2000 Annual Forum

at Glenburn Lodge, Muldersdrift

Trade and Labour Revisited

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Prepared to present at TIPS fourth annual trade and industry forum, *"Paths to Growth and Employment in South Africa"*, September 18 - 20, 2000. I am greatly thankful to Professor E. U. Choudhri (Carleton University, Ottawa), Rohinton Medhora and Susan Joekes (IDRC, Ottawa) for their helpful comments and guidance. Views expressed in this paper do not represent the Canada's International Development Research Centre.

1. Introduction

There continues to be considerable concern that the expansion of trade with developing countries (hereafter South) is lowering the relative wage of unskilled labour in developed countries (hereafter North). The issue of income divergence in the North is highlighted by the experience of the U.S., where a marked decline in the relative wage was observed during the 1980's and the 1990's. The striking feature of this decline was that it occurred during the period when the U.S. was following trade liberalization policies and expanding its imports from the South. Thus a similar fear of a decline in the relative wage has been expressed in these northern countries.

The causal relationship between international trade and the relative wage dispersion is normally explained in terms of the (well-known) Heckcher-Ohlin-Samuelson theory (hereafter HOS) with two factors (skilled and unskilled labour). In this model, Stolper-Samuelson theorem can be used to show that trade liberalization would lower the relative wage of unskilled labour in the skill rich North[1].

A number of studies, for example, Murphy and Welch (1991), Katz and Murphy (1992), Borjas, Freeman and Katz (1992), Batra (1993), Wood (1994, 1995), Sachs and Schatz (1994) and Leamer (1994, 1995, and 1996) provided empirical evidence in support of this HOS interpretation. They argued that the trade had been a contributing factor to the rising income differentials in the U.S. and other countries in the North.

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[1]North is relatively more skill abundant than the South. Thus in the presence of trade restrictions the price of the skill-intensive good relative to the unskilled -intensive good is lower in the North. Trade liberalization in the North will bring an increase in the real return of the skilled labour through a decrease (increase) in the relative price of the unskilled (skill) intensive good.

These findings, based mainly on the Factor Content approach, were criticized by Bhagwati (1991, 1994), Dehejia and Bhagwati (1994), Lawrence and Slaughter (1993), Slaughter and swagel (1997)[2]. They argued that Stolper-Samuelson theorem works through an intermediating step, a change in relative prices. If relative prices of goods had not changed in the required direction, then it is inappropriate to link international trade with the relative wage[3]. They suggested Hicks-neutral technological improvement in the skilled-labour-intensive sector as an alternative explanation. Such technological change would shift the unit value isoquant of the sector downwards and require a decline in the relative wage of unskilled labour at initial prices[4].

To date the phenomenon of a decline in factor prices in the North is well documented but it is not yet clear whether trade liberalization or technological change has actually caused this divergence. One problem with resolving this issue is that these two types of changes affect relative factor prices in the same direction. Trade liberalization, for example, would decrease relative factor prices in the North via a decrease in the skilled-unskilled labour ratio in both sectors. Similarly, a technological improvement in skilled-labour-intensive sector also leads to a decline in the skilled-unskilled workers

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[2]Factor Content approach involves finding out the difference between how much of skilled labour is required to produce the goods which are exported to the other country and how much of unskilled labour would have been required if imported commodities were being produced domestically.

[3]As a matter of fact, Bhagwati (1991) found a slight increase in the prices of the unskilled-labour-intensive goods. Lawrence and Slaughter (1993) further confirmed these results.

[4]Lawrence and Slaughter (1993) captured the impact of this variable by finding a higher Total Factor Productivity (TFP) growth in the skilled labour-intensive sector. Bhagwati and Dehejia (1994) explained the role of this variable in terms of Kaleidoscopic comparative advantage hypothesis; a term that usually refers to the frequent switch of comparative advantage status from production of one good to the other.

labour ratio in both sectors, and a decrease in the relative wage. It is thus difficult to discriminate between these two explanations of a decrease in the relative wage in the North[5]. However, the relative wage would respond differently to the above mentioned changes in the South. For example, trade liberalization would cause the relative wage to increase while the sectoral technological improvement would decrease the relative wage[6].

It is interesting to note that most of the empirical work has focussed on the North and little attention has been given to the other side of the picture. The only exception is Robbins (1996) who examines the behaviour of relative wages in developing countries but does not explicitly address one aspect of the above issue - - the influence and implications of technological change. His study does, however, examine one other explanation - - possible effects of changes in the relative supply of unskilled labour[7]. This study follows Robbins in focussing on the developing countries but extends it in two directions. First, it explores the role of technological change as an additional factor to explain changes in the relative wage. Second, it uses data for a broader set of countries to obtain a clearer picture of the relative wage behaviour in the South.

Using panel data for eleven developing countries from 1985 to 1994, we implement a test which nests cases of complete and incomplete specialization. This test allows us to examine the impact

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[5]Lawrence and Slaughter found a higher growth rate of TFP for the skilled-labour-intensive sector for the U.S. but at the same time they found skilled-unskilled labour ratio increasing for both sectors.

[6]It is normally believed that the technological changes are global. If in the North the technological improvement occurs in the skill-intensive sector then it should be similar for the South.

[7]For a small open economy, changes in the relative supply can only affect the relative wage if the country is completely specialized. See for example Leamer (1995).

not only of trade liberalization and Hicks-neutral technological change but also relative supply of skilled labour on the relative wage in the South.

The remainder of this paper is divided into four sections. Section 2 discusses a simple model to provide a theoretical background for examining the relationship of the relative wage to technological improvements and trade liberalization under complete and incomplete specialization. Section 3 describes the key features of the data. Section 4 presents results of the empirical test. Section 5 concludes the paper.

2. Theoretical Framework

Consider the standard HOS model with two countries, North and South; two goods 1 and 2; and two factors of production, skilled and unskilled labour. Modify this model to allow for Hicks-neutral sectoral differences between the two countries. Good 1 is relatively skill-intensive. All firms have identical and constant returns technologies in each sector. The production function for each sector can be written as

$$Q_i^j = A_i^j F_i(S_i^j, U_i^j) \qquad \text{i = 1, 2, j = N, S} \qquad (1)$$

where $Q_i^j, S_i^j, U_i^j,$ and A_i^j denotes, respectively, output, skilled labour, unskilled labour and Hicks-neutral technological index for good i and country j, and N and S stand for North and South.

Markets are perfectly competitive, factors of production are perfectly mobile between sectors and prices are perfectly flexible. The production function is linearly homogenous, and therefore, it can be expressed as;

$$\tilde{Q}_i^j = U_i^j f(q_i^j) \qquad \text{i = 1, 2, j = N, S} \qquad (2)$$

where $\tilde{Q}_i^j (\equiv \frac{Q_i^j}{A_i^j})$ denotes output normalized by technology index, $f_i(q_i^j) \equiv F(q_i^j, 1)$ and $q_i^j (\equiv \frac{S_i^j}{U_i^j})$ is the skilled-unskilled labour ratio. Sector 1 is relatively more skill intensive so that at a given relative wage $q_1^j > q_2^j$.

Marginal products of skilled and unskilled labour are $A_i f_i'(q_i^j)$ and $A_i[f_i(q_i^j) - q_i f_i'(q_i^j)]$, respectively. Profit maximization condition implies that the two factors are paid values of their marginal products. Denoting W_U^j, W_S^j as wages of the skilled and unskilled workers and P_i^j the price of good i, perfect mobility of two factors across sectors would imply that

$$W_S^j = \tilde{P}_1^j f_1'(q_1^j) = \tilde{P}_2^j f_2'(q_2^j) \qquad \text{j = N or S} \qquad (3)$$

$$W_U^j = \tilde{P}_1^j [f_1(q_1^j) - q_1^j f_1'(q_1^j)] = \tilde{P}_2^j [f_2(q_2^j) - q_2^j f_2'(q_2^j)] \qquad \text{j = N or S} \quad (4)$$

where $\tilde{P}_i^j (\equiv A_i^j P_i^j)$ represents the price of normalized units of output.

Now if we assume that each country is producing both goods, then changes in the wage of unskilled workers relative to skilled workers can be explained in terms of changes in relative prices and relative technology. These changes can be explained using Stolper-Samuelson (1941) and Findlay-Grubert (1959) analysis.

