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Labour Markets, Education and Duality of Returns

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ABSTRACT

The aim of this paper is to examine the impact of increased trade on wage inequality in developing countries, and whether a higher human capital stock moderates this effect. We look at the skilled-unskilled wage differential. When better educated societies open up their economies, increased trade is likely to induce less inequality on impact because the supply of skills better matches demand. But greater international exposure also brings about technological diffusion, further raising skilled labour demand. This may raise wage inequality, in contrast to the initial egalitarian *level* effect of human capital. We attempt to measure these two opposing forces. We also employ a broad set of indicators to measure trade liberalization policies as well as general openness, which is an outcome, and not a policy variable. We further examine what type of education most reduces inequality. Our findings suggest that countries with a higher level of initial human capital do well on the inequality front, but human capital which accrues through the trade liberalization channel has inequalitarian effects. Our results also have implications for the speed at which trade policies are liberalized, the implication being that better educated nations should liberalize faster.

Keywords: Integration, Trade Liberalization, Wage Inequality.

JEL Classifications: F-15, I-3

1 Introduction

Increased trade, particularly of the inter-industry variety, alters the composition of output in the economy away from non-traded goods towards traded products. This will affect the functional distribution of income, usually raising the demand for the factor of production employed intensively in the traded sector. In the developed world, it is skilled labour and we have witnessed an increase in the skilled-unskilled labor relative wage premium. In many OECD countries, this has meant a more unequal personal distribution of income. As far as developing countries are concerned, especially in those that export unskilled labour intensive manufactured goods, we would expect a fall in the skilled-unskilled labour relative wage premium leading to reduced inequality, since the unskilled are more numerous within the population. Yet this is generally not true, and inequality in the developing world has risen, mirroring events in the OECD. What accounts for this paradox? Perhaps developing countries have such quantities of unskilled labour that unskilled wages will not respond to increased demand. This certainly appears likely in cross-country studies where China and India are included. Alternatively, other less populous developing countries may be exporting relatively more skilled labour intensive products such as semi-conductors or capital-intensive commodities as is the case with fuels and minerals. Finally, an expansion in international trade may raise the demand for, and reward of, skilled labour even when the country in question is exporting unskilled labour intensive products due to skill shortages and other factor complementarities.

Many studies have tried to capture the relationship between trade liberalization and income inequality. A paper by Dollar and Kraay (2004) concludes that liberalization does not significantly affect the distribution of income, and at most, the relationship is of neutral nature. However, their results have been widely challenged because of their methodology and variable choice. (Ravallion 2003; Amann et al. 2002) Ravallion (2003) points out that increased openness can lead to a rise in the demand for relatively skilled labour, which tends towards less equal distribution in poor relative to rich countries. Arbache, Dickerson and Green (2004) find that imported technology raised the relative demand for highly skilled labour in Brazil and thus lowered the relative wages of less educated groups. Behrman, Birdsall and Szekely (2001) observe that inequality has increased in seven out of 18 Latin American countries that initiated market reforms in the mid-1980s. Jayasuriya (2002) accepts that trade liberalization may have reduced consumption poverty in South Asia, but is skeptical about the purportedly neutral distributional effects of liberalization. Many suggest that the distribution of the positive effects of liberalization is somewhat skewed towards urban households rather than rural ones, and to wealthy rather than poor households (see Chen and Ravallion 2003; Cockburn 2002; Friedman 2000; Lofgren 1999). The evidence in this regard comes mainly from Latin America because most of the economies there undertook rigorous reform policies in the mid-1980s following

the debt crisis in that decade. Legovini, Bouillon and Lustig (2001) find that inequality in Mexico rose sharply between 1984 and 1994, and rising returns to skilled labour accounted for 20 per cent of the increase in the inequality in household income. Similarly, Hanson and Harrison (1999) find that the reduction in tariffs and the elimination of import licenses accounts for 23 per cent of the increase in the relative wages of skilled labour during 1986-90, thus providing evidence for the role liberalization played in rising inequality in Mexico. Other country studies on Brazil, Chile, Colombia and Venezuela, also show that skilled workers received increased premiums after liberalization when compared to their unskilled counterparts. (World Bank 2001) Therefore, the balance of the evidence points to increased globalization inducing greater income inequality.

In (developing) countries, trade liberalisation is likely to have had conflicting effects on the distribution of earnings. On the one hand, standard trade theory implies that trade liberalisation should result in a reduction in the skill premium. On the other hand, trade flows bring in new technologies and ideas that enhance the productivity of all workers, but especially that of skilled workers. Clearly, the notion of “skilled” and “unskilled” workers differs across countries. In less developed economies, those at the top of the earning distribution often have no more than a secondary degree. Yet, they have skills that will be enhanced by the arrival of new technologies, thus increasing their wage relative to that of uneducated workers.

Irrespective of the exact nature of the cause of trade-induced inequality, it is sensible to presume that nations with higher stocks of human capital will experience less of the un-equalizing spiral consequent upon globalization and trade liberalization. Investment in education may yield a double dividend. It can not only promote growth, but also suppresses inequality by both bequeathing skills as well as moderating rises in skill-premia following an expansion of international trade. More generally, Tinbergen (1975) pointed out that changes in wage inequality are a result of the opposing forces that technological change (skilled labour demand) and education (skilled labour supply/ human capital) exert on relative wages. Eiche and Garcia-Penalosa (2001) suggest that human capital accumulation plays a dual role in development.

