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## ABSTRACT

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# Short and Long-Run Labor Market Effects of Developing Country Exports: Evidence from Bangladesh\*

This paper studies how a positive export shock - the sharp increase in garment-sector exports that began at the end of the Multifibre Arrangement (MFA) - spread through Bangladesh's labor markets. Although the end of the MFA was arguably exogenous to Bangladesh, we instrument export demand with OECD imports to ensure identification. We compare estimates of the local labor market effects (wages and informality) and estimates from wage equations that reflect the predictions from long-run, general-equilibrium neoclassical trade theory. As in other studies, we find that the export shock was localized both in terms of sector and geography. Wages increased and informality decreased in sub-districts more exposed to the export shock. Unlike in other studies, these local labor market effects dissipate quickly. Furthermore, Bangladesh's export shock was sector specific, limited predominantly to the female-intensive garment and textile sector. We show that, following the increase in exports of the female-intensive good, the male-female wage gap closes considerably throughout the country – not just in the apparel sector. In relatively small Bangladesh, the national labor market seems to be more integrated compared to larger countries studied, possibly suggesting that labor adjustment costs are lower in smaller countries.

**JEL Classification:** F13, F14, F15, F16, J23, J31, O15, O19

**Keywords:** local labor markets, Bangladesh, apparel, exports, wage inequality, Stolper-Samuelson

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## 1. Introduction

At the center of the debate about the net welfare effects of globalization is the question of whether these trade “shocks” remain localized or if they spread throughout the economy. In developed countries, the localized adverse effects of imports from developing countries (for example, Autor et al., 2013 and Hakobyan and McLaren, 2016) mirrored similar studies of the localized effects of imports in developing countries (for example, Topalova, 2010 and Edmonds et al., 2010). In particular, Dix-Carneiro and Kovak (2017) find that the localized effects of tariff reductions in Brazil grow over time because of imperfect inter-regional labor mobility driven by slow capital adjustment and agglomeration economies. In general, these papers find little support for the long-run labor market outcomes predicted by neoclassical trade models (Blanchard and Katz, 1992 and Bound and Holzer, 2000) because national labor market integration is inhibited by significant labor-market adjustment costs (Artuc, Chaudhuri, and McLaren, 2010).<sup>1</sup>

Although much of this literature focuses on the adverse effects of imports, globalization has been associated with falling poverty, falling inequality, and rising growth throughout the developing world since 2000, reflecting earlier studies demonstrating a positive cross-country relationship between trade and growth (Frankel and Romer 2000). In particular, the dramatic rise in exports from developing countries noted by Hanson (2012) coincided with a dramatic increase in labor demand (Robertson et al., 2009; Lopez-Acevedo et al., 2016) that has been associated with falling poverty (Harrison, 2007).

Part of the reason for the apparent disconnect is that, in developing countries, exports rather than imports are both the most salient dimension of globalization and the least studied. One important exception, McCaig and Pavcnik (2018), shows significant reallocation of labor following a positive export shock in Vietnam. This study suggests that it is possible that export shocks may be disseminated through national labor markets in ways consistent with neoclassical theory.<sup>2</sup>

This study compares the empirical approaches from recent studies of local labor market effects of imports with estimates of general-equilibrium predictions of neoclassical models using repeated cross-section worker-level data from Bangladesh. Bangladesh provides an excellent opportunity to evaluate the national labor-market dissemination of exports shocks for four reasons. First, since the 2013 Rana Plaza collapse, Bangladesh has been at the center of the debate about developing country exports.<sup>3</sup> Second, between 1980 and 2000 Bangladesh experienced a fundamental reorientation of its economic paradigm and production toward an open economy. When the Multi-Fibre Arrangement (MFA) ended December 31, 2004, demand for Bangladesh’s apparel exports increased dramatically. Although these changes in policy were arguably exogenous to local labor market outcomes, we use an instrumental variable technique to isolate the increase in exports due to changes in world demand to address concerns about endogeneity of the export shock.

Third, Bangladesh’s export growth was highly concentrated within the “ready-made” garments (RMG) sector. South Asia’s export portfolio is less diversified than other developing-country

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<sup>1</sup> Artuc, Chaudhuri, and McLaren (2010) developed a model to estimate worker-level adjustment costs. The seminal work of Artuc et al. (2010) brought labor-market adjustment costs to the center of a new wave of trade models because they show that adjustment costs critically affect welfare implications and that, in some cases, high adjustment costs may overwhelm the positive benefits of trade liberalization.

<sup>2</sup> Goutam et al. (2017) carry out a similar exercise for Bangladesh.

<sup>3</sup> See Elliott and Freeman (2003) describing early concern about sweatshops in developing countries.

regions, and Bangladesh's export portfolio is less diversified than those of its South Asian neighbors (Figure 1). The concentration in apparel help identify the effects of a sector-specific export shock clearer in Bangladesh than in other, more diversified, economies. Furthermore, the concentration of exports in RMG supports our identification strategy for two reasons. First, most production for these exports (and employment) is concentrated in few geographic districts. Second, females dominate employment in the sector; in the language of international trade models, RMG is a "female-intensive" industry.<sup>4</sup> To the extent that males and female are imperfect substitutes in production (Acemoglu et al., 2004), general equilibrium neoclassical models predict that the positive export shock in the RMG sector should increase the wages of women throughout the economy, not just in the RMG sector, and shrink the gender wage gap.

*(Figure 1 near here)*

Fourth, relative to other countries studied, such as India, dispersion of wages—a heuristic measure of local labor-market integration—is lower in Bangladesh. While admittedly an imperfect measure of labor market integration (Robertson, 2000), the lower geographic wage dispersion suggests that Bangladesh may be more likely to experience the kind of long-run general equilibrium effects predicted by neoclassical theory.

To compare the local labor market effects with general equilibrium predictions, we first apply the Bartik (1991) approach. The results show significant short-run local labor market effects that fade over time. Sub-districts more exposed to these export shocks experience a 3,062 *taka* increase in average annual wages in the short-run—between 2005 and 2010 period relative to less exposed sub-districts. A US\$100 gain in exports per worker between 2005 and 2010 lead to a 0.7 percent decrease in informality in sub-districts with a higher degree of exposure to trade. More fully-employed groups—males, high-skilled, and more experienced workers—seem to benefit the most in terms of wage increases. On the other hand, groups with less labor market attachment, such as female workers, experience the largest decrease in informality rate in sub-districts more exposed to export demand shocks.

Our results suggest that worker mobility between regions increases and regional wage dispersion decreases. Wage differentials exist across districts in Bangladesh, as is it case in most countries, but the dispersion of wages decrease consistently between 2005 and 2016, indicating that local labor markets may have become more integrated over time.<sup>5</sup> This finding holds for every year and type of worker. We show that the within-country labor market integration, necessary for national dissipation of wage and informality effects, is much higher in Bangladesh than in India, which may explain the differences between our results and those of other studies.<sup>6</sup>

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<sup>4</sup> Several studies have documented the RMG sector to be a key in driving female-intensive job creation across the world. In Bangladesh, the expansion of RMG sector led to a sustained increase in female labor force participation rates from 27.5 percent in 2003 to approximately 37 percent in 2010. Several studies have documented this "female-intensive" nature of the RMG sector (World Bank, 2012; World Bank, 2016).

<sup>5</sup> In contrast to India where mobility is a huge constraint, dispersion of wages across districts is substantially lower in Bangladesh. a

<sup>6</sup> In Brazil, Dix-Carneiro and Kovak (2017) found decline in formal wages and employment worsen over time in regions facing large tariff cuts. In fact, the impact of tariff changes on regional earnings 20 years after liberalization was three times the effect after 10 years. Imperfect inter-regional labor mobility is posited to be one of the key factors driving these prolonged impacts. In India, Artuc et al. (2019) find persistent (non-dissipating) wage effects for India.

Our results illustrate how the benefits of a concentrated export shock spread through the economy. Unlike recent studies, we find that the estimated local-labor market effects dissipate over time. Although the wage effect is significant between 2005 and 2013, the magnitude of the effect decreases substantially to 658 *takas* from 3062 *takas* between 2005 and 2010. By 2016, the higher wage effect completely diminishes in magnitude and becomes insignificant in sub-districts more exposed to the export shocks between 2005 and 2016. Similarly, results on informality decrease not only in magnitude but also in significance when taking into consideration additional years; between 2005 to 2013, informality decreased 0.4 percent (although not statistically significant in our model), while between 2005 and 2016 effects on decreasing informality for sub-districts more exposed to export shocks disappear. The dissipating effects are not driven by changes in labor market policies, such as revisions of minimum wages across industries.<sup>7</sup>

We then apply an approach used by Robertson et al. (2019) to estimate predictions of the neoclassical general-equilibrium trade models in Bangladesh. We find two key results. First, the Oaxaca-Blinder estimations highlight that the ‘unobservable’ component of the male-female wage gap explains most of the gap over time. The ‘explainable’ portion, which includes changes that might occur from women getting more education or experience, their age, if they are working in Textile and Garment industry, and number of hours worked, is relatively small and constant. Second, using Mincerian estimations we find that following the export shock, female earnings throughout the economy, not just in RMG, increase relative to male earnings. The female-male wage gap for the entire Bangladeshi economy falls from about -60 percent in 2005 to -12 percent in 2010 and to -11 percent in 2013. Despite a reversal in the direction of this trend in next years, when export growth falters during the “great trade collapse” (Baldwin, 2009), the wage gap between males and females remains substantially narrower compared to the first year after the end of the MFA. Similarly, high-skilled wage premiums relative to low-skilled workers decreased during the same time, from 70 percent in 2005 to 52 percent in 2016. These results align with our expectation that positive export shocks have an aggregate and economy-wide effect in Bangladesh labor markets, benefiting females and low-skilled workers across all sectors.

Our paper proceeds as follows. Section 2 outlines our conceptual framework, which includes some simple but illustrative simulation results. Section 3 describes the trade data, trends in trade and production, the labor market data, and relevant labor market characteristics. Section 4 describes the estimation data set, local labor market definition, and empirical methodology. Section 5 presents our results, including the short-run effects on wages and informality and the economy-wide changes that we observe in the long run. Section 7 concludes.

## 2. Conceptual Framework

Consider a two-sector model in which output,  $y$ , is produced using a fixed factor (“capital”) and two types of workers (“males” and “females”) that are indexed by  $j$ . Assuming perfect competition

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<sup>7</sup> Minimum wages in Bangladesh are industry-specific. Between 2005 and 2016, apparel industry in Bangladesh saw multiple revisions in minimum wages. Prior to 2006, the minimum wage for this industry stood at 930 *takas*, which was revised to 1,662 *takas* in 2006, further revised to 3,000 *takas* in 2010 and 5,300 *takas* in 2013. Such revisions of minimum wages across industries could potentially affect our model if they are binding industry-wise and region-specific. While not varying by region, minimum wages do vary across industries in Bangladesh. However, evidence of a considerable portion of apparel workers earning below the established minimum wage, from Kdensity plots for the apparel sector in Bangladesh, points to non-binding minimum wage measures in the region (see figure A1 in Appendix). Since minimum wages are not binding for apparel, we conclude that our findings might not be biased due to minimum wage changes through time.

and constant returns to scale, decisions of identical atomistic firms within each sector can be represented by the usual profit maximization decision in which firms take wages (determined in aggregate factor markets) and output prices (determined in global markets) as given. These decisions are often represented by cost functions in which the production cost  $C$  for sector  $i$  at time  $t$  is represented by:

$$(1) \quad C_{it} = f(p_{it}y_{it}, w_{itj})$$

Shephard's lemma allows us to derive factor demand curves from the cost function. Holding capital fixed, the demand for males and females are derived as a function of output prices and factor prices. Using  $\varphi_{itj}$  to represent the demand for factor  $j$  at time  $t$  in industry  $i$ :

$$(2) \quad \frac{\partial C_{it}}{\partial w_{itj}} = \varphi_{itj}(p_{it}, w_{itj})$$

Note that equation (2) represents the marginal revenue product of each factor, which, of course, is the factor demand curve. Under normal assumptions:

$$(3) \quad \frac{\partial \varphi_{itj}}{\partial w_{jt}} < 0 \quad \text{and} \quad \frac{\partial \varphi_{itj}}{\partial p_{it}} > 0$$

Assuming full employment in every period  $t$ :

$$(4) \quad \Phi_{tj} = \sum_i \varphi_{itj}$$

In the absence of adjustment costs, this model reduces simply to the Heckscher-Ohlin-Samuelson (HOS) model. Bernard, Redding, and Schott (2007) show that in the presence of firm heterogeneity, such as that described by Melitz (2003), the neoclassical predictions of the HOS model still hold. One of the well-established results of this model is the Stolper-Samuelson theorem (Stolper and Samuelson, 1941), which states that an increase in the relative output price of sector  $i$  will increase the wages of the factor that is intensively employed in sector  $i$  and reduce the wages of the other factor throughout the economy (that is, in both industries). For example, an increase in the price of RMG sector, which intensively employs women, would increase the earnings of women throughout the economy – not just in the RMG sector. The reason for this result is that differences in wages across sectors (or regions) are arbitrated away through factor mobility. Without adjustment costs, factors are perfectly mobile across sectors (or regions). Factor mobility, therefore, ensures that a given factor receives the same wage as the same factor earns in the other sector (but, of course, the earnings of different factors can be, and generally are, different).

