



UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

WORKING PAPERS IN ECONOMICS

No 205

**TRADE LIBERALIZATION AND WAGE INEQUALITY:
EVIDENCE FROM BANGLADESH'S COTTON TEXTILE INDUSTRY**

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**(April 2006)
Revised April 2015**

**ISSN 1403-2473 (print)
ISSN 1403-2465 (online)**

TRADE LIBERALIZATION AND WAGE INEQUALITY: EVIDENCE FROM BANGLADESH'S COTTON TEXTILE INDUSTRYⁱ

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April 2015

ABSTRACT

The prediction of standard economic theory that trade liberalization reduces income inequality in developing countries has been challenged by several studies during recent decades. This paper explores this issue by analyzing the relationship between trade liberalization and skilled-unskilled wage inequality in the Bangladesh cotton textile industry. First cointegration analysis is used to test for long-run relationships between real wages and trade liberalization over the period 1971-2010, and then a two-equation error correction model is estimated for wages of skilled and unskilled workers. Trade liberalization, proxied by the evolution of Bangladesh's international trade, is associated with increased real wages for both skilled and unskilled workers. The relative skilled-unskilled workers' wage fluctuates over the study period, but it has no trend and is not related to increased openness. Trade liberalization thus seems to have increased labor productivity in the cotton textile industry without any noticeable effects on wage inequality.

Key words: Bangladesh, openness, relative wages, trade liberalization, wage inequality

JEL codes: F13, F14, F15, O15, O24

ⁱThis is a heavily revised and updated version of 'Trade Liberalization and Wage Inequality: Empirical Evidence from Bangladesh' Working Papers in Economics, nr 205, April 2006, Dept. of Economics, University of Gothenburg.

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1. INTRODUCTION

According to several studies, a number of developing countries have experienced a substantial increase in wage inequality between skilled and unskilled workers after adopting trade liberalization policies¹ (Williamson, 1997; Arbache et al., 2004; Goldberg and Pavcnik, 2007; Gasparini and Lustig, 2011). Such findings are not in line with what traditional trade theory predicts; greater openness to trade should narrow wage inequality in developing countries by increasing the relative demand for unskilled workers compared to skilled workers (Stolper and Samuelson, 1941). The conflict of evidence has sparked an intense debate about the impact of trade liberalization on wage inequality that is far from settled (McNabb and Said, 2013).

Bangladesh embarked on a policy of trade liberalization in the early 1980s. Only a few studies evaluate its impact on inequality, and they obtain conflicting results: Ahmed and Sattar (2004) report that manufacturing sector wages of unskilled workers increased more those of skilled workers during the 1990s; Nath and Mamun (2007) find some evidence that trade drives sectorial wage inequality, via its response to growth; Hossain (2011) concludes that the ratio of non-production to the production workers' wages in manufacturing increased due to liberalization; and Munshi (2012) finds that liberalization decreased wage inequality in five manufacturing.

The purpose of this study is to investigate how trade liberalization has affected wage inequality in Bangladesh manufacturing sector by analyzing skilled and unskilled workers' wages in one of the largest manufacturing sectors, the cotton textile industry. Time series data for 1969-2010 are used, which cover recent years not included in earlier studies. We focus on a sector that

¹ Wage inequality here refers to the wage gap between skilled and unskilled workers. The definition of skilled labor includes all professional and technical workers, managers, and craftsman who have advanced education or substantial training or work experience (Wood, 1994).

was heavily protected before the 1980s, and therefore belong to those on which the debate on adverse effects of trade liberalization policies has concentrated (Ahmed and Sattar, 2004).

Our major finding is that in the long run both skilled and unskilled real wages move closely together with our indicators of trade liberalization (trade-to-GDP and exports-to-GDP ratios). Opening up to trade liberalization thus seems to have affected unskilled and skilled real wages, but in the same way as there is no change in wage inequality. Moreover, there is strong evidence that increased openness has raised real wages across the board.

These findings do not preclude that trade liberalization generates wage inequality among some types of employees or workers, both within and across different sectors, but one would expect the impact on the wage structure to be particularly pronounced in the cotton textile industry, which was heavily protected before the 1980s, compared to other sectors of the Bangladeshi economy, such as agriculture and construction. Moreover, the cotton textile industry has grown rapidly since the early 1980s, as predicted by standard trade theory, which should have raised demand and real wages for unskilled workers. However, there has also been substantial technical upgrading (Ahmed and Sattar, 2004), and as technical upgrading requires qualified workers, this has most likely raised demand for skilled workers. Thus, the combined effect of trade liberalization and technical upgrading are likely to explain the finding of no clear change in wage inequality.

The rest of the paper is organized as follows. The next section provides an outline of theories and gives an overview of the existing empirical evidence on trade liberalization and wage inequality. Section 3 describes Bangladesh's trade liberalization and labor market issues, while Section 4 outlines the main features of the cotton and textile industry. Section 5 presents the empirical model, the data and results from tests of the stochastic properties of the variables. Section 6 reports the results from the econometric analysis. The final section concludes the paper.

