

Trade Liberalisation and Wage Inequality in the Bangladesh Manufacturing Sector, 1973-1994

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This paper assesses the impact of trade liberalisation on wage inequality in the Bangladesh manufacturing sector over the period 1973-1994 by applying alternative techniques of two-stage least squares and error correction modeling. The study also examines the hypothesis that skilled labour and physical capital are complementary with each other. The study finds that wage inequality in the Bangladesh manufacturing sector, as measured by the ratio of the non-production workers' wage to the production workers' wage as well as by the Theil's wage inequality index, has widened over time. The econometric results suggest that export orientation of the Bangladesh manufacturing sector has contributed to the widening of wage inequality, while the relative demand for skilled workers had an offsetting effect. Furthermore, the findings do not support the claim that skilled labour and capital are complementary with each other.

I. INTRODUCTION

In the absence of a more robust alternative, economic growth is considered as the most significant indicator of national welfare, often as a rule. Accordingly, a country's development policies or the changes in the policy regimes are mainly intended for maximising the growth of gross domestic product (GDP). However, for several reasons, the issue of income distribution or its correlate, poverty, is considered as an overriding concern, and as such constitutes a crucial aspect of growth and development. First, for a given growth rate of GDP, a redistribution of income in favour of greater equality by itself can reduce poverty. Second, the

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ability of the growth of GDP to reduce poverty is conditioned by the existing structure of income distribution and the changes therein. Growth with rising inequality results in smaller reductions in poverty than growth with falling or unchanged inequality (Sen 1995). Third, the causality may be running from income inequality to growth rather than in the opposite direction, that is, the more equitable the income distribution, the greater the growth prospect and *vice versa* (Alesina and Perotti 1994, Deininger and Squire 1998). But empirical evidence to date has at best been mixed with regard to the changes in income inequality in the developing countries. Economic growth has almost invariably resulted in rising wage inequality world wide (Dollar 2002).

Bangladesh embarked on a liberalised external trade regime in the early 1980s by reforming import restrictions through reductions and phasing out of the quantitative restrictions and tariffs, and by providing various incentives to the export sector, including the exchange rate policy changes, as part of the so-called structural adjustment programmes.¹ The main objective of these reforms was to promote export activities by reducing the anti-export bias. Empirical studies suggest that Bangladesh has significantly benefited from the global integration of its economy in terms of exports and GDP growth (Islam 1998, Ahmed 2000, Hossain and Karunaratne 2002, Hossain and Alauddin 2004). Some even describe the trade performance of Bangladesh since 1990 as a textbook case of success (cf. Williamson 1999). A few studies also provide insights into poverty and/or personal income distribution (Khan 1990, Sen 2000, Khan and Sen 2001, Hossain 2003). However, no systematic study to date has been undertaken to relate trade liberalisation and/or economic growth with wage inequality. It is generally argued that in a developing country like Bangladesh, rising trade has no correlation with the changes in income inequality (Dollar 2002). It is against this backdrop that the present study assesses the impact of trade liberalisation on the distribution of income in Bangladesh by focusing on the wage disparity in the manufacturing sector.

Some researchers argue that the wage differentials between skilled and unskilled workers can be interpreted as an outcome of the skill-differentials (Wood 1994). This argument is further reinforced by the empirical findings that the demand for skilled labour is positively correlated with the demand for technology or physical capital (Hamermesh 1993, Goldin and Katz 1998). As a passing note, therefore, the paper also checks the validity of the hypothesis of complementarity in the context of the Bangladesh manufacturing sector. The

¹For a detailed description of the policy reforms in Bangladesh, see Rahman (1995) and Hossain and Alauddin (2004).

empirical results are obtained through the application of the two-stage least squares (2SLS) and the cointegration techniques.

The rest of the paper is organised as follows. Section II gives a brief account of the theoretical aspects underpinning trade and income distribution. Section III provides a short survey of the empirical evidence to date. Section IV describes the trends in wage structure, and skill and factor intensities in the Bangladesh manufacturing sector. Section V presents the empirical results. Section VI contains the concluding remarks.

II. TRADE AND INCOME DISTRIBUTION: THEORETICAL ISSUES

Economic theory *per se* does not provide a clear indication as to how international trade will affect income distribution and, over the years, there has been hardly any theoretical progress on the issue (Arbache 2002). Despite their limitations, the Heckscher-Ohlin and the Stolper-Samuelson theorems have remained the mainstay of the theoretical insights on the trade-income distribution relationship. Other conventional theories that complement these theories include the Factor Price Equalisation (FPE), the specific factor and the Rybczynski theorems. All of these theories treat labour as a homogeneous factor. Recognising the role of human capital, the endogenous growth theory classifies labour as skilled and unskilled. Accordingly, trade policy reforms may have different implications for the different categories of labour. The rest of this section reviews the implications of these theories for wage inequality in a developing country.