The aim of this paper is to examine the impact of increased trade on inequality, and investigate whether a higher human capital stock moderates this unequalising aspect of international trade; specifically the skilled-unskilled wage differential. High initial endowments of human capital, captured by data on average years of schooling for example, imply a more egalitarian society compared to countries with a lower human capital endowment. When societies that are more equal, open up their economies further, increased trade is likely to induce less inequality because the supply of skills better matches demand. Yet greater international exposure also brings about technological diffusion, see Winters (2004), further raising skilled labour

demand. This may raise wage inequality, in contrast to the initial egalitarian level effect of human capital. This paper will attempt to measure these two opposing forces. An innovation of this paper is to employ a broad set of openness indicators to measure trade-liberalization policies as well as trade policy variables. Another purpose of this analysis is to examine what type of education most reduces inequality. In settings of low human capital endowments, as measured by literacy or low primary school enrolment, a policy of relative neglect of primary in favour of expenditure on tertiary education may have a less than benign influence on inequality. The sample countries here exclude developed nations and economies in transition because of higher stocks of human capital in those regions (see table 1 at the end of the paper). The rest of the paper is as follows, section 2 presents the data and methodology, section 3 contains the empirical results, and finally section 4 concludes with some policy implications.

2 Data and Methodology

2.1 Data Description

We are interested to look into the patterns of wage inequality in growth promoting Industrial sectors of developing countries. The UTIP-UNIDO wage inequality Theil measure which is calculated by University of Texas Inequality Project (UTIP) measures the dispersion of pay across industrial categories in the manufacturing sector. The data on wages is drawn from the Industrial database published annually by United Nations Industrial Development Organization (UNIDO). Our principal reason for using the UTIP-UNIDO wage inequality Theil measure is that we are more interested in the functional distribution of income. Changes in the functional distribution between skilled and unskilled labour, will in turn affect the personal income distribution in countries that are unskilled labour abundant. Inequality will rise in developing countries as the skilled-unskilled labour wage premium increases and vice versa.

Table 2
Summary Statistics

| <i>Variables</i> | <i>Code</i> | <i>Source</i> | <i>Obs</i> | <i>Std. Dev</i> |
|---|-------------|--|------------|-----------------|
| <u>Dependent</u> | | | | |
| UTIP-UNIDO Wage Inequality THEIL Measure: Developing countries only, 1999 | Theil99dv | University of Texas Inequality Project (UTIP) http://utip.gov.utexas.edu | 109 | (0.108) |
| <u>Endogenous Independent</u> | | | | |
| <u>Openness Variables</u> | | | | |
| (Exports +Imports)/GDP, 1985 | Lcopen | Penn World Tables , Mark 6 | 170 | (0.589) |
| Import Penetration: overall, 1985 | Impnov85 | Pritchett (1996) | 96 | (21.08) |
| Import Penetration: manufacturing, 1985 | Impnov85m | Pritchett (1996) | 96 | (12.79) |
| Import Penetration: agriculture, 1985 | Impnov85a | Pritchett (1996) | 96 | (3.818) |
| Import Penetration: resources, 1985 | Impnov85r | Pritchett (1996) | 96 | (6.594) |
| Import Penetration: overall, 1982 | Impnov82 | Pritchett (1996) | 95 | (23.85) |
| Import Penetration: manufacturing, 1982 | Impnov82m | Pritchett (1996) | 95 | (13.107) |
| Import Penetration: agriculture, 1982 | Impnov82a | Pritchett (1996) | 95 | (3.67) |
| Import Penetration: resources, 1982 | Impnov82r | Pritchett (1996) | 95 | (9.66) |
| TARS trade penetration: overall, 1985 | Tars85 | Pritchett (1996) | 96 | (36.91) |
| TARS trade penetration: manufacturing , 1985 | Tars85m | Pritchett (1996) | 96 | (21.852) |
| TARS trade penetration: agriculture, 1985 | Tars85a | Pritchett (1996) | 96 | (8.758) |
| TARS trade penetration: resources, 1985 | Tars85r | Pritchett (1996) | 96 | (15.636) |
| TARS trade penetration,: overall, 1982 | Tars82 | Pritchett (1996) | 93 | (83.10) |
| TARS trade penetration: manufacturing , 1982 | Tars82m | Pritchett (1996) | 93 | (26.47) |
| TARS trade penetration: agriculture, 1982 | Tars82a | Pritchett (1996) | 93 | (9.786) |
| TARS trade penetration: resources, 1982 | Tars82r | Pritchett (1996) | 93 | (54.652) |
| <u>Trade Policy Variables</u> | | | | |
| <u>Tariffs</u> | | | | |
| Import duties as % imports,1985 | Tariffs | World Development Indicators | 99 | (8.903) |
| Tariffs on international inputs and capital goods, 1985 | Owti | Sachs and Warner (1995) | 98 | (0.165) |
| Trade taxes/ trade, 1982 | Txtrdg | Edwards (1997) | 54 | (0.031) |
| Weighted average of total import charges: overall, 1985 | Totimpv85 | Pritchett (1996) | 76 | (21.30) |
| Weighted average of total import charges: manufacturing, 1985 | Totimpv85m | Pritchett (1996) | 76 | (22.75) |
| Weighted average of total import charges: agriculture, 1985 | Totimpv85a | Pritchett (1996) | 76 | (21.57) |
| Weighted average of total import charges: agriculture, 1985 | Totimpv85r | Pritchett (1996) | 76 | (18.15) |
| <u>Non Tariff Barriers</u> | | | | |
| Non trade barriers frequency on intermediate inputs, 1985 | Owqi | Sachs and Warner (1995) | 96 | (0.242) |
| Non-tariff barriers Coverage: overall, 1985 | Nontar85 | Pritchett (1996) | 76 | (36.305) |
| Non-tariff barriers Coverage: manufacturing, 1985 | Nontar85m | Pritchett (1996) | 76 | (37.914) |
| Non-tariff barriers Coverage: agriculture, 1985 | Nontar85a | Pritchett (1996) | 76 | (35.268) |
| Non-tariff barriers Coverage: resources, 1985 | Nontar85r | Pritchett (1996) | 76 | (43.111) |
| <u>Composite Measures</u> | | | | |
| Sachs and Warner 1980s | Open80s | Edwards (1998) | 61 | (0.446) |
| <u>Measures based on residuals</u> | | | | |
| Leamers Measure, 1982 | Leamer82 | Edwards (1997) | 47 | (0.527) |
| Gravity-residuals, basic model, 1982 | Grmb | Hiscos and Kastner | 77 | (9.922) |