2. LITERATURE REVIEW

The main theory used to explain the effects of trade on wage inequality is that of Heckscher-Ohlin-Samuelson (H-O-S). The H-O-S theory asserts that, under a liberalized regime of international trade, a country's production structure is determined by its relative factor endowments. Accordingly, under certain assumptions, countries should produce and export those goods that use their abundant factor intensively, and import those goods that use their scarce factor intensively. Given that developing countries have a large supply of unskilled labor relative to skilled labor compared to developed countries, it is to their benefit to specialize in unskilled-labor-intensive goods. For skill-intensive developed countries, on the other hand, the best strategy is to specialize in producing skilled-labor-intensive goods. Increased trade between developed and developing countries, then, is predicted to increase the relative price of unskilled-labor intensive goods with a consequent increase in unskilled-labor wages in developing countries and that for skilled wages in the developed country. Consequently, a reduction in wage inequality in developing countries and vice versa in developed countries is expected (Stolper and Samuelson, 1941).

The empirical evidence on developing countries so far provides mixed evidence (Goldberg and Pavcnik, 2007; McNabb and Said, 2013). In general, greater openness to trade seems to have reduced wage inequality between skilled and unskilled workers in East Asia (Woods, 1994; 1997), in India (Kumar and Mishra, 2008), in Kenya (Bigsten and Durevall, 2006), and in Malaysia (McNabb and Said, 2013), but the Latin American experience is mixed (Goldberg and Pavcnik, 2007; Gasparini and Lustig, 2011). One possibility of this divergent finding in developing countries could be due to differences in factor abundance; most Latin American countries are abundant in natural resources whereas most Asian countries have a

relative abundance of unskilled labor. Openness may also affect wage distribution through changes in industry wage premiums. Goldberg and Pavcnik (2004) note that industrial wage-premiums account for a significant portion of wage-inequality in poor countries, and when there are labor-market rigidities hindering smooth reallocation of labor across sectors, this channel might be important. And recent studies have shown that trade liberalization might enhance the dispersion of revenues across firms within sectors, and that this can increase wage inequality among workers with similar jobs, possibly because of search and matching frictions or efficiency wages (Helpman et al., 2012; Akerman et al., 2013).

Nonetheless, according to recent research, the most important factor is likely to be technical change induced by increased international competition and awareness of best-practice technology abroad, in combination with improved access to imported capital (Feenstra and Hanson, 1996; Gasparini and Lustig, 2011). Technical upgrading usually takes the form of skill-biased technology transfers from developed to developing countries, resulting in increased demand for skilled workers. In some developing countries this effect might have had a stronger impact on wages than the increase in demand for unskilled workers. Acosta and Gasparini (2007) and Arbache et al. (2004) show that this was the case in Argentina and Brazil.

As mentioned, only a few studies analyze the relationship between trade liberalization and wage inequality in Bangladesh, and the methodologies used and findings differ greatly. Ahmed and Sattar (2004) review the period 1991-2002 in detail, arguing that the development of real wages in the manufacturing sector was in accordance with H-O-S theory, raising the wages of unskilled labor more than for skilled labor. As the manufacturing sector was the focus of the protection from international competition, it is likely that the evolution of the wages was related to trade liberalization. Nevertheless, Ahmed and Sattar (2004) only assume that the decline in wage inequality was due to trade liberalization, they do not show it.

Nath and Mamun (2007) use vector-auto regressions (VAR models) to examine the causal relations among trade, growth, and inequality for the period 1971-2000. Inequality is measured by the coefficient of variation for average wages in manufacturing, agriculture, construction wage, and fishery. This measure differs greatly from those mostly used in the literature since it focuses on sectors with varying degree of exposure to international trade, not on skilled and unskilled labor. Moreover, the measured inequality is small, the coefficient of variation is only about 12% on average, the maximum, 18%, was reached in the mid-1970s and early 1980s, and it was lower in late 1990s than in the mid-1980s. Hence, the evidence for increased inequality is not particularly strong.

Hossain (2011) finds that wage inequality, the ratio of non-production to production workers' wages, increased in the manufacturing sector during the period 1973-1994 due to trade liberalization. This finding is interesting but the change in wage inequality is small (as evident from his Fig. 2), and the period analyzed ends in 1994, when there were still a number of trade restrictions in place (Ahmed and Sattar, 2004). Furthermore, the measure used does not distinguish between skilled and unskilled production workers, which are the ones most likely to be affected by increased openness.

Finally, Munshi (2012) estimates a dynamic panel data model for wage inequality, measured by the ratio of skilled to unskilled wages in five manufacturing industries. She finds evidence of decreasing wage inequality due to increased openness during 1975-2002. Our study uses the same measure of wage inequality as Munshi (2012), but includes another eight years of data and focuses on the largest of the five sectors, the cotton textile industry. And more importantly, it explicitly models the long-run relationship between the key variables, real wages and indicators of trade liberalization, using cointegration analysis and multivariate error correction models.

3. TRADE AND LABOR MARKET ISSUES IN BANGLADESH

In this section we first provide an overview of the trade liberalization process in Bangladesh and then briefly describe the labor market, since labor market conditions affect the impact of trade liberalization in several ways.

After independence in 1971, Bangladesh followed an import substitution industrialization strategy for a decade. Liberalization of the trade regime started in the early 1980s under structural adjustment reforms initiated by the World Bank and the International Monetary Fund. The major objective of the trade reform was to encourage exports by reducing policy-induced anti-exports bias and import competitiveness. The various reform measures included simplification of import procedures, reduction and harmonization of tariff rates on similar products, gradual reduction of non-tariff barriers. The process accelerated and deepened in 1991, setting off the second phase of trade liberalization (Nath and Mamun, 2007), and around 2000 there was a change towards greater emphasis on pursuing free market economy under the WTO rules. The average applied MFN (Most Favored Nation) tariff rate was reduced from 70.6% in 1992 to 14.9% in 2012, and to simplify tariff structure the customs tariffs are based on the Harmonized Commodity Description and coding system (HS). The simplification procedure still continues with significant reductions in the inspection of the traded goods and in the number of signatures needed for clearance of import and export consignments.