2.1 The Traditional Theory Premises

The Heckscher-Ohlin model, which is an extension of the Ricardian model² of comparative advantage to two factors, capital and labour, states that a country has a comparative advantage in external trade in the product that uses the abundant factor intensively for the abundant factor tends to be cheaper than the scarce factor. The Stolper-Samuelson (SS) theorem implies that a liberal trade regime will unambiguously reduce the real returns to the scarce factor. This contradicts the long-held perception that free trade would unfailingly benefit labour (Deardorff 1993b). In a developed country, labour is scarce in relation to

²Although Ricardo's comparative advantage theory has decisively set out the causes and the underlying benefits of free trade, it falls short of a clear indication about the way in which a free trade regime might affect the distribution of income among the factors of production within a country. As Deardorff (1993a) points out, it is because of the assumption of the single factor of production that the issue of income distribution is absent in Ricardo's theory.

capital. Thus, the SS theorem makes a case for protection for a developed country. In a developing country, on the other hand, labour is abundant while capital is scarce. Thus, if the SS theorem holds, labour should benefit more than capital as the economy moves from autarky to free trade. The FPE theorem states that free trade equalises the product prices across countries. Countries with identical technology will, therefore, have their factor prices equalised. Thus, the implications of the FPE theorem coincide with those of the SS theorem in respect of the redistribution of income between capital and labour in the context of a developed economy. The SS and the FPE theorems rest on a number of assumptions. The assumptions of two goods, two factors, no transport costs, no trade barriers, product and factor homogeneity, identical technology for the trading countries and perfect inter-industry factor mobility are considered to be too restrictive. Due to these unrealistic assumptions, some argue that the SS hypothesis cannot be regarded as a major theoretical construct (Bhagwati and Dehija 1994), while others describe it as a long-run phenomenon (Cline 1997). However, it is argued that the collapse of transport costs and protective barriers, and improvement in communications in modern times may render the hypothesis a relevant tool of analysis (Bluestone 1994).

The Ricardo-Viner-Jones specific factor (RVJ) model implies that protection benefits the capital specific to the import-competing sector, hurts the capital specific to the export sector while labour may gain or lose. Finally, the Rybczynski theorem states that for a given commodity price ratio a rise in factor supply results in an absolute rise in the production of the commodity that uses the factor intensively and an absolute fall in the production of the other commodity. But under conditions of changing commodity prices, an increase in the factor used intensively by the commodity always leads to a decline in the price ratio of the commodity. The Rybczynski theorem is regarded as a proof of the Heckscher-Ohlin theory (Bhagwati and Srinivasan 1983).

2.2 The New Growth Theory Insights

Unlike the traditional theory, the new or endogenous growth theory classifies labour in terms of their skill attainment as measured by education and training (Romer 1990a and 1990b, Grossman and Helpman 1991, Aghion and Howitt 1992). The new growth theory thus adds a new dimension to the analysis of income inequality, especially wage inequality. Like capital, labour can also be a specific factor. For example, a textile industry will have unskilled labour as a specific factor while a software industry will have skilled labour as specific to it. Following the specific-factor theorem, the unskilled labour will gain if textiles were the export-promoting industries and skilled labour will lose if the software industry was import-competing. The argument is consistent with the view that in

the context of more than two goods and more than two factors, every good is a “friend” to some factor and an “enemy” to some other (Ethier 1984).³ Therefore, in a more-than-two-factor case, the “weakest but most general versions” of the SS theorem should hold in that any good will be a friend to the capital specific to its production (Deardorff 1993b).

Recent empirical findings indicate that skilled labour is complementary with technology and physical capital (Hamermesh 1993, Goldin and Katz 1998), which implies a positive correlation between the demand for skilled labour and the demand for physical capital or technology. This conforms to the argument that the wage differentials are due to the skill differentials (Wood 1994). Indeed, Goldin and Katz (1998) find a positive relationship between capital intensity and the wages of the non-production workers. Similarly, Autor, Katz and Krueger (1997) find that despite large increases in supply, workers with computer skills enjoyed a significant and growing wage premium.

2.3 Implications for a Developing Economy

The impact of trade liberalisation on income distribution in a developing economy is presumed to be the opposite of that in a developed economy (Arbache 2002). A shift from autarky to free trade will in general reduce the wage differentials between skilled and unskilled labours in a developing country (Krueger 1990). The source of the comparative advantage of a developing country arises from unskilled labour. As capital and skilled labours are complementary to each other, protection leads to a rise in the demand for skilled labour relative to unskilled labour, which distorts the prices in favour of capital. Transition to a liberal trade regime shifts the composition of employment and output in favour of unskilled labour thereby raising its demand and, hence, relative wages.

In short, the implications of trade liberalisation for wage inequality in a developing country are as follows. First, a developing country has a comparative advantage in the production of commodities that use labour intensively since labour is cheaper compared to capital. A rise in the demand for exports of these commodities raises the demand for labour. As a result, the rate of return to labour also increases relative to capital. Secondly, a developing country has comparative advantages in the production of commodities that use unskilled labour more intensively than skilled labour. Therefore, unskilled labour should gain more relative to skilled labour following trade liberalisation. The existence

³A good is considered a friend to a factor if a rise in the price of the good raises the price of the factor. Conversely, the good is an enemy to the factor if the rise in the price of the good lowers the price of the factor.

of complementarity between capital and skilled labour further strengthens this argument.

Nonetheless, one can also use the notion of “complementarity” in order to explore the impact of trade reforms on wage inequality in the non-export sector. A developing economy typically has an import-substituting and a non-tradable sector that are highly capital intensive. Trade reforms through reductions of import restrictions, *ceteris paribus*, reduce the prices of imported capital and intermediate inputs, and thus raise their demand. With imported capital comes the new technology. Since skilled labour is complementary with the new technology and capital, this raises the demand for skilled labour in the non-export sector. With the supply of skilled workers being relatively scarce, part of the wage disparity can be attributed to the “wage premium” that is due the skill differentials. Similarly, the export-promoting industries may also use imported capital and intermediate inputs in an effort to improving the productive efficiency, which in turn will raise the demand for skilled workers and, therefore, their wages.⁴ Conversely, in an economy with an excess supply of unskilled labour, additional demand for the same can be met without raising wages. Thus, the impact of trade liberalisation on wage inequality is at best uncertain, which essentially makes it an empirical issue.