| | | | | |
|---|-----------------|---|-----|---------|
| <i>Gravity-residuals, augmented model, 1982</i> | <i>Grma</i> | (2002) <i>Hiscos and Kastner</i> (2002) | 77 | (9.341) |
| Price Based Measures | | | | |
| <i>Black market premium, 1985</i> | <i>Black</i> | <i>Haririson (1996)</i> | 61 | (0.604) |
| Skills | | | | |
| <i>Average years of schooling, 1999</i> | <i>Skills99</i> | <i>Baro and Lee (2001)</i> | 109 | (2.914) |
| Higher Skills | | | | |
| <i>Average years of higher schooling, 1999</i> | <i>Hyr99</i> | <i>Baro and Lee (2001)</i> | 102 | (2.914) |
| Independent : | | | | |
| Initial Skills | | | | |
| <i>Average years of schooling, 1985</i> | <i>Skills85</i> | <i>Baro and Lee (2001)</i> | 105 | (2.799) |
| <i>Average years of schooling, 1980</i> | <i>Skills80</i> | <i>Baro and Lee (2001)</i> | 105 | (2.861) |
| <i>Average years of schooling, 1975</i> | <i>Skills75</i> | <i>Baro and Lee(2001)</i> | 106 | (2.703) |
| <i>Average years of schooling, 1970</i> | <i>Skills70</i> | <i>Baro and Lee (2001)</i> | 101 | (2.701) |
| <i>Average years of schooling, 1965</i> | <i>Skills65</i> | <i>Baro and Lee (2001)</i> | 99 | (2.516) |
| <i>Average years of schooling, 1960</i> | <i>Skills60</i> | <i>Baro and Lee (2001)</i> | 99 | (2.522) |
| Instruments | | | | |
| <i>Natural logarithm of predicted trade shares computed from a bilateral trade equation with 'pure geography' variables, 1999</i> | <i>Lfrkrom</i> | <i>Frankel and Romer</i> (1999) | 163 | (16.75) |
| <i>Drop out rate, 1980s</i> | <i>Drop80</i> | <i>Barro and Lee (1996)</i> | 125 | (0.802) |
| <i>Number of school days</i> | <i>Schday</i> | <i>Barro and Lee (1996)</i> | 139 | (23.43) |
| <i>Distance from the equator of capital city measured as abs (Latitude)/90</i> | <i>Disteq</i> | <i>Acemogolu (2001)</i> | 208 | (16.65) |

The UTIP- UNIDO wage inequality measure is the between-group component of Theil's T statistic, an entropy measure whose functional form is defined as:

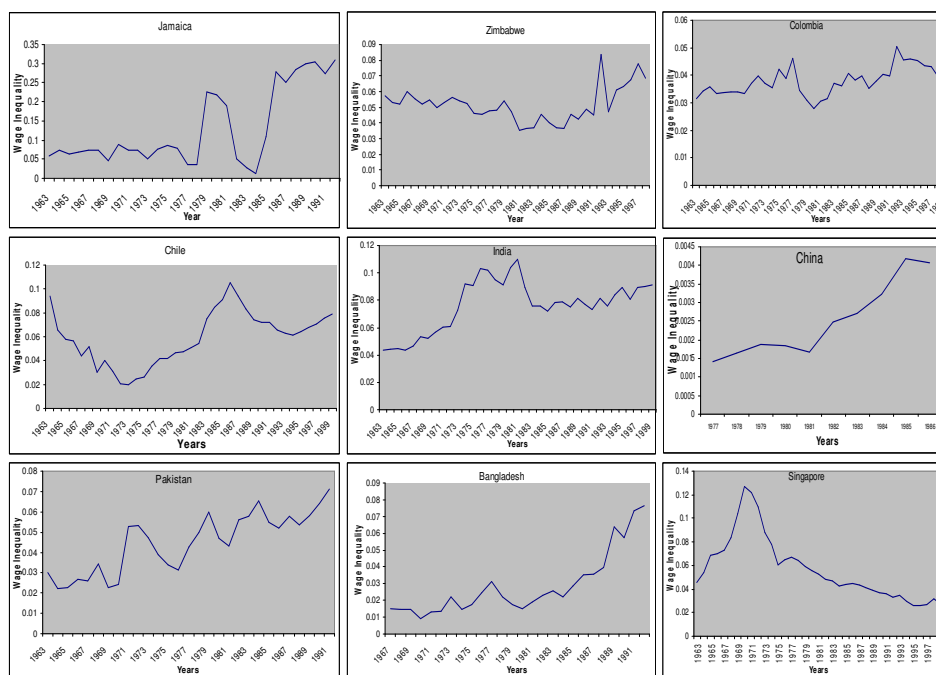
$$T = \sum \left(\frac{Y_i}{Y}\right) T_i + \sum \frac{Y_i}{Y} \log\left(\frac{Y_i/Y}{N_i/N}\right) = T^W + T^B \quad (1)$$

Where T^W and T^B indicate within-group and between-group inequality measures respectively. N and Y stand for total employment and total pay respectively, and subscript i denotes group identity. As mentioned, UTIP captures T^B as their inequality measure, where groups are defined as categories within the UNIDO industrial classification codes.

The UTIP data set provides Theil inequality measures for nearly 3,200 country/year observations, covering more than 150 countries during the period 1963 to 1999. Figure 1 illustrates trends in wage inequality between skilled and unskilled workers, over time in selected developing countries and is representative of different regions. All the country graphs, except one, show that wage inequality has been on the rise in the 1980s and 1990s. The only exception is Singapore, which belongs to a group associated with the 'East Asian Miracle' of the 1980s. However, this miracle remained confined to a few countries and as it is evident from the graphs, Singapore is not representative of the developing world. Since the 1980s and 1990s are associated with *Structural Adjustment Policies* under which many developing countries embraced trade liberalization, it is safe to suggest that the above trends in wage inequality also relate to these market reforms. The end of the paper lists all

developing countries, and the latest year for which the Theil wage inequality index is available.

Figure 1 Wage Inequality Trends in Some Selected Developing Countries



Here, we want to capture the effect of education (skilled) versus no education (unskilled) on relative wages. We would also analyze effect of higher skills within the framework to check if wage inequality between skilled and unskilled labour are rising also because of returns to higher education are rising at higher proportion when compared with overall levels of education. In other words, is wage inequality also pushed by favouring higher skills in developing countries, or presence of skills (having education) a factor decisive enough to explain rise in wage gaps between skilled labour and unskilled labour? There is already some evidence that secondary education is more important in alleviating wage inequality than higher levels of education suggesting close correlation between higher levels of education and wage dispersion (Acemoglu, 2001). Investing in higher education alone is less effective in alleviating wage inequality. Since Theil captures wage inequality and not wage equality, we can easily test the positive effect of higher education in wage inequality. We are not saying that decreasing higher levels of education would then decrease wage inequality as is generally true with interpretations upon getting a positive sign (say between Theil Index and higher levels of education). If there is a positive correlation, then the only way to minimize the education bias of inequality is to raise

the overall education levels of the population, which in turn would distribute skills homogenously within the population.

A simple Heckscher-Ohlin or Stolper-Samuelson model would suggest that the overall return to skills would decline, and with it incentives for education, when a skill-scarce developing country opens up. (Wood and Riddo-Cano 1999) However in a multi-dimensional Stolper-Samuelson model approximating reality, endogenous growth with increasing returns to R & D, a skill-bias in tradables, skill shortages or unlimited supplies of unskilled labour could all lead to an increase in returns to skill following greater integration. (Arbache et al. 2004) Integration can also lead to the diffusion of more efficient education technologies, which would further augment the level of skills in the economy. (Winters 2004) The expected effect of openness and trade policy on wage inequality is positive in developing countries where a majority of the population is unskilled and uneducated.

Initial education levels in a country capture the relative factor supply effect. Trade on the other hand captures the relative factor demand effect through skill bias technical change as also suggested by Acemoglu (1999; 2001). Other than the initial levels of education, trade becomes the second variable of interest. In view of this, the basic model for wage inequality between skilled and unskilled workers, based on integration is as follows

$$WageInequality = f[Integration(Integration, Skills_0)] \quad (2)$$

Skills represent education levels. Average years of schooling are a measure of average skill levels in a country. The initial skills $Skills_0$ in this paper represent average years of schooling obtained before 1980s. There are outcome based measures (openness) and incidence based (trade policy) measures of integration (trade liberalization). The literature often ignores the latter effect, which only employs openness indicators. Take note however, that openness is an outcome of trade and industrial policies and not a policy indicator *per se*. Our formal empirical model would have 2 separate identifications then:

$$Inequality = f[Integration(Openness), Skills_0] \quad (3)$$

(+) (-)

$$Inequality = f[Integration(TradePolicy), Skills_0] \quad (4)$$

(+) (-)

Here wage inequality is a positive function of integration, which in turn relates positively to the degree of the openness of the economy in Eq. (3), or trade policies that promote greater openness in Eq. (4). Wage inequality negatively relates to the initial stock of skills in the economy as discussed.