Defining $(\equiv \frac{W_U}{W_S})$ as the relative wage of the unskilled labour, p $(\equiv \frac{P_1}{P_2})$ as the ratio of prices of the skilled and unskilled labour-intensive goods and a $(\equiv \frac{A_1}{A_2})$ as relative technology, we can derive the following relationships

$$w^j = g(p^j, a^j) \qquad \text{j = N or S} \qquad (5)$$

where $\frac{\partial g}{\partial p^j} < 0$ and $\frac{\partial g}{\partial a^j} < 0$

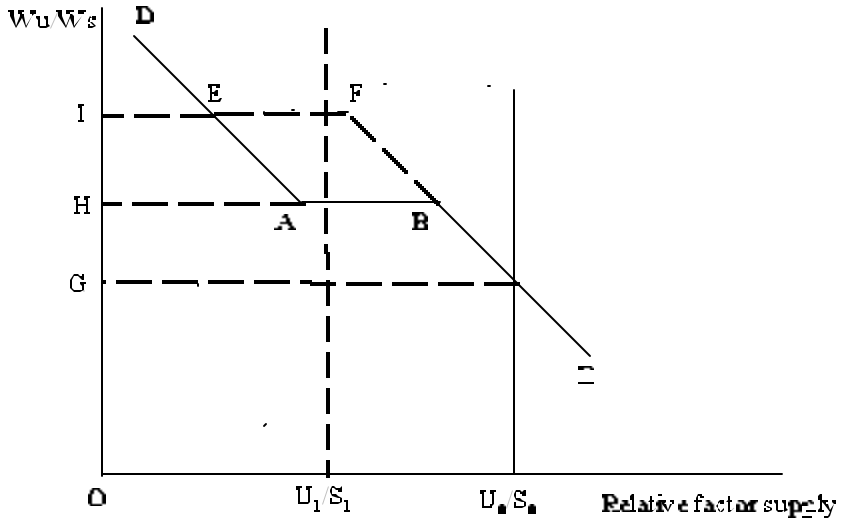
In contrast to diversified production, if we assume that both countries specialize in one of the two goods, then relative wage in each country can be expressed as a function of relative supplies of skilled and unskilled workers. That is

$$w^j = f(\bar{s}^j) \qquad \text{j = N or S} \qquad (6)$$

where $\bar{s}^j \left(\equiv \frac{\bar{S}}{\bar{U}}\right)$ is the ratio of the endowment of skilled labour ($\bar{S}$) and the unskilled labour ($\bar{U}$) and $\frac{d w^j}{d \bar{s}^j} > 0$.

In this simple theoretical framework, we have shown that the relative price, relative technology and the relative factor supplies can affect the relative wage. These effects are illustrated using a supply and demand curve diagram developed by Leamer (1995).

Diagram 1: Relative Supply and Relative Demand



In the above diagram, relative factor supplies are measured along the horizontal axis and the relative wage along the vertical axis. Once the country is open to trade, then line *DABD* is the demand curve, with the height of the flat segment, *AB*, determined by the relative international price and southern trade barriers. The length of the segment represents the range of factor endowments in which the country would be producing both goods in a trading equilibrium.

Consider for a moment that the relative supply in the South is at U_1/S_1 level, some where within the range, *AB,* and it changes over this range only (case 1 hereafter). Also assume that the South liberalizes its trade with the North and thus the demand curve shifts to, *DEFD.* It is then clear that in this case, the increase in the relative wage in the South occurs only because of trade liberalization

(which cause a decrease in the relative price in the South) and small changes in the relative supply has no effect[8].

Now assume that South is relatively abundant in unskilled labour and has relatively small endowment of skilled labour, represented by $\frac{U_0}{S_0}$ in Diagram 1 (case 2 hereafter). This will allow South to completely specialize in the production of unskilled labour-intensive good. In this case, the equilibrium occurs on the downward sloping segment, *BD*, of the *DABD* curve. Again let there be trade liberalization and the demand curve, *DABD*, shifts upward to *DEFD* and let relative supply shifts in either direction but remains on the *FD*, segment. In this case the relative wage will change only in response to the shift in the relative supply and trade liberalization (or technology) would have no effect.

Finally, assume that initially South has very little endowment of skilled labour, represented by, $\frac{U_0}{S_0}$ in Diagram 1 (case 3 hereafter). This will allow South to completely specialize in the production of unskilled-labour-intensive good. Again let there be trade liberalization and the demand curve, *DABD*, shifts up to *DEFD.* Also assume that due to expanded educational opportunities relative supply of unskilled labour decreases to $\frac{U_1}{S_1}$. This shift in the relative supply is assumed to move the South to the range of diversification. In this case, the relative wage changes in response to the shift in relative supply as well as trade liberalization. Initially the relative wage in the south was at *OG*. Once trade liberalization occurs and relative supply of skilled workers increases, the relative wage is then *OI*. An increase in the relative wage up to the portion *GH* is due to changes in the relative supply and *HI* is due to trade liberalization.

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[8]For simplicity, we discuss only the effect of a change in relative price but note that change in relative technology would shift the *DABD* curve downwards and would affect the relative wage to decrease.

The discussion of above three cases suggest the following general relation

$$w^j = q(p^j, a^j, \bar{s}^j) \qquad \text{j = N or S} \qquad (7)$$

where $\frac{\partial q}{\partial p^j}$, $\frac{\partial q}{\partial a^j}$ are negative if case 1 holds and equal to zero if case two holds. Similarly $\frac{\partial q}{\partial \bar{s}^j}$ is positive if case 2 holds and equal to zero if case 1 holds. In case 3, $\frac{\partial q}{\partial p^j}$, $\frac{\partial q}{\partial a^j}$ are negative and $\frac{\partial q}{\partial \bar{s}^j}$ is positive[9].

Relative price in the south is linked to the relative price in the North as follows;

$$p^S = tp^N \qquad (8)$$

where $\tau > 1$ is an index of trade restrictions that increases with τ^S or τ^N, which represents, respectively, trade restrictions in the South and the North. Using (8) and letting j = S, (7) can be expressed as[10]

$$w^S = q(t\ p^N, a^S, \bar{s}^S) \qquad (9)$$

In the empirical analysis below, we estimate log linear approximation of (9):

$$\ln w_{it} = a_0 + a_1 \ln(t_{it} + p_t^N) + b_2 \ln a_{it} + b_3 \ln \bar{s}_{it} \qquad (10)$$

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[9]Please note that case 1 refers to diversified production, case 2 refers to specialized production and case 3 is a mixed case where countries move from one state (e.g. specialized) to another state.

[10]In the presence of trade restrictions in the North and South, we have $P_1^S = (1 + t^S)P_1^N$ and $(1 + t^N)P_2^S = P_2^N$ therefore $p^S = tp^N$ with $t = (1+ t^S)(1+ t^N)$.

where subscript, *it*, represents the variable for Southern country *i* at time *t* and p_t^N is the relative price in the North at time *t*[11].

3. Data

The study attempted to include all developing countries for which relevant data series were available. The data on wage rate by detailed occupations (used to construct indexes for relative wage rates) for developing countries is reported by International Labour Organization (ILO) but is available on an irregular yearly basis from 1985 to 1994. Data for many countries, for example, is reported only once or twice during this time period. Because of this data limitation, the sample size was restricted to only eleven developing countries for which consistent time series on wage rates were available for at least four years. These include Bangladesh, Egypt, Honduras, India, Barbados, Bolivia, Thailand, South Korea, Singapore, Venezuela, and Uruguay.

Wage data has been obtained from the ILO, *A Special Supplement to the Bulletin of Labour Statistics, October Inquiry, (various issues).* This supplement provides information about wage rates for 159 occupations in 49 major industries. To construct wage indexes of skilled and unskilled labour, we have followed the approach used by Slaughter and Lawrence, which identifies skilled and unskilled labour with non-production and production workers. The non-production group includes 23 occupations in professional, technical and administrative

[11]We assume that Northern relative price is same for all Southern countries but varies over time.

categories. The remaining 136 occupations are classified as production group[12]. Skilled and unskilled wage rates (i.e. W_S and W_U) are then measured as simple averages of the wage rates for all occupations reported in the two groups[13].

