due to trade reform, they require more managers and, as a result, skill intensity acts as an additional channel through which demand for managers or managerial compensation rises. This is highest in the case of small firms, as they did not have any exposure before using these high-quality foreign intermediate inputs. On the other hand, the interaction terms of input tariffs and quartile dummies are significant across the size distribution, suggesting that skill intensity is not a channel (through which there is a rise in the demand for managers) for the big firms or the firms belonging to the 4th quartile.

Columns (2) and (3) divide the sample into exporters and non-exporters in order to understand whether there is any kind of premium attached to an exporting firm. As the results demonstrate, the effect of a drop in input tariffs on the demand for managers is observed for both exporters and non-exporters. However, the effect is stronger in the case of the exporting firms. Also, the evidence of skill intensity as a channel for the rise in demand for managers is stronger and greater for exporting firms than for non-exporters. The results point out to an interesting outcome. The rise in the demand for managers or for a set of skilled workers is not only restricted to the group of exporters, but rather it spans across the entire set of manufacturing firms. This is unlike the other cases, where the change in skill premium because of trade reform concentrates only on the exporters. In the case of India, the results suggest that the entire sector of manufacturing firms has undergone a change in their technological production processes.

Next, I categorize firms according to their end use – final and intermediate goods. The former comprises of consumer nondurable and consumer durable goods, whereas the latter includes intermediate, basic, and capital goods. I follow Nouroz (2001) and match the firm-level data set with the Input-Output (I-O) classification. Columns (4)–(5) present the required result. The point estimates show us that the effect of the trade liberalization on the demand for managers is significant only in the case of the intermediate goods sector. Similarly, for the evidence of skill intensity.

Lastly, I investigate the ownership structure of an Indian manufacturing firm. I divide the sample of firms into two different groups – domestic (which includes both private and public firms) and foreign. The coefficients of interest in columns (6) and (7) tell us that the main result is entirely driven by the change in the managerial compensation ratio in the domestic firms, more so for the privately owned ones. While it is not entirely unexpected that privately owned firms have undergone a change in their production processes due to the adoption of high-quality foreign inputs, it is nevertheless surprising to see that only the domestic firms are the main drivers of change in the overall change in the demand for managers observed and not the multinationals.

4.3 Discussion of Results and Policy Relevance

Let us first summarize the main results of the empirical analysis and provide further interpretations. The key finding is that a drop in input tariffs, or increased use of imported intermediate inputs, increases the compensation (intensive) and number (extensive) of managers, with no effect on nonmanagerial workers. The effect is acute: (i) across firm-size distribution; (ii) whether a firm is an exporter or not; (iii) in firms producing intermediate goods; and (iv) in privately owned domestic firms. In addition, the results show some evidence of skill intensity as an additional channel, but only in the case of firms below the halfway point of the size distribution.

Two key questions arise: (a) how may these findings be important for understanding the distributional effect, in terms of compensation of these two different kinds of workers (managers and nonmanagers), of trade policies? In particular, is the increase in wage gap between these two categories of workers solely due to an increase in the adoption of skill-biased technological inputs (due to a fall in input tariffs) or is there a fall in the supply of skilled labor, which accentuated the wage premium?; and (b) what is the role of the government in responding to changes in the demand for more skilled workers through the supply of managerial skills and other types of skills? In order to attempt to address these questions, I draw on previous related research on India, and consider a possible conceptual framework that can fit my findings into this broader picture.

I start by addressing the former. Input (output) tariffs relate to imported inputs (final goods). Goldberg et al. (2013) point out that because of the drop in input tariffs, due to the trade liberalization episode in India, imports of intermediate inputs saw the highest increase, of almost 300%; and the vast majority of the inputs are imported from the OECD countries. Table 9 lists India's top 10 destinations in India's percentage of imported capital. It shows that India imports around 82% of their capital goods from OECD destinations. Eaton and Kortum (2001) argue that the capital goods produced in the OECD countries are of high quality and R&D intensive. Thus, an increased use of imported inputs by a firm upgrades the technological intensiveness of the production technology it uses and therefore requires managers to cope with the new knowledge, thereby increasing their relative demand. Realizing the main effect is completely driven by the input side and hence implies that a quality upgrading channel is at work, operating via input-tariff liberalization.[16]

Table 9: Import of Capital Goods: Top 10 Destinations

	Trading	Imported Capital
Rank	**(1)**	**(2)**
1	US	20.14
2	Japan	16.80
3	Germany	16.73
4	UK	6.60
5	Singapore	4.98
6	France	4.96
7	Italy	4.63
8	Switzerland	3.10
9	Rep. of Korea	2.18
10	Taipei,China	1.91
	All Other	17.98
	Total	100

Notes: Numbers in the table represent the share of capital goods imported by India from different destinations.

