I Z A Institute of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 15411

Mending the Gap: Apparel Export Prices and the Gender Wage Gap in Bangladesh

Raymond Robertson
Deeksha Kokas
Diego Cardozo
Gladys Lopez-Acevedo

JULY 2022

I Z A Institute of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 15411

Mending the Gap: Apparel Export Prices and the Gender Wage Gap in Bangladesh

Raymond Robertson
Texas A&M and IZA

Deeksha Kokas
World Bank

Diego Cardozo
University of Chicago

Gladys Lopez-Acevedo
World Bank and IZA

JULY 2022

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Mending the Gap: Apparel Export Prices and the Gender Wage Gap in Bangladesh*

Are the wage gains from exports specific to exporting industries, or do they dissipate throughout the economy? In the language of trade theory, are the benefits from exporting industry specific or factor specific? To analyze this question, we study the case of Bangladesh. Bangladesh was the 4th largest apparel supplier to the United States market in 2020. Recent studies show the positive impact of apparel exports on female labor force participation in the formal labor market and a range of household decisions. We extend this literature by estimating the relationship between apparel exports and the male-female wage gap surrounding an exogenous policy change in the European Union that corresponded to a discrete increase in apparel-export unit values. We find that the increase in prices is associated with increases in women's wages that go beyond the apparel sector. The economy-wide male-female wage gap for less-educated workers in Bangladesh dropped by more than half with the increase in apparel export prices, consistent with trade theory, and that the change estimated with a cross-section IV approach matches simulation results of a simple heterogenous firm comparative advantage (HFCA) model. Our findings are not driven by either changing minimum wage levels (that are not binding for apparel in Bangladesh) or other changes through time, and are robust to incorporating input-output table data to account for the contributions of non-traded industries to export markets.

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

Keywords: Bangladesh, apparel, exports, male-female wage inequality, rules of origin

Corresponding author:
Gladys Lopez-Acevedo
Poverty and Equity Global Practice Group (PEGP)
World Bank
2232 40th Pl NW
Washington DC, 20007
USA
E-mail: gacevedo@worldbank.org

* This paper is a product of the Poverty and Equity Practice at the World Bank Group. It was funded by the South Asia Regional Trade Facilitation Program. The authors state that they have no other competing interests related to this paper. The authors are grateful to Juan Segnana, Nora Carina Dihel, Maurizo Bussulo, Nayantara Sarma, Erik Lewis, Joanna Lahey, and Mathias Poertner for helpful comments and valuable suggestions. The authors especially thank Shanthi Nataraj and the authors of Goutam et al. (2017) for their generous support and help with the IO tables. All remaining errors are the responsibility of the authors. Previous versions circulated under the title "Short and Long Run Labor-Market Effects of Developing Country Exports: Evidence from Bangladesh".

1. Introduction

The collapse in developed-country demand for developing-country exports during the 2020 Covid-19 crisis highlighted the significant contributions that global value chain (GVC) exports, particularly of apparel, have made in developing-country economies. In Bangladesh, the 4th largest supplier of apparel for the United States in 2020, apparel exports have been linked to falling informality (Goutam et al. 2017) and changes related to marriage, childbearing, school enrollment, and labor force participation of Bangladeshi women (Heath and Mobarak 2015). The goal of this paper is to evaluate the wage effects, particularly on women, of apparel exports in the apparel sector and beyond.

Bangladesh primarily exports apparel, raising the question of whether exporting in a particular industry generates benefits that go beyond the exporting sector. A closely related question is whether exports might affect wages of men and women differently. Trade can affect wages of men and women differently by affecting industries (Olivetti and Petrongolo 2014, Sauré and Zoabi 2014), regions (Hakobyan and McLaren 2016), and ability to discriminate due to market competition (Berik et al. 2004, Menon & Rodgers 2009).[1]

Trade theory offers helpful guidance in understanding how exports might affect wages. Recent advances in Heterogenous Firm Comparative Advantage (HFCA) models (Bernard, Redding, and Schott 2007, Lechthaler and Mileva 2019) implicitly nest these and additional explanations. These two-sector, two-factor models show how trade liberalization affects the wages of the two factors in the short run and long run by shifting demand between industries unequally across factors. While these models usually characterize the two factors as skilled and less-skilled workers, we show that men and women in Bangladesh have a relatively small elasticity of substitution, suggesting that they can be modeled as separate factors[2] and the recent insights from trade theory can guide studies of the male-female wage gap.

The HFCA models show how an increase in the output *price* (as opposed to quantities or export values) of the exported good affect wages in the export sector in the short run but, in the long-run, the wage effects become factor-specific. Specifically, these models show that wages increase in the exporting sector for both worker types in the short run, but over time shift to reward the factor intensively employed in the export sector – regardless of which sector in which those workers are working – in the long run. In our case, the prediction is that the increase in apparel prices increases male and female wages in the apparel sector in the short run, but eventually the effects dissipate to reward females relative to males throughout the economy (that is, closing the male-female wage gap).

Three conditions are necessary for the HFCA model to apply. The first is that the factor intensity of the export industry is different from the factor intensity of other industries. In our case, we show that apparel is clearly a female-intensive industry in Bangladesh (as it is throughout the developing world (Frederick et al. 2022)). The second is that the two factors – males and females – are imperfect substitutes in production. Following Berndt and Christensen (1973) and Hamermesh

[1] See Verhoogen (2018) and Atkin (2016) for more studies that use shocks to exporting to analyze exporting's impact on workers.

2 Modeling men and women as separate factors in production is not new. See Grant and Hamermesh 1981, Acemoglu et al. 2004, Galor and Weil 1996, De Giorgia et al. 2013, Guisinger 2020, and others.

(1993), we present estimates of the male-female elasticity of substitution in Bangladesh and show that our second condition is satisfied. The third condition is that workers are relatively mobile throughout the country. We evaluate this condition and show that there is considerable evidence of both migration and labor-market integration within Bangladesh.

Although the HFCA model, like many trade models, is driven by output price changes, few studies explicitly focus on price changes because examples of discrete or exogenous changes in export prices are very rare. In this study, we exploit the European Union's 2011 change in Rules of Origin (RoO) that was not specific to Bangladesh to estimate the changes in export values on wages in the country. In 2011, the European Union (EU) relaxed its rules of origin (RoO) affecting apparel imports from developing countries. The policy change opened the door to a discrete shift in exports from relatively lower-priced knit apparel (HS61) towards the higher-value woven apparel (HS62). The exogenous policy change was followed by an increase in EU demand of woven apparel from Bangladesh and a corresponding shift from the USA towards the EU. The relative drop in supply to the US market and the shift towards woven apparel coincided with a predicable increase in the price of US imports from Bangladesh. That is, the exogenous change in RoO induced a specific price shock to the Bangladeshi apparel sector that, according to the HFCA models, can translate into wage effects in the exporting sector and, eventually, throughout the entire economy in the form of a falling male-female wage gap.

Our main results come from a pooled cross section instrumental-variables (CSIV) approach (Hakobyan-McLaren 2016). The results show that the male-female wage gap fell sharply between 2010 and 2013, but moderated after 2013 when the quantity of exports increased but the export price fell. We find very limited, if any, evidence, of wage effects that are specific to the apparel sector just a few years after the policy change. These results emerge even while controlling for trends in other characteristics, such as education and wages. We also rule out the possibility that changing minimum wages drive these results, and show that the necessary conditions for minimum wage effects – that legal minimum wages are binding – do not hold in Bangladesh.

While our main conclusions come from the CSIV approach, we also apply the shift-share (Bartik 1991) approach that many prominent studies have applied to assess the effects of import competition on wages (see Autor et al., 2013 and Hakobyan and McLaren, 2016 for US studies and Topalova, 2010, Edmonds et al., 2010, Erten et al., 2019, and Artuç et al., 2019 for applications to developing countries). Studies that focus on exports, rather than imports, are relatively rare. Erten and Leight (2021) focus on China's accession to the World Trade Organization in 2001 and apply a local labor-market approach but focus on tariff uncertainty and exports. Since they find that the reduction in tariff uncertainty was associated with higher exports, their results are similar in spirit to ours. McCaig and Pavcnik (2018) show a significant reallocation of labor followed a positive export shock in Vietnam, demonstrating that the possibility that export shocks may be disseminated throughout national labor markets is important. Aguayo-Tellez et al. (2014) also find that labor reallocation (and within-industry shifts) favored women in Mexico when the North American Free Trade Agreement reduced tariffs on Mexican exports, resulting in rising relative wages of women. Brambilla et al. (2015) find results consistent with the heterogeneous firms models in the sense that more productive exporting firms pay higher wages and demand more skill. McCaig (2011) shows US tariff reductions on Vietnamese exports reduce poverty at the regional level using a similar shift-share approach. Tanaka (2020) uses distance to airports to capture the potential contribution exports have on working conditions (but finds no effect on wages) in Myanmar.

Overall, we find our results to be consistent with the predictions of HFCA models in that, when defining males and females as the two factors, the changes in wages that follow the policy change are factor-specific rather than industry-specific after two years. Our CSIV approach shows that the policy change coincided with a dramatic drop in the male-female wage gap that was not specific to the apparel industry. Our results are similar to Robertson (2004) who finds that the factor-specific (as opposed to industry-specific) effects of price shocks emerge in 3-5 years. There is little evidence of industry-specific effects over the 3-year timeframe we use in the empirical work. Our results from the shift-share approach corroborate the CSIV results in the sense that they reveal a positive relationship between exports and wages for less-educated females generally, but not significant for apparel workers or less-educated males.

We present our analysis in 3 subsequent sections. First, in Section 2, we describe the recent contributions of the HFCA models and summarize their wage predictions using a distilled model that illustrates how industry-specific shocks have factor-specific effects that go beyond the affected industry. We discuss how the prevailing empirical approaches relate to HFCA models' predictions. In Section 3 we evaluate the conditions required for the HFCA models to apply in our context. Specifically, use household surveys to show that apparel is a female-intensive industry, that males and females are imperfect substitutes in production, and that labor markets in Bangladesh are relatively integrated through migration. We also illustrate average wage differences and trends in Bangladesh before and after the change in EU RoO policy and use trade data to calculate unit values for both knit and woven apparel to demonstrate the change in average export prices that followed the policy change. In Section 4 we present both the CSIV and Bartik (1991) results. Both are consistent with the predictions of the model in that they show a larger gain to less-educated women and a closing of the wage gap driven by exports that coincides with the policy change. In Section 4, we also show that legal minimum wages are not binding in Bangladesh and therefore cannot explain the results. The final section concludes.

2. Conceptual Framework

Several recent papers illustrate the relationship between labor-market outcomes and international trade in the context of heterogenous firms (Melitz 2003, Bernard, Redding, and Schott 2007, Lechthaler and Mileva 2019). These two-factor models often define factors as skilled and less-skilled workers. Papers that focus on trade and gender wage differentials, in contrast, have focused on different mechanisms through which trade might affect the gender wage gap. Some papers argue that the increased competitiveness that trade brings reduces the ability of firms to discriminate between men and women (Berik, Rodgers, and Zveglich 2004). The discrimination hypothesis is industry specific because it relies on industry-specific competition and concentration. Others, including Grant and Hamermesh (1981), Hamermesh (1993), Galor, and Weil (1996), Acemoglu et al. (2004), De Giorgia, Paccagnella, and Pellizzari (2013), Olivetti and Petrongolo (2014), Sauré and Zoabi (2014), and Guisinger (2020) assume (implicitly or explicitly) that men and women are not perfect substitutes and therefore can be considered separate factors of production.

In this paper, we combine and simplify these approaches by developing a two-factor model in which the two factors are men and women. The framework below is not meant to be a novel contribution, but rather a distilled presentation of heterogeneous-firm comparative advantage (HFCA) models (Bernard, Redding, and Schott 2007, Lechthaler and Mileva 2019) that maintains the same essential predictions and dynamics. By assumption, gender is fixed and exogeneous but moving between sectors is costly (but not prohibitively so). Since our focus is on production, we relegate the specification of the consumption side of the model to the appendix.

a. Production

While production could be modeled with a constant elasticity of substitution production function, for simplicity, we rely on the more restrictive Cobb-Douglas technology that assumes that the elasticity of substitution between factors is equal to 1.[3] Specifically, each firm *j* belongs to a sector *i* and produces a unique variety at time *t* using a Cobb-Douglas production function that combines firm-level productivity (φ) , male workers (M), and female workers (F).

$$(1)\ y_{ijt} = \varphi_j F_{ijt}^{\alpha_i} M_{ijt}^{(1-\alpha_i)}$$

The Cobb-Douglas production coefficient α is sector specific and determines factor intensity. For example, sector 1 is female-intensive if $\alpha_1 > \alpha_2$. Since production is Cobb-Douglas, the relative factor demand for male and female workers depends on the difference between men and women, also known as the male-female wage differential or wage gap:

$$(2)\ \frac{w_{it}^m}{w_{it}^f} = \frac{(1-\alpha_i)}{\alpha_i}\frac{F_{it}}{M_{it}},$$

which shows the inverse relationship between the male-female wage differential and relative employment.

The presence of both a cost to start production κ_s and a cost to export κ_x generates two productivity cutoff points in each sector, φ_{il} and φ_{ih}, that define the minimum productivity for firms to produce (firms with productivity levels below the lower cut-off point in each industry φ_{il} produce nothing) and the minimum productivity for firms to export. Firms with productivity levels between φ_{il} and φ_{ih} produce and sell to the domestic market.

Equilibrium in this model is represented by an allocation of production and workers across sectors, imports, and exports that satisfy the demand of both foreign and domestic consumers. Let $L_i \in (M_i, F_i)$ represent either Male or Female labor supplied to sector *i*. Workers can switch sectors based on both the expected wage in each sector and the stochastic moving cost μ . Workers evaluate their choice in each period based on the moving cost observed in period *t*. Workers will move if expected earnings minus the mobility cost is larger in the other sector. The stochastic moving costs means that only some workers will take advantage of observed wage differentials across sectors in each period following a shock.

[3] Later in the paper, we relax this assumption to use a translog production function to estimate the elasticity of substitution between factors.

Both Bernard, Redding, and Schott (2007) and Lechthaler and Mileva (2019) model the effects of a reduction in trade costs. The reduction in trade costs affects both sectors, but, given that the two sectors differ in factor intensity, the reduction in trade costs is analogous to an increase in the relative price of the good that intensively uses the abundant factor. The change increases the demand for workers in the sector that intensively uses the abundant factor.