Many recent papers have shown that adjustment costs matter (Artuc, Chaudhuri, and McLaren, 2010 and others noted earlier). It is simple to modify this model to illustrate short-run effects and adjustment to the long-run. To illustrate the short-run effects, we begin with the Ricardo-Viner assumption that factors are fixed in the short run. In this case, an increase in the price of a given sector would increase the marginal revenue product of the factors employed in a given sector, as shown in (3) above.



An increase in the marginal revenue product in sector  $i$  implies that the willingness to pay for workers in sector  $i$  rises above the wages of the same factors in the other sector. As a result, the sector-specific earnings of both factors in sector  $i$  increase. When these differences are not arbitrated away, Krueger and Summers (1988) call the wage differences “inter-industry wage differentials” and can be identified through empirical approaches common in labor economics.

The increase in the marginal product implies a new equilibrium wage that would be reached in the long-run. We show comparison of the short-run inter-industry wage differentials and the transition to the long-run in Figure 2a. For illustrative purposes, consider an economy with two goods: apparel (A) and some substitute good (S), which represents “all other goods”. Assuming full employment, workers either work in Apparel or the Substitute industry. Total employment is represented by the length of the horizontal axis, and the intersection of the two labor demand curves (LA and LS, respectively) indicate the distribution of workers between the two industries. As long as workers are mobile between industries, the initial equilibrium wage is the same in the two industries, as indicated by the dotted horizontal line at the intersection of LA0 and LS0.

An increase in the price of apparel, the exported good, increases the labor demand of apparel. In Figure 2a, the price increase is indicated by an increase in LA0 to LA1. Before workers move, the wage in the apparel industry increases to  $W_{a1}$  from  $W_{a0}$ . The increase in labor demand, however, attracts workers from the Substitute industry. As workers leave the Substitute industry, wages in the Substitute industry rise. As workers enter Apparel, wages in apparel fall. This process continues until difference in wages across industries disappear, and the new economy-wide wage is represented by  $W_{a2}=W_{s2}$ .

*[Figure 2a near here]*

In the long-run, the Stolper-Samuelson theorem predicts that change in export price will change the relative wage of males and females. The change in the relative wage, for example, will depend on which kind of worker is hired more intensively in the export industry. Considering our two industries, apparel and a substitute industry, it is well-known (and easy to show) that apparel is female-intensive. In this case, we can represent the equilibrium zero-profit conditions (marginal cost is equal to price) in Figure 2b. In this figure, the equilibrium cost function for each industry is represented by a cost curve on a graph with female wages on the vertical axis and male wages on the horizontal axis. The cost curve for apparel is above the cost curve for the substitute industry because apparel is female-intensive. The intersection of the two curves represents the long-run equilibrium in which both factors are fully employed, and firms earn zero profits.

In Figure 2b, the intersection of the two curves demonstrates the equilibrium female and male wages in the economy as a function of the two output prices. It is important to note that in this model men in apparel earn the same as men in the substitute industry and females in apparel earn the same as women in the substitute industry; wages are not differentiated by industry. Instead they are differentiated by factor because workers are perfectly mobile between sectors. Clearly, these predictions are only valid in the long-run because they assume full mobility.

*[Figure 2b near here]*

The transition to the long-run tautologically depends on the time it takes for factors to move between sectors (or regions) to equalize wages and depends critically on the adjustment mechanism. Consider an adjustment parameter  $\mu$  that describes the share of the difference between current employment and long-run equilibrium employment level that is reduced each period. In this case, we can demonstrate an extremely simple calibration for the model above. Using a very simple parameterization of the model above, Figures 3a and 3b illustrate the transition in wages for males (Figure 3a) and Females (Figure 3b) as the result of a 20 percent increase in the relative price of industry 1 (apparel). Several important features emerge from Figures 3a and 3b. First, the initial increase in the price of industry 1 (apparel) creates a gap in industry wages (“inter-industry wage differentials”) that starts large but shrinks over time. Second, the differential gap is different for males and females. That is, in the short-run it makes sense to allow for different effects on wages from a price change in different factors.

*[Figure 3a near here]*

*[Figure 3b near here]*

Some papers estimate the sector-specific male-female wage differential. Figure 4 shows the evolution of the male-female wage gap over time following a 20 percent price shock to industry 1 (apparel). The male-female wage gap is initially different in the two industries, which motivates estimating the male-female wage gap separately within industries. Over time, however, Figure 4 shows that the male-female wage gap begins to converge as factors move between sectors.

Figure 4 also demonstrates that the male-female wage gap shrinks as a result of the initial price shock in the female-intensive industry. In our parameterization, the initial male-female wage ratio is 1.17, but the final wage ratio is 1.105, representing a drop of just over 5 percent. That is, the 20 percent increase in the relative output price of the female-intensive industry closes the wage gap by about 5 percent throughout the economy—not just in the industry that experienced a price change. The model also predicts that output of sector 1 increases about 12 percent relative to sector 2. This model therefore illustrates how a sector-specific trade shock can be disseminated throughout the economy.

*[Figure 4 near here]*

The goal of the rest of the paper is to estimate the relevant parameters that allow us to compare changes in Bangladesh to changes predicted by the models above. We begin with a description of the relevant data.

### 3. Data Description

Following McCaig and Pavcnik (2018), we start with labor force surveys and combine them with trade data. After describing these data, we present the empirical methodology that starts with the Bartik (1991) approach and extends with an approach to estimate the general-equilibrium predictions of the theory above. We first describe the trade data and trends in trade and production and then describe the labor market data and relevant labor market characteristics.

## Trade and Production

We begin our description of the changes in Bangladesh's trade and production patterns using annual, bilateral commodity trade data from COMTRADE using the 4-digit International System of Industrial Classification (ISIC) Rev. 3.1. Our main focus is on United States and European Union imports from Bangladesh over the 1990-2016 period. The main point is that exports have expanded significantly, and apparel and textiles have played the leading role.

Like many developing countries, Bangladesh followed an import-substitution-industrialization (ISI) strategy for much of the 20<sup>th</sup> century but turned and implemented liberalizing reforms in the 1990s. The government reduced the maximum import duty of 350 percent in 1993 to 32.5 percent in 2003 and 25 percent in 2005. Bangladesh also reduced the number of tariff bands from 15 in 1993 to 4 in 2016. Between 1992 and 2008, the unweighted average tariff rate declined from a high of 70 percent to low of 12.3 percent. During the 1990s several measures were designed to reduce the cost of imported inputs, including reducing tariffs, subsidized interest rates on bank loans, cash subsidies, exemptions from value added and excise taxes, bonded warehouse facilities, a duty drawback facility, duty-free imports of machinery and inputs for export industries, an export credit guarantee scheme, and income tax rebates for exporters. The government established Export Processing Zones (EPZs) that included basic factory structures with dependable utilities, secured industrial areas, central monitoring of labor compliance, and one-stop facilities for exports.

Bangladesh's various trade liberalization efforts, along with structural adjustment initiatives, opened the economy to world demand. Export value increased in nearly every year from 1989 to 2015, rising from US\$1.5 million to almost US\$30 million. At the same time, imports (primarily industrial raw material and capital machinery) increased from close to US\$4 million to slightly over US\$40 million.

This trend of sustained expansion in trade reversed in 2008. When the global financial crisis hit in 2008, export growth declined significantly due to falling global demand. In fact, imports and exports which have been growing as a share of GDP since the 1970s saw a decline with the global financial crisis (Figure 5a).

*[Figure 5a near here]*

A rise in exports could be the result of increasing supply (due to changes in Bangladesh) or a rising demand (due to changes in the global market). One way to differentiate between a change in supply and a change in demand is to follow the change in prices over time. Figure 5b shows the U.S. unit value (in dollars per square-meter-equivalent, or SME) from OTEXA for U.S. imports from Bangladesh both alone and divided by the unit value of SME imports from the rest of the world. Figure 5b clearly shows a sharp increase in the U.S. price for Bangladesh imports that begins when the MFA ends at the end of 2004.

*[Figure 5b near here]*

The change in world demand coincided with a significant change in the composition of exports. Jute and jute goods dominated export earnings in the 1970s and 1980s but gave way to ready-made

garments (RMG). Jute and jute-goods dropped from 68.5 percent of total export earnings in 1980–81 to less than 5 percent by 1999–2000. The share of export earnings from RMG products over the same period rose from 0.4 percent to more than 75 percent. Nearly 90 percent of the total export growth of Bangladesh is due to apparel (Figure 6).

[Figure 6 near here]

## Labor Market Data and Characteristics

Our main source of labor market data is the labor force survey (LFS) provided by Bangladesh Bureau of Statistics. Bangladeshi labor force surveys are cross-sectional containing detailed household and individual information about key labor market characteristics, household characteristics, and individual demographic characteristics with units of analysis as individuals and households. For the purpose of this paper, we use the LFS for 2005 (10th round), 2010 (11th round), 2013 (12th round), and the first round of the Quarterly Labor Force Survey introduced in 2015–16.

Our analysis includes the following variables: gender, age, wages, educational status, marital status, individual’s primary occupational status, and employment. The survey questionnaire and reported variables changed within the period 2006–15. To ensure compatibility over time, we harmonize key variables: the “education” variable is reaggregated from 19 to 6 categories and the “informality” variable is created from multiple categories of the “principle activity status” which were harmonized overtime. Workers are then classified as informal who are either self-employed, contributing family members, and day laborers across years. We also harmonized geographic and industrial codes overtime for effective comparison.

We found some irregularities in wage earnings variables across years. Wages increase substantially between 2005 and 2013. Specifically, we noticed that workers’ wages were way higher – about 10 times – for those who report a monthly payment frequency in 2005. It was found that workers who reported a monthly frequency of payment appeared to have reported their monthly wage instead of the weekly wage, as it was reported indicated in the questionnaire. We corrected for this anomaly and present how the variables look in the final dataset through the distributional plots of logarithm of wages across years, by division across years, and by different skills across years in figure A2, A3 and A4 in annex.

According to 2015-16 labor force survey, agriculture continues to be the presiding source of employment, generating nearly 42.7 percent of total employment in Bangladesh. The importance of industry and services in Bangladesh have also grown overtime with over 20.5 percent of employment being generated by industry and 36.9 percent by services in 2015-16. Analysis of these labor force surveys highlights three acute challenges faced by the Bangladeshi labor market—*informal employment, gender differences, and spatial disparities in key labor market characteristics.*

While there has been a modest 3 percentage point decline in informal employment in Bangladesh between 2005 and 2015, it continues to stand at a staggering 86 percent in 2015. A larger share of women are employed as informal workers as compared to men. In 2015, for example, 82 percent of males are employed as informal workers in contrast to 95 percent for females (Artuc et al., 2019). This gender bias is not surprising as women in Bangladesh tend to work more in subsistence agriculture and unpaid sectors which are predominantly informal in nature (Artuc et al., 2019).

Such gender discrimination can also be observed in other key labor market outcomes—*earnings and employment*. In terms of earnings, men tend to do better than women in Bangladesh in 2005 but this gap in the level of average weekly wages has narrowed down overtime. For example, average real weekly earnings for women workers were 758 *takas* in 2005 in comparison to 1080 *takas* for men. Overtime, this gap reduced, and average real weekly earnings stood at 1485 *takas* for females while 1558 *takas* for males in 2016. This pattern in average real weekly wages is consistent across most industries in Bangladesh. In addition, female labor force participation remains low in comparison to lower-middle income country average and the middle-income country average and low share of women engage in nonagricultural employment (Farole et al. 2017).

Geographical inequality is persistent as production and labor markets seem to be concentrated in few districts across the country. Labor force participation rates vary considerably by region (Figure 7). For example, a higher share of the population in the western divisions (Khulna and Rajshahi) participates in the labor market compared to those in the eastern divisions (Chittagong and Sylhet). Similar to other South Asian countries, most industries in Bangladesh remain concentrated in certain divisions—notably, in Dhaka and Rajshahi. Key labor market characteristics vary significantly at the sub-national level. Wage differences exists across districts in Bangladesh but are lower in comparison to other countries in the region. Figure 8 further shows considerable regional variation between 2005 and 2013 in share of female employment.

*(Insert figure 7 here)*

*(Insert figure 8 here)*

## Regional Wage Dispersion

The local labor market methodology used in many recent studies depends critically on the identification of distinct local labor markets. One “heuristic” measure of the presence of local labor markets is the standard deviation of wages for different types of workers across regions overtime. This measure is “heuristic”—that is, imperfect—because there are many reasons why wages might not equalize across regions.<sup>8</sup>

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<sup>8</sup> Wages may differ across regions due to preferences, distribution of capital, or other factors. Even if workers are perfectly mobile, wages will not equalize if there are “preference” shocks. Consider an assignment model, like Eaton-Kortum (2002, 2012), with no transportation costs, where there is a productivity or utility draw. In that model, wages will not equalize. While it might not be possible to separate mobility of labor from mobility of other factors (and the distribution of other factors) by looking at wage variances, wage variance across regions remains widely-used to measure labor market integration.