We used ratio of enrollments in the university to that in the primary school as a measure of relative supply. This measure closely matches the proxy for the relative factor supplies of skilled workers used by Robbins. One limitation of this approach is that enrollments actually represent addition to stocks of skilled and unskilled workers (i.e. ΔS and ΔU). However, if the rate of growth of enrollments in different categories (i.e. $\Delta S / S$ and $\Delta U / U$) were similar, then $\Delta S / \Delta U$ would provide a reasonable proxy for the relative factor supplies (i.e. S/U). Data on enrollments in universities and primary school is obtained from United Nations Educational, Scientific and Cultural Organization (UNESCO, *Statistical yearbook (various issues)*.

A number of proxies have been suggested in the literature to represent trade liberalization. These include average tariffs, average quantitative restriction coverage, average collected tariff ratios, the World Bank's index of outward orientation and the trade dependency-ratio index. Unfortunately data on any of these measures, except the trade dependency-ratio, is not available on a regular yearly basis for all of the eleven sample countries. We thus used the trade dependency-ratio index as a proxy

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[12]For example, these occupations include clerical, sales workers, service workers other than administrative or professional workers, animal husbandry, agriculture, forestry, hunting, transport equipment operators and all other unskilled workers engaged in processing, assembling, inspecting, storing, handling, packing and repair activities.

[13]Wages are not reported for occupations with small numbers.

for trade liberalization. This is simply measured by share of trade in Gross Domestic Product (GDP). One important limitation of this measure is that a country could distort its trade heavily but still could have high trade dependency-ratio. Nevertheless, this measure is considered a useful proxy and employed extensively by trade economists in empirical analysis[14].

The data on the value of exports and imports is obtained from the International Monetary Fund, *Direction of Trade Statistics, (various issues)*, while GDP data is taken from World Bank's, *World Tables, (various issues)*.

Construction of an index of relative technology, *a*, requires data on skilled and unskilled labour which is not available for sample countries. We employed nominal value added per employee, *RT*, as a proxy for the Hicks-neutral technology index. Letting $RT \equiv p^j(q_1^j / q_2^j)$ with

$q_i^j(\equiv Q_i^j / (S_i^j + U_i^j)$, and using equation (1), it can be shown that *RT* is a measure of the relative technology index, *a*, as

$$RT = a^j e \qquad \text{j = N or S} \qquad (11)$$

where $e = [\frac{f_1(q_1^j) / (q_1^j + 1)}{f_2(q_2^j) / (q_2^j + 1)}]$ is an error term that depends on the skilled/unskilled labour ratio.

To construct the proxy for the relative technology index, 3-digit (ISIC) industries were divided into skilled and unskilled labour-intensive groups on the basis of average earnings of the employees for each industry. RT is thus the ratio of average value added per employee in the skilled and unskilled

[14]Robbins, for example, used this measure for explaining trade liberalization in his study.

labour-intensive group of industries. Data on value added and employment is obtained from United Nations Industrial Development Organization (UNIDO), *International Yearbook of Industrial Statistics (various issues)* and information on average earnings of workers are available from the U.S. Bureau of Census, Department of Commerce, *Annual Survey of Manufactures (1998)*.

4. Empirical Analysis

Before presenting econometric results, we first review the data to explore long run trends of different variables in each developing country and variations of these variables across countries. Figure 4.1, shows the movement of the relative wage over time in each of the eleven developing countries. As the figure shows, relative wage exhibits considerable variability over time and it is difficult to discover a clear-cut trend in its behaviour for most countries. There exists a mild tendency for the relative wage to increase in South Korea, Venezuela and Uruguay and decrease in Egypt and Thailand. For rest of the countries, the relative wage does not exhibit any systematic trend.

Yearly fluctuations of relative wages are likely to be very sensitive to the short run cyclical factors. To get an indication of the underlying long run behaviour, we next look at average annual changes of the relative wage for the whole sample period.

Figure 4.1: Relative Wage in Eleven Developing Countries.

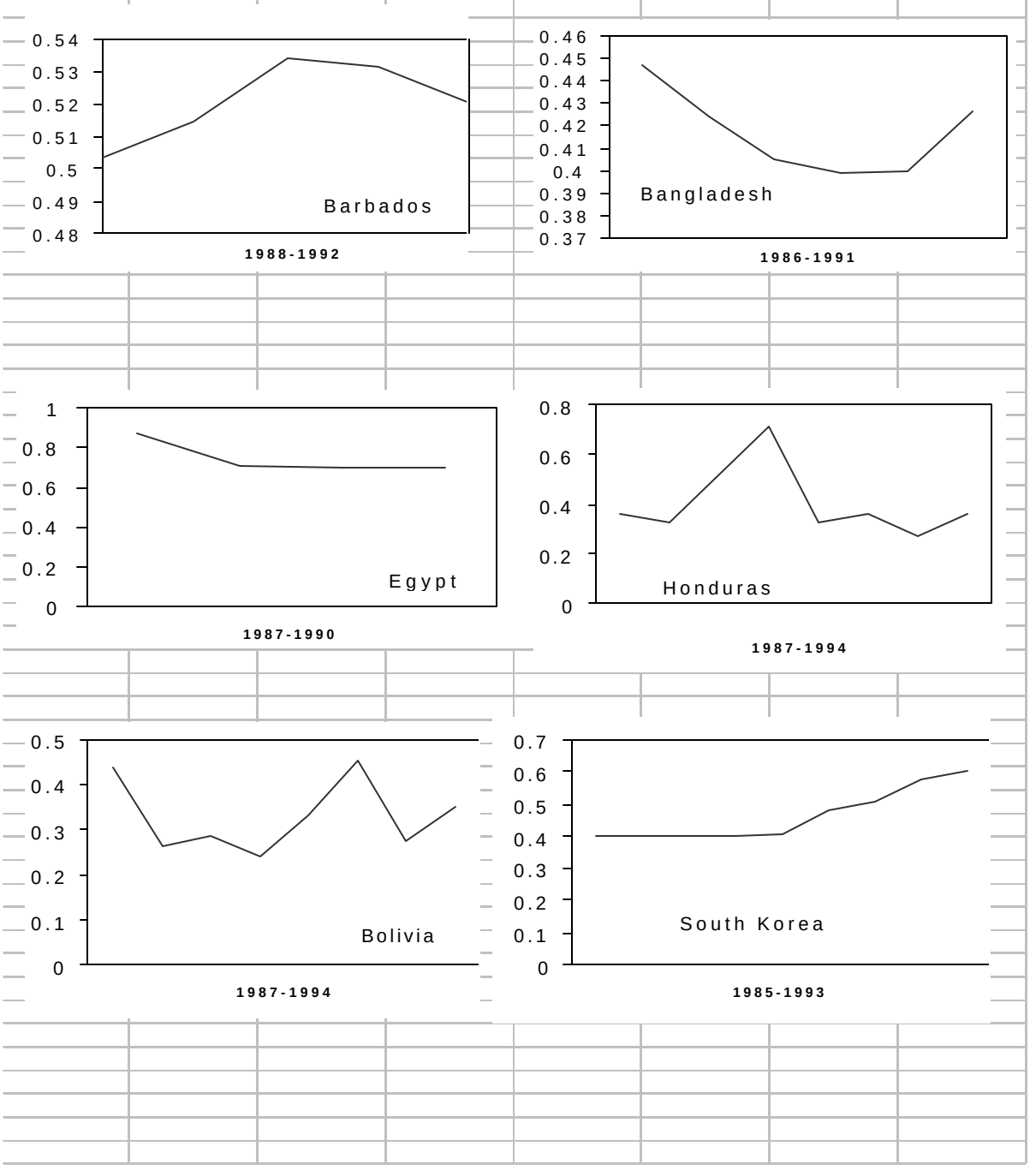


Figure 4.1 continued:

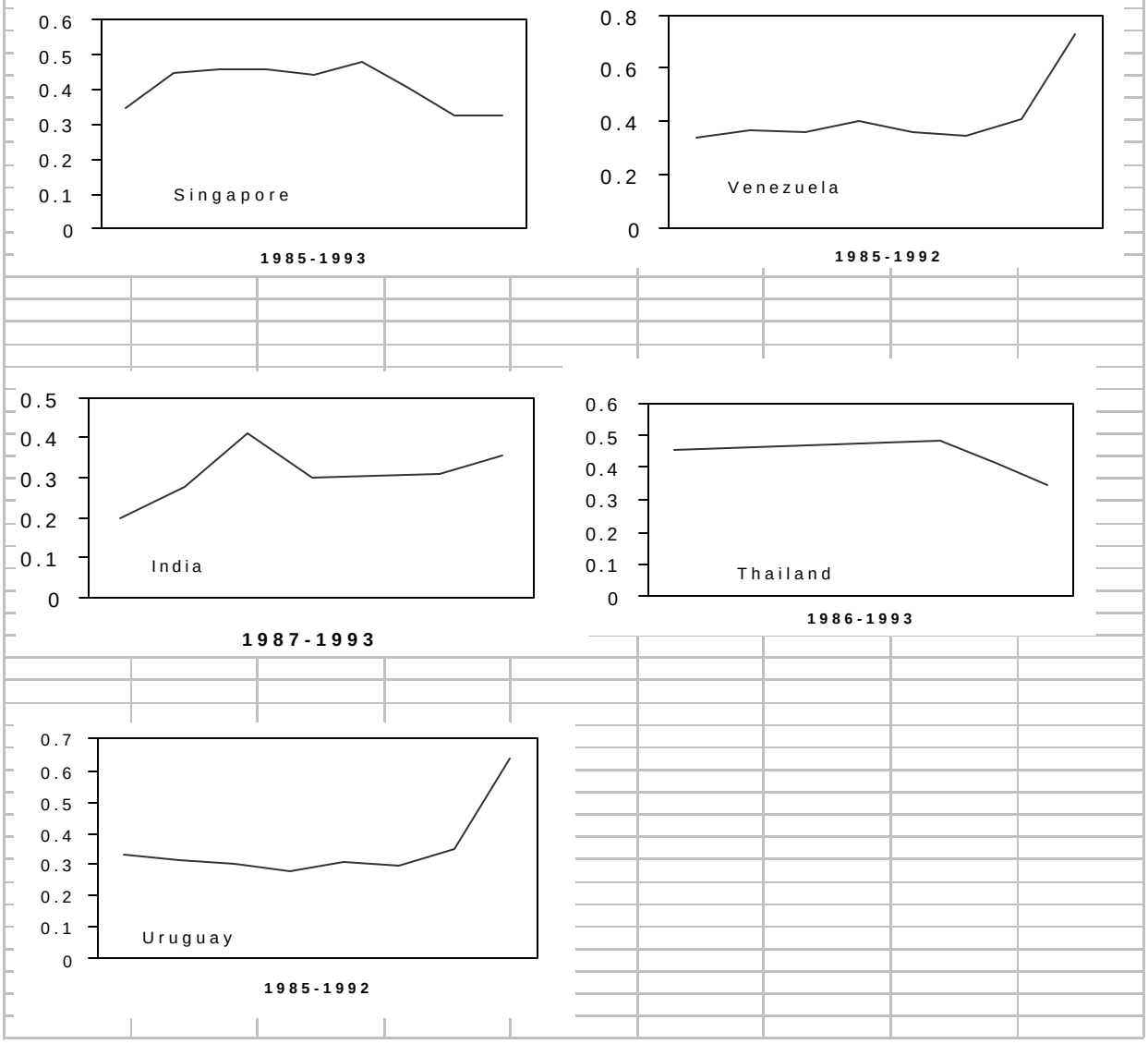


Table 4.1 reports the average annual change in the relative wage. The table shows that average change tends to vary considerably across countries. For example, four countries, Korea, Venezuela, India and Uruguay, experienced a significant increase of over 5% a year[15]; another two countries, Barbados and Bolivia, register only a modest increase between 0% to 1% a year; while remaining countries show a modest decline over time. It is interesting to explore whether these differences in the relative wage could be explained by variables defined in our model, that is, trade liberalization, relative factor supplies and the relative technology index. Average annual change in these variables are also reported in table 4.1.

The model in section 2 suggests that wages are positively related with the trade openness for diversified countries. This relation is explored in figure 4.2. The figure shows that there is no positive association between average annual changes in the relative wage and trade openness. In fact, countries that had a negative average change in trade openness tend to experience an increase in the relative wage[16].

[15]Uruguay exhibit over 15% per year increase in the relative wage but note that it is mainly due to a sharp increase in the relative wage in the year 1992 (as shown in Figure 4.1)

[16]For example, in South Korea, Barbados and Uruguay, trade openness declined at the rate of 3%, 2% and 0.07% per year while relative wages increased at an annual rate of 6%, 1% and 6% respectively. In Honduras, Thailand and Egypt, average annual increase in trade openness was 5%, 7% and 32% but relative wages declined at the rate of 3%, 2.7% and 7% per year. Only exceptions are India and Bolivia where a positive association between trade openness and the relative wage is observed.

Table 4.1: Average Annual Change in Relative Wage, Trade Openness, Relative Factor Supplies and the Relative Technology.

Countries	**Observations**	**Relative Wage**	**Trade Openness**	**Relative Factor Supplies**	**Relative Technology**
Barbados (BR)	5	0.009721	-0.017978	0.055182	0.026084
		(0.006772)	(0.029171)	(0.052021)	(0.075971)
Bangladesh (BN)	6	-0.012354	0.008753	-0.660240	0.043771
		(0.010527)	(0.011125)	(0.025387)	(0.099685)
Egypt (EG)	4	-0.069624	0.323171	0.005975	-0.073897
		(0.034206)	(0.207588)	(0.032833)	(0.045250)
Honduras (HN)	8	-0.031928	0.047138	-0.053128	0.026765
		(0.049099)	(0.043599)	(0.007681)	(0.004868)
Bolivia (BO)	8	0.005096	0.030744	0.004933	0.123170
		(0.039137)	(0.004079)	(0.009253)	(0.029530)
South Korea (KR)	9	0.056185	-0.037502	0.158481	0.001519
		(0.009235)	(0.004887)	(0.008125)	(0.003044)
Singapore (SN)	9	-0.022677	0.004745	0.082535	-0.028763
		(0.019703)	(0.010957)	(0.002762)	(0.007686)
Venezuela (VN)	8	0.068046	0.068778	0.020833	0.016531
		(0.031528)	(0.026158)	(0.013547)	(0.018016)
India (IN)	7	0.058176	0.038423	0.002107	0.005443
		(0.038481)	(0.010376)	(0.003817)	(0.009992)
Thailand (TH)	8	-0.027453	0.066295	0.037583	0.101547
		(0.014872)	(0.013368)	(0.010055)	(0.049163)
Uruguay (UR)	8	0.159763	-0.000712	0.050152	-0.032121
		(0.036028)	(0.008213)	(0.006495)	(0.013099)

Standard Errors are reported in parenthesis.