One advantage of the HFCA models is that they generate predictions for productivity, average firm size, and gains from trade (that emerge from both lower import prices and higher productivity, which both contribute to higher real earnings). Since our goal is to illustrate the relationship between an export shock on wages, we focus on the wage dynamics predicted by HFCA models. To illustrate the wage dynamics, we note that the cost functions for firm j in sector i can be expressed as

$$(3)\ \gamma_{ijt} = f(p_{ijt}, y_{ijt}, w_{it}^{m}, w_{it}^{f}, \varphi_j, \kappa_s, \kappa_x)$$

The derivatives of the cost functions generate expressions for male and female labor demand. For both males and females, the normal assumptions about factor demand curves imply

$$(4)\ \frac{\partial \gamma_{ijt}}{\partial w_{jt}} < 0 \quad and \quad \frac{\partial \gamma_{ijt}}{\partial p_{it}} > 0 \quad .$$

Firm-level factor demand curves can be aggregated into economy-wide factor demand curves for each sector that, under the assumption of full employment, determines the male and female wages in each sector as a function of output prices. Costless adjustment between sectors in these models implies that the wages of males would be the same in each sector and the wages of females would be the same in each sector, but an equilibrium difference in male and female wages could (would) exist.

b. Costly Adjustment

When adjustment is costless, workers would respond immediately by shifting between sectors. Lechthaler and Mileva (2019) model costly adjustment using a stochastic parameter that workers incur when they move between sectors. Differences in the adjustment cost parameters generate differences in the wage adjustment over time. Figures 1a and 1b present results from a simple simulation of the generalized HFCA model in which there is a 20%[4] positive price shock to the female-intensive export sector.

Figure 1a shows the evolution of four series: male wages in sector 1, male wages in sector 2, female wages in sector 1, and female wages in sector 2. The first main message from Figure 1a is that an increase in the export sector price has both (short-run) sector-specific effects and (long-run) factor-specific effects. The short-run effects are sector specific, raising the wages of males

[4] As we demonstrate later, apparel exports prices increased by about 20% between 2010 and 2013.

and females in the export sector in the short run. These results match Lechthaler and Mileva's (2019) description of how relative wages change in the short run.[5]

In the long run, however, the industry-specific effects dissipate and factor-specific effects emerge. In our case, an increase in the apparel export price eventually increases the wages of women everywhere (in all sectors, not just apparel), closing the male-female wage gap. Note that Figure 1a matches the long-run predictions described by both Bernard, Redding, and Schott (2007)[6] and Lechthaler and Mileva (2019).[7] Figure 1b shows that, in our simulation, the 20% increase in the exported-good final price is associated with a fall in the economy-wide male-female wage gap from 1.167 to 1.108, which is a decline in the wage gap of about 5%. In our simulation, the industry-specific effects dissipate and the factor-specific results emerge at around 24 quarters (2 years).

For these results to apply to Bangladesh, however, several conditions need to told. First, apparel should be female-intensive. Second, males and females should be imperfect substitutes. Third, workers need to be mobile (labor markets need to be integrated). Ideally, we would also like to observe an exogenous shock to export prices. In the next sections, we combine labor force surveys and trade data to show these conditions hold.

3. Stylized Facts

Apparel Export Growth and Female Intensity

Like many developing countries, Bangladesh followed an import-substitution-industrialization (ISI) strategy for much of the 20th 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.

More than other countries, Bangladesh's exports are concentrated in apparel (Figure 2). Jute[8] and jute goods dominated export earnings in the 1970s and 1980s but gave way to ready-made

---

[5] On page 435, Lechthaler and Mileva (2019) state that "The drop in transport costs increases demand in the exporting sector and, thus, raises the price in the exporting sector relative to the import-competing sector. This has an immediate impact on wages, which rise in line with the prices in the exporting sector relative to the import-competing sector. This is, of course, not only true for skilled workers but also for unskilled workers—both earn now higher wages in the exporting sector than in the import-competing sector, while they were earning the same wage in both sectors in the pre-liberalization steady state."

[6] The first effect of Bernard, Redding, and Schott (2007)'s Proposition 7 states that "The opening of costly trade has four sets of effects on the real income of skilled and unskilled workers: (a) The relative nominal reward of the abundant factor rises and the relative nominal reward of the scarce factor falls."

[7] Lechthaler and Mileva (2019, p.435) state that, in response to an increase trade liberalization, "In the medium and long run, the increased demand for the skill-intensive exporting good increases the demand for skilled labor and, thus, increases the skill premium."

[8] Jute is a natural fiber that is second to cotton in quantity produced and range of use. Its color and value give Jute its "golden fiber" nickname.

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.

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 data include 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 used to define "less educated" workers as those with less than high-school. The "informality" variable is created from multiple categories of the "principle activity status" that were harmonized over time. Informal workers are either self-employed, contributing family members, or day laborers. We also harmonized geographic and industrial codes over time.[9] We restrict the sample to workers between 15 and 65 years of age.

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 over time 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. Female labor force participation remains low in comparison to lower-middle income country average and the middle-income country average[10] and low share of women engage in nonagricultural employment (Farole et al. 2017). Goutam et al. (2017) conduct a shift-share (Bartik 1991) analysis and show that exports contributed to rising employment and labor force participation.

To address whether or not exports are female-intensive, consider Table 1. Table 1 contains summary statistics from the 2005, 2010, 2013, and 2016 Bangladesh labor force surveys for four main economic sectors: Apparel, Other Manufacturing (Other Mfg), Wholesale/retail, Transportation, Other Non-Manufacturing (Other Emp), and for those not working. About 36% of apparel employment is female. The share of total employment that is female in wholesale/retail and transportation is 7% and 4% respectively. About 16% of non-apparel manufacturing

[9] We found some irregularities in wage earnings variables across years. Wages increase substantially between 2005 and 2013. Specifically, we noticed that workers' wages were about 10 times higher for those who report a monthly payment frequency in 2005. 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.

[10] The World Bank development indicators reports female labor-force participation rates, including Bangladesh of 36.3% in 2017, a world average of 47.9% in 2010, and an average for low and middle income countries of 46.3% in 2010.

employment is female. Highlighting the importance of Goutam et al. (2017), the non-working population has the largest share of our initial sample.

Table 1 also shows that the average wages of apparel workers are higher than many other sectors of the economy, consistent with Robertson et al. (2009). Apparel workers also have slightly more education, are less likely to be married, and are younger than workers in the rest of the economy. Bangladeshi apparel workers are much like apparel workers elsewhere in the world (Frederick et al. 2022). These averages pool males and females, but perhaps males and females are imperfect substitutes in production. To consider this possibility, we formally estimate the male-female elasticity of substitution in Bangladesh.

Are Males and Females Imperfect Substitutes in Production?

Male and female workers can be considered to be different factors if they are imperfect substitutes in production. The measure of whether different factors are imperfect substitutes in production is called the elasticity of substitution. The elasticity of substitution ranges from infinity (perfect substitutes) to zero (factors that cannot be substituted in production). Papers that estimate the elasticity of substitution date back nearly a century. More recently, Berndt and Christensen (1973) show how the elasticity of substitution can be estimated from the translog production function. Hamermesh (1993) and many subsequent studies have applied this approach to estimate substitution elasticities between worker types. Since this literature already establishes that the elasticity of substitution between males and females is usually less than 10 (and usually ranges between 1 and 4) outside of Bangladesh, we present heuristic estimates for Bangladesh.

The derivation of the estimation equation starts with the familiar J-factor translog production function production function that shows how factors N_i (N_j) work together to produce output Q in labor market *s* at time *t*:

(5) $$\ln Q_{st} = \beta_0 + \sum_i \beta_i \ln N_{ist} + \frac{1}{2}\sum_i \sum_j \gamma_{ij} \ln N_{ist} \ln N_{jst}$$

Assuming constant returns to scale, linear homogeneity, and that factors are paid their marginal product imposes constraints on the production function parameters that allows us to derive an expression for the cost shares of each factor that are linear functions of these parameters (Ghosh and Liu 2018):

(6) $$s_{ist} = \alpha_0 + \sum_j \gamma_{ij} \ln \left({N_{ist}}/{N_{jst}} \right)$$

This definition of factor shares is then used to represent the elasticity of substitution between factors *i* and *j* as a function of factor cost shares and production function parameters (Ghosh and Liu 2018).

(7) $$\sigma_{ij} = \frac{\gamma_{ij} + s_i s_j}{s_i s_j}$$

In the two-factor case with males and female as separate factors, this approach implies that we can estimate γ_{ij} using labor-force surveys that define labor markets as regions and summing total factor income by region and year to measure the labor-market-specific values of cost shares for men and women. Although there is some debate about the stability and potential endogeneity of σ (see Ghosh and Liu 2018), we estimate (6) and use the results to estimate σ. Since technology and demand may shift over time and region, Table 2 includes four different specifications and four different estimates of the elasticity of substitution between men and women. ("Sigma" in the last line of Table 2). The estimates are based on collapsing wages in each upazila into three age groups for each year. The estimates range from 1.82 to 2.14, which fall in the range of the majority of studies that estimate the elasticity of substitution between male and female workers outside Bangladesh. To explore the robustness of these results, we also include all workers (not just less-educated workers). The results generate estimates of the elasticity of substitution that are slightly smaller, reflecting the lower substitutability between education groups. The main conclusion is that, at least from the perspective of trade models, men and women can be treated as separate factors.

Integrated Bangladeshi Labor Markets

The assumption of costly adjustment in the HFCA model implies that labor markets are integrated in the long run. One heuristic measure of labor-market integration is the standard deviation of wages for different types of workers across regions over time. This measure is heuristic because there are many reasons why wages might not equalize across regions.[11]

To explore the degree of labor-market integration within Bangladesh, we compute district and industry premiums. District and industry premiums can be indicators of segmented labor markets. A lack of labor mobility across sectors and districts, ceterus paribus, would result in persistent premiums. If labor is perfectly mobile, short-run wage premiums that result from an economic shock would 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.

There are few absolute measures of labor-market integration. To provide a potentially rough but relevant comparison, Figure 3 compares Bangladesh and India in terms of regional wages over time. 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.

One potential reason for falling earnings dispersion is intra-national migration. 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.[12] In this regard, migration statistics published by the Bangladesh Bureau

[11] 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.

[12] According to Marshall and Rahman (2013), 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.

of Statistics (BBS) based on the 2011 census document 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 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. The migration towards RMG jobs is consistent with the kind of positive demand shock that raises wages (because migrants respond to increased wage differentials by moving) predicted by dynamic adjustment HFCA models and migration can diffuse the export shock throughout the country.

In contrast, cross-district mobility in India has been historically low as documented in several studies.[13] Given that there is less wage dispersion and more internal migration in Bangladesh than India, it seems likely that labor market effects due to export shocks are more likely to dissipate countrywide over time.

An Exogenous Export Price Increase

Total export value increased in nearly every year from 1989 to 2015, rising from US$1.5 million to almost US$30 million. Figure 4 shows the evolution of both EU and U.S. apparel imports (HS61 and HS62 from the Comtrade database). Using the A2 tests described by Vogelsang and Perron (1998), we calculate the trend break test statistics for unknown trend breaks both EU imports from Bangladesh and U.S. imports from Bangladesh and. The test statistics indicate breaks around 2011 in both US and EU imports. The test results reflect a positive trend break for the EU series and a negative trend break in the U.S. series, which is consistent with a policy change that shifts production towards the EU and away from the United States.

The 2011 break both series coincides with an EU policy change in Rules of Origin (RoO) that affect prices. Rules of Origin have been shown to significantly affect trade patterns (Angeli et al. 2020 and literature therein). Angeli et al. (2020) argue that RoO are usually complex and therefore are difficult to associate with trade patterns. In some cases, such as the African Growth and Opportunity Act's special regime rules, the resulting change in exports is very large (de Melo and Portugal-Perez 2008). One rare example of a change in RoO that affected average export prices was the EU's 2011 policy change that relaxed RoO for the least-developed countries. The change allowed EU imports of clothing that used textiles[14] from any source and still qualify for preferential treatment. Curran and Nadvi (2015) show that this change had the very specific effect of

[13] Limited labor mobility in India has been widely documented in the literature. Few key studies include Srivastava and McGee (1998); Singh (1998); Srivastava (2012); Lusome and Bhagat (2006); and Kone et al. (2018).

[14] The distinction between apparel and textiles is often important. *Apparel* refers to garments and *textiles* refers to the fabric that is assembled into apparel.

increasing the EU demand for Bangladesh's exports of woven garments. Since Bangladesh had previously sourced nearly 90% of its knit fabric locally, and but only 25% of woven fabrics locally, the 2011 change in RoO allowed Bangladesh to shift towards woven garments (Curran and Nadvi 2015).

The distinction between knit-fabric garments (Harmonized System code 61) and woven-fabric garments (Harmonized System code 62) is important because the average unit values (often used as a proxy for output prices that are comparable across garments) of woven-fabric garments are generally higher than unit values for knit-fabric garments. Figure 5 uses kernel-density plots to compare the distribution of 1,943 10-digit HS categories within HS61 and 2,483 10-digit HS categories within HS62 that that US imported from Bangladesh in 2010. Figure 5 shows the difference in average prices for knit and woven US imports from Bangladesh in 2010. The higher average prices of woven goods are clearly apparent in Figure 5.

A rise in exports, such as shown in Figure 4, 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 compare the change in prices over time. Using unit values for both the US and the EU, Figure 6 shows a sharp increase in both the EU and US price for Bangladeshi imports that begins at the time of the EU policy change. Comparing Figures 4 and 6 shows that they are consistent with a shift in EU demand. Both the price and quantity of EU imports from Bangladesh increase. At the same time, the US unit values sharply rise but the quantity falls (the negative trend break shown in Figure 4). The changes in the US are consistent with falling supply to the US market. Together, these changes are consistent with Curran and Nadvi (2015), who argue that the change in EU RoO resulted in a significant shift in Bangladesh apparel exports towards the EU.