Table 1a shows that the standard deviation of wages in Bangladesh decreases consistently between 2005 and 2016, if assuming that highly integrated markets show lower wage differences among workers over time. Table 1a suggests that local labor markets in Bangladesh have become more integrated over time. In addition, we also compared this dispersion of wages across districts between India and Bangladesh for each year and worker type. Comparing Table 1a (Bangladesh) with Table 1b (India) shows that dispersion of wages across districts is substantially lower in Bangladesh relative to India, even when the means are very similar. This finding holds for every year and type of worker.

*[Table 1a and 1b near here]*

We complement these results by computing district and industry premiums for Bangladesh. First, state and industry premiums can be indicators of segmented labor markets. A lack of labor mobility across sectors and districts would result in premiums. If labor is perfectly mobile, wage premiums after any shock should decline over time since workers with the same characteristics would move to districts and industries offering higher wages. Furthermore, the correlation of the premiums over time should then be small and decline.

This is, however, not the case. Figure 9 compares Bangladesh and India in terms of regional wages over time. On the one hand, this figure clearly shows that the wages are not equalized across states in India. If anything, the states with the highest wages early in the sample have experienced the largest wage increases. For instance, weekly average real wages in Mizoram are more than three times larger than those in Tripura and Chhattisgarh. On the other hand, earnings dispersion across districts is not only much lower in Bangladesh but also seems to have been decreasing during the last decade. These findings suggest that Bangladeshi faces less labor mobility restrictions than India, spreading more rapidly the benefits from trade shocks over time.

*[Figure 9 near here]*

Migration has been a major feature in Bangladesh's recent history, and several studies have *directly* measured and documented trends on internal migration implied by decreasing wage differences for similar workers across regions.<sup>9</sup> In this regard, migration statistics published by BBS based on the 2011 census is a valuable source providing information on the movement of workers across districts between 2001 and 2011. This data source does not fully cover our period of primary interest, 2005 to 2015, but the information is nonetheless informative and the best available.

According to BBS (2015), Dhaka was the most popular district for internal migration between 2001 and 2011. When moving from one region to another employment was one of the primary reasons. Since Dhaka has a large presence of the export-oriented RMG sector, it is not unusual that it attracted most migrants. After Dhaka, people prefer to migrate to districts near Dhaka, such as Gazipur and Narayanganj for similar reasons. According to the last round of Economic Census for Bangladesh, districts of Dhaka and Gazipur reported the highest number of declared employees in the garment sector in Dhaka division in 2013. During the same period, a good proportion of

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<sup>9</sup> According to UNDP (2012), Bangladesh's urbanization rate stood at 3.03 percent over the period from 1975 to 2009—one of the highest in the world. A higher urbanization rate is indicative of greater internal migration or mobility for the country.

migrants settled in Chittagong division districts: Chittagong, Rangamati, Bandarban, Khagrachari, and Coxes' Bazar. Chittagong district, in particular, attracts migrants due to prevalence of job opportunities in the RMG sector.

In contrast, cross-district mobility in India has been historically low as documented in several studies.<sup>10</sup> Given the higher degree of internal migration in Bangladesh than India, it is possible that labor market effects due to export shocks are more likely to dissipate countrywide over time. In the next section, we describe how we evaluate this hypothesis.

## 4. Estimation Data Set and Methodology

Our main dependent variables are average wages and informality probability. Average wage variable is measured in real *takas* (normalized with the consumer price index). The informality variable is measured as probabilities at the sub-district level (rates).

To match the trade and labor market data, we use a concordance developed for the Bangladesh Standard Industrial Classification (BSIC). The structure of the BSIC 2001 is similar to the ISIC Rev.3. The structure of BSIC 2009 corresponds to ISIC Rev.4 with an additional division, 6 new groups, and 93 new classes to better correspond to Bangladeshi requirements. We link the BSIC 2001 with the BSIC 2009 and ISIC Rev.3.1 for further merging with the HSO–1988/92 trade classification used by the UN COMTRADE data.

The trade exposure index can be calculated on the basis of regions or industries as explained in the section on methodology. We consider a slightly modified exposure index calculated with only manufacturing industries, rather than all industries, to investigate if nonmanufacturing trade drove the results. The exposure variables are measured in real U.S. dollars (normalized with the consumer price index). We drop all workers who are younger than 15 years old from the sample. When calculating the trade exposure index, we include all individuals who reported an industry for their main activity. The reported industries of individuals in the labor force survey are mapped to the ISIC 3.1 industry codes at the 4-digit level so that the trade data can be merged with the labor data. When calculating the average wage and informality probability, we restrict the sample to the individuals who reported weekly wages larger than 100 takas.

### Methodology

This paper combines both the local labor market approach characterized by Bartik (1991) with an approach designed to generate evidence that can be compared with the long-run general equilibrium predictions described earlier.

#### Short Run Local Labor Market Effects of Positive Export Shocks

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<sup>10</sup> Limited labor mobility in India has been widely documented in the literature. Few key studies include Srivastava and McGee (1998); Singh (1998); Srivastava and Sasikumar (2003); Lusome and Bhagat (2006); and ZL Kone et al. (2018).

To estimate the relationship between exports and local labor market outcomes, we follow an unbiased econometric approach commonly employed in the literature to assess how exports affect workers in Bangladesh. Our starting point is that the impact of a trade shock should differ across regions, depending on the industry composition of each sub-district. For instance, let us imagine a trade shock especially prominent for a particular sector, regions where employment is more concentrated in that sector will be more affected. In this regard, differences in exposure of regions to this shock serves as an identification tool. A fundamental principle in this approach is existence of segmented labor markets. Identifiable labor mobility barriers or rigidities, such as commuting costs or lack of transport infrastructure, allows us to predict variations in local labor market outcomes and to estimate the effects of different exposure to trade.

We need to address potential endogeneity in trade exposure covariate. Since we observe changes in labor outcomes and exports simultaneously, we cannot identify which causes the other; an exogenous source of variation is required to determine direction of causality. Artuc et al. (2019) propose a strategy to estimate how an exogenous demand shock affects Indian and Sri Lankan labor markets. These authors ask how higher demand from the Organization for Economic Co-operation and Development (OECD) countries affects economic outcomes across districts in South Asian countries. They argue that local Indian and Sri Lankan market conditions are unlikely to affect OECD's total imports. In this paper, we follow a similar approach in that we use third countries' import demand as an exogenous source of variation for our trade exposure indicator.

We follow a two-stage econometric strategy. In the first stage, we use the contribution of external import demand to explain Bangladesh's export growth. By doing so, we ensure that our measure of Bangladesh exports will not be affected by local economic conditions. In the second stage, we estimate how an increase in exports per worker in Bangladesh affects local labor market outcomes, such as average wages and informality rates.

Unlike other South Asian countries, Bangladesh has a highly concentrated export basket both in terms of merchandise (garments) and trading partners (the U.S. and EU). This characteristic makes overall OECD imports a less suitable proxy for external demand for Bangladeshi exports. Therefore, we propose an instrument that better suits the Bangladesh export context. First, we focus on the U.S rather than all OECD countries. Our variable for the second stage of regressions consists of Bangladeshi exports per worker to the U.S.

Second, as mentioned above, most of these regions imports from Bangladesh consist of garments final goods. To ensure true exogeneity of our instrument, we need a variable that predicts imports from Bangladesh based solely on the United States internal demand growth, rather than supply-side determinants such as changes in production volumes from other garment export competing countries. Hence, we construct our instrument using time-series regressions of Bangladesh exports to the United States on the United States GDP by industry at the four-digit level, from 1991 to 2018 annually. Predicted values from these regressions proxy for Bangladesh exports to the U.S. explained exclusively by U.S domestic aggregate demand. This variable is, by construction, orthogonal to every supply-side factor in the international garments market, and to every Bangladeshi local market condition. Using this instrument helps us calculate the exogenous portion of the variation in exports from Bangladesh, preventing a bias in our regressions due to



endogeneity. In other words, it is extremely unlikely that local economic outcomes in Bangladesh determine U.S. domestic demand for apparel.

Figure 10 shows the relationship between EU-US imports from Bangladesh and imports from the world. The strong positive correlation suggests that the instrument is appropriate.

[Figure 10 near here]

Each sub-district in Bangladesh constitutes an observation in our regressions. Given lack of data on international trade at the sub-district level in Bangladesh, we use the approach proposed by Bartik (1991) that takes advantage of a concentration of production and local labor markets to assess the relationship between globalization and local labor market outcomes. In other words, we can compute a measure for sub-district exports based on the sub-district employment concentration in each exporting industry. We call this new variable our “trade exposure index”.

The change in industry  $i$  exports of Bangladesh between time  $t$  and  $t + n$  can be expressed as  $Q_{t+n}^i - Q_t^i$ . Then the change in exports per worker for industry  $i$  is equal to  $(Q_{t+n}^i - Q_t^i) / (\sum_r L_t^{i,r})$ . Thus, we can calculate the effective change in exports weighted by the labor shares for each region as:

$$x_{t,t+n}^r = \sum_i \frac{L_t^{i,r} (Q_{t+n}^i - Q_t^i)}{(\sum_j L_t^{j,r}) (\sum_d L_t^{i,d})}$$

Alternatively, we can express the exposure formula as:

$$x_{t,t+n}^r = \sum_i \frac{L_t^{i,r} (Q_{t+n}^i - Q_t^i)}{L_t^r L_t^{i,Bangladesh}}$$

where  $L_t^r$  is the total number of workers assigned to any industry in district  $r$  and  $L_t^{i,Bangladesh}$  is the total size of industry  $i$ . The trade exposure variable  $x_{t,t+n}^r$  can be interpreted as the change in exports per worker in district  $r$  measured in real U.S. dollars. Figure 11 shows the trade exposure index; that is, the change in exports per worker between 2005 to 2010, 2005 to 2013, and 2005 to 2016 for each district.

[Figure 11 near here]

We consider the following simple linear regression model:

$$y_{t,t+n}^{s,r} = \beta_0^s + \beta_1^s x_{t,t+n}^r + \beta_2^s y_t^{s,r} + \epsilon_{s,r}$$

where  $s$  is the type of worker,  $y_{t,t+n}^{s,r}$  is the dependent variable,  $\beta_0^s$  is the intercept,  $\beta_1^s$  is the coefficient of our trade exposure variable, and  $\beta_2^s$  is the coefficient of the control variable.  $x_{t,t+n}^r$  is our main independent variable, which stands for the sub-district level trade exposure index. We include time  $t$  levels of the dependent variable to control for effects from possible trends not related to the trade shock. The size of the sample equals the number of sub-districts. We can run these estimates for different types of workers by restricting the sample to type of worker  $s$ . The

interpretation of the regression is simple, and it tells us how much of the change in  $y_t^{S,r}$  between years  $t$  and  $t + n$  can be attributed to the change in exports per worker driven by exogenous demand in United States (explained exclusively by U.S. domestic aggregate demand).

## Long-run General Equilibrium Evidence

The conceptual framework suggests that trade shocks would first affect industry wages for all workers within those industries (inter-industry wage differentials), and then emerge in characteristics not associated specifically with industries, such as gender or education. That is, the Stolper-Samuelson theorem predicts that a change in the relative prices of a given sector will change returns to the factor employed intensively in that industry throughout the entire economy. Given the large concentration of Bangladesh exports in the garments sector, it is natural to define our external shock as the increasing demand for apparel exports from Bangladesh throughout the last decade.

Under this rationale, we would expect wages to increase for those types of workers most intensively employed in the garments industry; that is, females and low-skilled workers. Conversely, we would expect a decrease in wage premiums for males and high-skilled workers. We estimate these dynamics using Oaxaca-Blinder decomposition that separates the observed wage differences into the observable and unobservable components. In addition, we employ the technique of Mincerian wage equation. In particular, if positive export shocks have an aggregate beneficial wage effect for females and low-skilled workers in Bangladesh, we would expect coefficients in year-by-year Mincerian regressions corresponding to the dummy variables for these types of workers to increase across years because these coefficients capture the returns to these characteristics throughout the entire economy. We consider the following Mincerian wage equation:

$$y_{i,t} = \beta_0 + \beta_{1,t}female_{i,t} + \beta_{2,t}age_{i,t} + \beta_{3,t}age^2_{i,t} + \beta_{4,t}high - skilled_{i,t} + \beta_{5,t}RMG_{i,t} + \beta_{6,t}female * RMG_{i,t} + \beta_{7,t}industry + \beta_{8,t}hours + \epsilon_{i,t}$$

where the dependent variable  $y_{i,t}$  captures real weekly wages in log terms, and the vector of coefficients represents contribution to earnings of each of the represented elements. Our variables of interest are female, textiles and apparel, the interaction between female and the RMG dummy, and high-skilled workers. We also include control covariates such as age, age squared, industry dummies, and weekly hours worked. We also extend the same empirical model to include all years from 2005 to 2016 in the same regression, controlling for time fixed effects.

## 5. Results

We begin with the local labor market estimates and then compare the long-run Mincerian estimates against the Stolper-Samuelson predictions.

## Localized Effects of Export Shocks

To estimate the change in sub-district-level wages and informality rates due to positive export shocks experienced in Bangladesh, we define three different periods: 2005 to 2010, 2005 to 2013, and 2005 to 2016. We also carry out the analysis for different types of workers, such as males, females, low-skilled, and high-skilled. The results, shown graphically in Figure 12 and in Tables 2 (wages) and 3 (informality), show that sub-districts more exposed to trade experienced a 3,062 *taka* increase in average wages relative to less exposed sub-districts in the short-run, that is 2005 to 2010.