III. A BRIEF REVIEW OF EMPIRICAL LITERATURE

While empirical studies more often than not suggest a positive association between trade liberalisation, export expansion, and growth, the evidence on the impact of trade liberalisation on income inequality has been far from being convincing. Considering the vastness of the literature, this study avoids a complete exegesis of the empirical studies and concentrates only on the general direction of the findings. Empirical studies on the link between trade and wage disparity have mainly stemmed from the theoretical insights of the Heckscher-Ohlin-Stolper-Samuelson (HOS) model. To reiterate, the fundamental message of the HOS model in the context of the developing countries is that trade liberalisation will benefit labour in relation to capital, and unskilled labour relative to both skilled labour and capital since unskilled labour is more abundant than skilled labour in these countries. But empirical studies have shown mixed results, which in fact appear to contradict the prediction of the HOS hypothesis. Recent studies, on the other hand, support the new growth theory contention that

⁴These arguments follow from the basic tenets of the new growth theory. Aghion and Howitt (1998) provide a detailed survey of the theoretical pretext of the new theory of growth while Arbache (2002) provides a summary of the implications of these theories for the relationship between trade liberalisation and income distribution.

trade liberalisation in many countries has raised the demand for skilled labour relative to the unskilled labour and thus has been a source of deterioration of the distribution of income.⁵

Krueger (1978) and Bhagwati (1978) represent the most comprehensive of the earlier efforts on trade liberalisation and income distribution. Their ten-country study suggests no systematic and predictable relationship to exist between trade reforms and inequality. Similarly, in a nineteen-country study, Michaely *et al.* (1991) find the results “mixed” and “fragmentary” and, in most cases, inconclusive. A seven-country study by Robbins (1996) shows skilled workers to have gained more relative to unskilled workers. Atolia (2007) suggests that in the short run trade liberalisation may result in rising wage inequality, thereby contradicting the long-run prediction of the HOS theory. Mahajan and Nanda (2010) find that during the period 1991-92 to 2007-08 wages in the Indian manufacturing sector increased at lower rates as compared to the growth rates of exports and imports. Some of the other studies include Said and Elshennawy (2010), Goldberg and Pavcnik (2007), Robbins and Gindling (1999), Beyer *et al.* (1999), Feenstra and Hanson (1995) and Hanson and Harrison (1999). All these studies point to a widening of the wage inequality after trade liberalisation, and identify the increase in the demand for skilled labour relative to unskilled labour as the common factor responsible.⁶ In the context of the Philippines, Hasan and Jandoc (2010), however, find that the trade-induced effects on wage inequality is economically insignificant.

IV. OVERALL WAGE STRUCTURE, AND SKILL AND FACTOR INTENSITIES IN THE BANGLADESH MANUFACTURING SECTOR

In a strict sense, “wage inequality” is different from “wage disparity.” The former relates to the wages received by different quintiles of workers, while the latter and its synonyms “wage differentials” and “wage ratio” relate to the average wages received by the “skilled” workers relative to the “unskilled” workers or *vice versa*. Although there is a considerable overlapping between the definitions, in empirical applications the terms “skilled” and ‘unskilled’ are often substituted by “non-production” and “production” or “white” and “blue” collar

⁵Perhaps, Wood (1994,1999) finds the clearest of the instances where trade reforms resulted in a rise in the demand for unskilled labour relative to skilled labour as well as a decline in wage inequality. The countries concerned are South Korea, Taiwan and Singapore.

⁶Arbache (2002) contains a comprehensive survey of these studies as well as other empirical works including those on the developed countries.

workers depending on the availability of data. The present analysis is based on the data on non-production and production workers. Nonetheless, the study uses the corresponding terms interchangeably.

Table I presents a summary of the structure of wage, and skill and factor intensities in the Bangladesh manufacturing sector. The wages represent the weighted average of the annual wages per worker of 25 three-digit level industries, the weights being the shares of employment of the individual industries in total employment, and are expressed in constant prices of 1995. As can be seen from Table I, the real wage of the production workers showed an upward trend between 1973 and 1990 but fell quite dramatically thereafter. During the pre-liberalisation period of 1973 to 1982, real wage for the production workers rose by an average annual rate of 2.45 per cent, while during the post-liberalisation period it fell by 1.46 per cent on the average. On the contrary, the real wage for the non-production workers declined during the pre-liberalisation period but rose during the post-liberalisation period. The wage ratio of non-production workers to production workers remained more or less constant until the late 1980s, but registered a steady growth thereafter. The estimated Theil's entropy index shows that over time the wage inequality in the Bangladesh manufacturing sector has increased manifolds and that the rate of increase in the post-liberalisation period is astonishingly higher than the pre-liberalisation era. Between 1982 and 1992, wage inequality increased by 19.17 per cent per annum compared to only a 0.52 per cent annual increase between 1973 and 1982.