The fall in unit values in both the EU and US series at the end of the sample (2014-2016), even when the total value of exports is rising (EU) or falling slightly (US) is also relevant to results described later. Bossavie et al. (2019) attribute worsening labor market outcomes for women to the international response to the April 24, 2013 collapse of Rana Plaza, but do not consider the link between falling unit values and labor market outcomes. Perhaps more relevant for this paper, however, is that the results also imply the change in RoO induced a shift towards woven-fabric apparel, which contributes to the increase in unit value. That is, the RoO seems to have induced an exogeneous and specific price shock to the Bangladeshi apparel sector that, according to the HFCA models described above, can eventually translate into factor-specific wage effects.

Wage Trends and Descriptive Analysis

We differentiate from Goutam et al. (2017) by focusing on wages. Using the labor force surveys described earlier and summarized in Table 1, Figure 7 shows the changes in weighted mean log real wages (the mean of the natural log of real wages) for males and females both in apparel and in all other industries. Figure 7 shows the obvious gap between male and female earnings, both in and out of apparel. Apparel workers earn more, on average, than the average of all other sectors. Interestingly, the wage gap between women and men is largest in 2005, and it is larger in the apparel sector than in the other industries. Figure 7 shows a gradual increase in wages of all workers between 2005 and 2010, but sharp increases in wages between 2010 and 2013 (coinciding with the 2011 EU change in RoO described earlier). Note, however, that average wages fall between 2013 and 2016 for all workers. Figure 4 shows that exports continue to increase, but Figure 6 shows a sharp decline in the unit values for both the US and the EU near the end of our sample period.

Table 3 applies a hedonic (Mincerian) wage equation to describe wages across groups, industries, demographic characteristics, and time (Mincer 1974). Table 3 contains results from a single ordinary least squares regression with a binary variable equal to 1 for workers in the apparel sector (and 0 otherwise), a binary variable equal to 1 for males (and 0 otherwise), an interaction between the apparel and male variables, age, and a binary variable equal to 1 for workers with at least a high-school education (a rough proxy for the returns to education). Each of these variables are interacted with year effects to illustrate how the contribution of each variable changes over time. Each row represents the interaction term for the year shown in the first column. The columns represent the estimates for each variable. The rows for 2010, 2013, and 2016 show the difference between that year and the first row of the column, so, to get the total effect for a given year would require adding the year estimate and the estimate in the first row. For example, comparing estimates for 2010 and 2013 in the first column shows that conditional real mean wages increase sharply in 2013 following the 2011 policy change.

The second column is the apparel wage "premium," or the earnings of workers in apparel holding all other included demographic characteristic constant. In 2005, the estimated apparel wage premium was about 31%, suggesting that, all else equal, apparel workers earned about 30% more than comparable workers elsewhere in the economy. This is consistent with other studies, such as Robertson et al. (2009), who find a large apparel wage premium in apparel-exporting developing countries when holding other demographic characteristics (gender, age, education) constant.

The apparel premium falls between 2005 and 2010, but rises again between 2010 and 2013, coinciding with the sharp increase in apparel unit values. The premium falls between 2013 and 2016, consistent with Bossavie et al. (2019) and the fall in apparel unit values. Table 3 also shows that males earn about 28.4% more than women in 2005, holding other included variables constant. The premium falls to nearly zero in 2013, but rises again in 2016. In other words, the male-female wage gap nearly disappears between 2005 and 2013, showing that changes in factor returns are significant over time. Note that these patterns in Table 3 are consistent with the HFCA model simulation results in Figure 1. The model predicts that, if males and females are mobile between industries, the apparel priced shock will first affect workers within the industry (the apparel wage premium that applies to both males and females) and eventually result in a change in the male-female wage gap throughout the entire economy.

The next column, however, estimates the industry-specific gender differential and shows that there is no significant difference between male and female wages within the apparel industry. All estimates in this column are very small. Part of this result is explained by the fact that we hold age and education constant, so that, within the apparel industry, we are comparing observationally similar male and female production workers. Males, and especially more educated males, are more likely to be supervisors than women and therefore on average earn more when education and age are not considered, which helps explain the within-apparel wage gap shown in Figure 4.

The last column shows that workers with at least a high-school education earn much more than less-educated workers. This skill premium is over 62%, which is not unusual in developing countries. Between 2005 and 2010, the skill premium falls and then falls sharply again between 2010 and 2013. The skill premium rises again in 2016, following a path opposite of the apparel unit values. Interestingly, the co-movements of the apparel export unit values and the skill premium are consistent with the predictions of both Bernard, Redding, and Schott 2007 and Lechthaler and Mileva 2019 who use skilled and less skilled workers as their factors of production and describe the change in the output price and the skill premium.

Since we have a particular focus on less-educated workers, Table 4 presents a similar Mincerian regression with the sample restricted to workers with less than a high school education. The patterns are similar. The baseline wage level in the first row and column is only slightly lower because the samples include relatively few workers with more education (comparing the sample sizes of the Table 3 and Table 4 confirms this). Note that the apparel premium is higher in 2005 than in Table 3 and comparing the change between 2010 and 2013 shows that the apparel premium increases. The premium falls again in 2016 relative to both 2013 and 2005. Less-educated males enjoy a higher premium than estimated in the full sample, but, as in Table 3, the premium falls from about 33% in 2005 to about 2% (0.325-0.306) in 2013. As in Table 3, the male premium rises again when the exported apparel unit value falls. Also like Table 3, there is no statistically significant difference between male and female workers within the apparel industry. Overall, the results for less-educated workers are very similar to those in the full sample and heuristically correspond to the predictions of the HFCA models.

4. Estimating the Relationship between Exports and Wages

While the descriptive statistics suggest wage patterns consistent with the HFCA models, we present two approaches to formally estimating the relationship between exports and wages. Our dependent variable is average wages. The average wage variable is measured in real takas (converted from nominal values with the consumer price index). Both approaches pool the cross-section data and use instrumental variables, year controls, and worker-level data. 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.

Pooled-Cross-Section Instrumental-Variable Estimates

The labor-force data include four unlinked cross-sections. For the CSIV approach, we pool the four cross sections and estimate the relationship between exports and wages directly using worker-level observations. Heterogeneity across the samples is addressed by including year effects.

There are several estimation issues that arise with this approach. One is that many of the people in the sample work in industries that are not in export industries. Therefore, when we match the export data to the sample, we assign an export value of zero (we explore the robustness of this approach later in the paper using input-output tables). Second, although the 2011 policy change was arguably exogeneous, observed export values might be endogenous. To address this concern, we instrument exports to the United States and European Union with U.S. and EU imports from the rest of the world. To be clear, we follow a robust two-stage instrumental variables approach using the contribution of US and EU overall import demand to explain Bangladesh's export growth in the first stage. By doing so, we ensure that our measure of Bangladesh exports will not be affected by local economic conditions.

Since we are especially interested in the male-female wage differential, we interact the gender variable with exports. Additionally, we interact both exports and the gender-export interaction with year effects. Since exports are part of each of these interaction terms, we treat exports, the gender-export interaction, and the gender-export-year interaction terms as endogenous and use the US and EU imports from the rest of the world and appropriate interaction terms as instruments. Note that the model is not over-identified so that there are no overidentification test statistics to report. We do, however, report and discuss Kleibergen-Paap LM tests for underidentification and the Kleibergen-Paap F- statistics for weak instruments.

Table 5 presents the second-stage results of the OLS IV estimation.[15] Table 5 contains the results of a single estimation equation but follows a structure similar to Table 3 and Table 4. As in the descriptive Mincerian wage equations shown in Tables 3 and 4, males earn a significant wage premium over women when controlling for the other demographic characteristics in the sample unless they are more educated. Exports exhibit a negative and statistically significant relationship with earnings in 2005. Wages increase significantly between 2005 and 2010, but the interaction with exports suggests that exports were not entirely driving the large wage increase. In contrast, the marginal effect of exports increases between 2010 and 2013 before falling again in 2016.

Our main focus, however, is on the interaction between exports and the male-female wage differential, shown in Table 5 as the interaction between exports and the male indicator (Exports * Male in the last column). The interaction's largest negative value in 2013, which shows that the 2013 change in exports was associated with the largest decline in the male-female wage gap. The male-female wage gap increases again between 2013 and 2016 (as shown by the smaller absolute value of the estimated 2016 coefficient when compared to the 2013 coefficient).

To compare the results in Table 5 with the simulation results in Figure 1a and 1b, note that the simulation exercise started with a 20 percent increase in the relative apparel price and ended with about a 5 percent reduction in the male-female wage gap. Figure 6 implies that between 2010 and 2013 the weighted apparel price increased 21% ((1.24-1.07)/1.07 = 0.206). The results from Table 5 show that between 2010 and 2013, the male-female wage gap fell by about 9.6 percent ((0.012-0.001)/0.114 = 0.096).

The instrumental variable diagnostic statistics shown at the bottom of Table 5 evaluate the null that the equation is underidentified (meaning that the excluded instruments are correlated with the endogenous regressors) and that the instruments are weak (meaning that they are weakly correlated with the endogenous regressors) (see Stock and Yogo (2005) for additional discussion). Since we

[15] There are eight tables of first-state results for each column in Table 5 and are not reported to save space. They are available upon request.

drop the i.i.d. assumption and report robust standard errors, we evaluate the first null with the Kleibergen and Paap (2006) LM statistic. The large value reported in Table 5 leads us to reject the null of underidentification. Likewise, the large value of the Kleibergen-Paap F statistic leads us to reject the null of weak instruments.

To focus on less-educated workers, Table 6 reports the CSIV results for less-educated workers only. The results are similar but slightly larger than those reported in Table 5. The instrument diagnostics generate the same qualitative conclusions. The main message from Tables 5 and 6 is that exports are strongly associated with a decline in the male-female wage gap, with the effect being the strongest in the period following the exogeneous policy change associated with the sharp increase in apparel export prices. We also estimated the same specification using the sample restricted only to more-educated workers. With the exception of time, none of the interaction coefficients (neither exports nor the exports * male terms) generated statistically significant coefficients.

To relate the empirical results to the model simulation, the results from Table 6 suggest that between 2010 and 2013, the male-female wage gap fell by about 11 percent ((0.015-0.001)/0.132 = 0.114) for less-educated workers. Although the model is not formally calibrated, the similarity of the results supports the appropriateness of the HFCA framework for analyzing the effects of changes in export prices on the wage gap.

Shift-Share Estimates (Bartik 1991)

Our second approach applies a shift-share approach following Bartik (1991) that has been widely applied to study the labor market effects of imports following trade liberalization. While most studies apply this approach to import competition, we apply the approach to exports and focus on the less-educated male and female workers.

The key identification assumption in the shift-share approach is that production is unevenly distributed around the country and local labor markets characterize the national economy. In Bangladesh, geographical inequality is persistent as production seems to be concentrated in few districts across the country. Female employment rates vary considerably by region (Figure 8). 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.

The shift-share approach requires combining trade and labor market data matched at the industry level for each geographic region as in the previous section. The trade exposure index is calculated on the basis of regions or industries as explained in the methodology section below. The exposure variables are measured in real US dollars (normalized with the consumer price index). 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 we restrict the sample to the individuals who reported weekly wages larger than 100 takas.

In the second stage, we estimate how an increase in exports per worker in Bangladesh affects local labor market outcomes (average regional wages). Each sub-district in Bangladesh constitutes an observation in our regressions.[16] 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". Since they exhibit significant variation over time, rather than following similar trends, these measures are appropriate for identifying the effects of exports on wages.

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

$$x^r_{t,t+n} = \sum_i \frac{L^{i,r}_t \left(Q^i_{t+n} - Q^i_t\right)}{(\sum_j L^{j,r}_t)(\sum_d L^{i,d}_t)}$$

Alternatively, we can express the exposure formula as:

$$x^r_{t,t+n} = \sum_i \frac{L^{i,r}_t \left(Q^i_{t+n} - Q^i_t\right)}{L^r_t L^{i,\text{Bangladesh}}_t}$$

where L^r_t is the total number of workers assigned to any industry in region r and $L^{i,\text{Bangladesh}}_t$ is the total size of industry i. The trade exposure variable $x^r_{t,t+n}$ can be interpreted as the change in exports per worker in region r measured in real US dollars.

We consider the following simple linear regression model:

$$y^{s,r}_{t,t+n} = \beta^s_0 + \beta^s_1 x^r_{t,t+n} + \beta^s_2 y^{s,r}_t + \epsilon_{s,r}$$

where s is the type of worker, $y^{s,r}_{t,t+n}$ is the dependent variable, β^s_0 is the intercept, β^s_1 is the coefficient of our trade exposure variable, and β^s_2 is the coefficient of the control variable. $x^r_{t,t+n}$ 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

[16] We run the regressions at the sub-district, i.e. Upazila, level. Bangladesh has 492 sub-districts. Changes in the number of observations in the regressions across years and type of workers depend on the availability of individual-level data before collapsing it by sub-district. In other words, a specific sub-district is not included in the regressions if it does not have enough individual-level observations that meet the criteria.

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.

Results

Table 7 contains both the first-stage and second-stage results that focus on all workers, less educated males, less-educated females, and the apparel sector. The sample sizes are small due to the limited number of regions within Bangladesh with sufficient industrial employment. Results show positive and statistically significant effects of growing exports on average wages, for all workers, for the 2005-2010 period.

The next columns look at both a shorter time-frame and the period in which Bangladesh experienced a sharp increase in the apparel export unit values. The apparel unit values are not directly included in the estimation because we do not have comparable prices for all industrial sectors. As in most applications of the Bartik analysis, the value of exports is used. The results for 2010-2013 show very large and statistically-significant wage effects for less-educated women only. Note that none of the sector-specific (apparel) estimates are statistically significant, and none of the estimates for less-educated males are statistically significant at the conventional 5 percent level. The gains are concentrated with the factor used intensively in the export sector (women) and are not sector-specific in the sense that none of the apparel results are statistically significant.

Note that the instrument diagnostics suggest that the instruments are not particularly weak, but, in some specifications the instrument tests do not reject the null hypothesis of underidentification. Appendix B contains results from the shift-share estimation using an alternative instrument. The coefficient results and the underidentification test results are very similar.