The labor market in Bangladesh comprises formal and informal markets. Like most other developing countries, formal-sector employment is low and the informal sector is dominant; nearly 90% of the employed populations over 15 years are in the informal sector (Labor Force Survey, 2010). Formal workers are mostly employed in the manufacturing sector.

Wage setting is regulated by the government and has not changed much over the decades. The first labor policy of Bangladesh was declared in 1972. Under this policy, public sector wages

were determined by the government with the recommendation of the Industrial Worker Wage Commission; a commission comprised of representatives of private employees and government. In 1977 the commission was expanded and representatives of workers were included. Wages in the formal private sector were determined by collective bargaining, taking government-determined wages as the reference point. In sectors where trade unions did not exist or collective bargaining failed due to weak trade unions, minimum wages were determined on the basis of the recommendation of the Minimum Wage Board. The Minimum Wage Board recommended minimum wages after consultation with labor and the employer (Rashid, 1993). The second labor policy, declared in 1980, did not alter public and private sector wage setting and the minimum wage determination mechanism. However, a strong Tri-partite Consultative Committee, comprising the government, labor and employers, was formed with the objective of giving more rights to workers. The law declared that all future labor policies would be formulated on the recommendation of the committee and in conformity with ILO convention. The policy emphasized the role of collective bargaining, where workers were given the right to strike. On the other hand, the employers were given the right to lockout. However, these two instruments could be used only after exhausting all available legal processes.

The current labor policy framework was declared in 2010. It has many good features, such as gratuity and pension funds for all workers in public and private firms. And it commits the government to creating an institutional framework for enactment and implementation of appropriate laws to secure the rights and welfare of the informal sector workers. The revised policy thus stresses the protection of the domestic household workers. The limitation of the policy framework, however, is lack of clear direction on how to implement it.

Although the government makes decisions on public sector wages and allowances unilaterally, political pressures created by trade unions have historically played an important role.

Trade unions represent only 3% to 5% of the labor force and one-third of the formal workers², but they are powerful since almost all of them are linked to political parties. In spite of active unions, however, regulations regarding minimum wages, working hours, occupational safety, etc are often not enforced. Lack of organizational structure and legislative provisions are important reasons for private sector employees often getting wages that are below minimum wages. Market forces thus seem to have played an important role in the labor market during a large part of our study period, although adjustment was probably slow.

4. THE BANGLADESH COTTON TEXTILE INDUSTRY

West Pakistani entrepreneurs owned the majority of the Bangladeshi industries before independence. Since most of them moved to West Pakistan during the war of liberation in 1971, the government formally nationalized all abandoned or private large and medium scale industries three months after independence. The cotton textile companies were organized under Bangladesh Textile Mills Corporation (BTMC). After the political change in 1975, the new government abandoned public industrialization and adopted policies to encourage privatization, and by 1981 many of the small mills had been denationalized. The process of privatization got momentum with 1982 New Industrial Policy and 1986 Revised Industrial Policy. This, in combination with import liberalization, led to significant changes in the sector. Many state-owned-enterprises and inefficient private enterprises were forced to close down, and by 1997, 27% of the labor force had been retrenched in the private sector (ILO, 1999).

Currently the cotton textile industry is one of the most important industries in the tradable sector, contributing nearly 5% to the GDP, while its share in manufacturing production is nearly 25%. It provides close to 10% of the formal employment.

²According to a latest statistics provided by the Ministry of Labor and Manpower (March 2011), there are in total 2843 trade unions from 29 sectors of which 2136 are labor unions, 671 are employers union, and 36 federations.

The cotton textile industry comprises many composite textile mills, including activities like spinning, weaving, specialized weaving, knitting and hosiery, and dyeing-printing-finishing. Fiber (the raw material) is transformed into fabric (the final product) following these steps. The process begins with spinning where raw cotton is cleaned and twisted into yarn using spindles. The yarn is transformed into grey using looms in the second step. Because of the lack of specialization and coordination among small-scale manufacturers, the locally produced greys are mostly of inferior quality. In the final stage, following the process of dyeing-printing-finishing, the grey is transformed into fabric. The fabric is sold either in the market or used in ready-made garments. However, locally produced fabric meets only 32% of the local demand and 10% of the woven requirement for the export oriented garments industry.

Prior to trade liberalization in the mid 1980s, the cotton textile industry was heavily protected. However, the industry benefited from liberalization; tariff reduction and removal of quantitative restriction improved access to raw materials and machinery, as the industry depends heavily on imported raw materials. For instance, cotton (fiber) which is the basic raw material of the industry and all types of textile machinery (except spare parts if imported separately) are exempted from duties since the mid-1990s. The effective rate of protection on yarn and fabric declined significantly, and 100% export oriented enterprises enjoying duty free imports irrespective of rates since early 1980s. In addition, export incentives particularly to the readymade garments also contributed to a substantial increase in volume of trade in this sector. Exports of yarn, for example, increased from US\$19,947 million in 1990 to US\$30,810 million in 2002, while imports of yarn grew from US\$19,623 million in 1990 to US\$31,770 million. The exports and imports of woven cotton fabrics increased from US\$11,935 million and US\$13,133 million in 1988 to US\$26,480 million and US\$21,712 million respectively in 2003 (Trade policy Review Bangladesh, 2006).