The econometric form of the wage inequality model based on openness and trade policy is as follows:

$$THEIL_{1i} = \sigma_1 + \kappa_1 OPEN_i + \nu_1 skills65_i + \varepsilon_{1i} \quad (5)$$

$$THEIL_{2i} = \sigma_2 + \kappa_2 TP_i + \nu_2 skills65_i + \varepsilon_{2i} \quad (6)$$

Where $THEIL_i$ is wage inequality in a country i for the 1990s (employing the latest value available for the Theil index for every country: see table 1, end of the paper for the exact year), ε_i is the random error term, $OPEN_i$ captures openness and TP_i is the indicator for the trade policy stance in the 1980s respectively. Also $skill65_i$ measures initial skill levels proxied by average years of schooling for the population aged 25 in 1965. Note that the skill acquisition parameter refers to a period well before the trade liberalization episodes post-1980.

This analysis has a specific focus on trade and education. It employs 34 measures of openness and trade policy to carry out multiple regression analysis for Eqs (5) and (6), respectively. Average years of schooling for 1960, 1970, 1975 and 1985 are also employed for further robustness checks of the model with repeated specifications.

Below, the author presents the taxonomy for outcome based and incidence based measures of trade following the grouping offered by Rose (2004:):

1. openness (e.g. the ratio of trade or imports to GDP), an outcome based measure,
2. trade flows, adjusted for country-characteristics (outcome based),
3. tariffs (policy incidence-based)
4. non-tariff barriers (NTBs) (incidence based),
5. informal or qualitative measures,
6. composite indices, and,
7. Measures based on price outcomes.

The core openness variable remains the overall trade share (the ratio of nominal imports plus exports to GDP), which has been extensively used in the literature. (Frankel and Romer 1999; Acemoglu, Johnson and Robinson 2004; Alcalá and Ciccone 2002; Dollar and Kraay 2002; Rodrik et al. 2004) Two other measures of openness are trade penetration (*TARS*) derived from the World Bank's TARS system and overall import penetration (*Impenov*) respectively. Pritchett (1996) uses 16 cross-sectional measures of trade penetration for developing countries. These are provided for two different years (1982 and 1985) and four different categories (overall, manufacturing, agriculture and resources sectors). Trade penetration measures are available for imports alone. See table 2 for yearly and sectoral decomposition of these variables.

There are many indicators of trade restrictiveness (incidence based) acting as measures of trade policy (Edwards 1998; Greenaway et al. 2001; Rose 2004): Rodriguez and Rodrik (2000) recommend using simple averages of taxes on imports and exports. A simple import duty as a percentage of imports (Tariffs) is taken from World Development Indicators (WDI). Sachs and Warner (1995) constructed a composite measure of openness by using tariffs on intermediate inputs and capital goods (*Owti*). Edwards (1998) collected data on total revenues from taxes on international trade as a proportion of total trade (*Txtrdg*). Pritchett (1996) provides weighted average of total import charges (*Totimpov*), as well as sectoral categories of import charges (manufacturing, agriculture and resources). They can all be considered good proxies of trade restrictiveness and have been employed in the analysis.

In the category of non tariff barriers, the coverage in terms of total imports is a widely used measure of trade policy (Rose 2004). Sachs and Warner (1995) recommend the use of frequency of non trade barriers on intermediate inputs (*Owqi*). Pritchett (1996) provides data on non-tariff barrier coverage for developing countries based on sectoral categories from UNCTAD (United Nations Conference on Trade and Development). The four different categories are manufacturing, agriculture and resources respectively.

Sachs and Warner (1995) develop a composite measure of openness (*Open80*) but the measure has a drawback: 'It provides only a binary classification –a country is open or closed. As are results, countries with different degrees of trade intervention are equally classified as open.' (Edwards 1998; 385) *Open80* is also used in this analysis. Leamer (1988) used the differences between predicted and actual trade intensity ratios as indicators of trade barriers (*Leamer82*). A less structural approach is taken by Hiscox and Kastner (2002). They use fixed country-year residual effects from two gravity models of trade (*Grmb* and *Grma*) (a simple version which links imports to GDP and distance, and an augmented one which adds measures of wealth, land and capital) to derive measures of trade policy orientation (Rose 2004)

Finally, Sachs and Warner (1995) and Harrison (1996) have utilized a number of price-based measures of trade policy. The black market foreign exchange premium (*Black*) is one of them and we have employed it in our study.

Overall, we have been able to obtain 34 measures of integration. These 34 measures of integration would separately enter either equations (5) or (6) along with initial skills to determine wage inequality in at least 34 different regression equations. There could be potential endogeneity problems associated with the dependent variable, wage inequality and the explanatory variable, openness/trade policy. First, openness when measured by the trade share of national income is not truly exogenous, but an outcome of other factors. Second, the degree of wage inequality between skilled and unskilled workers, or the country's relative factor endowments

(Tavares 1998) may determine a country's trade policy choices. Even though gradual and under the aegis of structural adjustment policies, decisions regarding openness were taken, it may be that more egalitarian labour abundant nations may choose to open up faster than less equal land (or mineral) abundant nations.