Minimum Wages

One alternative explanation for the increase in wages of women might be a change in minimum wage laws. Although Bangladeshi minimum wages are not gender-specific, they are are industry-specific. Between 2005 and 2016, the apparel industry in Bangladesh experienced 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 results if they are binding (Bell 1997). Two necessary conditions determine whether or not minimum wages are binding. First, the minimum wage must be set above the equilibrium market wage. Second, setting the minimum wage level above the market wage only increases wages for workers if the minimum wage is effectively enforced.[17] Several studies show that minimum wage enforcement has not kept up with minimum wage levels in developing countries. The lack of labor inspectors and government capacity for enforcement means that workers effectively earn less than legal minimum wage levels (Bhorat 2014). Rani et al. (2013) review evidence from eleven developing countries and argue that effective enforcement is rare because effective enforcement requires more than inspectors and should include union/employer involvement and awareness raising campaigns.

[17] Gindling (2014) and Neumark and Corella (2021) survey the academic literature and find that negative employment effects, evidence of binding minimum wages, are tied to strong enforcement.

Bhorat, Kanbur, and Stanwix (2019) argue that the significant gap between regulatory intent and regulatory outcomes means that debate surrounding the minimum wage should be perhaps as much about institutional capacity as it is about wage levels.

Evidence for both conditions for Bangladesh can be found in Figures 9a and 9b, which show the wage distribution of less-educated apparel workers from each survey year and the minimum wage reference point (vertical lines). Note that for 2005, the reported minimum wage is actually the 2006 value (monthly earnings of 1662.50 Taka) that was increased over the 1994 value of 930 Taka (Hossain 2019). The 2006 value is shown to emphasize three main points of Figures 9a and 9b. First, the mass of workers earns above the legal minimum wage. Second, there is no wage "spike" at the level of minimum wage. Third, there are many workers earning less than the legal minimum wage. Together, these three points suggest that official minimum wages in the apparel sector are not binding. Since minimum wages are not binding for apparel, we conclude that our findings are not driven by either minimum wage levels or changes through time.

Export Diffusion through Domestic Inputs

One of the contributions of Goutam et al. (2017) is that they use the 2007 Input-Output table to estimate the extended effects of trade on informality. Input-output tables break down the use of inputs by economic sector. For example, Figure 10 shows the breakdown of inputs for Bangladesh's apparel sector in 2007. In addition to materials (represented primarily by cloth milling in Figure 10), apparel uses domestic services, such as transportation, retail and wholesale trade, financial services, and other non-traded but domestically produced inputs. An increase in apparel exports would likely increase the demand for, and employment in, non-traded sectors that service the apparel sector.

To explore the potential effects of export diffusion through domestic inputs, we use the 2007 Bangladesh Input-Output table[18] to calculate the input shares of each industry. The input shares are calculated as the input use divided by gross output (including the value added in the own-sector with own-sector inputs). These shares are then multiplied by final-sector exports and then summed over the input industry to get the total value of exports for each input sector (that is, the aggregate effect of servicing several exporting sectors). The value of exports used in the earlier analysis, which assigned non-traded sectors a value of zero for exports, are replaced with the implied import value and returned to the instrumental-variable estimation.

Not surprisingly, export diffusion blurs the predictions generated by the theoretic framework. As shown in Table 1, apparel is clearly female-intensive relative to other sectors. In addition, this approach relies more heavily on exports as a quantity demand rather than a price shock. As shown in figure 5, export quantities were rising since 2005, which means that the estimated effects are likely to be diffused through time as well as across industries.

Table 8 contains the cross-section instrumental-variable estimates for all workers. The number of observations is smaller in Table 8 than in Table 5 because merging the IO tables led to aggregating industries and some sectors were not matched (e.g. electrical equipment). Although the predictions

[18] We thank Shanthi Nataraj and the authors of Goutam et al. (2017) for their generous support and help with the IO tables.

of the theory are not strictly applicable to the diffusion approach, it is interesting that exports are still strongly associated with sharp increase in overall wages in 2013 (see column "Exports"). In addition, exports are associated with a drop in the male-female wage gap of about 5% (a drop of 0.01 from an estimated wage gap if about 0.21). Interestingly, this result is nearly identical to the simulation result of the HFCA model presented earlier. The drop in the male-female wage gap is spread over time, appearing in 2010, rising slightly in 2013, and holding steady in 2016. In other words, the results seem to be similar to Table 5 but diffused.

Table 9 presents the diffusion results when the sample is restricted to low-education workers. The qualitative results are very similar to those presented in Table 8. There is a positive wage change in 2013 associated with exports that drops off in 2016. The male-female wage gap drops significantly in 2010 and falls slightly more in 2013 and holds steady through 2016. Interestingly, the change in the wage gap is again about 5% (.009/0.170 = 5.2%), which also closely matches the simulation result.

Applying the input-output data to the shift-share approach generates the results shown in Table 10. The estimated results for apparel are never statically significant (due to being imprecisely estimated). The estimates for low-education females are relatively large and significant only between 2010 and 2013. Interestingly, since applying the IO table data extends the export shock to male-intensive wholesale/retail and transportation, Table 10 now shows positive and significant effects on male wages that are largest in the 2010-2013 period. Thus, allowing the export shock to diffuse across male-intensive industries seems to help us detect a wider diffusion (now to males) than suggested earlier.

Conclusions

Participation in global value chains has the potential to contribute to economic development in several ways. The apparel-led export growth strategy, such as followed by Bangladesh, Cambodia, Vietnam, and other countries has the potential to bring women into the formal labor force and increase agency within the household. In this study, we extend this literature by applying heterogeneous-firm comparative advantage models to illustrate how an increase in export prices can affect wage in the short and long run. Using both a shift-share and pooled cross-section instrumental variables analysis, we find a significant and consistent positive effect on female wages and a significant decline in the male-female wage gap in Bangladesh following an exogenous policy change that increased the price of Bangladeshi apparel exports in 2011.

The external validity of our study may be limited in several ways. First, Bangladesh is one of a very small group of countries whose exports are heavily concentrated in apparel. Thus, the two-sector, two factor heterogeneous firm comparative advantage models that seem to offer accurate predictions of short and long run wage movements may be less applicable in more diversified economies. Second, at least compared to India, Bangladesh seems to enjoy a more integrated domestic labor market. Other studies that apply similar empirical approaches as ours to both developed and developing countries both rely on, and often find, very high regional labor-market segmentation. Nevertheless, Bangladesh remains an important and highly visible apparel exporting developing country and our results suggest that women in particular in Bangladesh have experienced rising earnings through connections to global value chains.

References

Acemoglu, Daron; David H. Autor; David Lyle. (2004) "Women, War, and Wages: The Effect of Female Labor Supply on the Wage Structure at Midcentury" Journal of Political Economy 112(3): 497-551.

Aguayo-Tellez, Ernesto & Jim Airola & Chinhui Juhn & Carolina Villegas-Sanchez (2014) "Did Trade Liberalization Help Women? The Case of Mexico in the 1990s,"Research in Labor Economics, in: Solomon W. Polachek & Konstantinos Tatsiramos (ed.),New Analyses of Worker Well-Being, volume 38, pages 1-35, Emerald Publishing Ltd.

Angeli, Marietta; Julien Gourdon,Israel Gutierrez, and Przemek Kowalski (2020) "Rules of Origin" in Matoo, Aaditya; Nadia Rocha; and Michele Ruta (eds.) Handbook of Deep Trade Agreements, pp. 249-292. World Bank, Washington D.C. https://doi.org/10.1596/978-1-4648-1539-3

Artuç, Erhan, Gladys Lopez-Acevedo, Raymond Robertson, and Daniel Samaan. (2019) "Exports to Jobs: Boosting the Gains from Trade in South Asia (English)." South Asia Development Forum. Washington, D.C.: World Bank Group.

Atkin, David. (2016)"Endogenous skill acquisition and export manufacturing in Mexico" American Economic Review 106.8 2046-85.

Autor, David H., David Dorn, and Gordon H. Hanson.(2013) "The China Syndrome: Local Labor Market Effects of Import Competition in the United States." American Economic Review, 103 (6): 2121-68.

Bangladesh Bureau of Statistics, 2015. "Population distribution and internal migration in Bangladesh." 2015. Population monograph, Volume 6. Bangladesh Bureau of Statistics.

Bartik, Timothy. 1991. Who Benefits from State and Local Economic Development Policies? W.E. Upjohn Institute.

Bell, L. (1997). The Impact of Minimum Wages in Mexico and Colombia. Journal of Labor Economics, 15(S3), S102-S135. doi:10.1086/209878

Berik, Gunseli & Rodgers, Yana & Zveglich, Jr, Joseph. (2004) "International Trade and Gender Wage Discrimination: Evidence from East Asia" Review of Development Economics. 8. 237-254.

Bernard, Andrew B. & Stephen J. Redding & Peter K. Schott, 2007. "Comparative Advantage and Heterogeneous Firms," Review of Economic Studies, Blackwell Publishing. 74(1): 31-66.

Berndt, Ernst R. and Laurits R. Christensen. (1973). "The translog function and the substitution of equipment, structures, and labor in U.S. manufacturing 1929-68" Journal of Econometrics. 1(1): 81-113, ISSN 0304-4076. https://doi.org/10.1016/0304-4076(73)90007-9.

Bhorat, Haroo. (2014). Compliance with minimum wage laws in developing countries. IZA World of Labor, 1 doi:https://wol.iza.org/articles

Bhorat, Haroo; Kanbur, Ravi; Stanwix, Benjamin (2019) "Compliance with labor laws in developing countries, (updated)" IZA World of Labor, Institute of Labor Economics (IZA), June.

Bossavie, Laurent; Yoonyoung Cho, and Rachel Heath (2019). "The Effects of International Scrutiny on Manufacturing Workers" World Bank Group Social Protection and Jobs Global Practice Policy Research Working Paper 9065. http://www.worldbank.org/prwp.

Brambilla, Irene & Nicolas Depetris Chauvin & Guido Porto, (2015). "Wage and Employment Gains from Exports: Evidence from Developing Countries," Working Papers 2015-28, CEPII research center.

Curran, Louise and Khalid Nadvi (2015). "Shifting Trade Preferences and Value Chain Impacts in the Bangladeshi Textiles and Garments Industry" Cambridge Journal of Regions, Economy, and Society 8: 459-474.
De Giorgia, Giacomo & Marco Paccagnella & Michele Pellizzari, (2013). "Gender complementarities in the labor market," Questioni di Economia e Finanza (Occasional Papers) 183, Bank of Italy, Economic Research and International Relations Area
de Melo, Jaime and Portugal-Perez, Alberto. (2008). "Rules of Origin, Preferences and Diversification in Apparel: African Exports to the US and to the EU" CEPR Discussion Paper No. DP7072, Available at SSRN: https://ssrn.com/abstract=1311195
Eaton J, Kortum S. (2002). "Technology, geography and trade". Econometrica 70:1741–1779.
Eaton J, Kortum S. (2012). "Putting Ricardo to Work". Journal of Economic Perspectives 26:65–90.
Edmonds, Eric V., Nina Pavcnik, and Petia Topalova. (2010). "Trade Adjustment and Human Capital Investments: Evidence from Indian Tariff Reform." American Economic Journal: Applied Economics, 2 (4): 42-75.
Erten, Bilge and Jessica Leight. (2021). "Exporting out of Agriculture: The Impact of WTO Accession on Structural Transformation in China. The Review of Economics and Statistics. 00:ja, 1-46.
Erten, Bilge, Jessica Leight and Fiona Tregenna. (2019). "Trade liberalization and local labor market adjustment in South Africa." Journal of International Economics, Elsevier, vol. 118(C), pages 448-467.
Farole, Thomas; Yoonyoung Cho, Laurent Bossavie, and Reyes Aterido (2017). "Bangladesh Jobs Diagnostic" Jobs Series;No. 9.World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/28498 License: CC BY 3.0 IGO.
Frederick, Stacey; Lopez-Acevedo, Gladys; Robertson, Raymond; Vergara Bahena, Mexico A. (2022) From Jobs to Careers: Apparel Exports and Career Paths for Women in Developing Countries. South Asia Development Forum. Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/36529 License: CC BY 3.0 IGO.
Galor, O., & Weil, D. (1996). The Gender Gap, Fertility, and Growth. The American Economic Review, 86(3), 374-387. Retrieved April 1, 2021, from http://www.jstor.org/stable/2118202
Ghosh, Pallab and Liu (2018). "A Study of the Long-run Substitutability Between Men and Women" IZA Conference Paper, http://conference.iza.org/conference_files/Gender_2018/ghosh_p26064.pdf
Gindling, T. H. (2014). Does increasing the minimum wage reduce poverty in developing countries? IZA World of Labor, 1 doi:https://wol.iza.org/articles
Goutam, Prodyumna, Italo A. Gutierrez, Krishna B. Kumar, and Shanthi Nataraj, (2017). "Does Informal Employment Respond to Growth Opportunities? Trade-Based Evidence from Bangladesh" Santa Monica, CA: RAND Corporation. https://www.rand.org/pubs/working_papers/WR1198.html.
Grant, James H. and Daniel S. Hamermesh (1981) "Labor Market Competition among Youths, White Women, and Others" The Review of Economics and Statistics, 63(3): 354-360.
Guisinger, Amy Y. (2020) "Gender Differences in the volatility of work hours and labor demand" Journal of Macroeconomics, 66. https://doi.org/10.1016/j.jmacro.2020.103254
Hakobyan, Shushanik, and John McLaren. (2016). "Looking for Local Labor Market Effects of NAFTA." Review of Economics and Statistics 98(4): 728–41.
Hamermesh, Daniel (1993). Labor Demand Princeton, New Jersey: Princeton University Press