5. EMPIRICAL MODEL AND DATA DESCRIPTION

To investigate the impact of trade liberalization on wages, we first use cointegration analysis to test for long-run relationships between real wages and trade liberalizations. Since we find cointegration, we estimate reduced form wage equations for skilled and unskilled workers, specified as error correction models. The general error correction model is formulated as

$$\begin{aligned}\Delta rwsk_t &= \alpha_{10} + \alpha_{11}\Delta rwsk_{t-1} + \alpha_{12}\Delta rwusk_{t-1} + \alpha_{13}\Delta open_t + \alpha_{14}\Delta open_{t-1} \\ &\quad + \alpha_{15} [rwsk - \beta_1 open]_{t-1} + D + \varepsilon_{1t} \\ \Delta rwusk_t &= \alpha_{20} + \alpha_{21}\Delta rwsk_{t-1} + \alpha_{22}\Delta rwusk_{t-1} + \alpha_{23}\Delta open_t + \alpha_{24}\Delta open_{t-1} \\ &\quad + \alpha_{25} [rwusk - \beta_2 open]_{t-1} + D + \varepsilon_{2t}\end{aligned}\tag{1}$$

where Δ is the difference operator, $rwsk$ is the log of real wages for skilled workers, $rwusk$ the log of real wages for unskilled worker, $open$ is the log of a proxy for level of openness, and α_{ii} and β_i are coefficients. The speed of adjustment to long-run equilibrium relationships, $[rwsk - \beta_1 open]_{t-1}$ and $[rwusk - \beta_2 open]_{t-1}$, are measured by α_{15} and α_{25} , while β_i show how real wages are linked to openness in the long run. Since we use annual data, two lags of each variable are sufficient to capture dynamics of the model, implying one lag of the first differenced variables. We allow lagged wages for skilled workers to affect current wages for unskilled workers, and vice versa, to capture delayed interaction between the two groups. The coefficients of interest are α_{15} , α_{25} , β_1 and β_2 , since they show how trade liberalization impact real wages for skilled and unskilled workers in the short and long run.

Data Description

The variables used in the analysis are plotted in Figures 1-3 for the time period 1969 to 2010.³ Figure 1 depicts the evolution of average daily wages of skilled and unskilled workers in

³ Bangladeshi data are usually reported for the fiscal year: July-June. We use 1973 to represent 1972-73 and so on.

the cotton textile sector, measured at constant 1996 prices.⁴ A skilled worker is a person who possesses professional training and skill received either on-the-job or from any formal or informal training institute, while an unskilled worker is a person who has no professional training or skill for doing a job (Bangladesh Bureau of Statistics, 2013). The upper panel shows that both series exhibit a sharp decline during the first half of the 1970s, clearly related to independence in 1971. There is partial recuperation during the following years, but it is only after the beginning of the liberalization process in the mid-1980s that we observe strong upwards trends. Both wage series grow over most of the sample, albeit intermittently. However, it is first after 2005 that they have returned to the pre-independence levels.

The lower panel shows the spread between skilled and unskilled wages, measured as the log difference of the wage series. It is about 30% on average until from 1980 to 1986, when it rises to over 45%. The spread then declines and in 1995 skilled wages are only 16% higher than unskilled wages. There are also fluctuations in the spread the following decade but it is well below 25% most of the time. In 2008 the spread starts rising again and reaches 44% in 2009, then in 2010 it declines somewhat. Relative wages are thus highly volatile, but there is no clear trend.