Source: Kandilov, Leblebicioglu, and Manghnani (2016).

[16] To the extent that a higher demand for managers is associated with better management practices, these patterns are consistent with those documented by Bloom et al. (2016). They find that better-managed firms in the PRC and the US use more imported inputs, and specifically more expensive and higher-quality inputs.

Previous studies on both developing and developed economies pointed to an export-based quality-upgrading channel (Caliendo and Rossi-Hansberg 2012) or product market competition (e.g., Cunat and Guadalupe 2009; Bloom et al. 2010). Verhoogen (2004) finds strong support for this hypothesis in the case of Mexico. Greater exports as a result of the peso crisis resulted in better-quality products being produced by the exporters. Since higher-quality products require a higher proportion of skilled workers, the relative demand for, and returns to, skilled labor increased. This article shows how a developing economy can present different dynamics regarding this.

Several hypotheses other than the "quality-upgrading" channel can be put forward to explain this rise in demand for managers and skill intensity. Second, relates to economic reforms in general and not specifically to trade reform in driving the returns to skilled labor. According to this hypothesis, developing countries may experience higher returns to skilled-labor-intensive occupations – such as professional, managerial jobs – as a result of reforms that generate demand for individuals who can implement these reforms. The above results suggest that in India, external sector reforms may have created more white-collar jobs. Empirical evidence is mixed: Cragg and Epelbaum (1996) find support for this hypothesis for pre-NAFTA Mexico while Attanasio et al. (2004) find no changes in the occupational returns between 1986 and 1998 in Colombia.

Third, outsourcing or global production sharing has also been identified as one of the reasons to explain the rise in skill intensity or premium and demand for skilled labor in developing economies. Feenstra and Hanson (1996, 2003) argue that trade liberalization by the developing countries allows their counterparts (developed countries) to transfer the production of intermediate goods and services. These activities are skill intensive, which results in a greater demand for, and returns to, skilled labor. Therefore, the import of intermediate goods can benefit skilled workers in a developing economy, more so for firms that had the least exposure before the reform. Feenstra and Hanson (1997) find empirical support for this hypothesis for the case of Mexico.

The final one relates to SBTC. Wood (1995) argues that greater competition from foreign firms may induce domestic firms in a developing economy to either engage in R&D or to adopt new and advanced technologies in order to secure their market share in the domestic and international markets. Because of technology-skill complementarities, adoption of modern technologies raises the demand for, and returns to, skilled labor. He called this "defensive innovation." Harrison and Hanson (1999) and Attanasio et al. (2004) found empirical support for this hypothesis for Mexico and Colombia, respectively. In the case of Ghana, Gorg, and Strobl (2002) come to a similar conclusion (to mine): an increase in the relative wages of skilled labor (in my case, managers) brought about by skill-biased technological change induced through imports of technology-intensive capital goods. However, Pavcnik (2003) rejects the SBTC hypothesis for Chilean plants.

My analysis of managerial compensation of Indian manufacturing firms documents large demand shifts toward managerial workers but does not find significant evidence of a shift away from nonmanagerial workers. I find that skill intensity played an important role in widening the wage gap between managerial and nonmanagerial workers between 1990 and 1991, and between 2010 and 2011, in India, but for small and medium-sized firms. These demand shifts were for both exporters and non-exporters, and firms producing intermediate goods. The results also suggest that demand for managerial workers was primarily within industries during this period in India. This finding provides strong evidence for all the hypotheses discussed above – skill intensity as a result of external sector reforms played a major role in the creation of managerial jobs, thereby generating demand for skilled/managerial labor.

I now focus on the second question concerning the demand and supply factors influencing the role of skill intensity. Some of the existing literature (Dutta 2005; Kijima 2006; Chamarbagwala 2006) in India observes that the increase in wage inequality during the period 1983–1999 was mainly attributable to an increase in the returns to skills (as captured by educational attainment). However, Azam (2010) argues that the driving forces that led to the increase in wage premium for high-skilled workers (tertiary graduate workers) have not been fully explored. It is imperative to understand the determinants of the wage premium, as for policy makers it is important to know whether the increase in wage premium is driven by demand or supply since the policy responses differ for these two scenarios. In addition, changes in wage premium have important implications for the evolution of wage inequality, and hence overall income inequality.