[Figure 12 near here]

Although this effect is still significant for the time-span 2005 to 2013, the magnitude of the effect decreases substantially to 658 *takas*. In turn, in the most prolonged period of analysis, 2005 to 2016, impacts dissipate, not only diminishing in magnitude of the coefficient but also becoming not statistically significant. Looking at manufacturing workers exclusively, we observe the same effects: a positive and decreasing effect on wages over time, notwithstanding that the only statistically significant results are those for the 2005 to 2013 period.

We also analyzed the effects of an increase in trade exposure on textiles and apparel workers' outcomes, since the Bangladeshi export basket is highly concentrated in the garments industry. We found that the trend of dissipating effects over time holds, but no effect is statistically significant. A plausible explanation is that dissipation occurs very quickly; it may take less than five years for the expanding apparel industry to attract workers from other industries. In this case, we would not detect a significant effect on the apparel industry separately. Another possible explanation is that textiles and apparel industries tend to concentrate in a few sub-districts, reducing the number of observations the regressions capture, making it difficult to find conclusive results. Surprisingly, average wages of service sector workers increased by 4,810 *takas* in the short term but drastically fell to a non-significant 219 *takas* and 867 *takas* when looking at three and six additional years (2005 to 2010 and 2005 to 2016).

Consistent with findings of Artuc et al. (2019) for India, better-off groups also benefitted the most from trade in terms of wages in Bangladesh. Average wage increases in sub-districts more exposed to the trade shock were substantially higher for males relative to females, high-skilled workers' average wages increased five times more than low-skilled workers' wages, and experienced workers' wages grew twice as much as for younger workers. Interestingly, while wages increased only for urban workers in the short-run, workers in rural areas seem to benefit more in the long-run.

How did an increase in exports affect informality in Bangladesh? Again, results show a significant reduction in short-run informality rates, but the effect dissipates over time, as shown in Figure 12. For instance, a US\$100 increase in exports per worker between 2005 and 2010 led to a 0.7 percent decrease in informality in sub-districts with higher exposure to trade. Informality decreased not only in magnitude but also in statistical significance in additional years; for 2005 to 2013, the impact was just a 0.4 percent reduction, although not statistically significant, while looking at 2005 to 2016 we see no effect on informality. We find similar results when focusing on manufacturing

workers. Informality decreased from 1.2 to 0.4 percent when analyzing a longer time span. Surprisingly, no significant effects are observed for 2005 to 2013. As in Artuc et al. (2019), females seem to benefit more than males in terms of trade effects on informality reduction, 1.5 versus 0.7 percent. Unlike Artuc et al. (2019) findings in India, we do not observe a statistically significant difference in effects between low-skilled and high-skilled and between young and old workers.

In summary, we find significant short-run benefits for workers in labor markets, but they dissipate relatively quickly in the longer run. When taking into consideration more extended periods, region-specific wage increases and informality reductions, disappear, likely due to labor mobility and worker migration.

As explained above, our methodology can capture only region-specific effects on economic outcomes due to an export shock, and not the economy-wide aggregate effect. In the following sections, we propose a different approach that allows estimating aggregate effects from increased trade on labor market outcomes.

### Evidence of Long-run Predictions of Neoclassical Theory

In this sub-section, we describe the results from estimating the Oaxaca-Blinder decompositions and year-by-year Mincerian regressions using the econometric specification explained above.

The Oaxaca-Blinder decompositions shown in table 4 include education, experience, age, and the Ready-Made Garments (RMG) industry dummy and number of hours worked as observable characteristics. The decompositions show that in Bangladesh the gender differential was around 56.9 per cent in 2005, and it fell to 9.6 per cent until 2016. The table also shows that the ‘unobservable’ component of the male-female wage gap explains most of the gap over time. The ‘explainable’ portion, which includes changes that might occur from women getting more education and experience, their age, if they are working in RMG and number of hours worked is relatively small and constant. This means that the returns to different characteristics would be changing over time. These results suggest that we can look at changes in the betas of the Mincerian wage equation over time, because those changes clarify the ‘unexplained’ part of the Oaxaca-Blinder decomposition.

*[Table 4 near here]*

We present results from our Mincerian wage equations in Table 5 and Table 6. We observe that in 2005, on average, women in Bangladesh earned 60 percent less, on average, than males. As expected, substantial increases in demand for Bangladesh exports in the female-intensive garments sector significantly reduced this wage differential throughout the following years: the female-male wage gap decreased to -12 percent in 2010 and -11 percent in 2013. Despite a reverse in this trend in the next years, when exports fell, the female-male wage gap still remained substantially below 2005 levels. Similarly, high-skilled wage premiums relative to low-skilled workers decreased during the same time, from 70 percent in 2005 to 52 percent in 2016 (see Table 6).

*[Table 5 and 6 near here]*

Further, pooling all years together and adding interaction terms between time and gender helps us not only understand whether the female-male wage gap has varied across time but also test whether these changes are statistically significant (Table 7). Consistent with results in Table 6, the interactions of female and year dummies in column 3 of Table 7 show a dissipating wage differential over the years, shifting from -0.569 in 2005 (relative to 2013) to -0.0408 in 2010. Once again, we observe a slight downturn in 2016 due to the drop-in apparel exports, although far from 2005 levels. These results are consistent with the Stolper-Samuelson theorem equilibrium. Rising apparel prices beginning in 2005, caused by higher import demand from the U.S. and EU, had an aggregate economy-wide wage increase effect particularly on those type of workers more intensively employed in the apparel and textile industry; that is, for female, low-skilled, and younger workers.

*[Table 7 near here]*

## 6. Conclusions

Recent developing country research finds evidence that trade shocks affect local labor market outcomes including earnings, informal and formal employment levels, and skill premium. These impacts vary depending on the type of shock being considered. On one hand, evidence shows that rising exports to industrial countries reduced poverty and spurred reallocation of labor from informal to formal jobs in several developing countries like India, Vietnam, and China (McCaig, 2011; McCaig and Pavcnik, 2018; Artuc et al., 2019; and Erten and Leight, 2017). On the other hand, trade liberalization measures slowed the pace of poverty reduction and triggered a persistent declining trend in wages and employment in few developing countries like India and Brazil (Topalova, 2010; Dix-Carneiro, 2017; and Artuc et al., 2019).

Despite this burgeoning literature shedding light on the heterogeneous effects of trade shocks across regions, evidence on local labor market effects from “positive demand shocks” is only nascent, and transitional dynamics driving labor market effects from shocks have not been widely studied.

Using detailed data from Bangladesh, we extend the existing literature by estimating not only the short run effects but also dissipation and long-run general equilibrium effects linked to neoclassical trade theory of a positive demand shock for a low-middle income country. Our results show that labor market responses to export shocks differs across regional labor markets in the short-run — that is, between 2005 and 2010—but seem to dissipate in the longer run, 2005 to 2016, as neoclassical trade theory would predict. This suggests that trade shock effects on labor market outcomes differ regionally only temporarily in a country with labor markets where workers are mobile and with relatively low barriers to migration. In contrast, these effects seem to become more economy-wide driven by returns to factors and not industry or region specific as predicted by Stolper Samuelson theorem in the long run.

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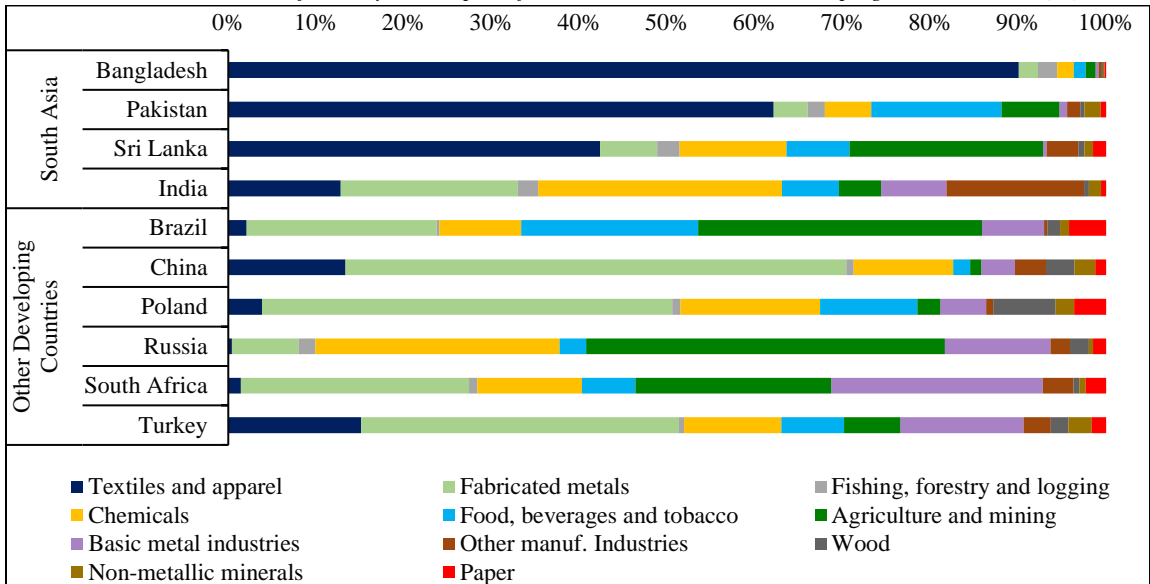
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**Figure 1. A big range in export portfolio concentration**

*Sectorial breakdown of country-wise exports from South Asia and other developing countries, 2016 (%)*



Source: Artuc et al., (2019).