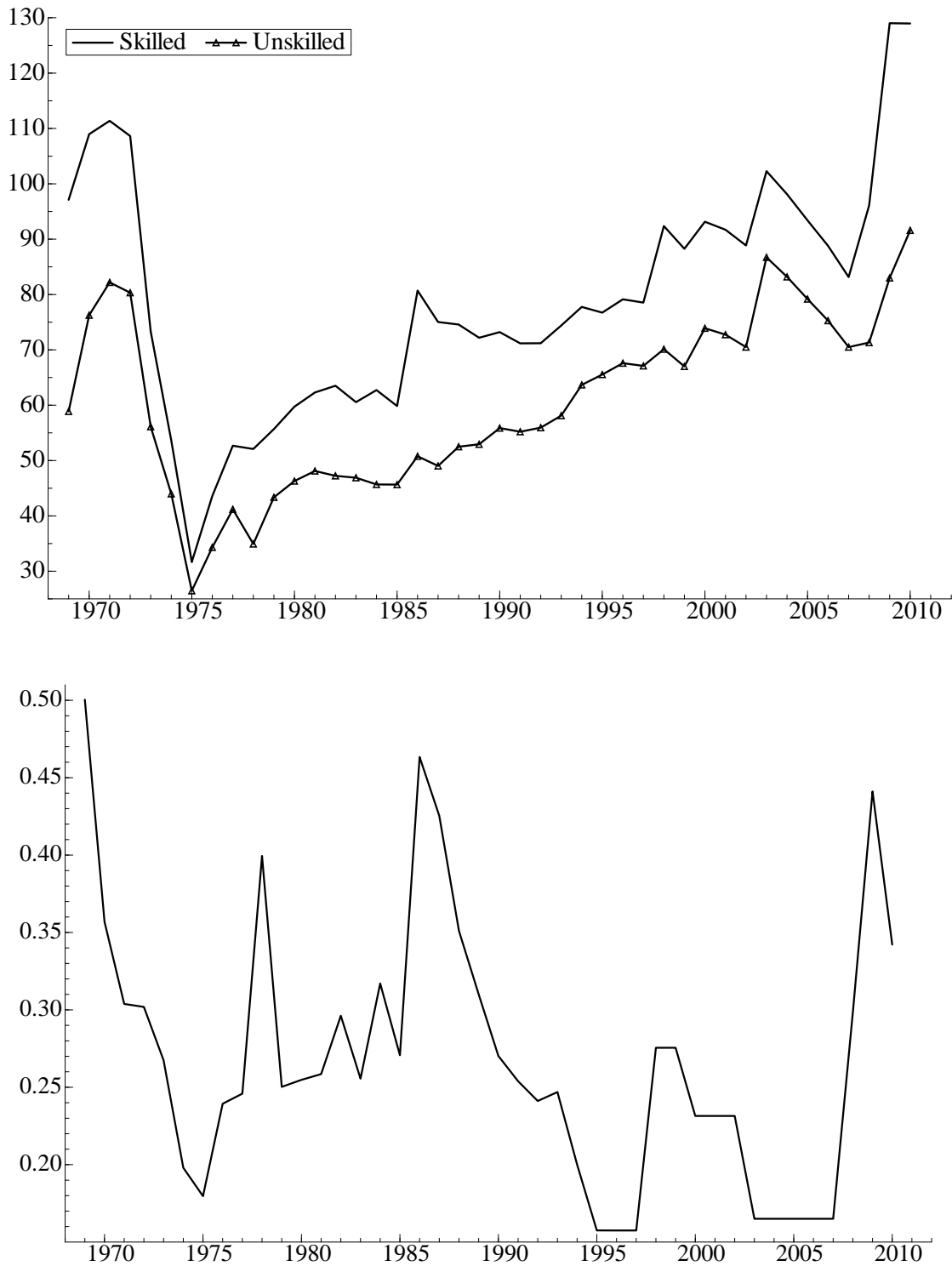
It is a challenge to find time series data on trade policy,⁵ so we consider two commonly used measures of openness: the trade dependency ratio, defined as the ratio of exports plus imports to GDP; and the export orientation ratio, defined as the ratio of exports to GDP. Most importantly, both of them to some extent capture the outcome of trade liberalization, which can cause an endogeneity problem. However, they correspond well to the expected evolution of

⁴The GDP deflator is used as the price index when converting series to constant prices. However, the consumer price index produces, for all practical purposes, the same result.

⁵See McCulloch et al. (2002) for a general review of openness measures used by different researchers.

international trade based on qualitative information about Bangladesh's trade policy reform, and the Johansen cointegration approach allows us to test for endogeneity.

Figure 1. Real wages (upper panel) and relative wages (lower panel) in Bangladesh cotton textile sector 1969-2010

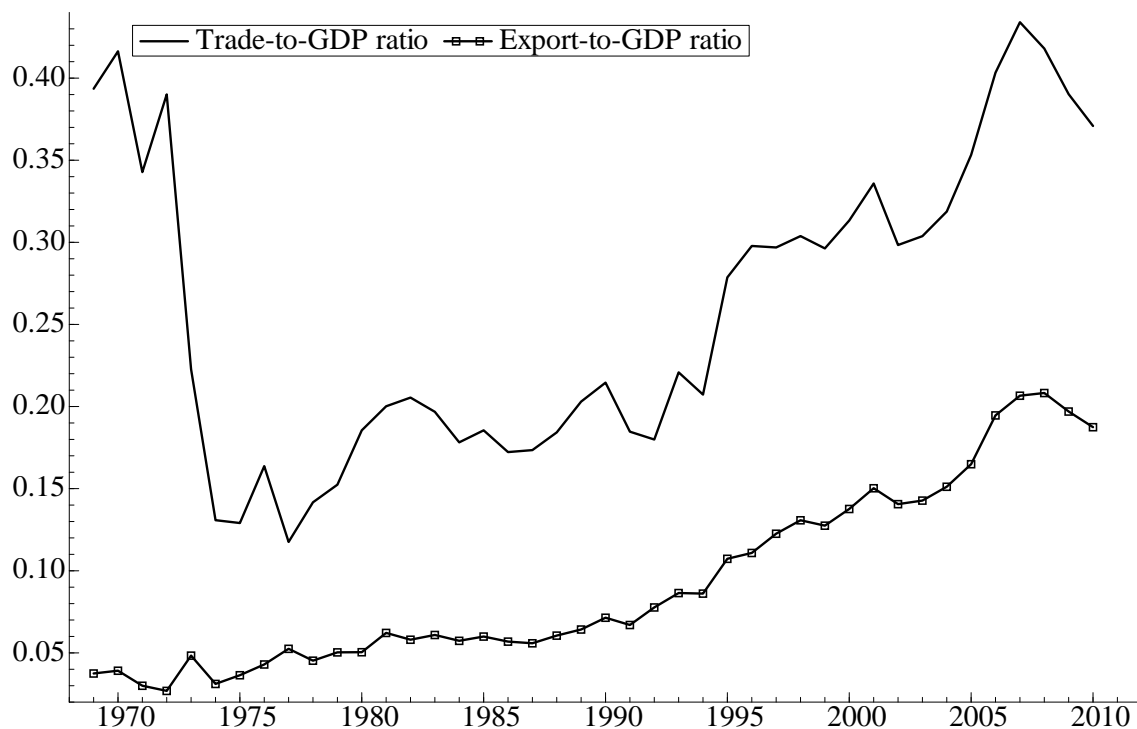


Note: Upper panel: Average daily real wages for skilled and unskilled workers in 1995/96 constant prices. Lower panel: log difference between wages for skilled and unskilled workers.