In order to understand whether the supply or demand factor played a role, I first look at the change in employment shares of different types of workers between 1987 and 2004. Table 10 divides workers according to educational status. The table uses data from four schedules (1987–1988, 1993–1994, 1999–2000, and 2004–2005) of the Employment and Unemployment Schedule administered by the NSSO Govt. of India. It shows that the employment share of workers with a graduate degree went up from 22% to 30% between 1987 and 2004. Though the supply of workers with a graduate degree and above increased between 1987 and 1999, it ceased to grow between 1999 and 2004. For the workers with primary and below primary education, the employment shares fell from 14% to 10% and 21% to 15%, respectively, between 1987 and 2004. However, it increased a little between 1999 and 2004. The employment share of secondary graduates also declined between 1999 and 2004.

Table 10: Employment Share: By Educational Status

	1987	1993	1999	2004
	(1)	(2)	(3)	(4)
Below Primary	21.35	17.96	14.63	14.57
Primary	13.61	9.99	8.40	9.70
Middle	13.87	14.47	14.46	14.52
Secondary	29.47	31.14	32.72	31.50
Graduate and Above	21.71	26.45	23.79	29.71

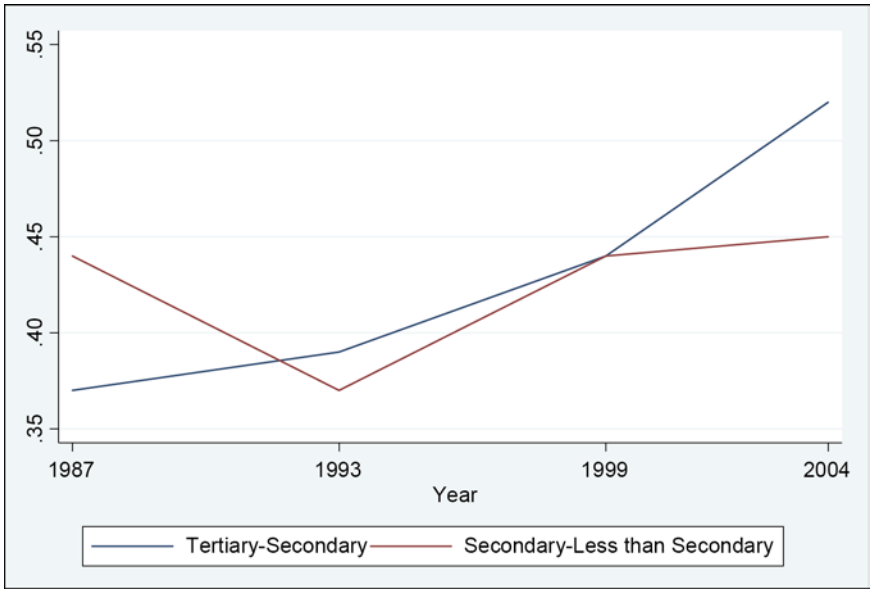
Notes: Numbers in the table indicate the share of regular employed male workers in urban India in 23–57 age group.

Source: Azam (2010).

Next, I look at the wage premiums. Figure 6 plots the wage premiums for graduate and secondary urban male workers. The figure shows two important things: (a) the wage premium for graduate workers (calculated as the difference in mean log hourly wages between regular male workers with a tertiary or graduate degree and those with a secondary degree) increased from 0.37 to 0.52, whereas for secondary workers (wage premium calculated with respect to workers with below a secondary degree), it almost remained the same; and (b) most of the increase in wage premium occurred in the 1990s, while it was relatively stable in the 1980s. Table 11 breaks down the wage premium estimates for all these years by different age categories. For the 23–27 age group, the wage premium increased between 1987 and 1993, declined between 1993 and 1999, and then increased sharply between 1999 and 2004. The wage premium for the 28–32 age group increased continuously during the period 1987–2004. However, the wage premium for older age groups, 48–52 and 53–57, remained about the same between

1987 and 2004. This shows that the overall increase in wage premium of tertiary graduate workers between 1987 and 2004 was mostly driven by younger age groups. Figure 7 plots the wage gap between tertiary and secondary degree workers for the age groups 23–32 (younger group) and 48–57 (older group). It also shows similar trends.

Figure 6: Wage Premium, Tertiary and Secondary Degree Workers, 1987–2004



Notes: The figure presents the wage premium for workers with a graduate degree and below a graduate degree, 1987–2004.

Source: Azam (2010).