Table I by itself does not capture the dynamics of the wage structure. As shown in Figure 1, the real wage for the production workers showed a mixed pattern during the sample period. It recorded a sharp fall in 1975, showed an upward trend between 1976 and 1981, and remained steady between 1982 and 1986 at a level lower than the previous few years though significantly higher than the initial (1973) level. Production workers' real wage again rose remarkably in 1987 but only to be followed by steady declines in the succeeding years. During 1991-1994, the real wage for the production workers stayed just marginally higher than the 1973 level. In contrast, the real wage for the non-production workers showed an upward trend during the entire sample period except for the abrupt fall in 1975 and the slight drift in the early 1980s. The wage ratio between non-production and production workers steadily declined until 1976, recovered a little in 1977 and remained mainly stable until 1988. However, it rose steadily since 1989. The Theil's index showed a mixed pattern during 1973-1980, but a rising trend thereafter.

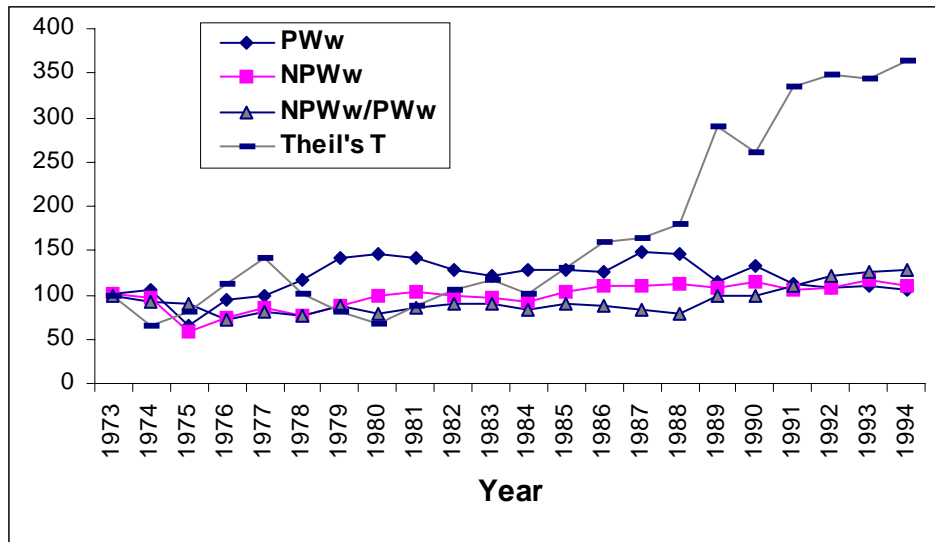
TABLE I
**WAGE STRUCTURE, SKILL AND CAPITAL INTENSITIES AND EXPORT
 ORIENTATION IN THE BANGLADESH MANUFACTURING SECTOR, 1973-
 1994 (SELECTED YEARS)**

Attributes	1973	1978	1982	1986	1990	1994	Average % Change	
							1973-82	1982-94
Wages								
Production Workers (1973 = 100)	100.0	115.9	127.3	125.0	133.5	104.9	2.45	-1.46
Non-Production Workers (1973 = 100)	100.0	76.5	98.5	111.1	115.0	110.4	-0.14	1.01
(Wage Ratio of Non- Production to Production Workers)	1.92	1.46	1.71	1.68	1.91	2.47	-0.99	3.70
Theil's Entropy Index (Theil's T)	100.0	100.8	105.8	160.5	260.3	349.1*	0.52	19.17**
Skill Intensity								
Production Workers	0.846	0.777	0.781	0.792	0.840	0.865	-0.81	0.90
Non-Production Workers	0.154	0.223	0.219	0.208	0.160	0.135	4.83	-3.20
(Non-Production/ Production Workers)	0.183	0.287	0.281	0.263	0.191	0.156	6.21	-3.74
Capital Intensity (million Tk. per labour) (million Tk. per labour)	0.010	0.016	0.031	0.065	0.077	0.105	19.09	19.85
Memorandum Items:								
(Manufacturing Exports / Manufacturing Output)	0.93	0.153	0.167	0.305	0.287	0.477	7.23	15.47
Imported Capital as Share of GDP	0.024	0.014	0.029	0.033	0.041	0.038	6.42	2.59

Source: Bangladesh Statistical Yearbook (various issues). The Theil's entropy index series is compiled from the University of Texas Inequality Project website: http://utip.gov.utexas.edu/web/world_theils.htm.

Note: *indicates 1992 and **indicates the period 1982-1992.

Figure 1: Trends in the Wage Structure in the Bangladesh Manufacturing Sector (Index: 1973=100)

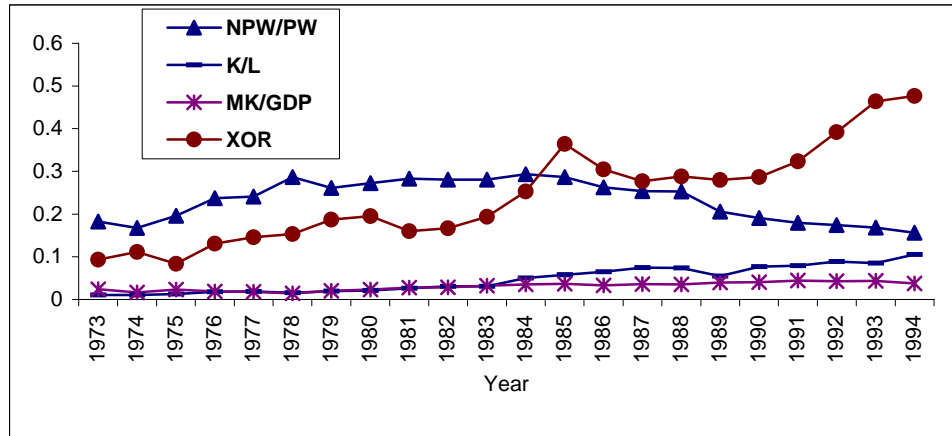


Note: PWw = production workers' real wage; NPWw = non-production workers' real wage; and NPWw/PWw = relative wage of non-production to production workers.