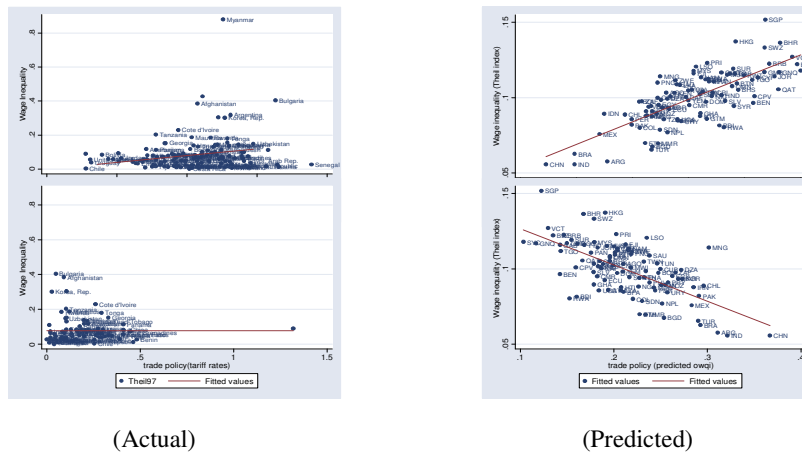
An instrument is required to solve for the openness and trade policy variables' potential endogeneity with wage inequality. The paper uses the predicted trade share from a gravity equation following Frankel and Romer (1999) to instrument for openness/trade policy. Following Rodrik et al. (2004), distance from the equator is the second instrument for openness/trade policy variables because the level of integration of an economy also depends upon its location in the world map. The Instrumental Variable (IV) regression model is a two stage least squares (2SLS) estimate beginning with

$$OPEN_{1i} = \zeta_1 + \tau_1 FR_i + \psi_1 Disteq_i + \varepsilon_{3i} \quad (7)$$

$$TP_{1i} = \zeta_2 + \tau_2 FR_i + \psi_2 Disteq_i + \varepsilon_{4i} \quad (8)$$

Here FR_i stands for predicted trade shares from gravity equations computed by Frankel and Romer (1999), whereas $Disteq_i$ (distance from the equator) is a proxy for geography.

Figure 2
Responsiveness of Wage Inequality w.r.t Openness and Trade Policy



In the first stage, Eqs (7) and (8) generate predicted values of openness and trade policy variables by regressing them on the two instruments. The second and final stage of the regression analysis involves employing the predicted openness and trade

policy variables in Eqs (5) and (6) respectively. Before carrying out the IV analysis, it is informative to look at simple bi-variate relations between integration (predicted trade shares and predicted tariff rates) with the Theil index. First column graphs are between openness, trade policy and Theil index for developing countries (*Theil99dev*) only. Trade indices show no clear relationship with wage inequality. However, once predicted, clear relations develop between trade and wage inequality as the second column in figure 2 shows. *Increases* in trade shares after liberalization leads to higher wage inequality, and the second graph also suggests that *decreases* in import tariffs exerts a negative and unequal distributional effect on wages. Steep slopes show high responsiveness of wage inequality with changes in these measures of trade. One of the reasons for the decrease in relative wages of unskilled labour, as tariffs fall, can be that the heavily protected sectors in many developing countries tend to be industries that employ a high proportion of unskilled workers. (Goldberg and Pavcnik 2004)

3 Results

Before presenting second stage results, it is important to test the instruments. Figure 2 shows good results for the relevance of instruments. Nevertheless, usual first order and second order relevance and validity tests are required to have confidence on IV relationships. We have utilized a rich set of openness and trade policy proxies though. Generally for most of the definitions, FR bilateral trade share has not been used before as an instrument. Table 3 presents first stage and higher order tests for the quality of instruments. The 2nd, 3rd and 4th columns present first stage results for all IV regression equations. FR trade shares significantly and positively determine all trade proxies. Though distance from the equator has been insignificant, we do know that location does matter in trade nevertheless. F-Statistics mostly pass Cragg and Donald rule of thumb test. In most cases for trade policy variables, the F-statistics is close to 10. Higher order asymptotic test results are presented in columns 5, 6 and 7. Heteroskedasticity robust estimates are used in the second stage. 2SLS bias is close to 0 in most cases confirming the observation made in figure 2 regarding the suitability and power of IV over a simple OLS. The regressors are exogenous to the error term in all cases as all regression equations reject presence of endogeneity as can be seen from insignificant Sargan Statistics in column 5. Column 9 provides R-square for each corresponding second stage regression equation. High R squares obtained in the second stage with no presence of endogeneity give further credence to the second stage results.