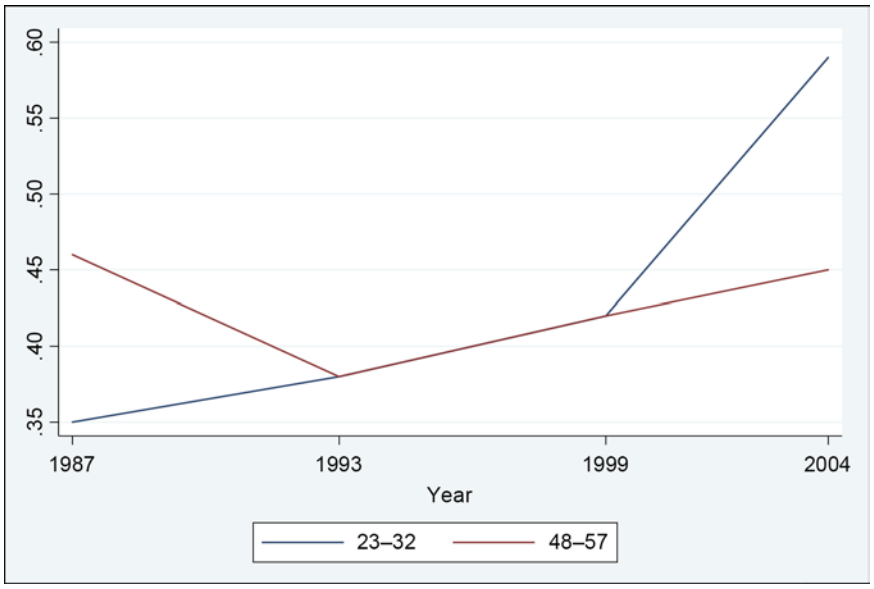
Table 11: Tertiary-Secondary Wage Premium: By Age Group

Age Group	23–27	28–32	33–37	38–42	43–47	48–52	53–57
Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1987	0.36	0.35	0.35	0.32	0.42	0.41	0.53
	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.06)
1993	0.41	0.37	0.40	0.37	0.39	0.43	0.33
	(0.05)	(0.05)	(0.04)	(0.05)	(0.05)	(0.06)	(0.08)
1999	0.33	0.48	0.45	0.46	0.51	0.44	0.36
	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.10)
2004	0.63	0.55	0.42	0.59	0.52	0.45	0.45
	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)	(0.06)

Notes: The table entries are wage differential in mean log hourly wages between a tertiary graduate worker and secondary graduate worker. Numbers in parenthesis are robust standard errors.

Source: Azam (2010).

Figure 7: Wage Premium, Different Age Groups, Tertiary and Secondary Degree Workers, 1987–2004



Notes: The figure presents the wage premium for workers with a graduate degree and below a graduate degree for different age groups, 1987–2004.

Source: Azam (2010).

Putting all these together, it can be argued that as the relative supply of tertiary workers (or workers with a graduate degree or above) slowed down during the 1990s and 2000s, coupled with the increase in demand for them as the firms started to use more technologically intensive inputs due to a drop in tariffs, it led to a rise in wage premium. Further, this wage premium is particularly high for workers belonging to the 23–32 age group.

5. CONCLUSION

This article investigates the effect of India's trade liberalization episode in the form of a drop in tariffs on the demand for managerial workers for the period 1990–2011. Additionally, it checks whether the demand for managers can be explained through a widely researched phenomenon, an increase in skill intensity. The study uses detailed data on compensation for Indian manufacturing firms and shows that a drop in input tariffs, and not output, significantly increases the demand for managers. A 10% drop in input tariffs increases the share of managerial compensation by 0.5%–3.5%. The trade-induced demand shifts toward managerial workers find some support for quality upgrading, sharing of production activities, or the skill-biased technical change hypothesis, even though it is not possible to decompose the demand increase for managerial workers into its exact source.

The results also show that one possible channel for an increase in the compensation share of managers for firms below the halfway point of the size distribution may be through an increase in skill intensity. On the other hand, the estimates do not show any kind of demand shift away from nonmanagerial workers. Therefore, it cannot be conclusively argued that trade reforms may have resulted in skill premium. Further analysis shows us that it is the shortage in the supply of skilled workers during the late 1990s and 2000s, coupled with the increase in demand for these workers, which led to

an increase in wage premium for these workers. And this wage premium was highest for the workers belonging to the 23–32 age cohort. This suggests that the demand for skill in the Indian economy was not solely due to an increase in the use of intermediate inputs, but also to changes within the economy that were not related to trade. Dutta (2005) decomposes the wage regression functions to highlight that the industry affiliation of workers can also explain about a quarter of the wage inequality.