**Figure 2a: Theoretic Intuition of a Short-Run Export Shock's Effects on Labor Markets**

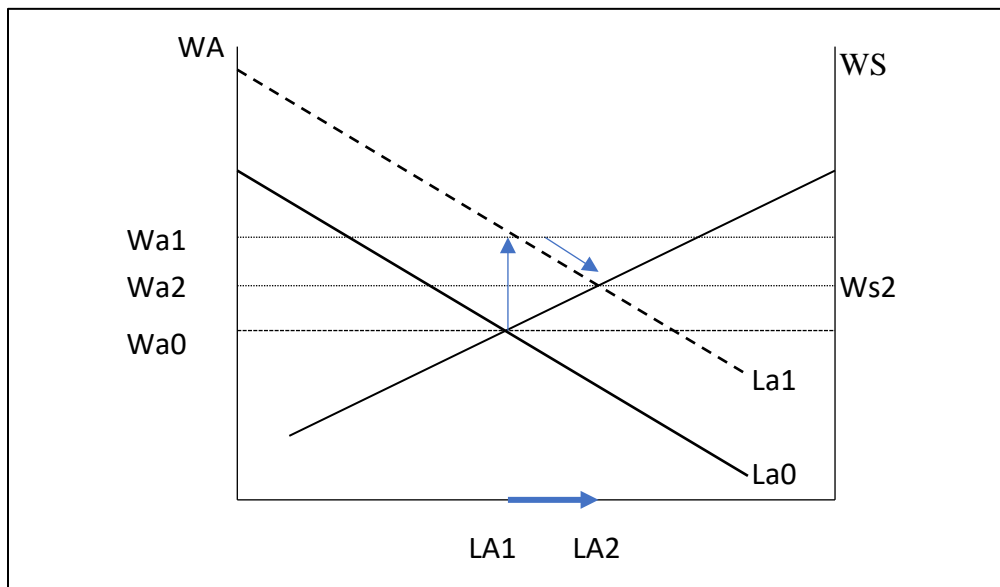


Figure 2b: Long-Run Effects of an Export Shock

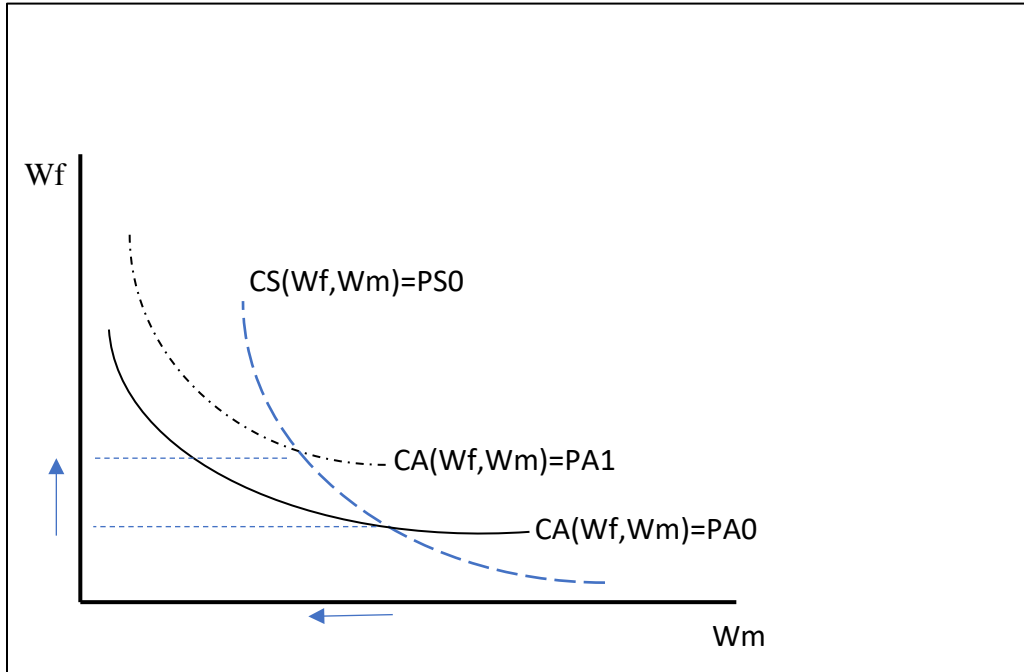
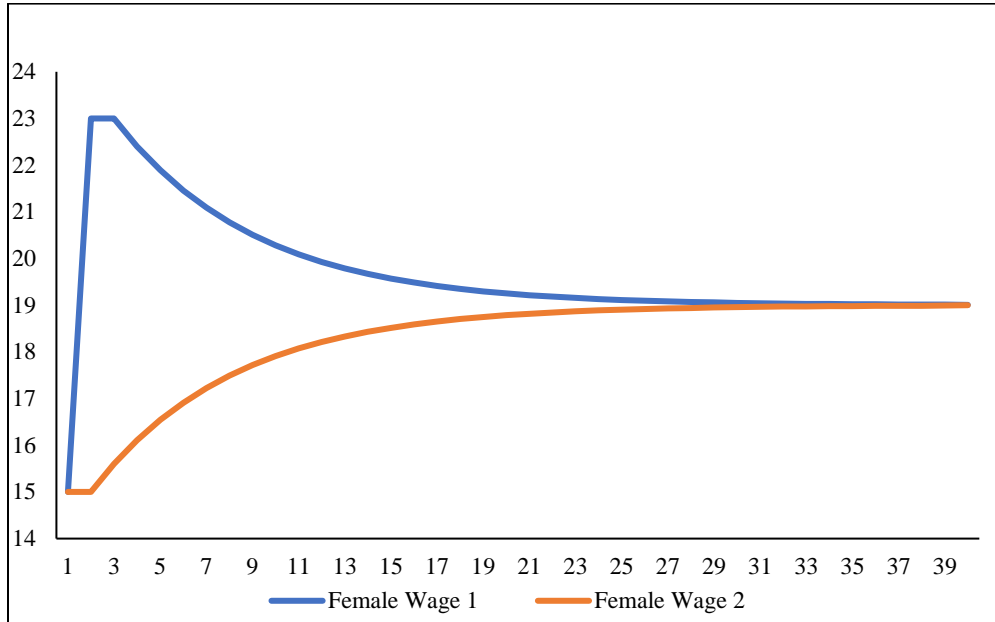


Figure 3a: Dynamic Adjustment in Specific Factors Model: Males



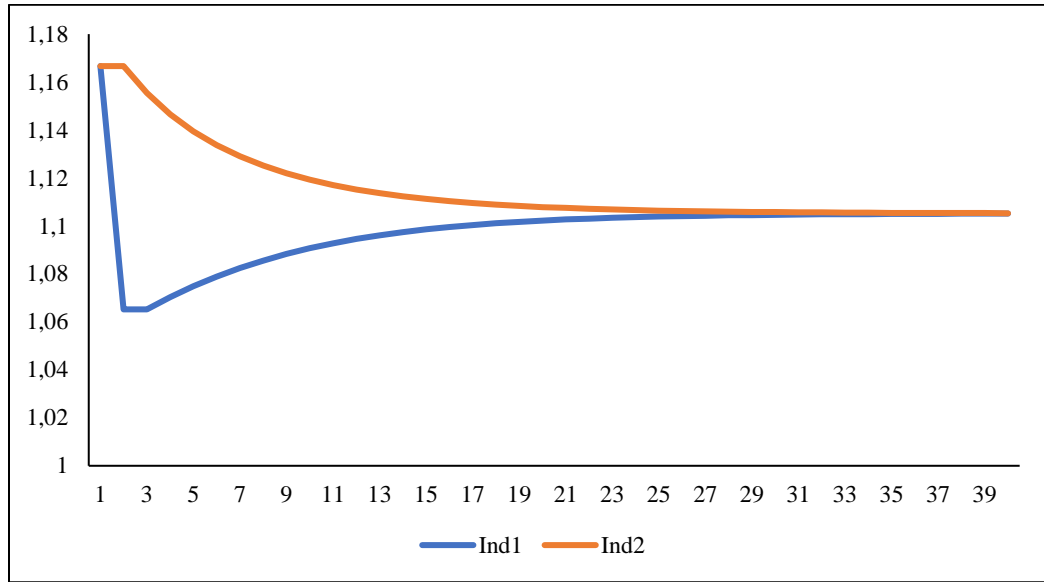
**Notes:** This figure shows the effects of a 20% relative price shock to industry 1. The initial equilibrium wage is 17.5 and the final wage is 21. The simulation uses the adjustment parameter  $\mu=0.15$ . Note that the gap in industry wages starts large but shrinks over time, and that the differential is different for males and females (from Figure 1b). Time periods are shown along the horizontal axis and the shock occurs in period 1.

**Figure 3b: Dynamic Adjustment in Specific Factors Model: Females**



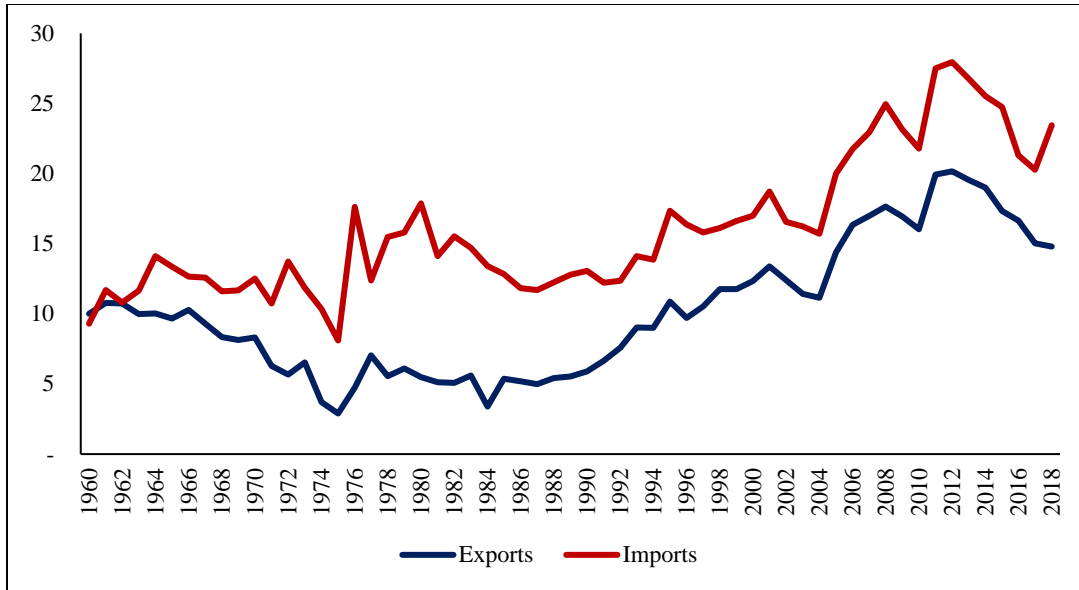
**Notes:** This figure shows the effects of a 20% relative price shock to industry 1. The initial equilibrium wage is 15 (the male-female wage ratio starts at 1.17) and the final wage is 19. The simulation uses the adjustment parameter  $\mu=0.15$ . Note that the gap in industry wages starts large but shrinks over time, and that the differential is different for males and females (from Figure 1b). Time periods are shown along the horizontal axis and the shock occurs in period 1.

**Figure 4: Adjustment to General Equilibrium: Male-Female Wage Ratios**



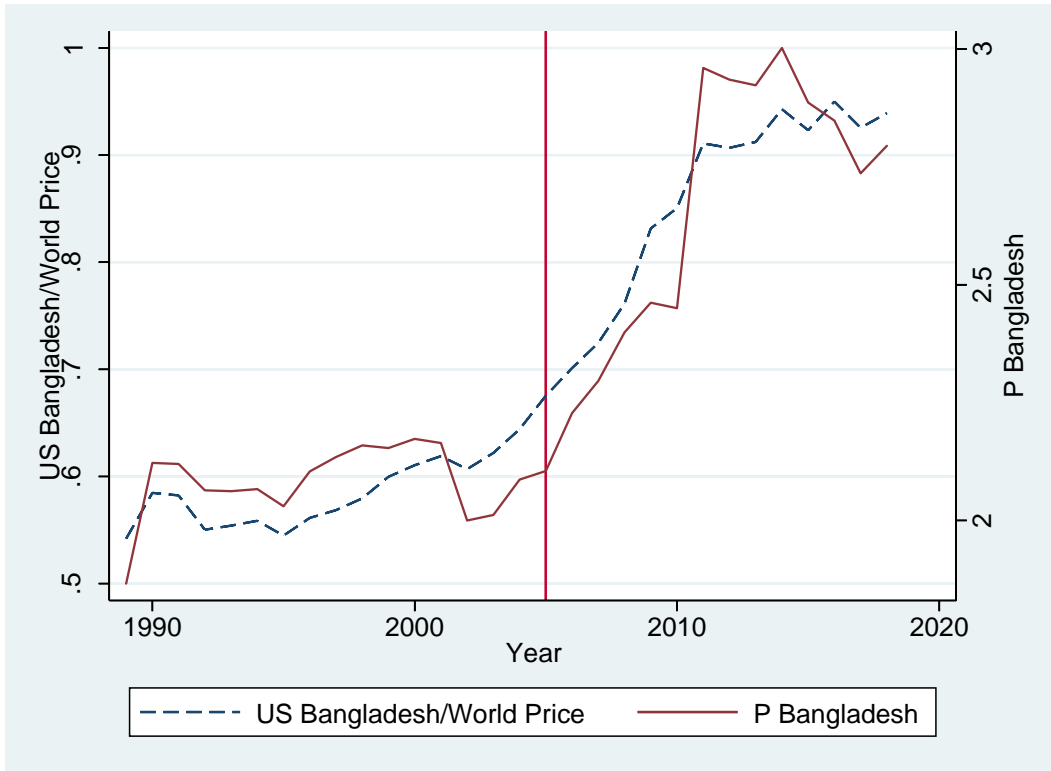
**Notes:** This figure shows the effects of a 20% relative price shock to industry 1. The initial equilibrium male-female wage ratio starts at 1.167. The simulation uses the adjustment parameter  $\mu=0.15$ . Note that the wage differentials change in each industry in the short run, but equalize in the long run. The final male-female wage ratio is 1.105.

**Figure 5a: Bangladesh's exports and imports up sharply starting in 2005**  
(Bangladesh's exports and imports as a share of GDP, 1970–2016, %)



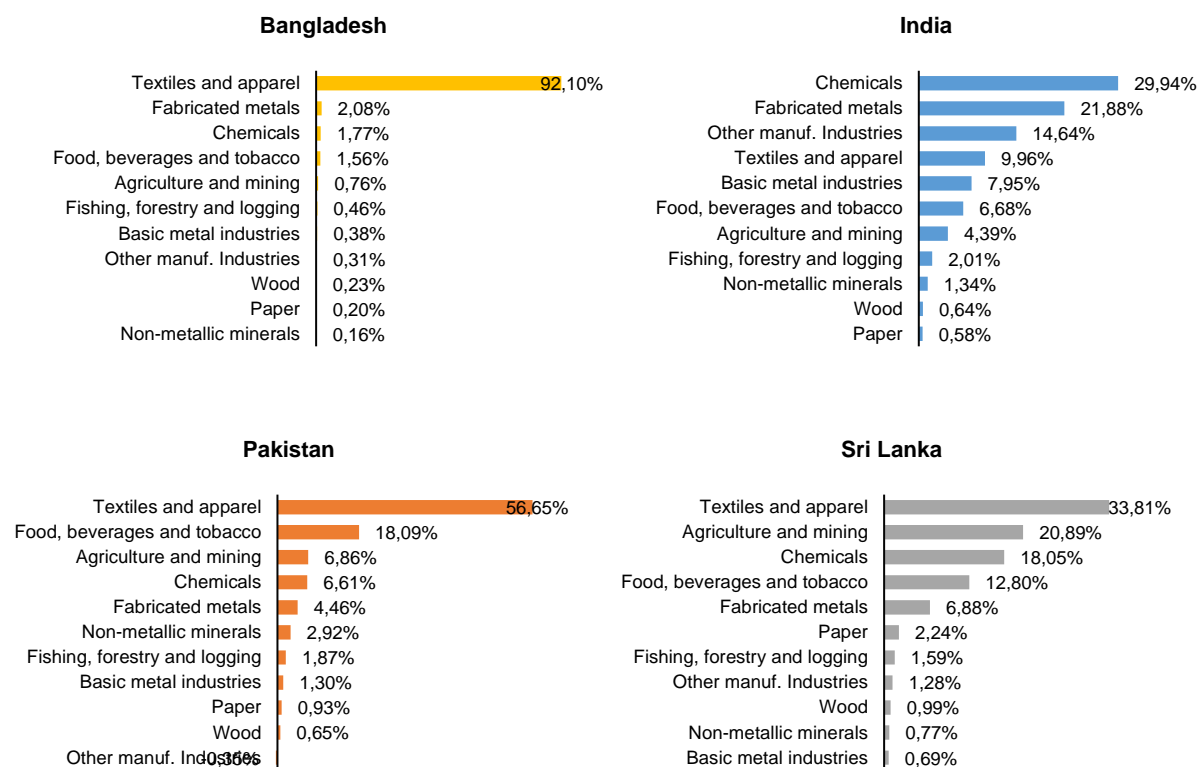
Source: World Development Indicators database at the World Bank.