Heath, Rachel & Mushfiq Mobarak, A., (2015). "Manufacturing growth and the lives of Bangladeshi women" Journal of Development Economics, Elsevier, 115(C):1-15.
Hossain Ovi, Ibrahim (2019) "A Brief History of the Minimum Wage in the Garment Sector" Dhaka Tribune. https://www.dhakatribune.com/bangladesh/nation/2019/01/11/a-brief-history-of-the-minimum-wage-in-garment-sector
Kleibergen, F. and Paap, R. (2006) "Generalized Reduced Rank Tests Using the Singular Value Decomposition" Journal of Econometrics, 133: 97-126.
Kone, Zovanga L; Maggie Y Liu, Aaditya Mattoo, Caglar Ozden, Siddharth Sharma. (2018). "Internal borders and migration in India" Journal of Economic Geography, 18(4): 729–759.https://doi.org/10.1093/jeg/lbx045
Lechthaler, W., Mileva, M. (2019). "Trade liberalization and wage inequality: new insights from a dynamic trade model with heterogeneous firms and comparative advantage" Rev World Econ 155: 407–457. https://doi.org/10.1007/s10290-019-00347-0
Lusome, R., Bhagat, R. (2006). Trends and patterns of internal migration in India, 1971-2001. In Paper presented at the 'Annual Conference of Indian Association for the Study of Population (IASP)', vol. 7, p. 9.
Marshall, Richard, and Shibaab Rahman. (2013). "Internal Migration in Bangladesh: Character, Drivers and Policy Issues." UNDP
McCaig, Brian, and Nina Pavcnik. (2018) "Export Markets and Labor Allocation in a Low-Income Country." American Economic Review, 108 (7): 1899-1941.
McCaig, Brian. (2011). Exporting out of poverty: Provincial poverty in Vietnam and US market access, Journal of International Economics, 85, (1), 102-113
Melitz, Marc. (2003). "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity" Econometrica, 71(6) November: 1695-1725.
Menon, Nidhiya & Rodgers, Yana. (2009). International Trade and the Gender Wage Gap: New Evidence from India's Manufacturing Sector. World Development. 37. 965-981. 10.1016/j.worlddev.2008.09.009.
Mincer, Jacob. (1974). Schooling, Experience and Earnings. New York: National Bureau of Economic Research. ISBN 9780870142659.
Neumark, David and Munguía Corella, Luis Felipe (2021). "Do minimum wages reduce employment in developing countries? A survey and exploration of conflicting evidence" World Development 137,105165,ISSN 0305-750X,https://doi.org/10.1016/j.worlddev.2020.105165.
Olivetti, Claudia and Barbara Petrongolo (2014) "Gender Gaps Across Countries and Skills: Deman, Supply, and the Industry Structure" Queen Mary University of London Working Paper 723. https://www.econstor.eu/bitstream/10419/122079/1/817140069.pdf
Rani, U., Belser, P., Oelz, M., & Ranjbar, S. (2013). Minimum wage coverage and compliance in developing countries. International Labour Review, 152(3-4), 381-410. doi:http://onlinelibrary.wiley.com/journal/10.1111/%28ISSN%291564-913X/issues
Robertson, Raymond (2004) "Relative Prices and Wage Inequality: Evidence from Mexico" Journal of International Economics .December 64(2): 387-409.
Robertson, Raymond, Drusilla Brown, Gaëlle Pierre, and Maria Laura Sanchez-Puerta, eds. (2009) Globalization, Wages, and the Quality of Jobs: Five Country Studies. Washington, DC: World Bank.
Sauré, Philip & Hosny Zoabi (2014) "International trade, the gender wage gap and female labor force participation" Journal of Development Economics, 111:17-33.
Singh, D. (1998). Internal migration in India: 1961-1991. Demography India, 27: 245–261.

Srivastava, R. (2012). Internal migrants and social protection in India. Human Development in India. New Delhi, India: UNICEF Country Office.

Srivastava, R., McGee, T. (1998) Migration and the labour market in India. Indian Journal of Labour Economics, 41: 583–616.

Stock, J.H. and Yogo, M. (2005) "Testing for Weak Instruments in Linear IV Regression." In D.W.K. Andrews and J.H. Stock, eds. Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg. Cambridge: Cambridge U y Press, 2005, pp. 80-108. Working paper version: NBER Technical Working Paper 284. http://www.nber.org/papers/T0284.

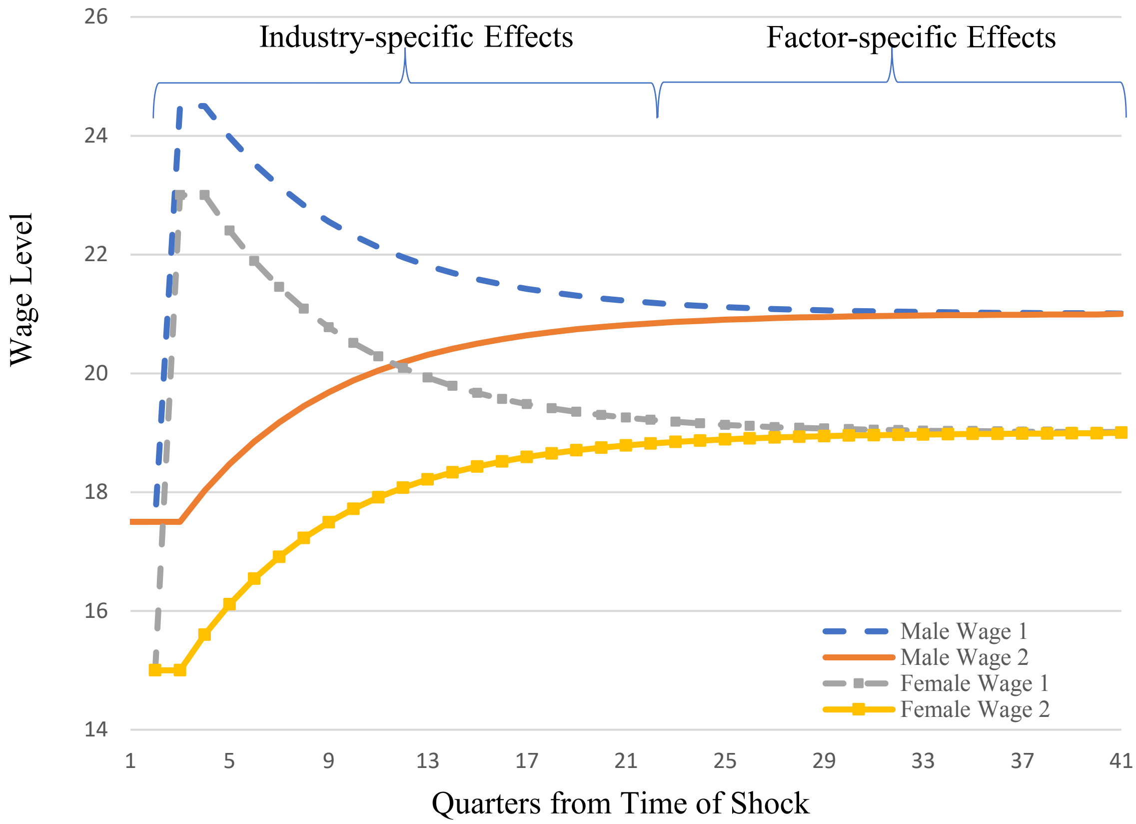
Tanaka, Mari. (2020). "Exporting Sweatshops? Evidence from Myanmar." Review of Economics and Statistics 102(3): 442-456.

Topalova, Petia. (2010). "Factor Immobility and Regional Impacts of Trade Liberalization: Evidence on Poverty from India." American Economic Journal of Applied Economics 2(4): 1–41.

Verhoogen, Eric A. (2008) "Trade, quality upgrading, and wage inequality in the Mexican manufacturing sector." The Quarterly Journal of Economics 123(2): 489-530.

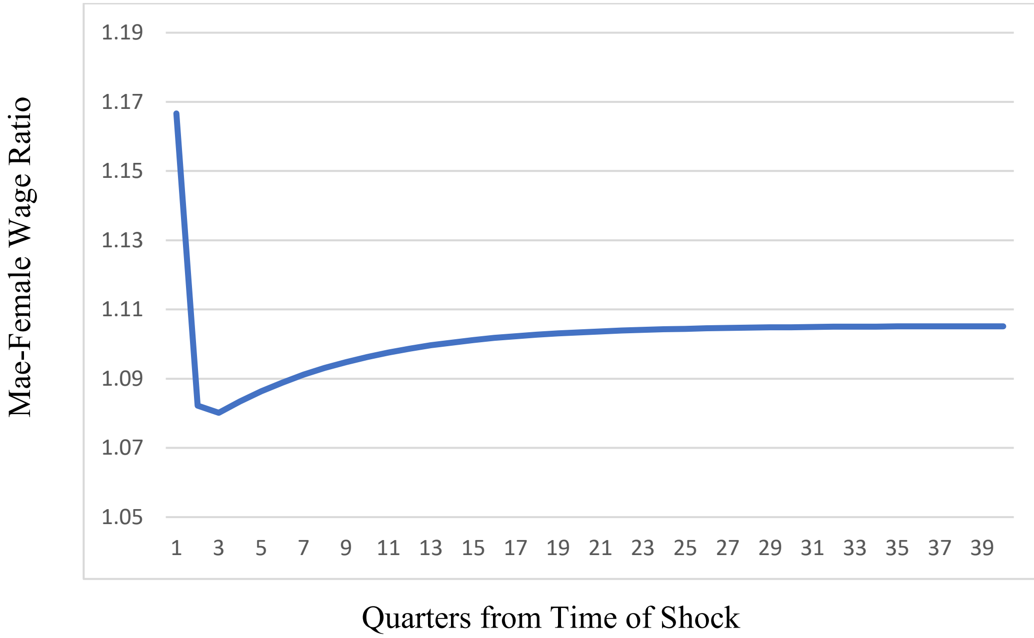
Vogelsang, T., & Perron, P. (1998). Additional Tests for a Unit Root Allowing for a Break in the Trend Function at an Unknown Time. International Economic Review, 39(4), 1073-1100. doi:10.2307/2527353

Figure 1a: Dynamic Wage Adjustment in HFCA Models



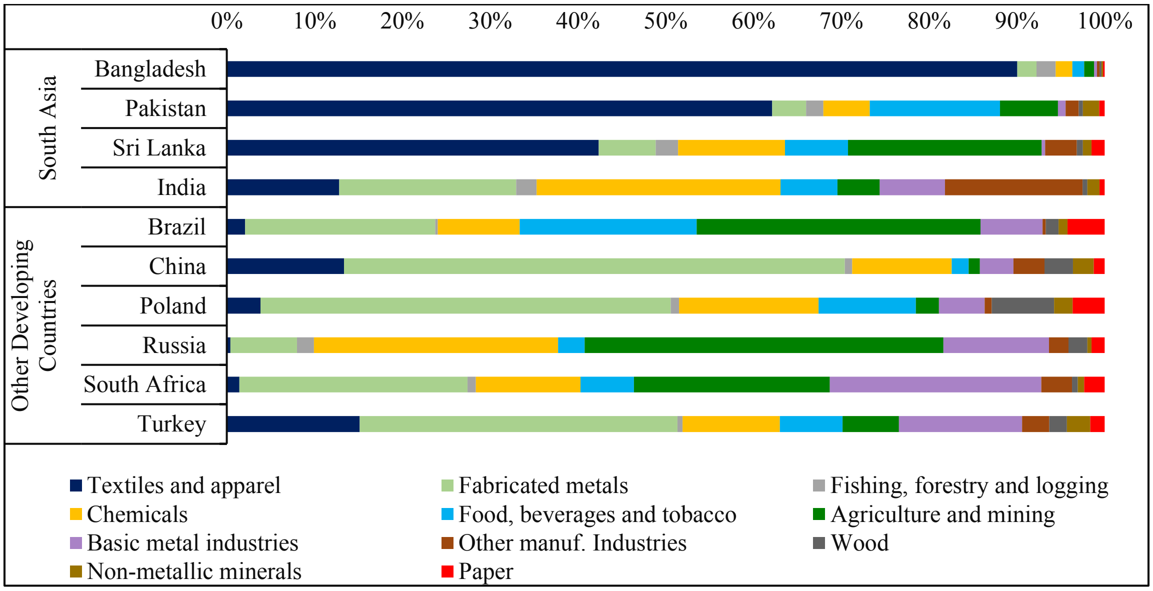
Notes: This figure shows the effects of a 20% relative price shock to industry 1. Using alpha values of 0.6 and 0.4, the initial equilibrium wage is 17.5 for males and 15 for females. The final wage is 21 for males and 19 for females. The Male-Female wage gap falls from 1.167 to 1.105 (see figure 1b). Time periods (quarters) are shown along the horizontal axis and the shock occurs in period 1.

Figure 1b: Dynamic Adjustment of Aggregate Male-Female Wage Ratio



Notes: This figure shows the effects of a 20% relative price shock to industry 1. See Figure 1a for details. The Male-Female wage gap falls from 1.167 to 1.105. Time periods (quarters) are shown along the horizontal axis and the shock occurs in period 1.