In India, low mobility between industries and a lack of transferable skills prevent workers from moving out of industries with declining relative wages in response to trade reform. All the results put together and this characteristic of the labor market in India suggest the current need to increase labor market flexibility through labor market and other institutional reforms. However, these reforms would also need to be supplemented by adequate provisions for social protection. Safety net programs for workers affected by trade reforms are necessary to minimize the short-run adjustment costs faced by workers from which there was a demand shift. There is also a need for a coherent strategy for social protection such as the rationalization of severance pay schemes, a movement toward insurance mechanisms covering both the organized and unorganized sectors, and skill development programs for workers.

REFERENCES

Acemoglu, D. (2003), Patterns of Skill Premia, The Review of Economic Studies 70 (2): 199−230.

Acemoglu, D., F. Zilibotti (2001), Productivity Differences, The Quarterly Journal of Economics 116 (2): 563−606.

Acemoglu, D., P. Aghion, C. Lelarge, J. Van Reenen (2007), Technology, Information and the Decentralization of the Firm, The Quarterly Journal of Economics 122 (4): 1759−1799.

Ahsan, R. (2013), Input Tariffs, Speed of Contract Enforcement, and the Productivity of Firms in India, Journal of International Economics 90 (1): 181−192.

Ahsan, R., D. Mitra (2014), Trade Liberalization and Labor's Slice of the Pie: Evidence from Indian Firms, Journal of Development Economics 108 (1): 1−16.

Amiti, M., L. Cameron (2012), Trade Liberalization and the Wage Skill Premium: Evidence from Indonesia, Journal of International Economics 87 (2): 277—287.

Amiti, M., D. R. Davis (2012), Trade, Firms, and Wages: Theory and Evidence, The Review of Economic Studies 79 (1): 1−36.

Amiti, M., J. Konings (2007), Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia, The American Economic Review 97 (5): 1611−1638.

Araújo, B. C., L. S. Paz (2014), The Effects of Exporting on Wages: An Evaluation Using the 1999 Brazilian Exchange Rate Devaluation, Journal of Development Economics 111: 1−16.

Attanasio, O., P. Goldberg, N. Pavcnik (2004), Trade Reforms and Wage Inequality in Colombia, Journal of Development Economics 74 (2): 331−366.

Autor, D. F. Levy, R. J. Murnane (2003), The Skill Content of Recent Technological Change: An Empirical Exploration, The Quarterly Journal of Economics 118 (4): 1279−1333.

Azam, M. (2010), India's Increasing Skill Premium: Role of Demand and Supply, The B. E. Journal of Economic Analysis and Policy 10 (1): 1−26.

Baumgarten, D. (2013), Exporters and the Rise in Wage Inequality: Evidence from German linked Employer−Employee Data, Journal of International Economics 90 (1): 201−217.

Behrman, J. R., N. Birdsall, M. Székely (2000), Economic Reform and Wage Differentials in Latin America, IADB Research Department Working Paper #435, IADB Washington, DC.

Berman, E., J. Bound, Z. Griliches (1994), Changes in the Demand for Skilled Labor Within U.S. Manufacturing: Evidence from the Annual Survey of Manufactures, The Quarterly Journal of Economics 109 (2): 367−397.

Bemard, A. B., J. B. Jensen (1997), Exporters, Skill Upgrading, and the Wage Gap, Journal of International Economics 42 (1−2): 3−31.

Beyer, H., P. Rojas, R. Vergara (1999), Trade Liberalisation and Wage Inequality, Journal of Development Economics 59 (1): 103−123.

Bloom N., B. Eifert, A. Mahajan, D. McKenzie J. Roberts (2013), Does Management Matter? Evidence from India, The Quarterly Journal of Economics 128 (1): 1−51.

Bloom, N., J. Van Reenen (2007), Measuring and Explaining Management Practices Across Firms and Countries, The Quarterly Journal of Economics 122 (4): 1351−1408.

———. (2010), Why do Management Practices Differ Across Firms and Countries? Journal of Economic Perspectives 24 (1): 203−224.

Bloom, N., K. Manova, S. Sun, J. Van Reenen, Z. Yu (2016), Managing Trade: Evidence from China and the US, Mimeo.

Bloom, N., L. Garicano, R. Sadun, J. Van Reenen (2014), The Distinct Effects of Information Technology and Communication Technology on Firm Organization, Management Science 60 (12): 2859−2885.

Bloom, N., R. Sadun, J. Van Reenen (2010), Does Product Market Competition Lead Firms to Decentralize?, The American Economic Review Papers and Proceedings 100: 434−438.

Biscourp, P., F. Kramarz (2007), Employment, Skill Structure and International Trade: Firm-level Evidence for France, Journal of International Economics 72 (1): 22–51.