Again it can be seen from Table I that the share of production workers in total employment fell during the pre-liberalisation period and recovered steadily during the post-liberalisation period. But compared to 1973, the production workers' employment share rose only marginally in 1994. The opposite scenario holds for the non-production workers' employment share. Hence, the skill intensity, defined by the ratio of employment of non-production workers to production workers, rose during the pre-liberalisation period and fell during the post-liberalisation period. Capital intensity, defined as the real money value expressed in millions of 1995 domestic currency per unit of labour, showed an upward trend throughout the sample period. The annual rates of increase are almost identical across the pre- and post-liberalisation periods, which are 19.09 and 19.85 per cent respectively. The trend in capital intensity clearly indicates that the manufacturing sector has become more capital-intensive over time. The ratio of manufacturing exports to manufacturing output, that is, the export orientation of the manufacturing sector grew at an average annual rate of 7.23 per cent between 1973 and 1982 and at an impressive rate of 15.47 per cent between 1982 and 1994. The imported capital-GDP ratio rose steadily during the entire sample period. But the growth rate for the post-liberalisation period was much

lower than that for the pre-liberalisation period, the rates being 2.59 and 6.42 per cent respectively. Figure 2 presents the fuller dynamics of the employment shares, skill and capital intensities, export orientation of the manufacturing sector and the imported capital-GDP ratio.

Figure 2: Dynamics of Skill and Factor Intensities and Export Orientation in the Bangladesh Manufacturing Sector, and Imported Capital-GDP Ratio, 1973-1994



Note: NPW/PW=skill intensity; K/L = capital intensity; MK/GDP = imported capital-GDP ratio; and XOR = export orientation.

V. TRADE LIBERALISATION AND WAGE INEQUALITY: AN ECONOMETRIC INVESTIGATION

This section investigates the relationship between various measures of trade liberalisation and wage disparity in the manufacturing sector of Bangladesh by using the two-stage least squares (2SLS) and the cointegration techniques. Two different measures of wage inequality have been made use of. They are: (a) the ratio of non-production workers' average real wage to the production workers' average real wage, (NPWw/PWw), henceforth, denoted by *RW* (relative wage); and (b) Theil's T index.

While modeling wage inequality in the HOS framework, empirical studies have considered a wide range of explanatory variables such as the export-GDP and imported capital-GDP ratios (Robbins 1995), relative prices of skilled to unskilled labour-intensive products and relative demand for skilled labour (Hansen and Harisson 1999), and trade-GDP ratio, relative price of unskilled to skilled labour-intensive products and supply of skilled workers (Beyer *et al.* 1999). This study considers export orientation (XOR) of the manufacturing

sector as a whole and the skill intensity, NPW/PW , (RD henceforth) on the ground that these two variables indirectly capture the impacts of imported capital and relative product prices. The fundamental dictate of the HOS hypothesis is that trade liberalisation affects factor prices by changing the relative product prices. Thus, XOR and relative product prices are likely to be highly correlated in which case one can be substituted for the other.⁷ Similarly, imported capital may contribute to greater export orientation by improving the productive efficiency. Second, the relative product price impacts on the relative demand for factor inputs, which in turn affect relative wages. If capital and skilled labour are complementary, imported capital will also raise the relative demand for skilled labour. However, the study uses both imported capital and relative product price as instruments for XOR and RD while applying the 2SLS method.

Ideally, the relative demand for skilled labour should be determined by estimating a simultaneous equations system involving both the demand for and supply of skilled workers in order for the demand function to be identified, since relative wage (RW) appears as an argument in both the demand and the supply equations. The process also helps ascertain and separate out the extent of wage differentials that is due to the “skill premium” as exercised in some previous empirical applications. In the present context, pursuing the same procedure is ruled out by the unavailability of time series data on labour supply. For Bangladesh, data on the pertinent variables such as the labour force participation rate, employment and education are based on irregular surveys, which are, therefore, not sufficient for constructing a meaningful time series for the supply of skilled workers. The basic models of interests of this study are thus given as follows:

$$RW_t = \alpha_0 + \alpha_1 XOR_t + \alpha_2 RD_t + \varepsilon_{1t} \quad (1)$$

$$THLT_t = \beta_0 + \beta_1 XOR_t + \beta_2 RD_t + \varepsilon_{2t} \quad (2)$$

where,

RW_t = relative wage of skilled workers at time t;

XOR_t = export orientation at time t;

RD_t = relative demand for skilled workers; and

$THLT_t$ = Theil's entropy index at time t.