The trade dependency ratio, used by Nath and Mamun (2007), for example, also suffers from the weakness of only covering actually traded goods, not all tradable goods. In this sense the measure underestimates the degree of openness in a country. Another potential problem with this measure is that the ratio can increase because of terms of trade improvements, resulting from exogenous export and import price changes. The export orientation ratio is even more restricted and suffers from the same weaknesses; though it seems reasonable that trade liberalization should result in increased export share, while imports could grow due to aid inflows or external borrowing. Nevertheless, Jalil (2011) finds that exports and imports of Bangladesh are cointegrated, and both indicators work well empirically.

Figure 2 depicts both series over 1969-2010. As evident, they convey the same message from the mid-1980s and onwards, in line with the general view of Bangladeshi's opening up process. However, there are some notable differences during the period 1969-1980; the trade dependency ratio drops sharply during the war of independence, while the export orientation ratio is quite stable.

Figure 2. Trade dependency ratio and export orientation ratio (1969-2010)



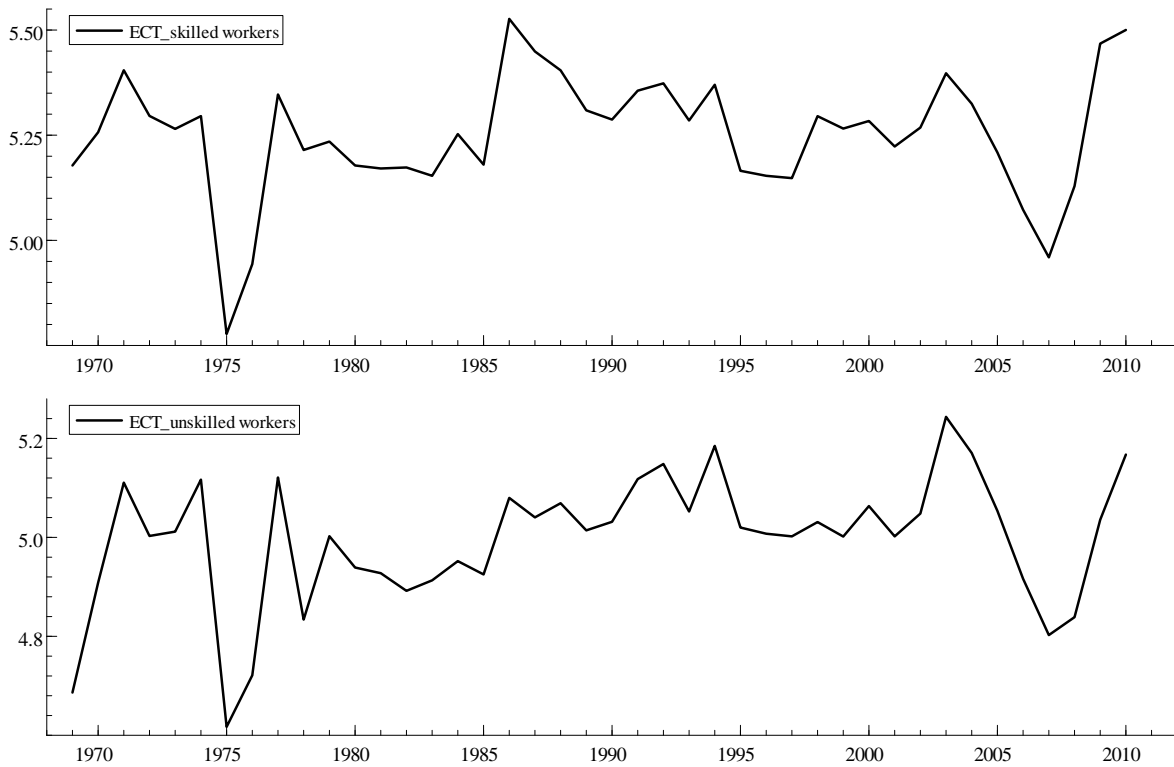
6. ECONOMETRIC ANALYSIS

In this section we report the results from the econometric analysis. Since the variables have trends, the Johansen (1988) method is used to test for integration and cointegration, that is, whether the variables are non-stationary, and whether the non-stationary variables have stochastic trends that can be removed by taking linear combinations. This allows us to test whether skilled and unskilled real wages are cointegrated with each other, and whether they are cointegrated with our measures of trade liberalization. Since we find cointegration, we then estimate a two-equation error correction model for wages of skilled and unskilled workers to evaluate the dynamic adjustment to the long-run relationships obtained with the cointegration analysis.⁶

⁶See Juselius (2006) for a readable description of the Johansen approach.

The results from the application of Johansen's maximum likelihood procedure are reported in Appendix. The key finding is that real wages and the openness measures are cointegrated, though we only report the results with the export orientation ratio, because they are a bit stronger than the ones with trade dependency ratio. The long-run relationship for skilled workers is $rwsk - 0.65open$ and the one for unskilled workers is $rwusk - 0.66open$. Figure 3 shows the relationships (deviations from the long-run 'equilibrium'), which appear to be stationary. Both long-run relationships are included as error correction terms (ECTs) in the error correction model (ECM).