Bonfatti, R., M. Ghatak (2013), Trade and the Allocation of Talent with Capital Market Imperfections, Journal of International Economics 89 (1): 187−201.

Bustos, P. (2011), The Impact of Trade Liberalization on Skill Upgrading: Evidence from Argentina, Mimeo.

Caliendo, L., E. Rossi-Hansberg (2012), The Impact of Trade on Organization and Productivity, The Quarterly Journal of Economics 127 (3): 1393−1467.

Card, D., J. DiNardo (2002), Skill-Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles, Journal of Labor Economics 20 (S4): S733−S783.

Chamarbagwala, R. (2006), Economic Liberalization and Wage Inequality in India, World Development 34 (12): 1997−2015.

Chamarbagwala, R., G. Sharma (2011), Industrial De-licensing, Trade Liberalization, and Skill Upgrading in India, Journal of Development Economics 96 (2): 314−336.

Chakraborty, P., O. Raveh (2018), Input-Trade Liberalization, and the Demand for Managers: Evidence from India, Journal of International Economics 111: 159−176.

Chen, C. (2017), Management Quality and Firm Hierarchy in Industry Equilibrium, American Economic Journal: Microeconomics 9 (4): 203−44.

Chen, B., M. Yu, Z. Yu (2017), Measured Skill Premia and Input Trade Liberalization: Evidence from Chinese firms, Journal of International Economics 109: 31−42.

Cragg, M.I., M. Epelbaum (1996), Why has Wage Dispersion Grown in Mexico? Is it the Incidence of Reforms or the Growing Demand for Skills? Journal of Development Economics 51 (1): 99−116.

Cunat, V., M. Guadalupe (2009), Globalization and the Provision of Incentives Inside the Firm, Journal of Labor Economics 27 (2): 179−212.

Currie, J., A. Harrison (1997), Sharing the Costs: Trade Reform and Labor Market Adjustment in Morocco, Journal of Labor Economics 15 (S3): S44−S71.

De Loecker, J., P. Goldberg, A. Khandelwal, N. Pavcnik (2016), Prices, Markups and Trade Reform, Econometrica 84 (2), 445−510.

Debroy, B., A. T. Santhanam (1993), Matching Trade Codes with Industrial Codes, Foreign Trade Bulletin XXIV (1): 5−27.

Dutta, P. V. (2005), Accounting for Wage Inequality in India, Indian Journal of Labour Economics 48 (2): 273−295.

———. (2007), Trade Protection and Industry Wages in India, Industrial and Labor Relations Review 60 (2): 268−286.

Eaton, J., S. Kortum (1996), Trade in Ideas Patenting and Productivity in the OECD, Journal of International Economics 40 (4): 251−278.

———. (2001), Trade in Capital Goods, European Economic Review 45 (7): 1195−1235.

Ebenstein, A., A. Harrison, M. McMillan, S. Phillips (2014), Estimating the Impact of Trade and Offshoring on American Workers Using the Current Population Surveys, The Review of Economics and Statistics 96 (4): 581−595.

Feenstra, A. D., G. H. Hanson (1996), Foreign Investment, Outsourcing and Relative Wages. In R. C. Feenstra, G. M. Grossman, and D. A. Irwin (Eds.), Political Economy of Trade Policy: Papers in Honor of Jagdish Bhagwati (pp. 89−127), Cambridge, MA: MIT Press.

———. (1997), Foreign Direct Investment and Relative Wages: Evidence from Mexico's Maquiladoras, Journal of International Economics 42 (3−4): 371−393.

———. (2003), Global Production Sharing and Rising Inequality: A Survey of Trade and Wages. In E. Choi, and J. Harrigan (Eds.), Handbook of International Trade (pp. 146−185). Malden, MA: Blackwell.

Feliciano, Z. (2001), Workers and Trade Liberalization: The Impact of Trade Reforms in Mexico on Wages and Employment, Industrial and Labor Relations Review 55 (1): 95−115.

Frías, J. A., D. S. Kaplan, E. Verhoogen (2009), Exports and Wage Premia: Evidence from Mexican Employer-Employee Data, Mimeo.

———. (2012), Exports and Within-Plant Wage Distributions: Evidence from Mexico, The American Economic Review 102 (3): 435−440.

Galiani, S., P. Sanguinetti (2003), The Impact of Trade Liberalization on Wage Inequality: Evidence from Argentina, Journal of Development Economics 72: 497−513.

Garicano, L. (2000), Hierarchies and the Organization of Knowledge in Production, Journal of Political Economy 108 (5): 874−904.