Figure 5b: Unit Values of U.S. Imports from Bangladesh



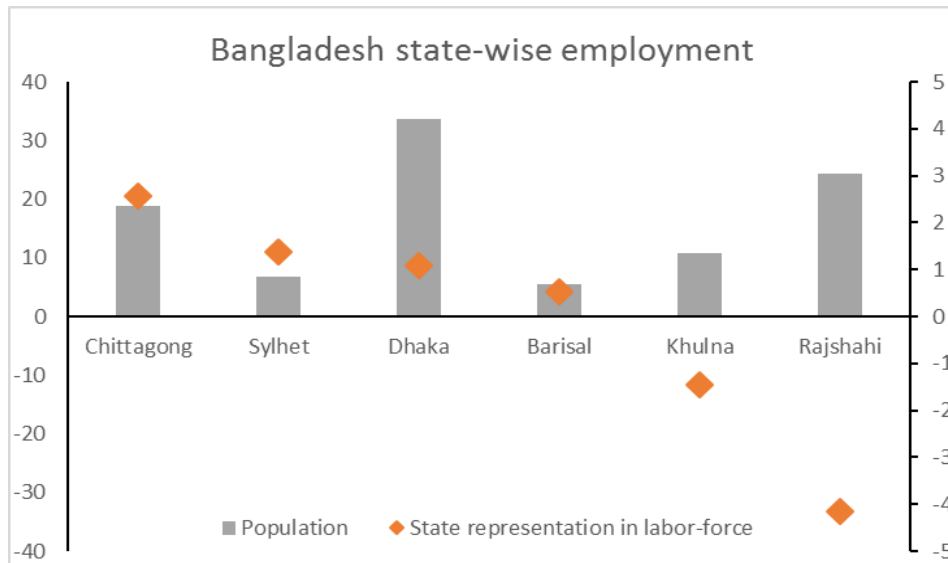
**Source:** U.S. Department of Commerce, Office of Textiles and Apparel (OTEXA). Unit Values are calculated as the total import value divided by the total quantity of apparel measured in square-meter-equivalent. The World Price is measured as the total U.S. value of imported apparel (OTEXA Category 1 (Apparel)) divided by the total U.S. SME import quantity.

**Figure 6. Textiles and apparel leading South Asian export growth**  
*(Industry-wise contribution to exports growth in South Asia, 2000–16 (%))*



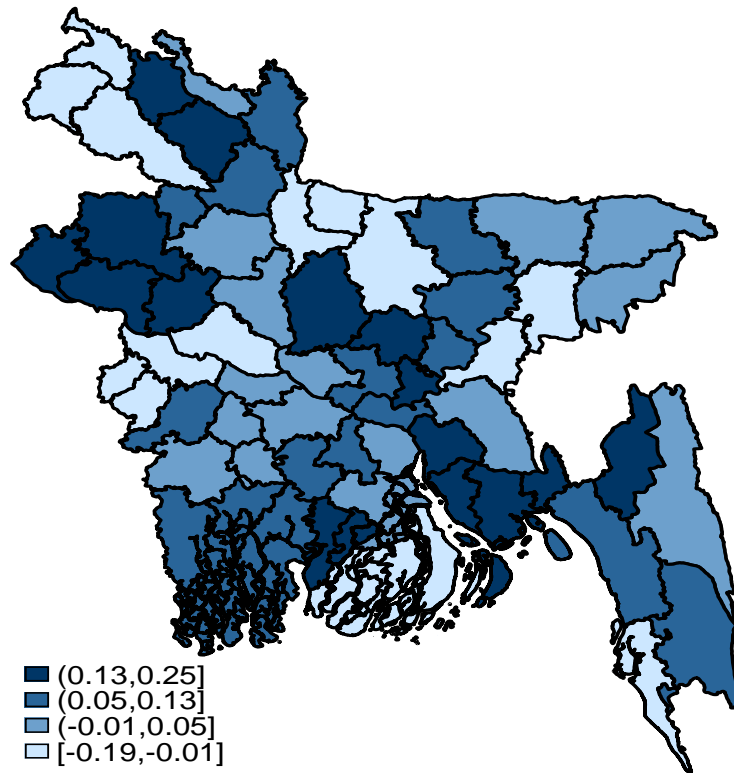
Source: Artuc et al., (2019)

**Figure 7. Jobs are concentrated in a few states in a few areas**  
*(Division-wise employment patterns in Bangladesh, 2016)*



Source: Calculations based on Labor Force Surveys for Bangladesh

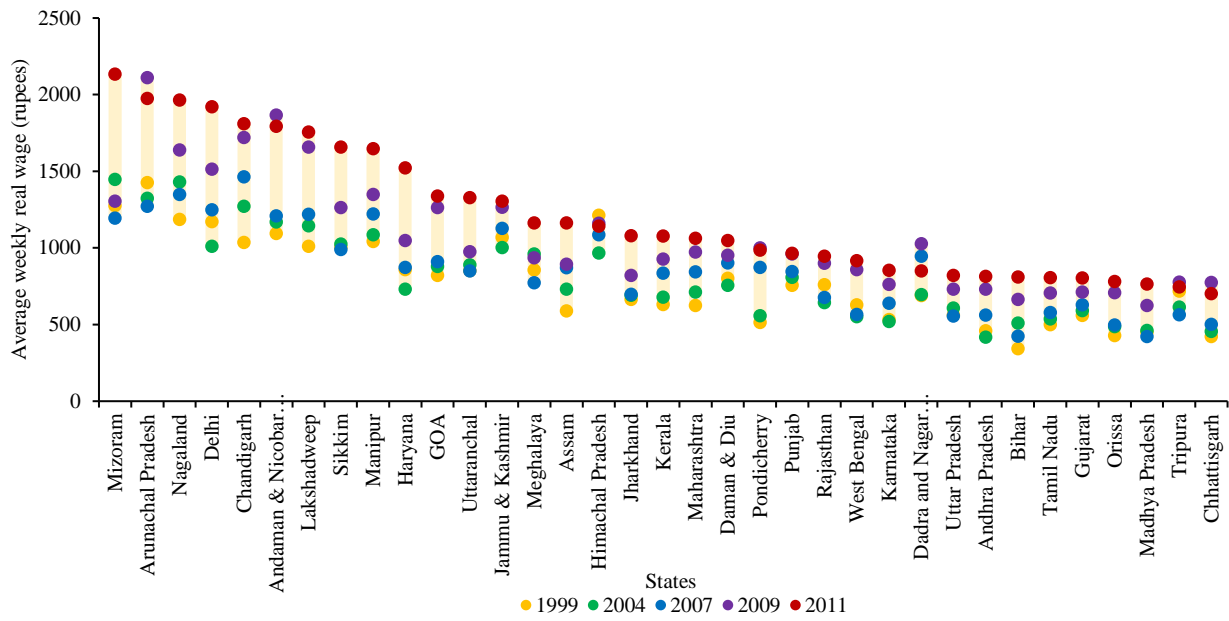
Figure 8: Regional variation in female employment in Bangladesh between 2005 and 2013



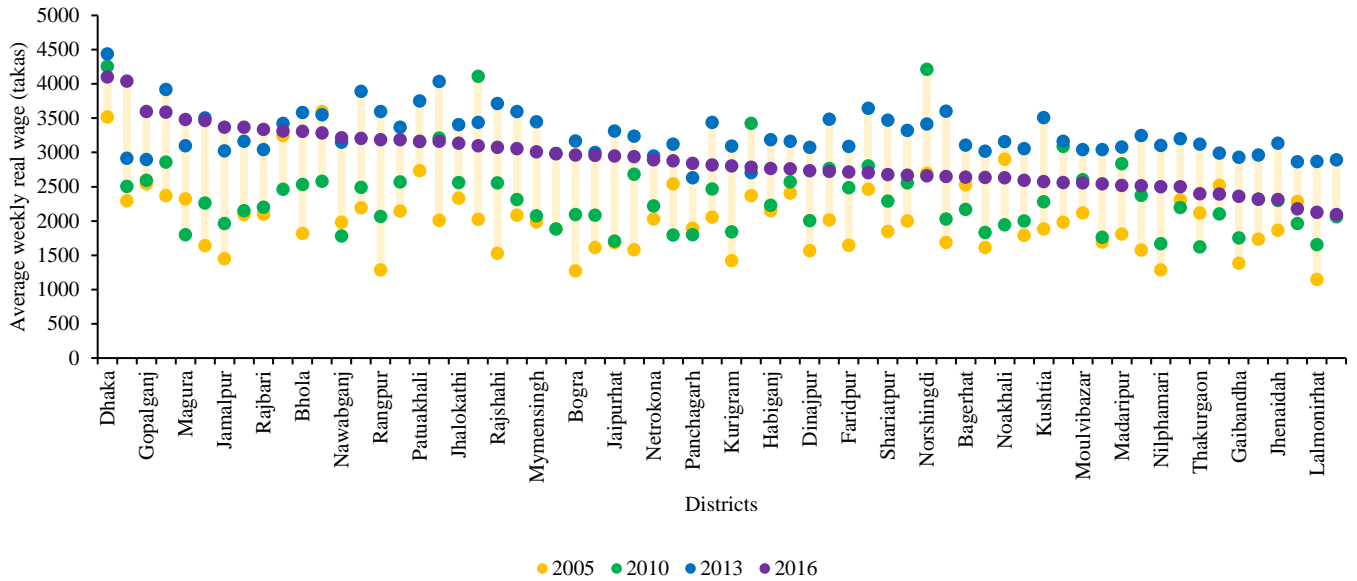
Source: Calculations based on Labor Force Surveys for Bangladesh.



**Figure 9. Average Real Wages Across Regions**  
**a) India**

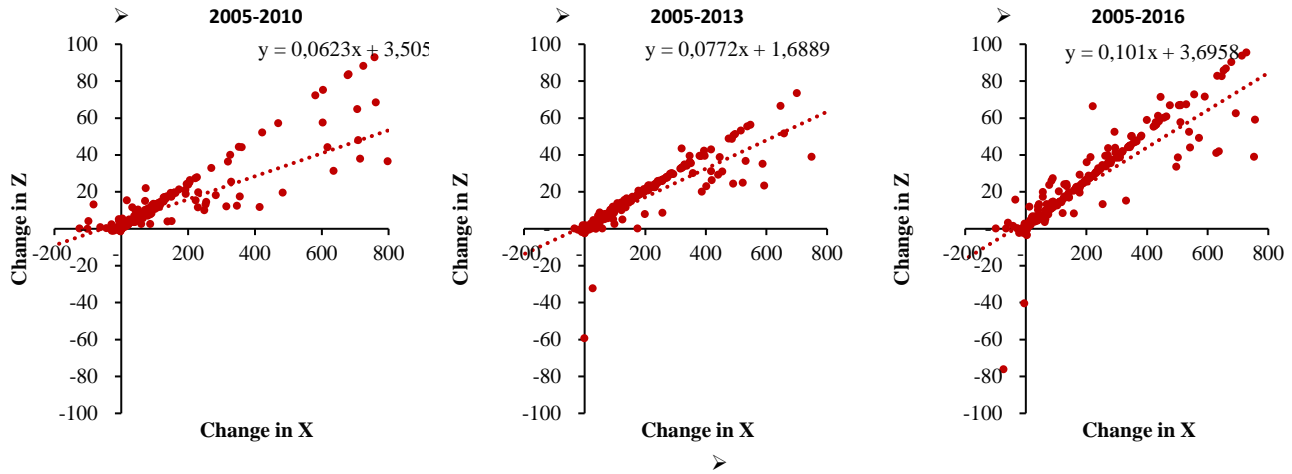


**b) Bangladesh**



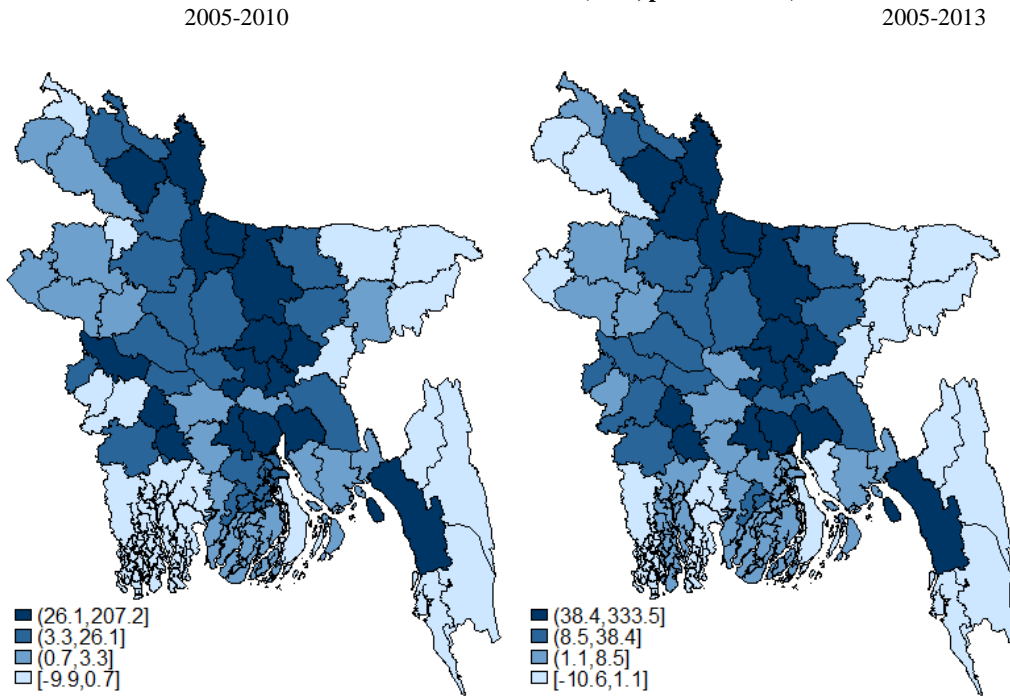
Source: Calculated by the authors using data form the Bangladeshi and Indian LFS.