Figure 3. Cointegrating vectors for wages of skilled and unskilled workers (1969- 2010)



The bivariate general ECM model, estimated over 1970-2010, has one lag of each variable and the ECTs lagged one period.⁷ The variable *open* is weakly exogenous, as shown by the lack of feedback effect reported in Table A1 in Appendix. This means that its adjustment coefficient is insignificant, implying that we can include the contemporaneous rate of change of *open* in the ECM without having a simultaneity problem. In addition, we added three impulse dummies that have the value of unity in the year indicated and zeros elsewhere. They capture exceptional events not explained by the other variables: Both wage series declined sharply in 1975 due to a rapid increase in inflation, and there are two instances of rapid increases in real wages; in 1986 for skilled workers and in 2003 for both skilled and unskilled workers (see Figure 1).

The model is estimated with Full Information Maximum Likelihood (FIML). Table 1 reports the parsimonious model; the general model is available on request.⁸ Three variables are excluded from the general model: the rate of change of lagged unskilled wages in both equations, the rate of change of lagged skilled wages and the first difference of lagged *open* in the equation for unskilled workers. We keep $\Delta ruwsk_1$ in the equation for unskilled wages for illustrative purposes, although it is clearly insignificant.

The ECTs, $rwsk - 0.65open$ and $rwusk - 0.66open$, are highly significant. The adjustment is rapid: 0.67% (skilled wages) and 0.48% (unskilled wages) of a deviation from long-run equilibrium is removed within one year. This supports our results from the cointegration analysis by showing that openness drives real wages. Moreover, increased openness has increased real wages for both skilled and unskilled workers. Interestingly, skilled wages seem to respond faster than unskilled workers to changes in openness.

⁷ The number of lags in the error correction model is the same as in the VAR model used to test for cointegration, but it is formulated in log-differences, while the VAR is in log-levels.

⁸ See Ericsson, Campos and Tran (1990) for a comprehensive and accessible description of the general-to-specific methodology.

The contemporaneous coefficients on $\Delta open$ are also significant in both equations with the expected sign; though some of the strong response of skilled wages are removed by the negative effect of lagged $\Delta open$. The lagged growth rate of real skilled wages, $\Delta rwsk_{t-1}$, affects current real skilled wages, while lagged unskilled real wages, $\Delta rwusk_{t-1}$, is insignificant. This, and the rapid adjustment in skilled real wages, is signs of the leading role of skilled wages and passive role of unskilled wages.

Statistically the model appears well specified; there is no evidence of vector serial correlation (EGE-AR test), vector heteroscedasticity (Vector Hetero test), and vector non-normality (Vector Normality), or in the single-equation diagnostic tests. The reduction of the general model was carried out by removing one clearly insignificant lag at the time, and then using likelihood ratio tests to check the validity of the simplification. The χ^2 test reported in Table 1 is insignificant, $p\text{-value} = 0.46$, implying that our simplification is statistically valid.

Table 1. Error correction model for skilled and unskilled workers

Variable	Δr_{wsk}	Δr_{uwsk}
Δr_{wsk_1}	0.26*** (0.08)	
Δr_{uwsk_1}		0.07 (0.08)
ECT_skilled_1	-0.67*** (0.08)	
ECT_unskilled_1		-0.48*** (0.08)
$\Delta open$	-0.39*** (0.08)	-0.34*** (0.08)
$\Delta open_1$	-0.18*** (0.05)	
Dum1975	-0.58 (0.09)	0.45 (0.09)
Dum 1986	0.22 (0.04)	
Dum 2003		0.11 (0.04)
Constant	3.52 (0.40)	2.39 (0.39)
Vector SEM-AR 1-2 test	F(8,60)=1.01[0.43]	
Vector Normality test	$\chi^2(4)=7.75[0.10]$	
Vector hetero test	F(36,77)=1.34[0.14]	
Test of model reduction	$\chi^2(3)=2.57[0.46]$	
Estimation method FIML Time period 1970-2010		

Note: Standard errors in parenthesis. ***, ** and * denote statistical significance at 1%, 5%, and 10% levels.

7. CONCLUDING REMARKS

In the early 1980s Bangladesh embarked on a trade liberalization process to adopt an export-oriented industrialization strategy. The purpose of this study was to investigate how this change of policy has affected wage inequality.

Our major finding is that there is no evidence that trade liberalization has changed the relation between wages of unskilled and skilled workers in the cotton textile sector. Thus, we fail to find that greater openness has decreased wage inequality, as predicted by standard trade theory. On the other hand, trade liberalization seems to have raised real wages for both skilled and unskilled workers. The reason for this is not analyzed but a possible explanation is that trade liberalization led to more rapid technical progress and capital accumulation. This is also consistent with the finding of no change in relative wages. Because technical change usually generates demand for skilled workers, there have probably been two countervailing forces at work, the standard Stolper and Samuelson mechanism where relative prices change in favor of labor intensive goods and increase the relative demand for unskilled workers compared to skilled workers, and skill-biased technical change that raises demand for skilled workers.

Our findings do not support many of the pessimistic views about globalization, free markets and inequality that currently are popular in many circles, not at least after the publication of the book by Picketty (2014). The policy implication of the study is thus that the government should continue in its pursuit of free trade. Although, wage inequality might have increased in other sectors or among other types of workers, such as non-production and production workers, there seems to have been a rapid increase in real wages across the board in Bangladesh, at least during the recent decade (Xiaobo et al., 2013). Income inequality is best addressed by collecting taxes and providing services to the poor. There is also ample scope for improving working conditions among manufacturing workers in Bangladesh, enforcing existing regulations on safety, child labor, minimum wages, etc.