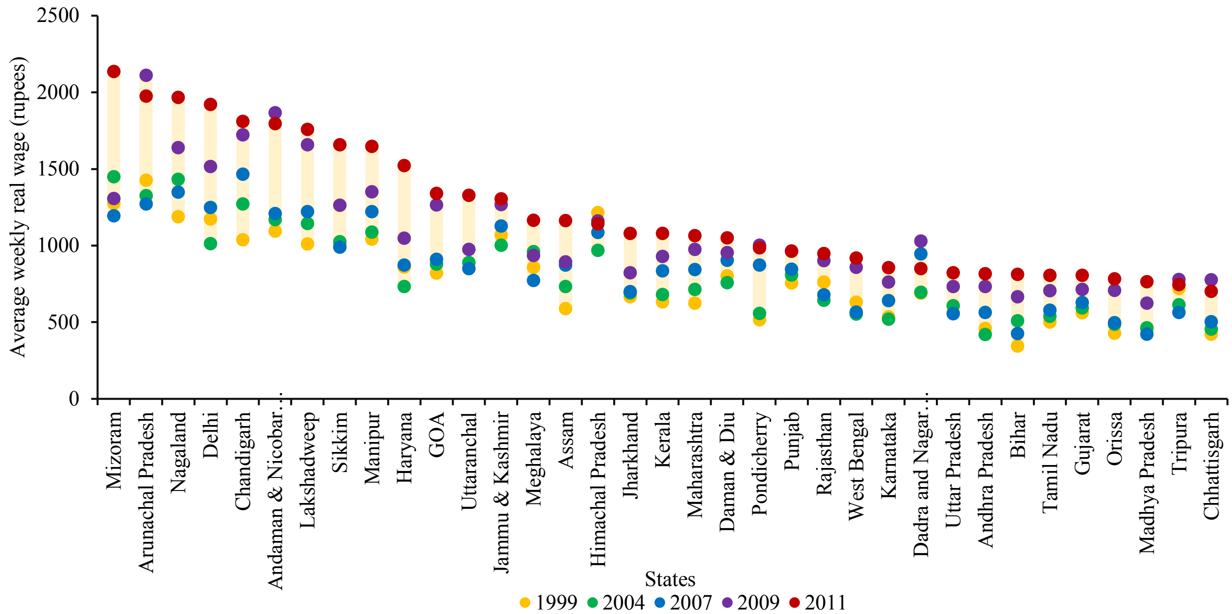
Figure 2. Bangladesh Exports by Sector



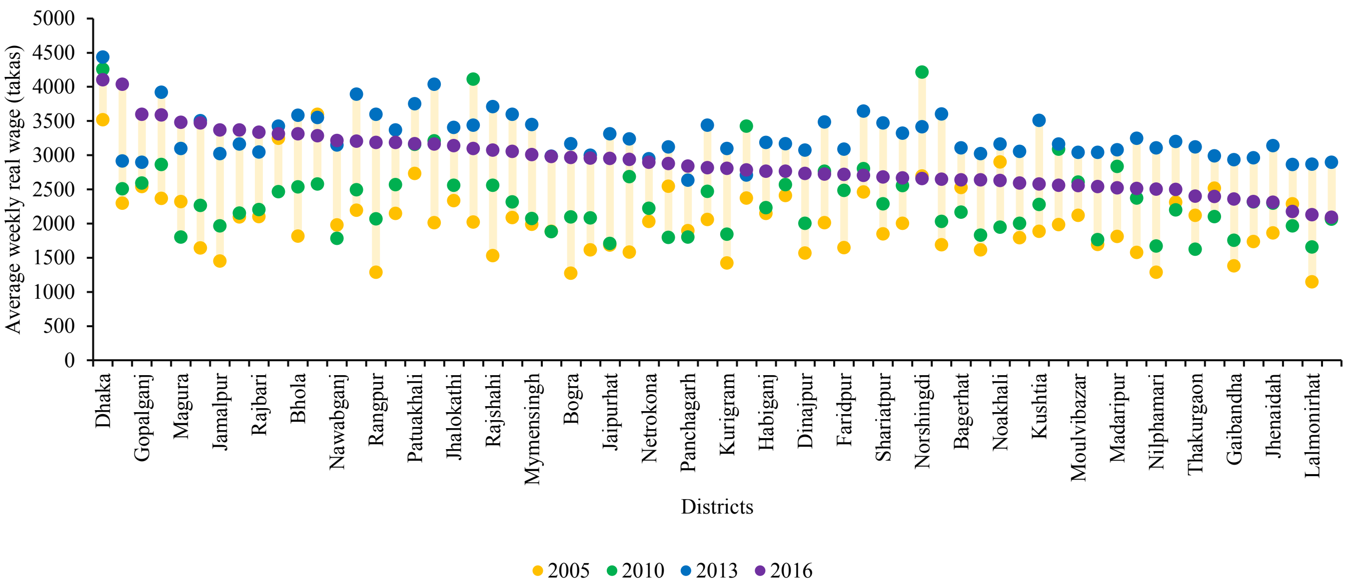
Notes: Sectorial breakdown of country-wise exports from South Asia and other developing countries, 2016 (%). Source: Artuç et al., (2019).

Figure 3. Average Real Wages Across Regions

a) India

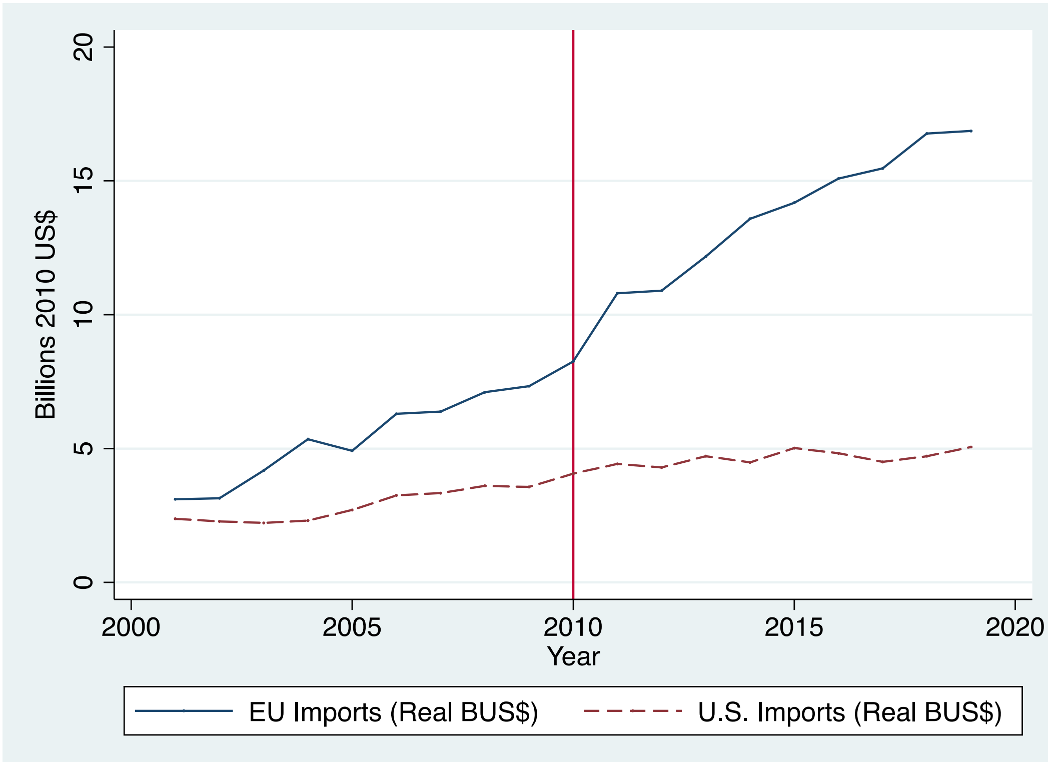


b) Bangladesh



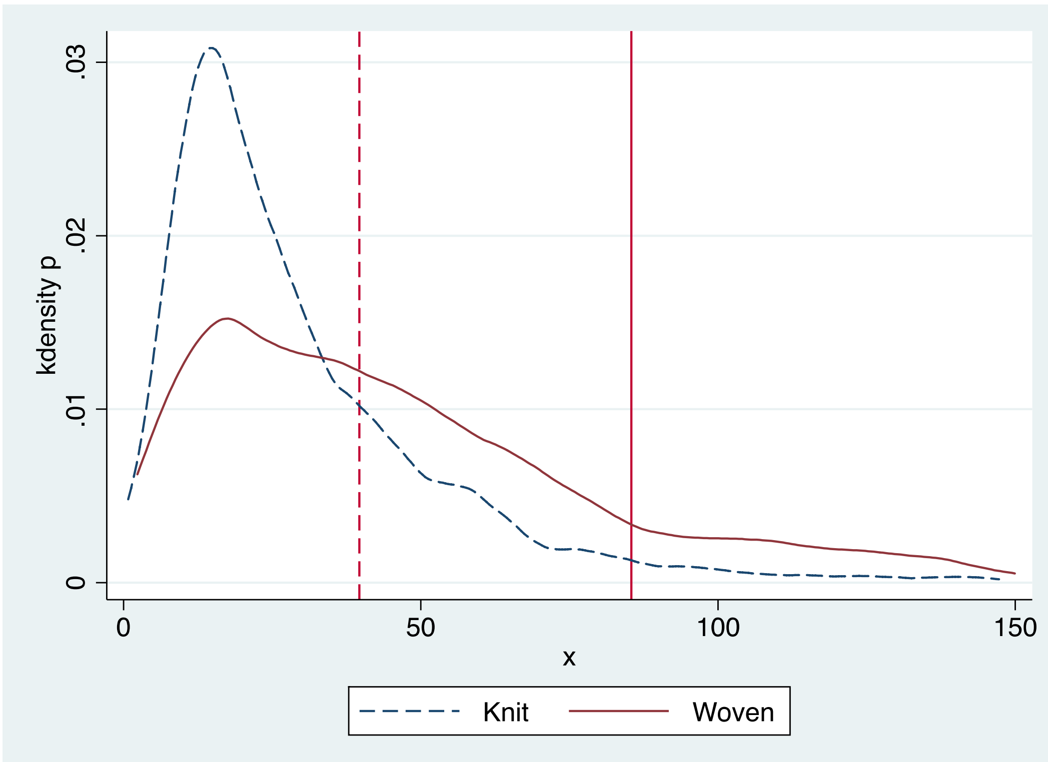
Source: Calculated by the authors using data form the Bangladeshi and Indian LFS.

Figure 4. EU and US Apparel Imports from Bangladesh



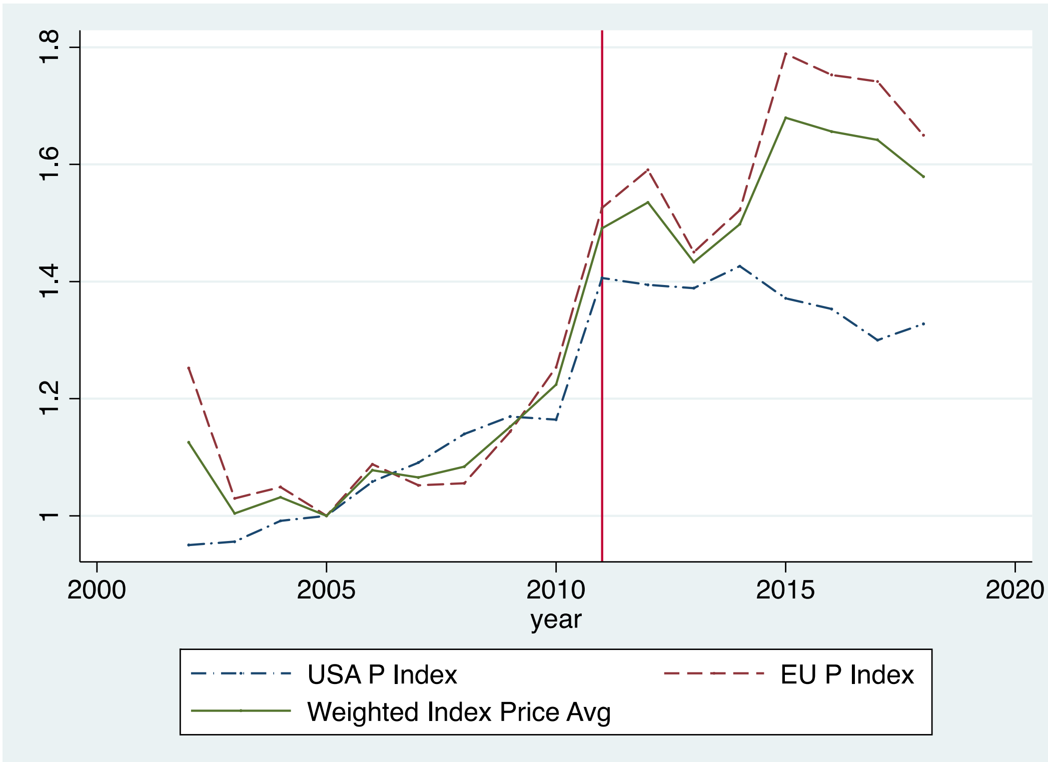
Notes: Data come from COMTRADE HS61 and HS62. A2 trend break tests from Vogelsang and Perron (1998) show breaks in 2009-2010 for the EU and 2010 for the US. The annual trend (standard error) prior to 2010 for the EU series is 0.548 (0.036) and after 2010 is 0.0832 (0.048) and the different in trend is statistically significant at the 1% level.

Figure 5: Knit (HS61) and Woven (HS62) Unit Price Indices



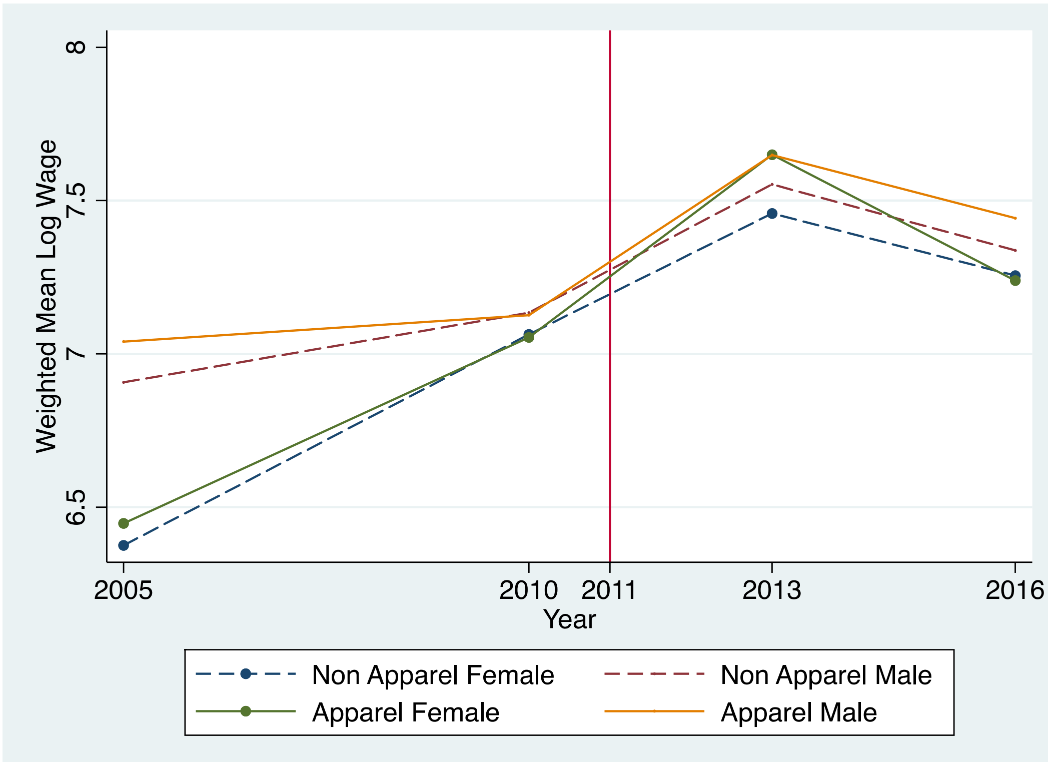
Notes: Values represent the kernel density graphs of the unit values of all 1,943 10-digit HS61 and all 2,483 10-digit HS62 categories imported by the US from Bangladesh in 2010. The vertical lines represent means within each group. The mean for Knit is 39.67 and the mean for Woven is 85.42. Source: OTEXA.