**Figure 10. Relationship between OECD and US-EU imports from Bangladesh (X) and imports from all around the world (Z, instrument)**



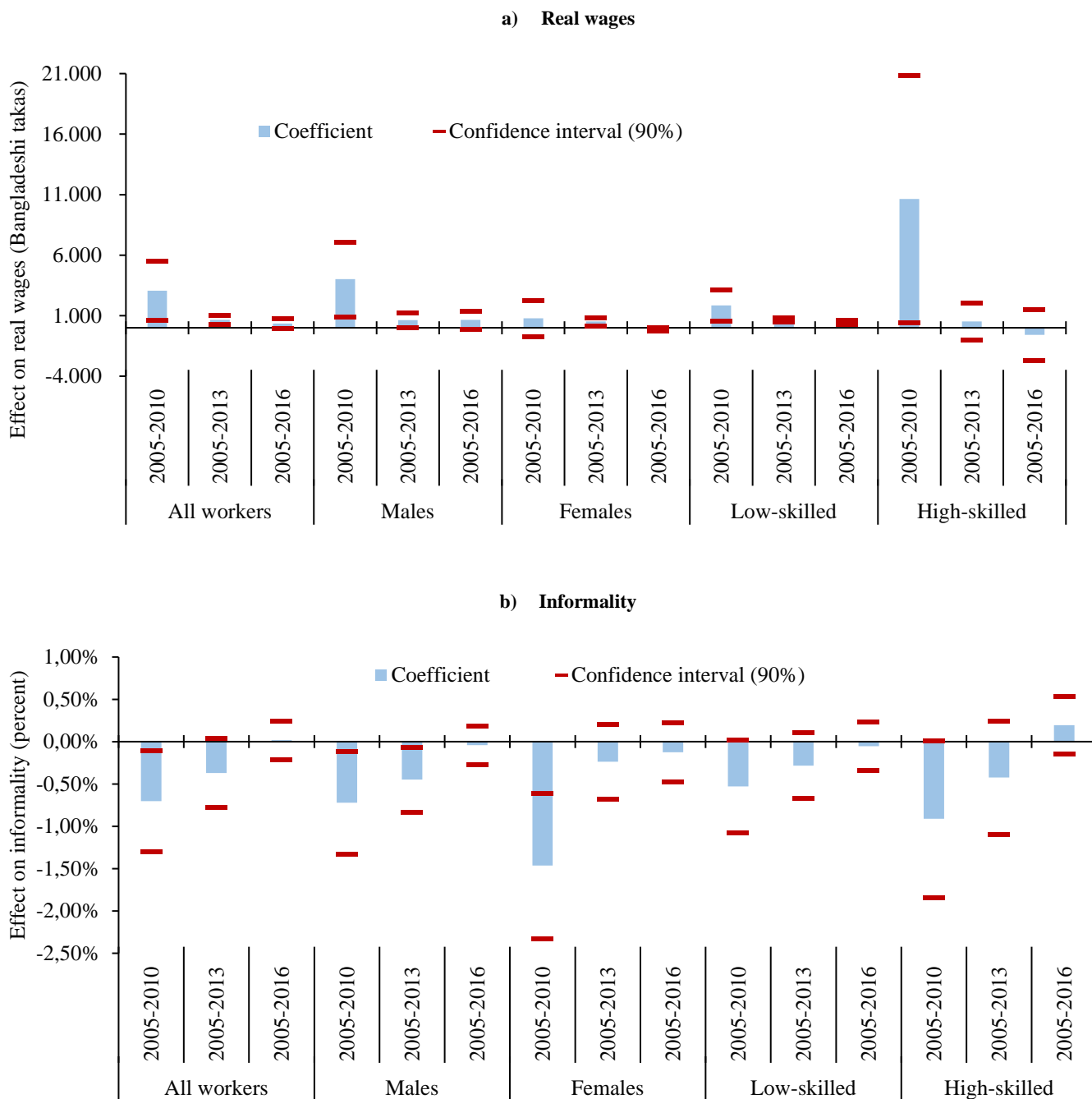
Source: Prepared by the authors using data from the Bangladesh LFS.

**Figure 11: Change in exports per worker between 2005-2010 and 2005-2013 (USD, prices of 2005)**



Source: Prepared by the authors using data from the Bangladesh LFS. These heat maps show regional variation in trade exposure i.e. change in exports per worker between 2005-2010 and 2005-2013 (USD, prices of 2005).

**Figure 12: Change in the average annual real wage and the informality rate after a US\$100 increase in exports per worker (Real Bangladeshi Takas of 2017 and percentage)**



**Notes:** Author's estimates using data from Bangladesh LFS and UN COMTRADE. The confidence intervals are set at the 90% level. These graphs are based on 2SLS regression computed to estimate effect of an increase in exports on real wages and informality. This relationship is estimated for different worker types (male, female, rural, skilled, unskilled, young, and old).

**Table 1a. Coefficient of variation of real weekly wages across sub-districts in Bangladesh**

<b>Bangladesh</b>				
	All sectors			
	2005	2010	2013	2016
All workers	0.27	0.24	0.09	0.14
Males	0.27	0.27	0.10	0.16
Females	0.38	0.17	0.21	0.18
Young	0.25	0.22	0.09	0.11
Old	0.30	0.29	0.13	0.20
High-skilled	0.19	0.26	0.13	0.16
Low-skilled	0.28	0.21	0.07	0.11

	Textiles & Apparel			
	2005	2010	2013	2016
All workers	0.37	0.27	0.15	0.18
Males	0.40	0.34	0.21	0.23
Females	0.75	0.36	0.16	0.28
Young	0.38	0.33	0.14	0.19
Old	0.80	0.41	0.26	0.31
High-skilled	0.43	0.37	0.24	0.33
Low-skilled	0.95	0.30	0.16	0.17

Note: Real weekly wages in USD and prices of 2011. Author's estimates using labor force survey data from Bangladesh.

**Table 1b. Coefficient of variation of real weekly wages across sub-districts in India**

<b>India</b>					
	All sectors				
	1999	2004	2007	2009	2011
All workers	0.64	0.59	0.55	0.62	0.54
Males	0.60	0.54	0.50	0.61	0.52
Females	0.96	0.81	1.32	0.78	0.78
Young	0.64	0.65	0.53	0.65	0.50
Old	0.65	0.56	0.57	0.63	0.60
High-skilled	0.47	0.47	0.46	0.59	0.47
Low-skilled	0.87	0.59	0.62	0.62	0.43

	Textiles & Apparel				
	1999	2004	2007	2009	2011
All workers	1.01	0.83	0.93	0.92	1.36
Males	0.95	0.77	0.90	0.93	1.28
Females	0.77	1.23	0.65	0.76	0.68
Young	0.60	0.69	0.69	0.87	0.69
Old	0.92	0.79	1.05	0.87	1.33
High-skilled	0.89	0.77	0.95	0.87	1.36
Low-skilled	0.92	0.70	0.76	0.67	0.58

Note: Real weekly wages in USD and prices of 2011. Author's estimates using labor force survey data from India.

**Table 2. Change in the average annual real wages after a US\$100 increase in exports per worker (Real Bangladeshi Takas of 2017 and percentage) using Two-Stage Least Squares (2SLS) Regression Analysis**

Type of worker		1st Stage			2nd Stage (Wages)		
		2005-2010 (1)	2005-2013 (2)	2005-2016 (3)	2005-2010 (1)	2005-2013 (2)	2005-2016 (3)
All	Coefficient	13.16***	11.05***	8.828***	3,062**	658.2***	347.6
	Standard error	(1.576)	(1.102)	(0.681)	(1,475)	(246.5)	(252.5)
	N	448	448	448	408	395	423
Manufacturing	Coefficient	13.28***	11.60***	9.163***	1,810	448.3**	245.1
	Standard error	(2.013)	(1.321)	(0.904)	(1,446)	(216.0)	(162.4)
	N	132	132	132	70	71	115
Textiles and apparel	Coefficient	12.61***	12.19***	9.497***	990.4	105.4	205.7
	Standard error	(2.645)	(1.538)	(1.103)	(1,485)	(404.5)	(176.9)
	N	46	46	46	29	24	35
Services	Coefficient	14.20***	9.267***	7.889***	4,810*	218.7	866.7
	Standard error	(2.169)	(1.673)	(0.819)	(2,729)	(808.5)	(854.0)
	N	256	256	256	223	161	230
Males	Coefficient	13.07***	10.66***	8.575***	4,014**	638.8*	659.3
	Standard error	(1.422)	(1.000)	(0.552)	(1,878)	(363.7)	(460.2)
	N	439	439	439	401	370	411
Females	Coefficient	13.62***	11.63***	9.241***	782.7	515.9**	-123.2
	Standard error	(2.237)	(1.506)	(1.022)	(893.0)	(207.3)	(92.46)
	N	100	100	100	47	57	89
Low-skilled	Coefficient	13.23***	11.21***	8.925***	1,838**	676.4***	467.6***
	Standard error	(1.656)	(1.156)	(0.733)	(783.9)	(104.4)	(100.4)
	N	426	426	426	386	352	399
High-skilled	Coefficient	13.32***	9.804***	8.117***	10,653*	516.4	-591.4
	Standard error	(1.807)	(1.231)	(0.606)	(6,212)	(936.3)	(1,275)
	N	150	150	150	93	86	130
Young	Coefficient	13.18***	11.38***	9.035***	2,326*	473.5***	255.8**

	Standard error	(1.727)	(1.187)	(0.781)	(1,345)	(158.8)	(116.2)
	N	355	355	355	304	264	327
Old	Coefficient	12.55***	9.767***	7.986***	4,794**	960.7	908.8
	Standard error	(1.662)	(1.078)	(0.533)	(2,242)	(721.9)	(618.6)
	N	365	365	365	323	247	344
Rural	Coefficient	10.44***	10.45***	7.657***	2,284	1,671***	1,111**
	Standard error	(0.813)	(0.389)	(0.462)	(1,583)	(385.1)	(442.1)
	N	389	389	389	353	319	355
Urban	Coefficient	13.56***	11.00***	8.911***	2,550*	93.32	-190.0
	Standard error	(1.779)	(1.278)	(0.777)	(1,407)	(279.8)	(275.7)
	N	191	191	191	116	135	143

Note: Robust Standard errors are in parentheses. \*, \*\*, \*\*\* significance level at 10%, 5% and 1%.

Source: Author's estimates using data from Bangladesh LFS and UN Comtrade. This table shows the first and second stage of the 2SLS regression. In the first stage, we estimate the contribution of US import demand to the increase in Bangladesh exports, and in the second stage we estimate the effect of an increase in exports on real wages. This relationship is estimated for different worker types (male, female, rural, skilled, unskilled, young, and old).