Following the HOS hypothesis, both XOR and RD are expected to have negative coefficients, and following the new growth theory explanation, the sign

⁷In the present application, the correlation coefficient between export orientation and relative price is estimated to be .54.

of the coefficient of RD is positive *a priori* in both equations. In the light of the past empirics, however, the coefficients may as well be zero. The regression results based on the alternative empirical techniques are presented in the following three sub-sections. All the variables are expressed in natural logarithms. The study covers the sample period 1973-1994.⁸

5.1 Estimated Results Based on the 2SLS Method

As noted before, neither export orientation nor relative demand is strictly exogenous in models (1) and (2) as they depend on a host of other factors. Thus, these variables are likely to be correlated with the error terms due to the omission of the relevant variables in which case the use of the OLS could produce inconsistent parameter estimates. Also, there exists a simultaneous relationship between relative demand and relative wage for skilled labour. Thus, the use of OLS is likely to produce spurious regression coefficients. The 2SLS overcomes these problems. Accordingly, model (1) is redefined by the following system of equations:

$$RW_t = \alpha_0 + \alpha_1 XOR_t + \alpha_2 RD_t + u_{1t} \quad (1.1)$$

$$XOR_t = \alpha_{10} + \alpha_{11} RER_t + \alpha_{12} MK_t + u_{2t} \quad (1.2)$$

$$RD_t = \beta_{10} + \beta_{11} MK_t + \beta_{12} RP_t + \beta_{13} RW_t + u_{3t} \quad (1.3)$$

where

RW_t , XOR_t and RD_t are defined as before, and

RER_t = real effective exchange rate applied to exports;

MK_t = imported capital-GDP ratio; and

RP_t = relative price of unskilled to skilled labour intensive products.⁹

⁸The basic source of data is the Census of Manufacturing Industries conducted annually. The latest year the data are available for is 1996. Since no survey was conducted for the year 1995, we limit the study period to 1994. For the Theil's T index, the 1993 and 1994 figures are based on a linear extrapolation.

⁹ Following Beyer, Rojas and Vergara (1999), we use the domestic wholesale price of textiles (including wearing apparel) relative to the domestic wholesale price of the rest of the three-digit level manufacturing industries to represent the relative price of unskilled labour-intensive products to skilled labour-intensive products. Over the years, the textiles and readymade garments industries have remained the most unskilled labour-intensive industries for Bangladesh. The relative price is constructed by calculating the weighted average indices of prices, the weights being the same as that suggested by the Bangladesh Bureau of Statistics.

Again, the variables are all expressed in natural logarithms. RER_t and MK_t are indicators of trade liberalisation, and together constitute key determinants of the expansion of exports. At the same time, these variables are not expected to directly influence the variations in relative wages and, therefore, can be considered as appropriate instrumental variables. The inclusion of MK_t in the equation for relative demand also enables the verification of the complementary relationship between relative demand and capital intensity. It must be noted here that the capital-labour ratio is another candidate variable for inclusion in the relative demand equation. But replacing MK_t by the capital-labour ratio does not markedly change the results as they are highly correlated (the correlation coefficient being (+) .89). We choose MK_t since it is directly related to import liberalisation in terms of reductions in quantitative restrictions and tariffs. Following the HOS hypothesis, RP_t is expected to have a negative impact on RD_t . RW_t is included in equation (1.3) in order to allow simultaneity between RW_t and RD_t . Obviously, the inclusion of the four separate exogenous variables leaves equation (1.1) over-identified. The presence of multiple instruments in equations (1.2) and (1.3) also allows the use of the linear combinations of the variables as instruments for estimating equation (1.1).

In order for the instrumental variables to be empirically valid, at least one of the exogenous variables in equations (1.2) and (1.3) should be statistically significant. As shown in Table II, the coefficients of all the explanatory variables, except MK_t in the equation for RD_t , are statistically significant and the null hypothesis that all parameters have simultaneously zero coefficients is rejected on the basis of the F-statistic for each equation. The estimated XOR_t and RD_t therefore qualify as instruments for XOR_t and RD_t respectively in the second stage estimation of equation (1.1).

TABLE II
EMPIRICAL VALIDITY OF THE INSTRUMENTAL VARIABLES

Regressors	Dependent Variable: XOR_t	Dependent Variable: RD_t
<i>Constant</i>	-9.00 (12.37*)	-1.56 (1.41)
RER_t	0.67 (2.55*)	.....
MK_t	0.52 (4.20*)	0.08 (1.71)
RP_t	.....	-0.47 (1.99**)
RW_t	.....	-1.27 (7.08*)
	$R^2 = .86$	$R^2 = .76$
	Adj. $R^2 = .85$	Adj. $R^2 = .72$
	DW =1.28	DW =1.65
	F(2,19)=59.25*	F(3,18)=19.32 *
	N=22	N=22

Note: * significant at 5% level or less. **significant at 10% level.

The equation for RD_t in Table II has interesting implications for the HOS hypothesis and the new growth theory. First, the negative coefficient of the relative price variable, RP_t , conforms to the prediction of the HOS hypothesis in that a rise in the relative price of the unskilled labour-intensive products would lead to a reduction in the relative demand for skilled labour (or an increase in the relative demand for unskilled labour). As a result, wage disparity should decrease. Secondly, although the imported capital variable has a positive coefficient indicating a complementary relationship between capital and skilled labour, the coefficient is not statistically significant at the 10 per cent level. In fact, the correlation coefficient between RD_t and MK_t is found to be negative and very small (-.21). The correlation coefficient between RD_t and RP_t is estimated to be (-).29.

The estimated 2SLS results for RW_t are presented in the second column of Table III. The coefficient of XOR_t is positive and significant at the 10 per cent level of significance, which implies that export orientation has been responsible for a widening of the wage disparity in the Bangladesh manufacturing sector. On the other hand, the negative and statistically significant coefficient of RD_t indicates that the relative demand for skilled workers has had an offsetting effect.