Figure 6: EU and USA Bangladesh Unit Value Indices



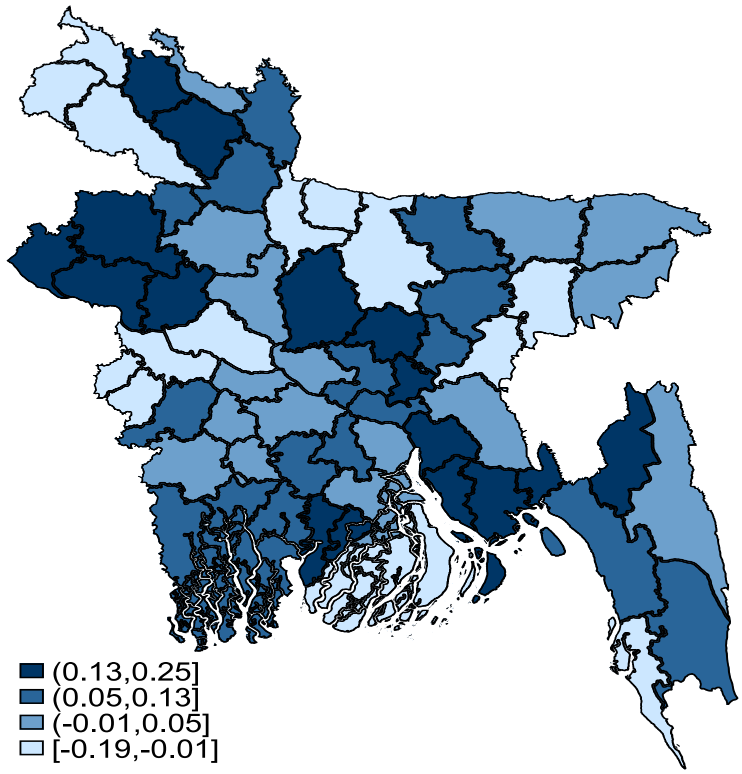
Notes: EU unit values are based in kilograms and USA unit values are based in square-meter-equivalent and are calculated by dividing the total value by the total quantity in each year. Both series are normalized to 1 in 2005. The solid weighted index price average line uses the shares of Bangladesh apparel exports going to the U.S. and the EU to weight the index values. US data are from the US Department of Commerce, Office of Textiles and Apparel (OTEXA). EU data are from EUROSTAT.

Figure 7: Weighted Mean Log Wages,
by Gender, Sector, and Time



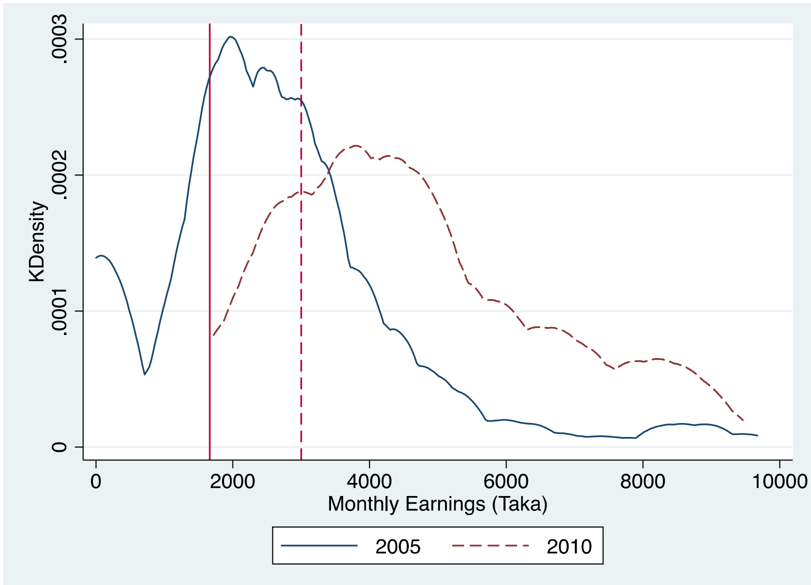
Notes: Authors' elaboration using real wages from Labor Force Surveys as described in the text. Means are calculated across all regions using survey-provided population weights.

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



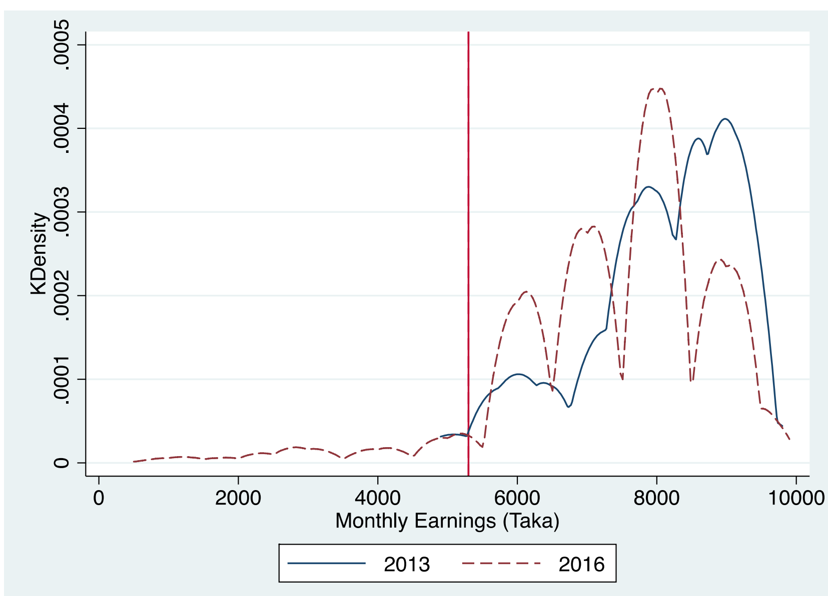
Notes: Authors' calculations based on Labor Force Surveys for Bangladesh.

Figure 9a: Bangladesh Minimum Wages and the Wage Distribution of Less-Educated Bangladeshi Workers in 2005 and 2010



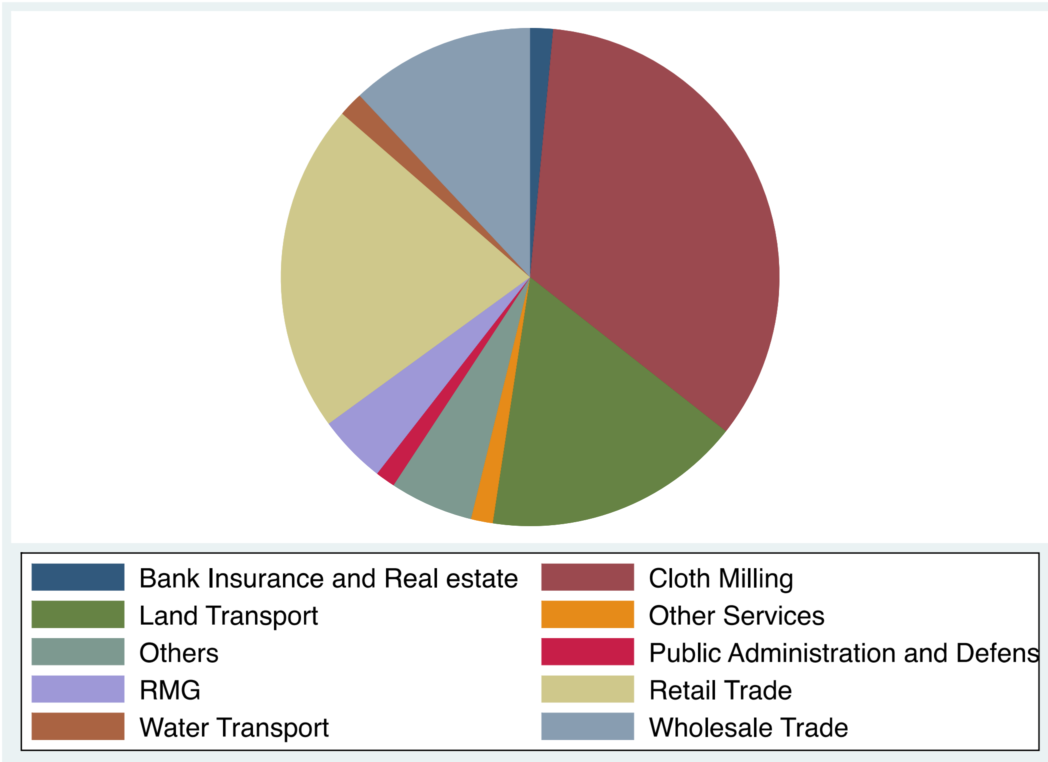
Notes: Earnings are in nominal local currency units (Taka). The minimum wage line labeled as 2005 actually represents the 1662.50 minimum wage for apparel workers set in 2006, which increased the minimum wage from 930 Taka that had been established in 1994.

Figure 9b: Bangladesh Minimum Wages and the Wage Distribution of Less-Educated Bangladeshi Workers in 2013 and 2016



Notes: Earnings are in nominal local currency units (Taka). Note that the same minimum wage applies to both the 2013 and 2016 samples.

Figure 10: Ready-Made Garment (Apparel) Inputs by Sector



Notes: Author's elaboration based on the 2007 Bangladesh Input-Output table used in Goutam et al. (2017). The main inputs are textiles, transportation, and wholesale/retail trade, and services.

Table 1: Labor Force Summary Statistics

Industry	Sample Size	Female Share	Percent Married	Mean Wage	Mean Education	Mean Age
Apparel	22,520	0.41	0.7	2281.03	5.42	29.81
Other MFG	15,628	0.16	0.71	2158.4	5.13	33.24
Wholesale/Retail	15,769	0.07	0.72	2172.23	5.31	34.24
Transport	13,402	0.04	0.83	2086.17	4.19	34.92
Other Sectors	98,244	0.2	0.77	2286.19	5.1	36.64
Not Working	202,007	0.36	0.85	0	4.4	37.42

Notes: Authors' elaboration using the combines labor forced surveys from 2005, 2010, 2013, and 2016.

Table 2: Estimates of the Elasticity of Substitution between Less-Educated Males and Females in Bangladesh

VARIABLES	(1) None	(2) Time	(3) Region	(4) Both
LfLm	0.040***	0.052***	0.040***	0.055***
	(0.003)	(0.004)	(0.003)	(0.004)
Local Exports A	0.016***	0.017***	0.013***	0.013***
	(0.002)	(0.002)	(0.002)	(0.002)
Local Exports B	0.013***	0.007**	0.007**	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)
Constant	-0.161***	-0.066**	-0.022	0.110**
	(0.030)	(0.032)	(0.044)	(0.043)
Observations	1,094	1,094	1,094	1,094
R-squared	0.243	0.354	0.405	0.516
Fixed Effect	None	Time	Region	Both
Sigma	1.820	2.065	1.826	2.135

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All equations us the total population of each city-age group-year cell as analytic weights. The LfLm variable generates the gamma estimate in (6). The estimated elasticity of substitution between males and females is represented by "Sigma" in the last row.

Table 3: Descriptive Mincerian Wage Equation Results (All Workers)

Year	Main Effects	Apparel	Male	Apparel x Male	Age	High Skill
2005	6.227***	0.305***	0.284***	-0.009	0.003***	0.626***
	(0.052)	(0.057)	(0.048)	(0.061)	(0.001)	(0.040)
2010	0.498***	-0.177**	-0.137***	0.065	-0.001	-0.184***
	(0.058)	(0.077)	(0.053)	(0.086)	(0.001)	(0.049)
2013	1.034***	-0.077	-0.265***	-0.019	0.000	-0.380***
	(0.054)	(0.060)	(0.049)	(0.066)	(0.001)	(0.044)
2016	0.778***	-0.139**	-0.172***	0.076	-0.004***	0.129***
	(0.055)	(0.061)	(0.050)	(0.066)	(0.001)	(0.044)

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. This table contains the results from one estimation equation with interaction terms that are organized into rows and columns for ease of comparison. The total number of observations is 49,829 and the R-squared value is 0.288.

Table 4: Descriptive Mincerian Wage Equation Results (Less Education)

Year	Main Effects	Apparel	Male	Apparel x Male	Age
2005	6.193***	0.378***	0.325***	-0.001	0.003***
	(0.044)	(0.050)	(0.040)	(0.057)	(0.001)
2010	0.540***	-0.241***	-0.172***	0.015	-0.001
	(0.051)	(0.073)	(0.046)	(0.084)	(0.001)
2013	1.070***	-0.148***	-0.306***	-0.026	0.001
	(0.046)	(0.053)	(0.042)	(0.062)	(0.001)
2016	0.861***	-0.214***	-0.223***	0.102	-0.005***
	(0.047)	(0.054)	(0.043)	(0.062)	(0.001)

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. This table contains the results from one estimation equation with interaction terms that are organized into rows and columns for ease of comparison. The total number of observations is 45,278 and the R-squared value is 0.230.

Table 5: Pooled Cross-Section LFS IV Estimation

	Time	Exports	Exports*Male
2005	6.327***	-0.009**	-0.001
	(0.028)	(0.004)	(0.003)
x2010	0.311***	-0.030**	0.001
	(0.026)	(0.015)	(0.005)
x2013	0.608***	0.017***	-0.012***
	(0.030)	(0.006)	(0.002)
x2016	0.449***	0.003	-0.006***
	(0.027)	(0.006)	(0.002)
Male		0.114***	
		(0.010)	
Education		0.168***	
		(0.005)	
Age		0.005***	
		(0.000)	
Observations		160,754	
R-squared		0.315	
Kleibergen-Paap LM UnderID		32.03	
Kleibergen-Paap F statistic for Weak ID		100.208	

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The table contains the results from a single, exactly-identified OLS instrumental variable regression for 2005, 2010, 2013, and 2016 Labor Force Surveys (LFS).

Table 6: Less-Educated Worker IV Estimation

	Time	Exports	Exports*Male
2005	6.359***	-0.002	-0.000
	(0.031)	(0.004)	(0.003)
x2010	0.410***	-0.011	0.001
	(0.026)	(0.007)	(0.005)
x2013	0.789***	0.009**	-0.015***
	(0.026)	(0.004)	(0.002)
x2016	0.523***	-0.004	-0.008***
	(0.027)	(0.004)	(0.002)
Male		0.132***	
		(0.012)	
Education		0.115***	
		(0.003)	
Age		0.003***	
		(0.000)	
Observations		130,490	
R-squared		0.219	
Kleibergen-Paap LM UnderID		31.417	
Kleibergen-Paap F statistic for Weak ID		95.565	

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The table contains the results from a single, exactly-identified OLS instrumental variable regression. The difference between the coefficients (standard error for the test of coefficient difference) on the Male x Export interaction terms for 2010 and 2013 is a statistically significant-0.015 (0.006). Standard errors are clustered on Upazila.