A limitation of this study, and all the previous ones, is that technical progress is not directly analyzed. Moreover, the use of aggregate data hides possible changes within the groups studied, and these might be substantial. However, analyzing these issues requires access to better

data, particularly firm and individual data. Furthermore, all studies ignore the informal sector, also due to paucity of appropriate data. There is thus scope for further research.

ACKNOWLEDGEMENT

The authors wish to thank two anonymous referees, Arne Bigsten and Fredrik Sjöholm for useful comments and suggestions.

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Appendix: Cointegration test

In this section we report the results from the cointegration analysis. Since the variables have trends, the Johansen (1988) method is used to test for integration and cointegration, that is, whether the variables are non-stationary, and whether the non-stationary variables have stochastic trends that can be removed by taking linear combinations. This allows us to test whether skilled and unskilled real wages are cointegrated with each other, and whether they are cointegrated with our measures of trade liberalization. Since we find cointegration, we then estimate a two-equation error correction model for wages of skilled and unskilled workers to evaluate the dynamic adjustment to the long-run relationships obtained with the cointegration analysis.⁹

Results from the application of Johansen's maximum likelihood procedure are summarized in Table A1. The vector autoregressive model (VAR) consists of the log of wages of skilled workers, *rwsk*, log of wages of unskilled workers, *rwusk*, and the log of the aggregate trade to GDP ratio, *open*; the other openness indicator, exports to GDP ratio, performed less well over the whole sample due its behavior during the 1970s, as evident when comparing Figure 1 and 2. The model is estimated over 1969-2010, to use as many observations as possible. Two lags are sufficient to capture the dynamics, as indicated by an F-test for the exclusion of the third lag; $F(9,70) = 0.99 [0.45]$.

The first row in Table A1 lists the estimated eigen values. Two of these are clearly larger than zero, indicating that there are two cointegrating vectors. Evidence of two long-run relations in the data is also given by the trace eigen value statistics (λ_{trace}), for rank 0 and 1, which both reject the null of no cointegrating vector at the 95% significance levels. As indicated by the exclusion tests, all three variables are significant, which also implies that all variables are

⁹See Juselius (2006) for a readable description of the Johansen approach. Ericsson, Campos and Tran (1990) give a comprehensive description of the general-to-specific methodology.

integrated of order one (see Fig. 1 and 2). Table A1 also reports the standardized eigenvectors, β , and the adjustment coefficients α . They show that the β 's for *rws*k and *rwus*k are close to unity, and that their adjustment coefficients are large -0.33 and -0.48, indicating that *rws*k and *rwus*k are endogenous variables.

To identify the cointegrating vectors, we restricted *rws*k and *rwus*k to enter one cointegrating vector each, and set adjustment coefficients to zero for *open*. As reported under 'Restricted and identified cointegrating vectors', the test statistic is insignificant; *p-value*=0.36, and the estimated coefficients are significant. Hence, real wages seem to adjust to changes in *open* in the long run, and as expected, there is no feedback effect from real wages to *open*.

To test whether real wages for skilled and unskilled workers follow each other in the long run, we also tested if there is one cointegrating vector consisting of *rws*k and *rwus*k with equal coefficients (of opposite sign) and one consisting of *rws*k and *open*. This seems to be the case, as reported under 'Alternative identification and test of log-run homogeneity'. The *p-value* = 0.11, so there is no evidence that trade liberalization has increased wage inequality by generating a more rapid growth in real wages for skilled labor.

Table A1: Cointegration analysis of real wages and openness, 1969-2010

Rank test			
Null hypothesis	$r=0$	$r\leq 1$	$r=\leq 2$
Eigenvalues	0.43	0.27	0.06
Trace statistic	39.64**	15.76**	2.47
Probability-value	0.002	0.044	0.12
Standardized eigenvector β_i			
	<i>rws</i>	<i>rwus</i>	<i>open</i>
	1.00	- 0.80	-1.26
	-0.92	1.00	-0.10
Standardized adjustment coefficients α_i			
	-0.33	-0.18	0.21
	-0.003	-0.48	-0.43
Exclusion/Stationarity tests $\chi^2(2)$ test statistic and p-values			
	<i>Rws</i>	<i>rwus</i>	<i>open</i>
	19.480 [0.0001]**	11.651 [0.003]**	15.864 [0.0004]**
Restricted and identified eigenvectors β_i			
	<i>rws</i>	<i>rwus</i>	<i>open</i>
	1.00	-	-0.65 (0.08)
	-	1.00	-0.66 (0.13)
		-	
Restricted adjustment coefficients α_i			
	-0.60 (0.098)	-	-
	-	-0.30 (0.089)	-
Likelihood ratio test, restricted cointegrated vectors: $\chi^2(4) = 4.37$ [0.36]			
Alternative identification and test of log-run homogeneity			
	<i>rws</i>	<i>rwus</i>	<i>open</i>
	1.00	-	-0.67 (0.062)
	1.00	-1.00	-
Likelihood ratio test, restricted cointegrated vectors: $\chi^2(1) = 2.51$ [0.11]			

Note: Standard errors are in parentheses and p-values are in brackets. The VAR includes two lags on each variable.