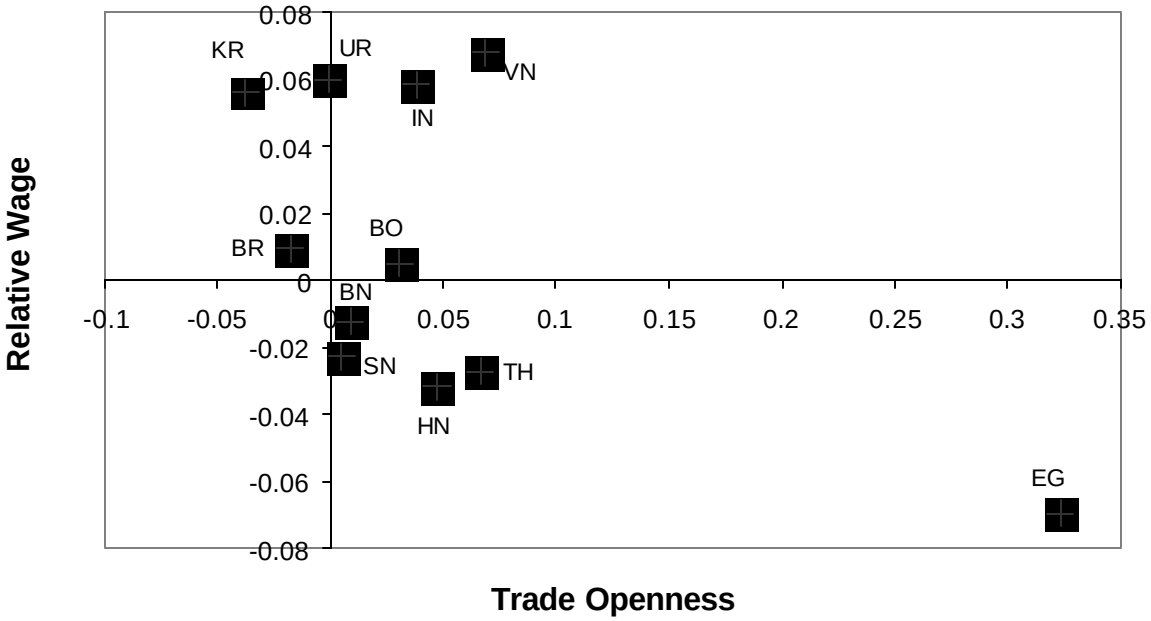


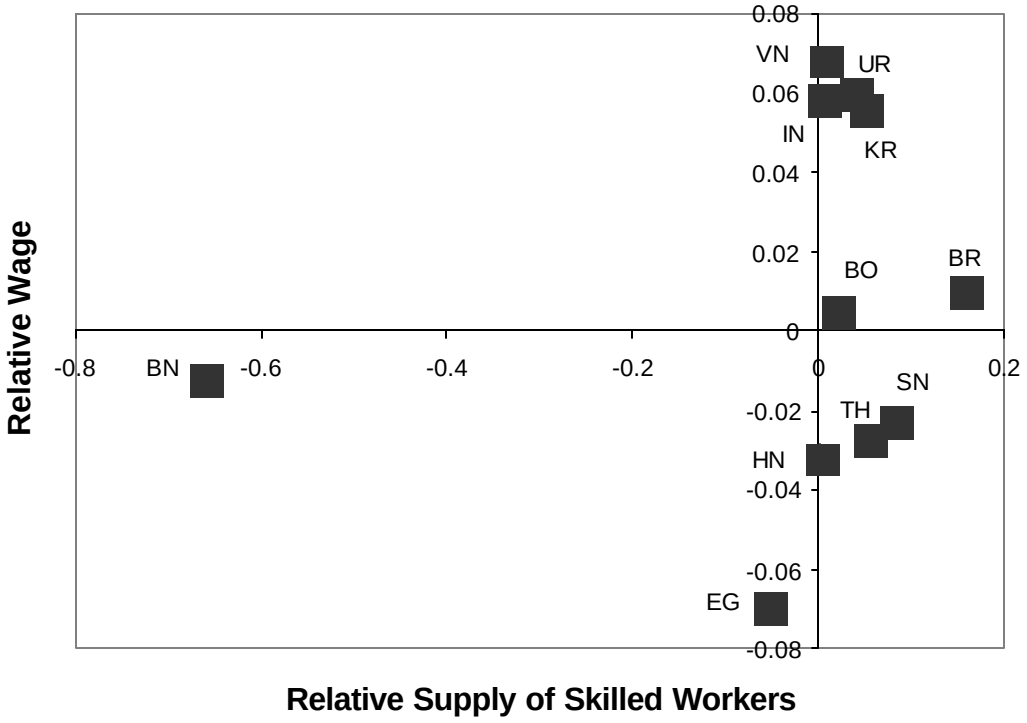
Figure 4.2: Relative Wage and Trade Openness (Average Annual Changes)

The model also predicts a positive association between relative wages and the relative factor supplies if countries are either completely specialized in production or they move from a specialized to a diversified production. Figure 4.3 explores this relation using the measure of relative factor supplies based on a university-primary-school enrollment ratio (RS1). The figure reveals no clear-cut relation between average changes in relative factor supplies and the relative wage. It is interesting, however, to compare these findings with results of Robbins (1996). Robbins noted a sharp increase in the supply of skilled workers in his sample of developing countries, which he attributed to expanded educational facilities[17]. He also found that changes in the supply of skilled workers were positively related to changes in the relative wage. The data in this study also confirms that relative factor supplies of skilled workers increased in most countries[18]. In contrast to Robbins' findings, however, increase in relative supplies of skilled labours in this study's sample of countries did not generally produce an increase in relative wages.

[17]Robbins' study includes Argentina, Chile, Costa Rica, Colombia, Malaysia, Mexico, Philippines, Taiwan and Uruguay.

[18]Notable exception is Bangladesh where relative supplies of skilled workers declined by 66%.

Figure 4.3: Relative Wage and Relative Factor Supplies (Average Annual Changes)



Finally, Figure 4.4 examines the relation between average changes in the relative technology index and the relative wage. The theory implies that Hicks-neutral technological improvement in the skill intensive sector would lead to a decrease in the relative wage. Figure 4.4, however, does not support this prediction. In fact, the figure suggests a weak positive association between the relative technology index and the relative wage.

Figure 4.4: Relative Wage and Relative Technology (Average Annual Changes)

One reason that the above data does not show an association between the relative wage and the explanatory variables might be that the sample is based on a short time period. It is possible that average annual changes over this short time period are very sensitive to short-term factors and do

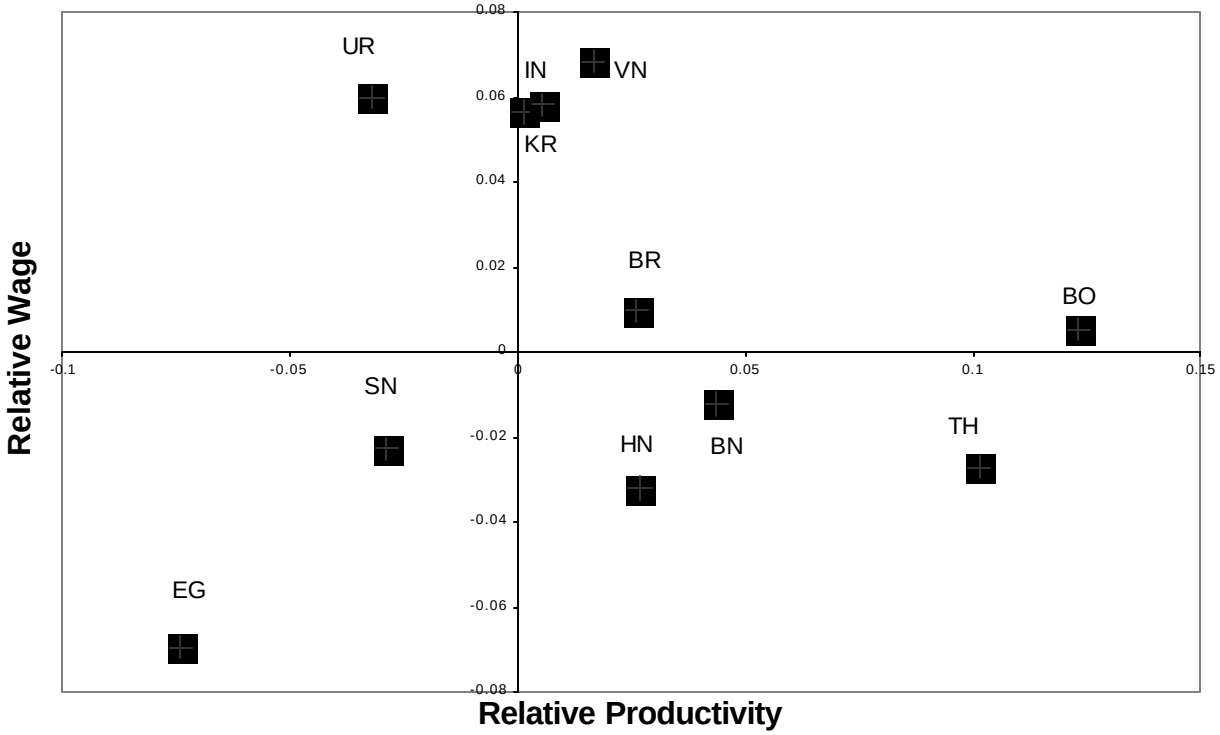


Table 4.2: Average levels of relative wage, trade openness, relative factor supplies and the relative technology.