TABLE III
THE 2SLS REGRESSION RESULTS ON RW_T AND $THLT_T$.

Regressors	Dependent Variable: RW_t	Dependent Variable: $THLT_t$
<i>Constant</i>	-0.35 (2.12*)	-3.77 (6.62*)
XOR_t	0.08 (1.99**)	0.97 (6.07*)
RD_t	-0.73 (6.89*)	-1.23 (3.76*)
	$GR^2 = .92$	$GR^2 = .88$
	Adj. $GR^2 = .91$	Adj. $GR^2 = .87$
	DW = 1.24	DW = 1.60
	F(2,19) = 6.79*	F(2,19) = 30.45*
	N = 22	N = 22

Note: * significant at 5% level or less. **significant at 10% level.

The above procedure is repeated for model (2), that is:

$$THLT_t = \beta_0 + \beta_1 XOR_t + \beta_2 RD_t + \varepsilon_{2t}$$

The instruments used for the RW_t equation are retained for the estimation of the $THLT_t$ equation. The justification for the use of equation (1.2) is as follows. Theil's T is a composite index and, therefore, is less likely to have a direct impact on relative demand. But it may indirectly affect relative demand through relative wages. Thus, we retain both equations (1.2) and (1.3) in order to

instrument XOR_t and RD_t in the above equation. The estimated results, set out in the last column of Table III, are similar to the results obtained on the equation for RW_t . Alternatively, export orientation has had a positive impact on wage inequality, while relative demand had a negative impact.

5.2 Empirical Results Based on Cointegration Estimation

The findings of the previous section may not stand valid in the light of the empirical findings that most macroeconomic time series are not stationary in their levels. It must be acknowledged that cointegration is not an ideal option for a small sample such as the one in question. Nonetheless, the procedure is pursued here as robustness check to the 2SLS results. An application of the Phillip-Perron (PP) test on the levels and first differences of the variables suggests that all four variables are non-stationary in their levels but stationary in the first differences meaning that the level variables are all I(1). Table IV presents the results.

TABLE IV
THE PP TESTS FOR UNIT ROOTS IN THE LEVELS
AND FIRST DIFFERENCES OF THE VARIABLES

Series	t-Values (with a constant)	Comment
RW_t	-0.70	Not I(0)
XOR_t	-1.21	Not I(0)
RD_t	-0.83	Not I(0)
$THLT_t$	-0.57	Not I(0)
ΔRW_t	-4.55	I(0)
ΔXOR_t	-4.59	I(0)
ΔRD_t	-7.42	I(0)
$\Delta THLT_t$	-5.33	I(0)

Notes: (a) critical value for t-statistic with a constant at 5% significance level is -3.04 for $n=18$. (b) t-statistics are based on a truncation lag of 3.

To test the presence of cointegration between relative wage, export orientation and relative demand for skilled labour and between Theil's T, export orientation and relative demand for skilled labour, we construct the following unrestricted VAR (vector autoregression) models:

$$\text{VAR 1: } (RW_t, XOR_t, RD_t)$$

$$\text{VAR 2: } (THLT_t, XOR_t, RD_t)$$

By virtue of being I(1), the variables in each VAR are all cointegrated and, therefore, can be represented in an error correction model (Engle and Granger 1987). A third and a second order VAR are chosen for the first and second model respectively, which are consistent with the diagnostic checks such as the serial correlation and normality of the individual equations in the unrestricted VAR. The results of the cointegration tests, based on the Johansen and Juselius (1990) method, are presented in Tables V and VI. Both λ_{\max} and λ_{trace} statistics indicate the existence of one cointegrating vector for each of the VARs.

TABLE V
TEST STATISTICS FOR COINTEGRATING RANK: (Z_T : RG_T , XOR_T , RD_T)

Null	Alternative	λ_{\max} statistic	95% Quintile	Null	Alternative	λ_{\max} statistic	95% Quintile
$r = 0$	$r = 1$	32.22	21.12	$r = 0$	$r \geq 1$	39.88	31.54
$r \leq 1$	$r = 2$	7.65	14.88*	$r \leq 1$	$r \geq 2$	7.67	17.86*
$r \leq 2$	$r = 3$	0.02	8.07	$r \leq 2$	$r \geq 3$	0.02	8.07

(Eigen Values: 0.81650 0.33154 0.00902)

Note: r denotes the number of cointegrating vectors.

TABLE VI
TEST STATISTICS FOR COINTEGRATING RANK: (Z_T : $THLT_T$, XOR_T , RD_T)

Null	Alternative	λ_{\max} Statistic	95% Quintile	Null	Alternative	λ_{\max} Statistic	95% Quintile
$r = 0$	$r = 1$	23.83	21.12	$r = 0$	$r \geq 1$	31.77	31.54
$r \leq 1$	$r = 2$	6.69	14.88*	$r \leq 1$	$r \geq 2$	7.95	17.86*
$r \leq 2$	$r = 3$	1.25	8.07	$r \leq 2$	$r \geq 3$	1.25	8.07

(Eigen Values: 0.69629 0.28455 0.06049)

Note: r denotes the number of cointegrating vectors.

The long run cointegrating vectors after normalising on RW_t and $THLT_t$ respectively for VAR1 and VAR2 are obtained as follows:

$$RW_t = 0.27 XOR_t - 0.28 RD_t \quad (VAR1)$$

(0.06) (0.08)

$$THLT_t = 0.52 XOR_t - 1.61 RD_t \quad (VAR2)$$

(0.16) (0.24)

The asymptotic standard errors (in brackets) suggest that the long run coefficients of XOR_t and RD_t are statistically significant in both equations. The estimated error correction equations for the two models are presented in Table VII.