Table 4 provides results for OLS and IV. Column 2 covers all openness and trade policy variables for 34 regression equations. Column 5 gives results for initial skills representing average years for schooling for 1965. Such early levels of schooling are rightly assumed to be uncorrelated with post 1980 trade reforms and would exogenously determine wage inequality. The results show that initial skill endowments *skills65* relates negatively to inequality suggesting that developing

countries that are more educated to begin with do well on wage inequality. This is expected, and in-line with the theory that the countries where skill endowment is more evenly distributed, they are less prone to an adverse distributional effect in relative wages (Fisher 2001; Tuelings and van Rens 2002; Eiche and Cecilia 2001; Bourguignon and Morrisson 1990; Tilak 1989) Not only average years of schooling, but secondary years of schooling for all initial years 1960, 1965, 1970 and 1975 have been found to be negatively related with wage inequality. In contrast higher years of schooling for such initial years are weakly related with wage inequality as found by Mamoon and Murshed (2008)

OLS results depict the same trend of insignificance seen in figure 2 for both openness and trade policy variables. However, by using FR trade shares (*Lfrkrom*) and distance from the equator (*Disteq*) as instruments improve the results significantly. The improvement has been observed for all regression equations. All openness and trade policy variables carry expected signs, and nearly all of them bear significant relationship to wage inequality. It would therefore, appear that trade liberalization does worsen the distribution of wages between skilled and unskilled labour in developing countries. If total trade as a percentage of GDP doubles this would lead to a 40 percent increase in wage inequality which is quite significant. However the other variables that capture the importing side of trade have much smaller impact on wage inequality

Above, we have checked the effects of relative factor supply for initial periods when it has been exogenous to trade reforms. Now we come to post reform effect known as skill bias technical change. Trade puts an upward pressure on skill demands. The dynamic trade models suggest that this is also true for developing countries. Many developing countries now invest in education and many have transformed a part of their populations into skilled labour to exploit increased opportunities of good jobs (skilled labour demand) which integration has brought to their door steps. Countries like China and India are good examples. In absolute terms they have more educated people than countries in North East Asia, where education levels are equally distributed among population. However we also know that populations in China and India have been less educated to start with. Education (years of schooling) has been heterogeneous, as only a segment of population (urban) have been provided with increased educational opportunities. Whereas, the uneducated also take part in improved opportunities which international trade provides through industrial sector growth. Most of them form the unskilled of all such sectors. In other words, supply of unskilled labour is far more elastic than supply of skilled labour in both countries. Nowadays, many developing countries have been trying to jump into the Chinese and Indian bandwagon by investing in education. Since developing countries face resource constraint; they can only focus on higher levels of education to exploit the dividends of growth through processes like trade. We would show in

coming lines that this phenomenon has inequalities partly because the focus has not been on ‘education for all’.