Countries	**Observations**	**Relative Wage**	**Trade Openness**	**Relative Factor Supplies**	**Relative Technology**
Barbados	5	0.520704	0.500071	0.206413	1.382758
		(0.012507)	(0.040996)	(0.055550)	(0.296047)
Bangladesh	6	0.416841	0.226139	0.040145	1.963461
		(0.019225)	(0.010220)	(0.006463)	(0.613435)
Egypt	4	0.743092	0.189505	0.110321	0.582144
		(0.085577)	(0.129753)	(0.010281)	(0.077532)
Honduras	8	0.403658	0.562822	0.048351	1.524012
		(0.142041)	(0.176677)	(0.002220)	(0.111831)
Bolivia	8	0.330055	0.342528	0.083933	2.323944
		(0.080201)	(0.027268)	(0.006234)	(0.774522)
South Korea	9	0.463730	0.569826	0.356539	1.479041
		(0.081288)	(0.062150)	(0.057564)	(0.033330)
Singapore	9	0.410579	3.081666**	0.206882	2.217866
		(0.061338)	(0.249246)	(0.047089)	(0.210806)
Venezuela	8	0.412210	0.424709	0.134588	1.993935
		(0.130110)	(0.095134)	(0.011575)	(0.247903)
India	7	0.308562	0.145177	0.048541	2.136053
		(0.065653)	(0.014156)	(0.001034)	(0.105868)
Thailand	8	0.446059	0.589521	0.151718	2.991890
		(0.045815)	(0.099064	(0.023741)	(0.989595)
Uruguay	8	0.352636	0.334665	0.188878	1.720781
		(0.116151)	(0.016732)	(0.018934)	(0.195189)
All Countries	**80**	**0.420782**	**0.706610**	**0.149807**	**1.921052**
		(0.124750)	**(0.870279)**	**0.099119)**	**0.694665)**

Standard deviations are in parenthesis. ** Mainly due to re-exports.

not adequately represent long-term trends. As an alternative, we next explore if inter-country differences in levels suggest an association between the relative wage and the explanatory variables.

Table 4.2 reports average levels of relative wage, trade openness, relative factor supplies and the relative technology index for each sample country. Average level of the relative wage ranges from a low

level of 0.30 for India to a high level of 0.75 for Egypt. The value for Egypt is, however, surprisingly very high and presumably reflects peculiarities of Egyptian wage data. If Egypt is excluded, average level of relative wage fluctuates between 0.30 to 0.52. To explore if inter-country differences in average levels of the relative wage could be explained by differences in average levels of explanatory variables, we plot average levels of the relative wage against average levels of each of the three variables in Figures 4.5 - 4.7.

Figure 4.5 examines the relation between average levels of relative wages and trade openness. The figure does not suggest a strong positive link between these variables. However, it is interesting to note that if the two outliers (Egypt and Singapore) are excluded, then the figure does indicate a positive association between the relative wage and trade openness. Figure 4.6 goes on to relate average levels of relative wage to average levels of relative supplies of skilled workers (RS1). This figure also does not show a clear association between RS1 and the relative wage. However, a positive, albeit weak, relation does emerge if the two outliers (Egypt and South Korea) are excluded.

Finally, Figure 4.7 examines whether countries with a higher level of relative technology would have a lower level of relative wages. A strong negative association between levels of relative technology and the relative wage is clearly indicated in this figure, and this relation survives even if the outliers, Egypt and Thailand, are ignored[19]. Thus the evidence on level differences between countries provides some support for all three hypotheses, and is especially favourable to the relative technology hypothesis. These hypotheses are formally tested below.

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[19]Because Egypt has exceptionally high level of relative wage it appears as an outlier in all three variables. The other outliers are based on relatively higher value of the three explanatory variables and these vary from one figure to the other.

Figure 4.5: Relative Wage and Trade Openness (Average Levels)

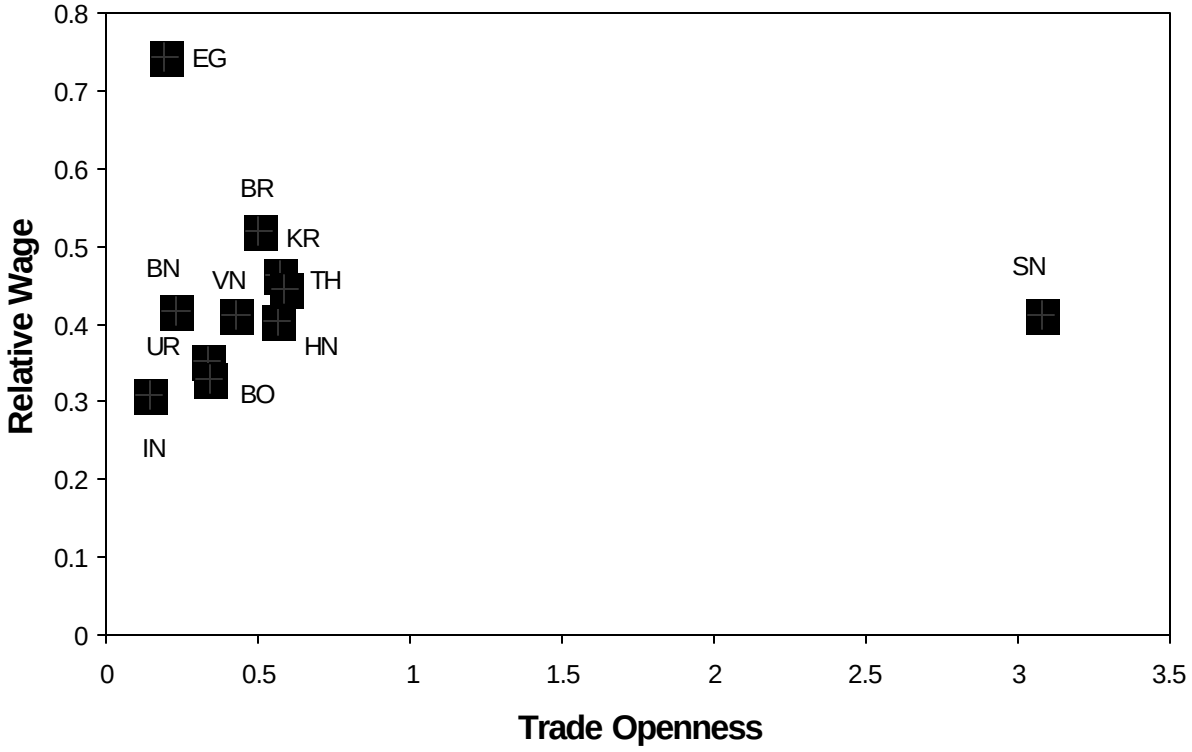


Figure 4.6: Relative Wage and Relative Factor Supplies (Average Levels)