Garicano, L., E. Rossi-Hansberg (2004), Inequality and the Organization of Knowledge, The American Economic Review 94 (2): 197−202.

———. (2006), Organization and Inequality in a Knowledge Economy, The Quarterly Journal of Economics 121 (4): 1383−1435.

Ghosh, S. (2014), Manufacturing Sector in India: Role of External Economies and Industrial Policy, Mimeo, Jawaharlal Nehru University.

Goldberg, P. K., N. Pavcnik (2005), Trade, Wages, and the Political Economy of Trade Protection: Evidence from the Colombian Trade Reforms, Journal of International Economics 66 (1), 75−105.

———. (2007), Distributional Effects of Globalization in Developing Countries, Journal of Economic Literature 45 (1): 39−82.

Goldberg P., A. Khandelwal, N. Pavcnik (2013), Variety In, Variety Out: Imported Input and Product Scope Expansion in India, In J. Bhagwati and A. Panagariya (Eds.), Reforms and Economic Transformation in India (pp. 168−199), Oxford University Press.

Goldberg, P. K., A. Khandelwal, N. Pavcnik, P. Topalova (2010), Imported Intermediate Inputs and Domestic Product Growth: Evidence from India, The Quarterly Journal Economics 125 (4): 1727−1767.

Gonzaga, G., N. Menezes-Filho, C. Terra (2006), Trade Liberalization and the Evolution of Skill Earnings Differentials in Brazil, Journal of International Economics 68 (2): 345−367.

Gorg, H., G. Strobl (2002), Relative Wages, Openness, and Skill-biased Technological Change in Ghana, Mimeo.

Grossman, G., E. Rossi-Hansberg (2008), Trading Tasks: A Simple Theory of Offshoring, The American Economic Review 98 (5): 1978−1997.

Haltiwanger, J., A. Kugler, M. Kugler, A. Micco, C. Page (2004), Effects of Tariffs and Real Exchange Rates on Job Reallocation: Evidence from Latin America, Policy Reform 7 (4): 191−208.

Harrison, A., G. Hanson 1999, Who Gains from Trade Reform? Some Remaining Puzzles, Journal of Development Economics 59 (1): 125−154.

Hummels, D., R. Jorgensen, J. Munch, C. Xiang (2014), The Wage Effects of Offshoring: Evidence from Danish Matched Worker-Firm Data, The American Economic Review 104 (6): 1597−1629.

Kandilov, I., A. Leblebicioglu, R. Manghnani (2016), Tariffs on Imported Capital and Firm-level Investment in the Indian Manufacturing Sector, Mimeo, North Carolina State University.

Kijima, Y. (2006), Why did Wage Inequality Increase? Evidence from Urban India 1983−-99, Journal of Development Economics 81: 97−117.

Koren, M., M. Csillag, J. Kollo (2019), Machines and Machinists: Importing Skill-Biased Technology, Mimeo, CEU.

Krishna, P., D. Mitra, S. Chinoy (2001), Trade Liberalization and Labor Demand Elasticities: Evidence from Turkey, Journal of International Economics 55 (2): 391−409.

Krishna, P., J. P. Poole, M. Z. Senses (2014), Wage Effects of Trade Reform with Endogenous Worker Mobility, Journal of International Economics 93 (2): 239−252.

Kumar, U., P. Mishra (2008), Trade Liberalization and Wage Inequality: Evidence from India, Review of Development Economics 12 (2): 291−311.

Levinsohn, J., A. Petrin (2003), Estimating Production Functions Using Inputs to Control for Unobservables, The Review of Economic Studies 70 (2): 317−341.

Ma, L., D. Ruzic (2018), Globalization and Top Income Shares, Mimeo.

Marin, D., T. Verdier (2008), Power Inside the Firm and the Market: A General Equilibrium Approach, Journal of the European Economic Association 6 (4): 752–788.

———. (2014), Corporate Hierarchies and International Trade: Theory and Evidence, Journal of International Economics 94 (2): 295−310.

Martins, P. S., L. Opromolla (2010), Exports, Imports and Wages: Evidence from Matched Firm-Worker-Product Panels, Mimeo.

McCaig, B. (2011), Exporting out of Poverty: Provincial Poverty in Vietnam and U.S. Market Access, Journal of International Economics 85 (1): 102−113.

Mehta, A., R. Hasan (2012), The Effects of Trade and Services Liberalization on Wage Inequality in India, International Review of Economics and Finance 23: 75−90.

Menezes-Filhoz, N., and Muendler, M-A. (2011), Labor Reallocation in Response to Trade Reform, Mimeo.