**Table 3. Change in the informality rate after a US\$100 increase in exports per worker (Real Bangladeshi Takas of 2017 and percentage) using Two-Stage Least Squares (2SLS) Regression Analysis**

Type of worker		1st Stage			2nd Stage (Informality)		
		2005-2010	2005-2013	2005-2016	2005-2010	2005-2013	2005-2016
		(1)	(2)	(3)	(1)	(2)	(3)
All	Coefficient	14.14***	10.65***	8.665***	-0.00703*	-0.00369	0.000168
	Standard error	(1.558)	(1.223)	(0.700)	(0.00361)	(0.00246)	(0.00139)
	N	429	452	448	429	452	448
Manufacturing	Coefficient	13.44***	11.60***	9.226***	-0.0121**	0.00177	0.00412**
	Standard error	(2.679)	(1.651)	(1.035)	(0.00573)	(0.00223)	(0.00197)
	N	119	123	176	119	123	176
Textiles and apparel	Coefficient	12.79***	10.01***	9.437***	-0.00609	0.00763**	-0.00358
	Standard error	(3.460)	(0.769)	(1.302)	(0.00501)	(0.00355)	(0.00262)
	N	33	31	41	33	31	41
Services	Coefficient	13.55***	10.38***	8.497***	-0.00328	0.000861	0.000939
	Standard error	(1.586)	(1.168)	(0.604)	(0.00269)	(0.00162)	(0.000897)
	N	391	363	415	391	363	415

Males	Coefficient	13.72***	10.61***	8.583***	-0.00722*	-0.00448*	-0.000417
	Standard error	(1.429)	(1.084)	(0.602)	(0.00370)	(0.00233)	(0.00138)
	N	428	452	448	428	452	448
Females	Coefficient	14.05***	10.95***	8.988***	0.0146***	-0.00236	-0.00126
	Standard error	(2.084)	(1.527)	(0.964)	(0.00522)	(0.00269)	(0.00209)
	N	300	285	316	300	285	316
Low-skilled	Coefficient	15.27***	10.36***	8.583***	-0.00529	-0.00284	-0.000525
	Standard error	(1.800)	(1.537)	(0.864)	(0.00334)	(0.00235)	(0.00177)
	N	426	449	445	426	449	445
High-skilled	Coefficient	12.94***	9.831***	8.096***	-0.00912	-0.00424	0.00194
	Standard error	(1.598)	(1.117)	(0.550)	(0.00563)	(0.00406)	(0.00208)
	N	194	189	249	194	189	249
Young	Coefficient	15.02***	10.49***	8.659***	-0.00690*	-0.00188	-0.00126
	Standard error	(1.863)	(1.581)	(0.923)	(0.00353)	(0.00289)	(0.00174)
	N	422	447	447	422	447	447
Old	Coefficient	13.37***	10.55***	8.528***	0.00807**	-0.00417**	-0.000719
	Standard error	(1.372)	(0.994)	(0.544)	(0.00382)	(0.00164)	(0.00105)
	N	426	449	448	426	449	448
Rural	Coefficient	11.71***	10.45***	7.617***	-0.0134	0.00741***	-0.00196
	Standard error	(0.872)	(0.474)	(0.545)	(0.00989)	(0.00236)	(0.00252)
	N	377	395	387	377	395	387
Urban	Coefficient	14.21***	10.70***	8.787***	-0.00615*	-0.00209	0.00148
	Standard error	(1.731)	(1.329)	(0.740)	(0.00345)	(0.00236)	(0.00155)
	N	119	149	150	119	149	150

Note: Robust standard errors are in parentheses. \*, \*\*, \*\*\* significance level at 10%, 5% and 1%.

Source: Author's estimates using data from Bangladesh LFS and UN Comtrade. This table shows the first and second stage of the 2SLS regression. In the first stage, we estimate the contribution of US import demand to the increase in Bangladesh exports, and in the second stage we estimate the effect of an increase in exports on informality rates. This relationship is estimated for different worker types (male, female, rural, skilled, unskilled, young, and old).

**Table 4. Oaxaca-Decomposition (2005-2016)**

	(1)	(2)	(3)	(4)
VARIABLES	2005	2010	2013	2016

male	6.902*** (0.006)	7.134*** (0.003)	7.564*** (0.003)	7.353*** (0.003)
female	6.333*** (0.020)	7.061*** (0.011)	7.528*** (0.005)	7.258*** (0.006)
difference	0.569*** (0.021)	0.073*** (0.011)	0.035*** (0.006)	0.096*** (0.006)
explained	0.024*** (0.009)	0.020*** (0.004)	-0.020*** (0.003)	0.004 (0.003)
unexplained	0.545*** (0.019)	0.053*** (0.011)	0.055*** (0.006)	0.091*** (0.006)
Observations	22,567	40,687	24,913	71,149

Source: Calculations based on Bangladesh labor force surveys. Note: Standard errors are in parentheses. Statistically significant coefficients at the 10,5, and 1 percent level are indicated by one, two, and three asterisks respectively.

**Table 5. Mincerian Wage Premium Estimates, by each year**

	Logarithm of real wages			
	(1)	(2)	(3)	(4)
	Only 2005	Only 2010	Only 2013	Only 2016
Female	-0.56*** (0.01)	-0.09*** (0.01)	-0.06*** (0.01)	-0.15*** (0.00)
Textile and Apparel	0.57 (0.42)	0.15 (0.15)	0.16*** (0.00)	0.09*** (0.00)
Age	0.04*** (0.00)	0.02*** (0.00)	0.03*** (0.00)	0.03*** (0.00)
High Skilled	0.70*** (0.01)	0.48*** (0.01)	0.25*** (0.01)	0.51*** (0.00)
Constant	5.47*** (0.06)	6.54*** (0.03)	6.98*** (0.02)	6.59*** (0.02)
N	22567	40687	24913	71149
F-test	445.89	251.08	297.67	1444.5
Adjusted R2	0.36	0.15	0.26	0.37

Note: The grand mean effects of the industries are calculated; additional controls include age squared, weekly hours worked, and industry dummies. Standard errors are in parentheses. Statistically significant coefficients at the 10,5, and 1 percent level are indicated by one, two, and three asterisks respectively. High-skilled workers are those with upper secondary or above. Source: Author's estimates using data from Bangladesh LFS.



**Table 6. Mincerian Wage Premium Estimates, with T&A and female dummy interaction**

	Logarithm of real wages			
	(1)	(2)	(3)	(4)
	Only 2005	Only 2010	Only 2013	Only 2016
Female	-0.592*** (0.0148)	-0.123*** (0.0109)	-0.108*** (0.00625)	-0.179*** (0.00558)
Textile and apparel	0.0560*** (0.0151)	-0.00425 (0.00941)	0.0999*** (0.00631)	0.0654*** (0.00465)
Female*Textile and apparel	0.163*** (0.0319)	0.134*** (0.0218)	0.158*** (0.0115)	0.103*** (0.00991)
Age	0.0384*** (0.00200)	0.0160*** (0.00138)	0.0284*** (0.00103)	0.0255*** (0.000807)
High-skilled	0.699*** (0.0130)	0.485*** (0.00895)	0.249*** (0.00543)	0.515*** (0.00456)
Constant	5.405*** (0.0388)	6.521*** (0.0286)	6.966*** (0.0192)	6.584*** (0.0157)
N	22567	40687	24913	71149
F-test	431	244	296	1402
Adj R-square	0.37	0.15	0.26	0.37

Note: The grand mean effects of the industries are calculated; additional controls include age squared, weekly hours worked, and industry dummies. Standard errors are in parentheses. Statistically significant coefficients at the 10, 5, and 1 percent level are indicated by one, two, and three asterisks respectively. High-skilled workers are those with upper secondary or above. Source: Author's estimates using data from Bangladesh LFS.

**Table 7. Mincerian Wage Premium Estimates, yearly**

	(1)	(2)	(3)
	Logarithm of real wages	Logarithm of real wages	Logarithm of real wages
Female	-0.197*** (0.00416)	-0.195*** (0.00416)	-0.0914*** (0.00782)
Textile and Apparel	0.0579***	0.143***	0.0600***

	(0.00369)	(0.00767)	(0.00366)
Female*Textile and Apparel	0.149*** (0.00764)	0.133*** (0.00770)	0.129*** (0.00761)
Age	0.0250*** (0.000595)	0.0250*** (0.000594)	0.0254*** (0.000591)
High-Skilled	0.496*** (0.00346)	0.496*** (0.00346)	0.495*** (0.00344)
Year dummy: 2005	-0.746*** (0.00507)	-0.722*** (0.00545)	-0.649*** (0.00562)
Year dummy: 2010	-0.406*** (0.00439)	-0.379*** (0.00476)	-0.387*** (0.00485)
Year dummy: 2016	-0.277*** (0.00371)	-0.260*** (0.00409)	-0.256*** (0.00425)
Interaction: 2005*Textile and Apparel		-0.158*** (0.0150)	
Interaction: 2010*Textile and Apparel		-0.182*** (0.0123)	
Interaction: 2016*Textile and Apparel		-0.0908*** (0.00952)	
Interaction: 2005*Female			-0.569*** (0.0130)
Interaction: 2010*Female			-0.0408*** (0.0113)
Interaction: 2016*Female			-0.0739*** (0.00843)
Constant	6.811*** (0.0118)	6.810*** (0.0118)	6.781*** (0.0119)
N	159316	159316	159316
F-test	2684.25	2471.24	2555.56
Adj R-square	0.3572	0.3582	0.366

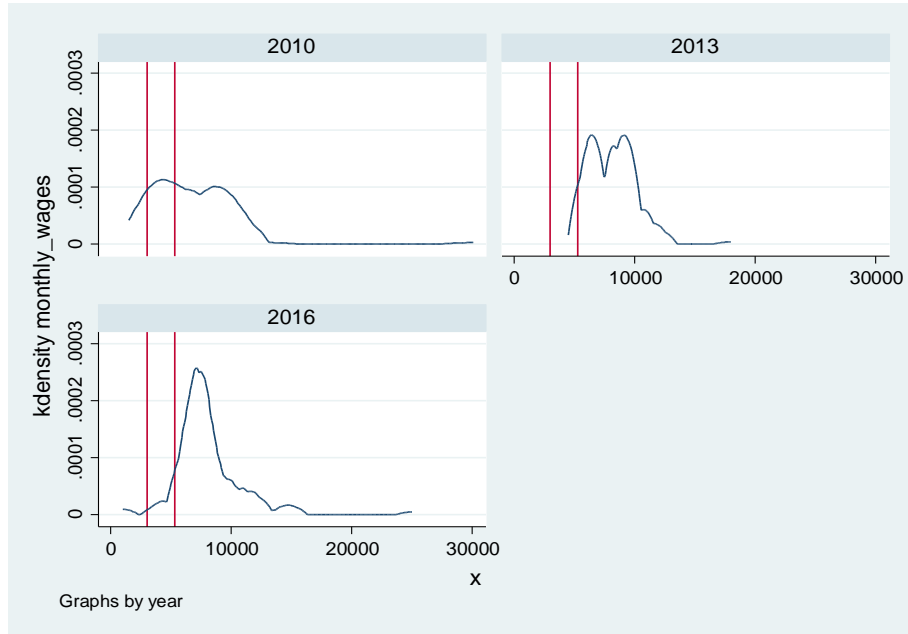
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Note: The grand mean effects of the industries are calculated; additional controls include age squared, weekly hours worked, and industry dummies. Standard errors are in parentheses. Statistically significant coefficients at the 10, 5, and 1 percent level are indicated by one, two, and three asterisks respectively. Source: Author's estimates using data from Bangladesh LFS.

# Appendix

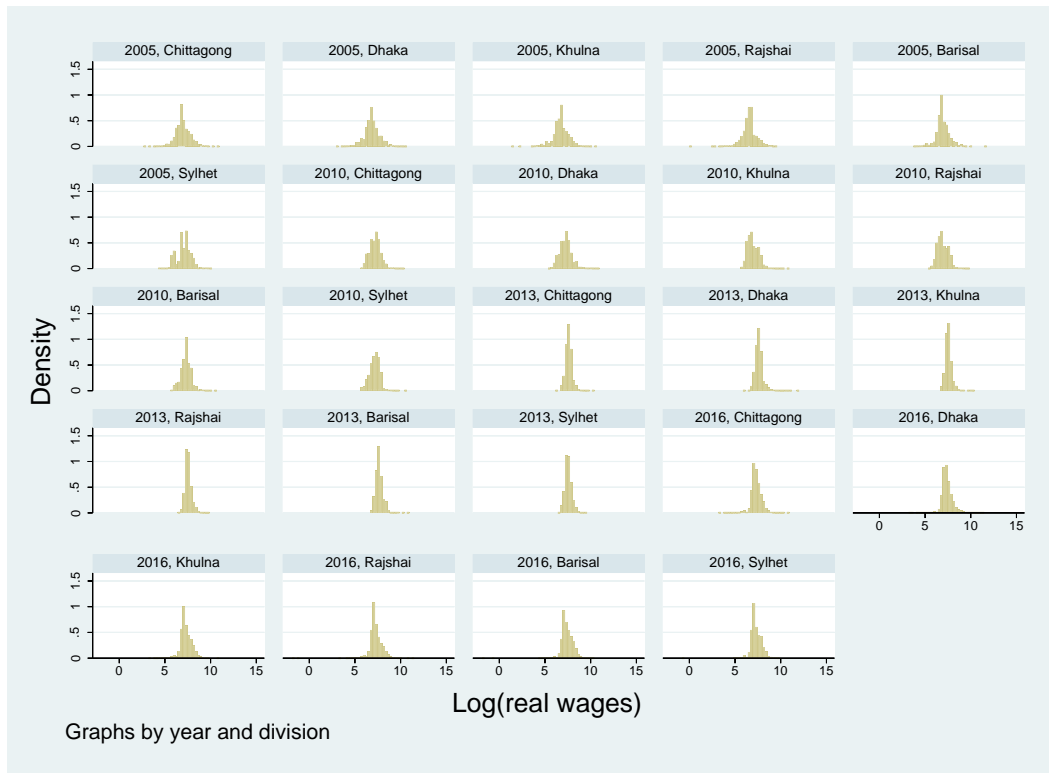
**Figure A1. Kdensity plots for the apparel sector in Bangladesh,**



**Figure A2. Real wages (Logs) distribution by year**



**Figure A3. Real wages (Logs) distribution by division**



**Figure A4. Real wages (Logs) distribution by Educational Attainment**