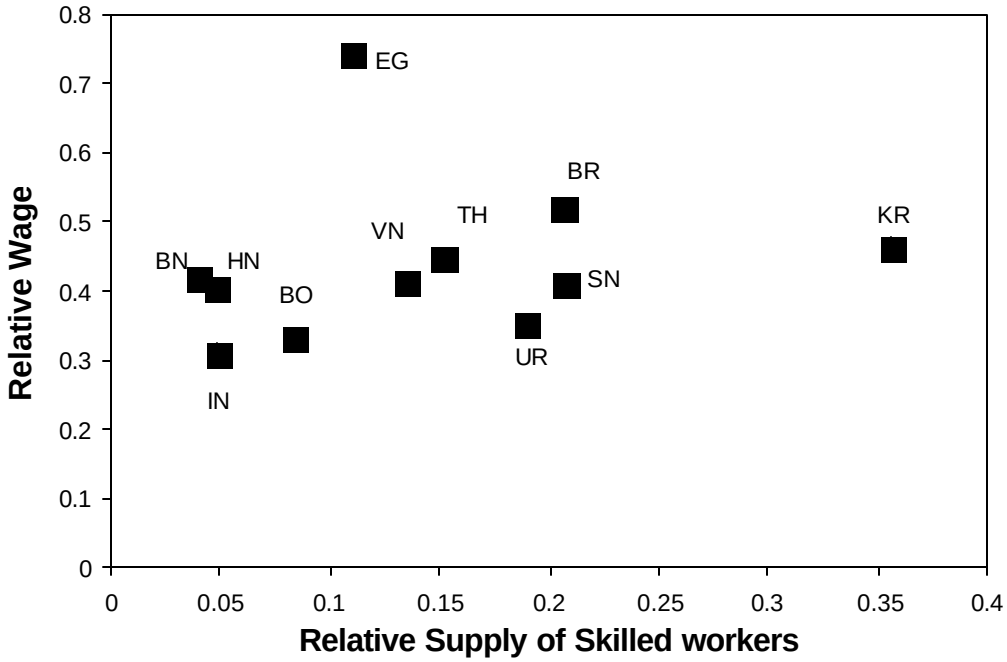
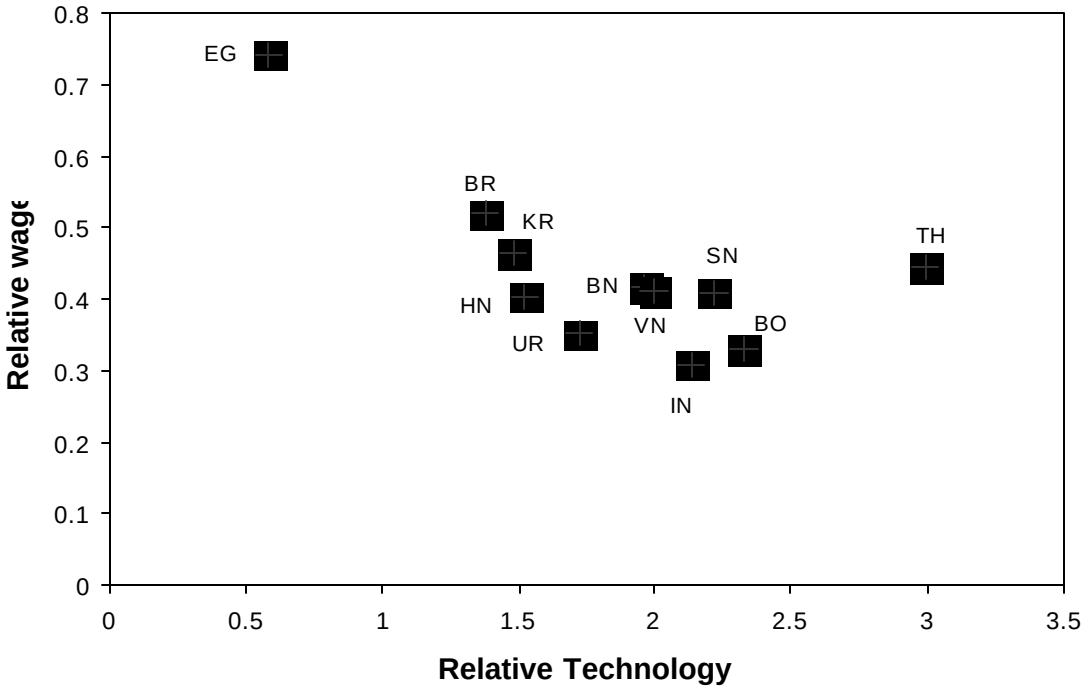


Figure 4.7: Relative Wage and Relative Technology (Average Levels)

To undertake econometric analysis and to investigate the effect of trade liberalization, relative technology and relative factor supplies on the relative wage of unskilled workers in the South, we first pool the data for eleven countries. Equa



tion (10) is estimated with following form:

$$\ln \quad_{it} = a_0 + d_t + b_1 \ln TR_{it} + b_2 \ln RT_{it} + b_3 \ln RS1_{it} + e_{it} \qquad (11)$$

where TR_{it} is a proxy for (t_{it}), RT_{it} and $RS1_{it}$ are measures of a_{it} and $\bar{s}_{it}$, d_t is a time dummy which represents the effect of ($\ln p_t^N$), (which is the same for all sample countries but can vary over time), and e_{it} is the error term[20].

The error term in (11) could be subject to hetroskedasticity and auto-correlation. To address these problems we use the Newey-West (1987) procedure to obtain hetroskedasticity and auto-correlation consistent estimates of standard errors. Since the intercept in (11) is the same for all countries, we estimate a regression with common intercept for all the eleven countries. This restriction is implied by the model that assumes identical technology across countries. The model also implies that $\beta_1 < 0$, $\beta_2 < 0$, and $\beta_3 = 0$ if countries are engaged in diversified production; $\beta_1 = 0$, $\beta_2 = 0$ and $\beta_3 > 0$ if countries are specialized in production; $\beta_1 < 0$, $\beta_2 < 0$ and $\beta_3 > 0$ if countries move from one of these states (e.g. specialization) to another. Table 4.3 reports these results.

[20]With $\ln(TR) = \ln(1 / \textit{trade dependency ratio})$

Table 4.3: Results of pooled regression for 11 developing countries

Newey-West HAC Standard Errors & Covariance (lag truncation=3)

Variable	**Coefficient**	**Std. Error**	**t-Statistic**
ln(*TR*)	0.040932	0.049605	0.825149
ln(*RT*)	-0.334565	0.123189	-2.715877
ln(*RS1*)	0.071168	0.055935	1.272323
1986	0.124817	0.091174	1.369003
1987	0.112476	0.094263	1.193209
1988	0.061270	0.098967	0.619098
1989	0.165083	0.091611	1.802003
1990	0.151400	0.095410	1.586829
1991	0.159388	0.067513	2.360858
1992	0.280899	0.102365	2.744102
1993	0.007756	0.113344	0.068430
1994	0.095126	0.055743	1.706531
Constant	-0.656221	0.110899	-5.917279
Adjusted R-squared	0.209756	R-squared	0.329793

As Table 4.3 shows, of the three explanatory variables (i.e. trade openness, relative factor supplies and the relative technology index), only relative technology has a statistically significant effect on the relative wage of the unskilled-skilled workers. The other two variables do not help explain changes in the relative wage. These results for the southern countries support the Slaughter and Lawrence findings for the U.S. that technological improvement in skilled-intensive sector is a key determinant of the relative wage. These results, however, do not support Robbins' view that changes in the relative wage largely resulted from changes in relative supply of skilled workers.

To explore the sensitivity of results to outliers in the data, we re-estimate the regression equation (11) without the outliers identified above. As figures 4.5 - 4.7 show, countries that appear as outliers depend on what relation is being considered. For example, Egypt and Singapore are outliers when the

relative wage is related to trade openness. We first re-estimate equation (11) without these two countries. Results are reported in Table 4.4. Although Table 4.4 suggests a significant influence of trade liberalization on the relative wage, it is only significant when the two outliers, Egypt and Singapore are excluded from the sample.

Table 4.4: Results of Pooled Regression without outliers (common intercept)

Variables	Without Egypt & Singapore	Without Egypt and South Korea	Without Egypt and Thailand
ln*TR*	0.192506**	0.086226	0.071523
	(0.091651)	(0.046642)	(0.049409)
ln*RT*	-0.142618	-0.105260	-0.317646**
	(0.092765)	(0.107264)	(0.099642)
ln*RS1*	0.036155	0.015256	0.040801
	(0.071196)	(0.071866)	(0.057397)
1986	0.148250	0.182178	0.157900
	(0.095766)	(0.092447)	(0.092553)
1987	0.091842	0.102410	0.065911
	(0.089656)	(0.104205)	(0.081926)
1988	0.064112	0.090333	0.032822
	(0.095332)	(0.099987)	(0.398893)
1989	0.180555**	0.198853**	0.155570**
	(0.089430)	(0.088912)	(0.072375)
1990	0.159680	0.173488	0.172871
	(0.107192)	(0.111604)	(0.098082)
1991	0.180161**	0.163744	0.166679**
	(0.065349)	(0.076261)	(0.068770)
1992	0.357435**	0.298838**	0.321858**
	(0.083778)	(0.129001)	(0.124042)
1993	0.052006	-0.098665	0.046058
	(0.180043)	(0.066273)	(0.139051)
1994	0.056522	0.086777	0.123159**
	(0.0735080)	(0.066273)	(0.051690)
Constant	-0.735080**	-0.930183	-0.754935**
	(0.093424)	(0.168125)	(0.094355)

R-Squared	0.342987	0.247371	0.309759
Adjusted R-Squared	0.209756	0.080121	0.159160

Standard errors are in parentheses. ** represents that t-statistics is greater than 2.