Moulton, B. R. (1990), An Illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Units, The Review of Economics and Statistics 72 (2): 334−338.

Nouroz, H. (2001), Protection in Indian Manufacturing. MacMillan Publishers, MacMillan India Ltd., India.

Pavcnik, N. (2003), What Explains Skill Upgrading in Less Developed Countries? Journal of Development Economics 71 (2): 311−328.

Pavcnik, N., A. Blom, P. Goldberg, N. Schady, (2004), Trade Liberalization and Industry Wage Structure: Evidence from Brazil. World Bank Economic Review 18 (3): 319−344.

Raveh, O., A. Reshef (2016), Capital Imports Composition, Complementarities, and the Skill Premium in Developing Countries, Journal of Development Economics 118: 183−206.

Revenga, A. (1997), Employment and Wage Effects of Trade Liberalization: The Case of Mexican Manufacturing, Journal of Labor Economics 15 (S3): S20−S43.

Smith, J. P., D. Thomas, E. Frankenberg, K. Beegle, G. Teruel (2002), Wages, Employment and Economic Shocks: Evidence from Indonesia, Journal of Population Economics 15 (1): 161−93.

Topalova, P., and A. Khandelwal (2011), Trade Liberalization and Firm Productivity: The Case of India, The Review of Economics and Statistics 93 (3): 995−1009.

Verhoogen, E. (2004), Trade, Quality Upgrading and Wage Inequality in the Mexican Manufacturing Sector: Theory and Evidence from an Exchange-rate Shock, Mimeo, University of California, Berkeley.

———. (2008), Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector, The Quarterly Journal of Economics 123 (2): 489−530.

Wood, A. (1995), How Trade Hurt Unskilled Workers, Journal of Economic Perspectives 9 (3): 57−80.

Zhu, S. C., D. Trefler (2005), Trade and Inequality in Developing Countries: A General Equilibrium Analysis, Journal of International Economics 65 (1): 21−48.

APPENDIX

A. Data

I use an annual-based panel of Indian firms that covers up to 8000+ firms, across 108 industries within the manufacturing sector, over the period 1990–2011 (with the exception of specific cases, where specified). Unless otherwise specified, variables are based on data from the PROWESS database of the Centre for Monitoring Indian Economy (CMIE). All monetary-based variables are measured in millions of rupees, deflated to 2005 using the industry-specific Wholesale Price Index. All industry-level cases are based on the 2004 National Industrial Classification (NIC).

Variable definitions

- **Managerial Compensation/Total Compensation:** Share of managerial compensation in total labor compensation; compensation defined as the sum of all salaries, and additional bonuses.
- **Total Managers:** Total number of managers in a firm. This is the sum of the total number of managers at the top and middle management level.
- **Managerial Compensation:** Total managerial compensation of a firm. This is the sum of all the management layers put together.
- **Nonmanagerial Compensation:** Total nonmanagerial compensation of a firm. This is the sum of compensation of all nonmanagerial workers.
- **Input/Output Tariffs:** Input/output tariffs at the 4-digit industry level, obtained from Ahsan and Mitra (2014) for the period 1990–2003, with the balance collected from Chakraborty and Raveh (2018).
- **Imp/GVA:** Share of total imports in Gross Value Added.
- **ImpRaw/GVA:** Share of raw material imports in Gross Value Added.
- **ImpCap/GVA:** Share of capital imports in Gross Value Added.
- **ImpSto/GVA:** Share of stores and spares imports in Gross Value Added.
- **ImpFin/GVA:** Share of final goods imports in Gross Value Added.
- **Exp/GVA:** Share of total exports in Gross Value Added.
- **GVA:** Gross Value Added, defined as the difference between total sales and expenditures on raw materials.
- **Skill Intensity:** The 3-digit industry-level ratio of nonproduction workers to all employees, obtained from the Indian Annual Survey of Industries (2001–2011) and from Ghosh (2014) (1990–2000).
- **Capital Employed:** Total amount of capital employed by a firm.
- **Productivity:** Total Factor Productivity (TFP) at the firm level is computed using the Levinsohn and Petrin (2003) methodology.
- **Factories:** The 3-digit industry-level number of factories/plants.
- **Management Technology:** The 4-digit industry-level management quality score in 2004, obtained from Bloom and Van Reenen (2010); the score is between 1 and 5, with 5 denoting the highest quality.

- **Technology Adoption:** Share of R&D expenditure and royalty payments for technical know-how in Gross Value Added.
- **Assets:** Total assets of a firm. This is an indicator of size.
- **Age:** Age of a firm in years.
- **Ownership:** This indicates whether a firm is domestically owned or foreign owned.