TABLE VII
ESTIMATED ERROR CORRECTION EQUATIONS

Regressors	Dependent Variable: ΔRW_t	Dependent Variable: $\Delta THLT_t$
Constant	0.41 (5.44*)	-1.34 (3.17*)
ΔRW_{t-1}	0.44 (3.19*)	.....
ΔRW_{t-2}	-0.17 (1.56)	.....
ΔXOR_{t-1}	0.16 (2.24*)	-0.10 (0.39)
ΔXOR_{t-2}	-0.36 (5.62*)	.....
ΔRD_{t-1}	0.44 (3.25*)	0.73 (1.69)
ΔRD_{t-2}	-0.33 (2.82)	.....
$\Delta THLT_{t-1}$	.....	0.17 (1.42)
$EC1_{t-1}$	-0.67 (3.69*)	.....
$EC2_{t-1}$	.....	-0.40 (2.06**)
	$R^2 = .91$ $LMS = 0.79$	$R^2 = .30$ $LMS = 1.37$
	$Adjusted R^2 = .86$ $RESET = 0.06$	$Adjusted R^2 = .08$ $RESET = 0.21$
	$DW = 2.79$ $NORM = 1.03$	$DW = 1.74$ $NORM = 1.32$
	$F(7,11) = 16.60^*$ $HET = 1.00$	$F(4,14) = 1.38$ $HET = 2.43$

Note: *significant at 5% level or less. **significant at 10% level or less.

Diagnostic Tests:

LMS: Lagrange multiplier test for residual serial correlation.

RESET: Ramsey RESET test for functional form mis-specification.

NORM: Jarques-Bera test for normality of residuals.

HET: Test for heteroskedasticity based on squared residuals.

The error correction terms, derived from the respective long-run relationship, are as follows:

$$EC1_t = RW_t - 0.27XOR_t + 0.28RD_t$$

$$EC2_t = THLT_t - 0.52XOR_t + 1.61RD_t$$

The estimated error correction equation for RW_t suggests that there exists a short term adjustment process pertaining to the long run relationship between wage ratio, export orientation and relative demand for skilled workers as indicated by the negative and statistically significant coefficient of the error correction term $EC1_{t-1}$. An absolute value of 0.67 of the coefficient of $EC1_{t-1}$ suggests a very high speed of adjustment towards the long run equilibrium, just about one and a half year. In the presence of the significant error correction term, the significant coefficients of the lagged XOR_t and RD_t imply Granger causality from both export orientation and relative demand for the skilled workers to wage disparity. Finally, past records of wage disparity have positive impacts on current wage disparity, that is, the greater the past inequality, the greater the current inequality.

As to the error correction equation for $THLT_t$, although the coefficient of the error correction term $EC2_{t-1}$ has a correct sign and appears statistically significant (at 10 % level), it can effectively be zero as the F-statistic is statistically insignificant implying an absence of short term adjustment mechanism whatsoever to lead to the possible long term equilibrium. At the same time, no causal directions are discernible from either export orientation or the relative demand for skilled workers to the Theil's entropy index.

VI. CONCLUDING REMARKS

This paper has analysed the implications of trade policy reforms for wage inequality in the Bangladesh manufacturing sector. After reviewing the trends in employment, wages and factor intensity, the study has applied relevant time series empirical techniques to see how trade liberalisation has affected wage inequality in the sector. Finally, the study has shed light on the complementarity between skilled labour and capital.

The findings suggest that wage inequality in the Bangladesh manufacturing sector has increased over the period 1973-1994. Econometric assessments show that export orientation has exacerbated wage inequality while relative demand for skilled workers had a counterbalancing impact. Thus, the net effect depends on how these two effects outweigh each other. Though not clear, *ceteris paribus*, the results are indicative of a positive impact of trade liberalisation on wage disparity in the Bangladesh manufacturing sector.

The results also suggest that there is either negative or no correlation between the relative demand for skilled to unskilled labour and imported capital thus refuting the hypothesis of complementarity between skilled labour and capital. The corollary of this is that the demand for unskilled labour may have increased or remained the same relative to skilled labour thus possibly complying with the HOS prediction. Figure 2 aptly verifies this observation. The argument is also supported by the negative correlation between relative price of unskilled labour-intensive products and relative demand for skilled labour. One reason for the non-complementarity of skilled labour and imported capital may be the fact that it is the import of intermediate inputs rather than capital equipment that has increased following trade liberalisation. Studies show that imports of capital goods in Bangladesh drastically fell over the period 1982-1991 while imports of materials for capital goods rose quite notably (Salim 1999, Hossain and Alauddin 2004). The new technology thus, if any, was embodied in intermediate inputs thereby not requiring skilled labour to complement its use.

While the present study supports a plethora of previous empirical studies, the findings must be interpreted conservatively. Although trade liberalisation in Bangladesh was launched in the early 1980s, it took a definitive and comprehensive shape only after 1991. A larger sample may produce more robust econometric results. This limitation notwithstanding, it may be emphasised that the use of export orientation as an indicator of trade liberalisation has definitely lent credence to the findings of the study. It remains to be seen how future empirical research works incorporating larger and/or disaggregated data complement the present study.

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