Table 7: Shift-Share IV Estimation

Type of worker		1st Stage				2nd Stage (Wages)			
		2005-2010	2010-2013	2010-2016	2013-2016	2005-2010	2010-2013	2010-2016	2013-2016
		1	2	3	4	5	6	7	8
All	Coefficient	0.4***	-0.2	-0.0	0.0	2829.6**	604.3	644.5	-30066.0
	Std. Errors	(0.1)	(0.1)	(0.0)	(0.0)	(1319.7)	(1164.7)	(1562.8)	(174233.2)
	N	471	451	451	512	408	389	422	429
	Underidentification F					7.017	4.980	5.231	0.040
	Underidentification p-value					0.008	0.026	0.022	0.842
	Weak identification Wald F					6.047	22.533	2.689	0.040
Less educated males	Coefficient	0.4***	-0.2	-0.0	0.0	2104.6*	1359.2	1384.4	33098.0
	Std. Errors	(0.1)	(0.1)	(0.0)	(0.0)	(1239.1)	(961.7)	(850.4)	(91542.6)
	N	471	451	451	512	371	332	407	356
	Underidentification F					10.687	4.747	5.340	0.124
	Underidentification p-value					0.001	0.029	0.021	0.724
	Weak identification Wald F					5.802	12.245	2.123	0.127
Less educated females	Coefficient	0.4***	-0.2	-0.0	0.0	521.0	3838.1**	1347.6***	2894.2
	Std. Errors	(0.1)	(0.1)	(0.0)	(0.0)	(1832.9)	(1495.2)	(379.1)	(6147.0)
	N	471	451	451	512	28	55	83	91
	Underidentification F					2.586	1.651	2.242	1.236
	Underidentification p-value					0.108	0.199	0.134	0.266
	Weak identification Wald F					3.010	1361.692	89.913	0.949
Apparel	Coefficient	0.4***	-0.2	-0.0	0.0	68.0	-2359.2	-3499.1	-2521.5
	Std. Errors	(0.1)	(0.1)	(0.0)	(0.0)	(2412.7)	(1742.1)	(4396.7)	(8172.4)
	N	471	451	451	512	29	42	65	60
	Underidentification F					2.164	1.671	2.329	1.517
	Underidentification p-value					0.141	0.196	0.127	0.218
	Weak identification Wald F					1.435	333.859	139.250	1.018

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

Table 8: Diffused (IOT) IV Estimation

	Time	Exports	Exports*Male
2005	7.270***	-0.062***	0.014***
	(0.196)	(0.010)	(0.002)
x2010	0.107	0.030**	-0.009***
	(0.259)	(0.014)	(0.002)
x2013	-0.153	0.063***	-0.010***
	(0.185)	(0.009)	(0.002)
x2016	0.339*	0.029***	-0.010***
	(0.180)	(0.009)	(0.001)
Male		0.208***	
		(0.032)	
Education		0.140***	
		(0.004)	
Age		0.003***	
		(0.000)	
Observations		100,658	
R-squared		0.278	
Kleibergen-Paap LM UnderID		60.523	
Kleibergen-Paap F Weak Ins		98.56	

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The table contains the results from a single, exactly-identified OLS instrumental variable regression. Standard errors are clustered on Upazila. This table is analogous to Table 5 but incorporates input-output table data to diffuse the exports across direct and indirectly-exporting industries. Indirectly exporting industries are domestic industries that supply inputs to exporting industries.

Table 9: Diffused (IOT) Less-educated Worker IV Estimation

	Time	Exports	Exports*Male
2005	7.076***	-0.055***	0.022***
	(0.172)	(0.008)	(0.002)
x2010	0.424*	0.022*	-0.008***
	(0.236)	(0.013)	(0.002)
x2013	0.448***	0.042***	-0.009***
	(0.153)	(0.008)	(0.002)
x2016	0.679***	0.019**	-0.009***
	(0.167)	(0.009)	(0.001)
Male		0.170***	
		(0.035)	
Education		0.100***	
		(0.004)	
Age		0.001***	
		(0.000)	
Observations		85,785	
R-squared		0.229	
Kleibergen-Paap LM UnderID		57.821	
Kleibergen-Paap F Weak Ins		83.118	

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The table contains the results from a single, exactly-identified OLS instrumental variable regression. The difference between the coefficients (standard error for the test of coefficient difference) on the Male x Export interaction terms for 2010 and 2013 is a statistically significant -0.015 (0.006). Standard errors are clustered on Upazila. This table is analogus to Table 6 but incorporates input-output table data to diffuse the exports across direct and indirectly-exporting industries. Indirectly exporting industries are domestic industries that supply inputs to exporting industries.

Table 10: Shift-Share Estimation with Diffused Export Effects

Type of worker		1st Stage				2nd Stage (Wages)			
		2005-2010	2010-2013	2010-2016	2013-2016	2005-2010	2010-2013	2010-2016	2013-2016
		1	2	3	4	5	6	7	8
All	Coefficient	0.0***	0.0***	0.0***	-0.0	-10.3***	60.3***	-2.5	20.1
	Std. Errors	(0.0)	(0.0)	(0.0)	(0.0)	(3.4)	(14.9)	(5.9)	(18.2)
	N	471	452	452	516	408	390	422	429
	Underidentification F					22.006	30.143	13.819	6.191
	Underidentification p-value					0.000	0.000	0.000	0.013
	Weak identification Wald F					312.792	85.634	4.446	3.246
Less educated males	Coefficient	0.0***	0.0***	0.0***	-0.0	-6.1**	41.4***	4.0**	13.8*
	Std. Errors	(0.0)	(0.0)	(0.0)	(0.0)	(2.6)	(7.6)	(2.0)	(7.4)
	N	471	452	452	516	371	332	407	356
	Underidentification F					21.216	36.943	14.151	2.738
	Underidentification p-value					0.000	0.000	0.000	0.098
	Weak identification Wald F					265.297	93.039	4.522	1.296
Less educated females	Coefficient	0.0***	0.0***	0.0***	-0.0	-2.7	31.9***	2.2	-1.2
	Std. Errors	(0.0)	(0.0)	(0.0)	(0.0)	(3.3)	(6.8)	(1.6)	(4.2)
	N	471	452	452	516	28	55	83	91
	Underidentification F					9.856	14.261	6.440	1.453
	Underidentification p-value					0.002	0.000	0.011	0.228
	Weak identification Wald F					248.856	131.362	8.263	2.911
Apparel	Coefficient	0.0***	0.0***	0.0***	-0.0	2.5	-48.2	-11.2	216.8
	Std. Errors	(0.0)	(0.0)	(0.0)	(0.0)	(5.6)	(32.4)	(10.0)	(483.9)
	N	471	452	452	516	29	42	65	60
	Underidentification F					12.101	10.950	10.659	0.241
	Underidentification p-value					0.001	0.001	0.001	0.624
	Weak identification Wald F					149.441	39.371	9.685	0.237

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

Appendix A: Consumption in a simple HFCA model

Consider two types of workers, males and females, who seek to optimize expected lifetime utility using a common intertemporal utility function

(8) $E_t\{\sum_{k=0}^{\infty} \beta^k U_k(L_{ik}, \mu_t, C_k)\}$

subject to an income constraint. Let β represent the discount factor and let $L_i \in (M_i, F_i)$ represent inelastically supplied labor for either Males or Females to sector *i*. Workers can switch sectors based on both the expected wage in each sector and the stochastic moving cost μ. Workers evaluate their choice in each period based on the moving cost observed in period *t.* Workers will move if expected earnings minus the mobility cost is larger in the other sector. The stochastic moving costs means that only some workers will take advantage of observed wage differentials across sectors in each period following a shock.

C represents an aggregate composite good that both men and women aggregate using the same Cobb-Douglas function with specified by *a.*

(9) $C = C_1^a C_2^{(1-a)}$

Each consumption good (1,2) is itself an aggregation of a number of varieties. Defining the elasticity of substitution between varieties as $\lambda = 1/(1-\rho) > 1$, we follow Bernard, Redding, and Schott, 2007 and define both the consumption index and price index using constant elasticity of substitution functions for each sector as

(10) $C_i = [\int q_i(z)^\rho dz]^{1/\rho}$ and $P_i = [\int p_i(z)^{1-\lambda} dz]^{1/(1-\lambda)}$.

Product varieties are indexed by *z* , and *q* represents quantity. These conditions generate demand functions varieties and consumption bundles that are functions of the prices relative to the aggregate price index. Varieties are imported and exported in each sector.

Appendix B: Alternative Instrument Shift-Share Results

An alternative exogenous instrument for US demand for Bangladesh imports is internal demand growth. As a robustness check, we construct an alternative 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 US explained exclusively by U.S aggregate demand. This variable is, by construction, orthogonal to every supply-side factor in the Bangladeshi 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 because it is extremely unlikely that local economic outcomes in Bangladesh determine US aggregate domestic apparel demand. Panel B of Figure 8 displays a positive correlation for every period.

Table 4 contains the results from the alternative instrument using the same construction of the trade exposure index and the same regression approach as described above. Both the first stage and second stage results are reported. Overall, results are consistent across both approaches. We observe significant effects on wages of all workers and less-educated males for the 2005-2010 period. The main difference is that the estimate for less-educated males for 2010-2013 is positive and significant under this approach. Note that the same significant positive results emerge for less-educated women and the results follow the same pattern as shown in Table 3. Either instrumental variable approach generates the same result of a larger and more significant positive relationship between exports and wages of less-educated women.

Table B1: Shift-Share Estimation with Alternative Instrument

Type of worker		1st Stage				2nd Stage (Wages)			
		2005-2010	2010-2013	2010-2016	2013-2016	2005-2010	2010-2013	2010-2016	2013-2016
		1	2	3	4	5	6	7	8
All	Coefficient	12.9***	-1.9	1.2	1.5	3062.4**	1131.3	365.3	1338.6
	Std. Errors	(1.7)	(7.8)	(3.2)	(1.9)	(1475.0)	(1565.5)	(1552.6)	(7256.2)
	N	471	451	451	512	408	389	422	429
	Underidentification F					8.923	6.287	2.399	1.937
	Underidentification p-value					0.003	0.012	0.121	0.164
	Weak identification Wald F					68.219	28.117	3.747	3.849
Less educated males	Coefficient	12.9***	-1.9	1.2	1.5	2423.7**	1800.3**	1686.7	5749.2
	Std. Errors	(1.7)	(7.8)	(3.2)	(1.9)	(969.2)	(838.9)	(1413.8)	(4941.9)
	N	471	451	451	512	371	332	407	356
	Underidentification F					10.312	6.792	2.071	1.822
	Underidentification p-value					0.001	0.009	0.150	0.177
	Weak identification Wald F					79.891	33.149	2.751	3.595
Less educated females	Coefficient	12.9***	-1.9	1.2	1.5	1001.8	3138.8**	1374.7***	1012.7
	Std. Errors	(1.7)	(7.8)	(3.2)	(1.9)	(1002.4)	(1409.6)	(363.2)	(1609.6)
	N	471	451	451	512	28	55	83	91
	Underidentification F					4.438	1.077	2.251	1.826
	Underidentification p-value					0.035	0.299	0.133	0.177
	Weak identification Wald F					18.701	6.034	29.820	4.454
Apparel	Coefficient	12.9***	-1.9	1.2	1.5	990.4	-3442.2	-3205.9	-2999.6
	Std. Errors	(1.7)	(7.8)	(3.2)	(1.9)	(1484.5)	(2824.3)	(4260.2)	(4843.0)
	N	471	451	451	512	29	42	65	60
	Underidentification F					4.176	1.006	2.173	1.725
	Underidentification p-value					0.041	0.316	0.140	0.189
	Weak identification Wald F					17.874	5.169	40.457	8.036

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

Table B2: Shift-Share Estimation with Alternative Instrument and Diffused Exports

Type of worker		1st Stage				2nd Stage (Wages)			
		2005-2010	2010-2013	2010-2016	2013-2016	2005-2010	2010-2013	2010-2016	2013-2016
		1	2	3	4	5	6	7	8
All	Coefficient	-8751.7***	398.0	-148.7	2006.0	-12.9**	161.6	-1803.7	-37.2
	Std. Errors	(431.6)	(363.6)	(825.4)	(1550.8)	(5.2)	(160.7)	(85511.2)	(47.6)
	N	471	452	452	516	408	390	422	429
	Underidentification F					10.321	1.250	0.000	2.598
	Underidentification p-value					0.001	0.264	0.983	0.107
	Weak identification Wald F					359.820	0.787	0.000	0.813
Less educated females	Coefficient	-8751.7***	398.0	-148.7	2006.0	-10.0***	142.6**	32.1	13.5*
	Std. Errors	(431.6)	(363.6)	(825.4)	(1550.8)	(3.1)	(69.6)	(48.9)	(7.1)
	N	471	452	452	516	371	332	407	356
	Underidentification F					11.568	2.757	0.293	2.942
	Underidentification p-value					0.001	0.097	0.588	0.086
	Weak identification Wald F					402.215	1.242	0.191	3.617
Less educated females	Coefficient	-8751.7***	398.0	-148.7	2006.0	-2.4	40.1	-1.7	-1.0
	Std. Errors	(431.6)	(363.6)	(825.4)	(1550.8)	(5.6)	(58.0)	(9.7)	(9.5)
	N	471	452	452	516	28	55	83	91
	Underidentification F					6.314	0.254	0.364	0.820
	Underidentification p-value					0.012	0.614	0.546	0.365
	Weak identification Wald F					39.736	0.561	0.904	0.909
Apparel	Coefficient	-8751.7***	398.0	-148.7	2006.0	-8.4	255.9	40.3	62.3
	Std. Errors	(431.6)	(363.6)	(825.4)	(1550.8)	(18.9)	(418.6)	(63.7)	(107.2)
	N	471	452	452	516	29	42	65	60
	Underidentification F					2.105	0.427	0.852	0.556
	Underidentification p-value					0.147	0.514	0.356	0.456
	Weak identification Wald F					6.556	0.593	0.929	0.541

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