Egypt and South Korea are outliers when the relative wage is related to the relative factor supplies. We drop these two countries in the next regression equation. These results are also reported in the Table 4.4. As the table suggests, relative factor supplies does not help explain changes in the relative wage. Finally, Egypt and Thailand are outliers for average levels of relative technology and the relative wage relationship. We exclude these two countries in the third regression equation. Results reported in Table 4.4 still strongly suggest a significant influence of relative technology on the relative wage.

It is possible that the proxy for trade openness does not fully capture the effect of trade liberalization. Sachs and Warner (1995) have classified economies as open or closed based on a number of characteristics[21]. Using this classification as an alternative measure of trade liberalization, we divide the countries into two groups. Group 1 includes those countries that were open in 1985-86 and remained open

[21]Sachs and Warner judged a country to have a closed trade policy if it has at least one of the following characteristics:

1. Non-tariff barriers covering 40% or more of trade;
2. Average tariff rates of 40% or more;
3. A Black-market exchange rate that is depreciated by 20% or more relative to the official exchange rate, on average, during the 1970 or 1980's;
4. A socialist economic system (as defined by Kornai, 1992);
5. A state monopoly on major exports.

They defined an open economy as one in which none of the five conditions applies.

till 1994. This group consists of Barbados, Bolivia, Korea, Singapore and Thailand. Group 2 includes the remaining countries. The following equation is then estimated:

$$\ln w_{it} = a_0 + d_t + b_1 G1 + b_2 \ln RT_{it} + b_3 \ln RS1_{it} + e_{it} \qquad (12)$$

where *G1* is a dummy variable that equals 1 if a country is in group 1 and 0 otherwise. Table 4.4 reports these results. As the table shows, even this proxy for trade openness has no effect on the relative wage.

Table 4.4: Results of pooled regression for 11 developing countries (Countries are classified with trade openness)

Variable	**Coefficient**	**Std. Error**	**t-Statistic**
ln*(G1)*	0.091988	0.112800	0.815503
ln*(RT)*	-0.345869	0.117633	-2.940233
ln*(RS1)*	0.054881	0.077977	0.703809
1986	0.116475	0.088075	1.322444
1987	0.093313	0.096688	0.965096
1988	0.041020	0.098107	0.418113
1989	0.145809	0.095940	1.602721
1990	0.139273	0.095940	1.451664
1991	0.146866	0.064626	2.272545
1992	0.266027	0.101167	2.629582
1993	-0.004214	0.102566	-0.041090
1994	0.071807	0.074566	0.962988
Constant	-0.745953	0.187596	-3.976386
Adjusted R-squared	0.216821	R-squared	0.335785

Finally, we test for the presence of country fixed effects. Although the model does not imply such effects, they could arise because of country-specific biases in indexes used to measure explanatory variables. A limitation of the fixed effect model, however, is that its estimates are based on within-country variations, which is relatively small and subject to influences of short-term factors. This model is estimated as

$$\ln w_{it} = a_i + d_t + b_1 \ln TR_{it} + b_2 \ln RT_{it} + b_3 \ln RS1_{it} + e_{it} \qquad (13)$$

Results are reported in Table 4.5. In this table, the country dummy variables represent the effect relative to the omitted country Barbados. F-test rejects the hypothesis that country dummy variables are the same. The table shows moreover that all three variables becomes insignificant once the country fixed effects are introduced. This result may simply reflect the fact that much of the variation in explanatory variables is between countries and this type of variation is suppressed in the fixed-effect model. Thus the earlier model without country fixed effects may be useful in assessing the influence of trade liberalization, relative technology and relative factor supplies on relative wages.

Table 4.5: Regression results for 11 developing countries $(a_i \neq a)$

Newey-West HAC Standard Errors & Covariance (lag truncation=3)

Variable	Coefficient	Std. Error	t-Statistic
ln(*TR*)	-0.002878	0.125560	-0.022917
ln(*RT*)	-0.036688	0.196515	-0.186695
ln(*RS1*)	-0.035824	0.198848	-0.180157
Bangladesh	-0.213439	0.341033	-0.625859
Egypt	0.302896	0.215098	1.408181
Honduras	-0.326261	0.330181	-0.988127
Bolivia	-0.457544	0.218275	-2.096181
Korea R. P.	-0.057171	0.123068	-0.464544
Singapore	-0.158374	0.241224	-0.656545
Venezuela	-0.210137	0.125276	-1.677398
India	-0.542148	0.333612	-1.625084
Thailand	-0.069278	0.103837	-0.667182
Uruguay	-0.369306	0.109048	-3.086648
1986	0.118266	0.061894	1.910790
1987	0.126215	0.078120	1.615662
1988	0.080774	0.065279	1.237374
1989	0.169833	0.067745	2.506942
1990	0.172107	0.078338	2.196994
1991	0.178333	0.059564	2.993954
1992	0.327209	0.133528	2.450482
1993	0.111054	0.148906	0.745801

1994	0.198603	0.104473	1.900993
Constant	-0.873829	0.338923	-2.578248
F-statistic $(a_i \neq a)$	4.13212		
R-squared	0.611459	Adjusted R-squared	0.461495

5. Conclusion

The debate about the extent to which relative wages are influenced by trade liberalization, relative factor supplies and relative technology dates back to the experience of the U.S., where a marked decline in the relative wage of unskilled workers was observed during the 1980's and 1990's. The striking feature of this decline was that it occurred during the period when U.S. was liberalizing its trade with developing countries. Although in other developed countries, especially those with relatively rigid wages such as United Kingdom, France and Italy, the effect of a shift in demand in the favour of skilled labours was mainly felt on employment, a similar fear of a decline in the relative wage had been expressed in these northern countries.

In this paper we explored the influence of trade liberalization, relative technology and relative factor supplies on the relative wage of unskilled workers in the South, using panel data for eleven developing countries from 1985 to 1994.

In a model with Fixed-effects , the effect of all three explanatory variables is not significant one limitation is that its estimates are based on within-country variations, which is relatively small and subject to influences short-term factors. The study also examines the model without fixed effects and finds a

stronger link between relative wage and the relative technology index. Some support, however, emerges for a link between relative wages and trade liberalization, it only exists if we drop the outliers. Our main findings, in general, suggest that trade liberalization and the relative factor supplies do not have strong influence on the relative wage but relative technology index does help explain changes in the relative wage.

Our results support the Slaughter and Lawrence (1993), Slaughter and Swagel (1997) and other's findings for the U.S. that technological improvement in skilled-labour-intensive sector is a key determinant of the relative wage. These results, however, do not support Robbins' (1996) view that changes in the relative wage in the developing countries largely resulted from changes in relative supply of skilled workers.

This study do not find strong evidence that trade liberalization has caused relative wage to increase in the South. This evidence would raise serious doubts that trade liberalization is accounted for changes in the relative wage in the North. Thus the study does not lend support to the concern that increase in trade between developed and developing countries is a main cause of income inequality in the North.

In our analysis we assume that technological changes and trade liberalization are independent factors. However, It is possible that at least for developing countries technology is transferred largely through international trade. If this is the case then trade liberalization could have an impact on income inequality indirectly through the technology transfer. It is important, however, that policy actions should not be aimed to restrict the trade liberalization process but to provide incentives for workers and the firms to adjust and gain from these economic changes. One possibility is to improve the productivity of

the unskilled workers through enhanced vocational training and educational opportunities. This policy action would provide the unskilled workers opportunities to learn new skills and to adjust successfully in the changing economic environment. Finally, we strongly recommend that the policymakers should not trade off long-term benefits of the trade liberalization with short term gains of a restricted trade policy. This is because of the fact that due to globalization and technological improvements today's world economy is much healthier than the past and benefits of these improvements can only be achieved through a successful long-term planning.

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