Table 3 2nd Order Relevance and Exogeneity Tests for Instruments

| Variables | Instruments (1 st Stage results) | | | Exogeneity (2 nd Stage Higher Order) | Relevance (2 nd Stage Higher Order) | | | |
|---|--|-----------|----------|--|---|------------------------------|--|------|
| | Lfrkrom | Distq | F | | Sargan statistic | Maxima 1 2SLS Bias (b) | 1 st Stage heterosk edasticit y-robust | N |
| Endogenous Independent | | | | | | | | |
| Openness Variables | | | | | | | | |
| (Exports +Imports)/GDP, 1985 | 0.689*** | -0.013 | 40.68*** | 0.896 | 0.000 | robust | 63 | 0.67 |
| Import Penetration: overall, 1985 | 21.073*** | -0.186 | 14.05*** | 0.941 | 0.000 | robust | 51 | 0.47 |
| Import Penetration: manufacturing, 1985 | 13.391*** | -0.125 | 14.82*** | 0.925 | 0.000 | robust | 51 | 0.48 |
| Import Penetration: agriculture, 1985 | 3.544*** | -0.010 | 14.37*** | 0.900 | 0.000 | robust | 51 | 0.47 |
| Import Penetration: resources, 1985 | 3.652*** | -0.053 | 4.05** | 0.825 | 0.003 | robust | 51 | 0.20 |
| Import Penetration: overall, 1982 | 26.717*** | -0.343 | 13.83*** | 0.718 | 0.000 | robust | 51 | 0.47 |
| Import Penetration: manufacturing, 1982 | 13.823*** | -0.213 | 14.88*** | 0.671 | 0.000 | robust | 51 | 0.48 |
| Import Penetration: agriculture, 1982 | 3.792*** | -0.013 | 13.60*** | 0.844 | 0.000 | robust | 51 | 0.47 |
| Import Penetration: resources, 1982 | 8.888*** | -0.096 | 6.53*** | 0.759 | 0.000 | robust | 51 | 0.29 |
| TARS trade penetration: overall, 1985 | 33.041*** | -0.599 | 11.48*** | 0.702 | 0.000 | robust | 51 | 0.42 |
| TARS trade penetration: manufacturing , 1985 | 18.502*** | -0.202 | 10.27*** | 0.894 | 0.000 | robust | 51 | 0.39 |
| TARS trade penetration: agriculture, 1985 | 3.810*** | -0.267*** | 10.18*** | 0.163 | 0.000 | robust | 51 | 0.39 |
| TARS trade penetration: resources, 1985 | 9.991*** | -0.101 | 4.44*** | 0.891 | 0.001 | robust | 51 | 0.22 |
| TARS trade penetration:, overall, 1982 | 39.081*** | -0.773 | 10.14*** | 0.580 | 0.000 | robust | 50 | 0.41 |
| TARS trade penetration: manufacturing , 1982 | 19.468*** | -0.312 | 10.78*** | 0.683 | 0.000 | robust | 50 | 0.41 |
| TARS trade penetration: agriculture, 1982 | 4.900*** | -0.297*** | 11.54*** | 0.193 | 0.000 | robust | 50 | 0.43 |
| TARS trade penetration: resources, 1982 | 13.874*** | -0.131 | 4.14** | 0.800 | 0.001 | robust | 50 | 0.21 |
| Trade Policy Variables | | | | | | | | |
| Tariffs | | | | | | | | |
| Import duties as % imports,1985 | -2.565* | 0.146 | 2.27* | 0.129 | 0.083 | robust | 48 | 0.13 |
| Tariffs on international inputs and capital goods, 1985 | -0.124*** | 0.002 | 4.86*** | 0.756 | 0.001 | robust | 51 | 0.24 |
| Trade taxes/ trade, 1982 | -0.013 | 0.0002 | 0.70 | 0.914 | 0.297 | robust | 27 | 0.08 |
| Weighted average of total import charges: overall, 1985 | -18.861*** | 0.344 | 8.04*** | 0.711 | 0.000 | robust | 49 | 0.35 |
| Weighted average of total import charges: manufacturing, 1985 | -20.300*** | 0.401 | 8.38*** | 0.677 | 0.000 | robust | 49 | 0.36 |
| Weighted average of total import charges: agriculture, 1985 | -12.121* | 0.164 | 3.73** | 0.867 | 0.125 | robust | 49 | 0.20 |
| Weighted average of total import charges: agriculture, 1985 | -26.180*** | 1.075** | 6.19*** | 0.338 | 0.000 | robust | 49 | 0.29 |
| Non Tariff Barriers | | | | | | | | |
| Non trade barriers frequency on intermediate inputs, 1985 | -0.042 | 0.003 | 0.68 | 0.239 | 0.425 | robust | 51 | 0.04 |
| Non-tariff barriers Coverage: overall, 1985 | -17.042*** | 0.423 | 4.79*** | 0.6133 | 0.006 | robust | 49 | 0.24 |
| Non-tariff barriers Coverage: manufacturing, 1985 | -16.367** | 0.392 | 4.29*** | 0.643 | 0.015 | robust | 49 | 0.22 |
| Non-tariff barriers Coverage: agriculture, 1985 | -12.121* | 0.164 | 3.73** | 0.867 | 0.125 | robust | 49 | 0.20 |
| Non-tariff barriers Coverage: resources, 1985 | -26.18*** | 1.075 | 6.19*** | 0.338 | 0.000 | robust | 49 | 0.29 |
| Composite Measures | | | | | | | | |
| Sachs and Warner 1980s | 0.146 | 0.003 | 0.90 | 0.455 | 0.266 | robust | 31 | 0.09 |
| Measures based on residuals | | | | | | | | |
| Leamers Measure, 1982 | 0.162*** | -0.0002 | 5.03*** | 0.544 | 0.001 | robust | 22 | 0.46 |
| Gravity-residuals, basic model, 1982 | -11.686*** | 0.179** | 28.01*** | 0.436 | 0.000 | robust | 36 | 0.72 |
| Gravity-residuals, augmented model, 1982 | -10.863*** | 0.141 | 26.20*** | 0.419 | 0.000 | robust | 36 | 0.11 |
| Price Based Measures | | | | | | | | |
| Black market premium, 1985 | 0.260 | 0.012 | 1.13 | 0.312 | 0.187 | robust | 39 | 0.08 |

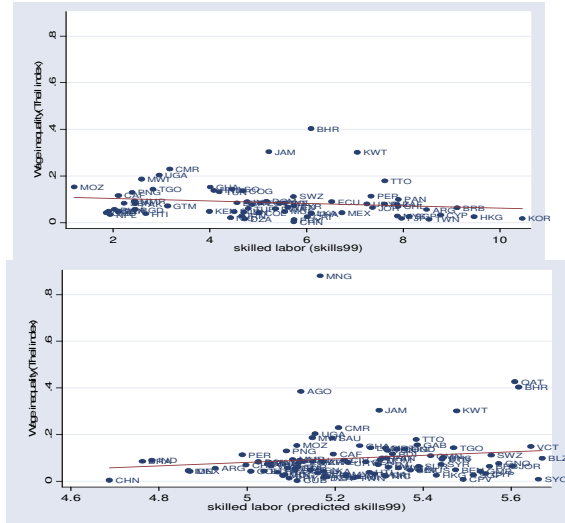
***, **, * denotes significance at 1%, 5 % and 10% levels respectively

Table 4
OLS and IV Regression Results for Theil99Developing

| Dependent Variable: Theil99dev | | | | | | |
|--------------------------------|--------------------|-------------------------------|-------------------|----------------|--------------------|------------------|
| Eq. | Openness Variables | <u>Endogenous Independent</u> | | Initial Skills | <u>Independent</u> | |
| | | OLS | IV | | OLS | IV |
| 1 | Lcopen | 0.031** (0.014) | 0.391** (0.017) | Skills65 | -0.014**(0.0064) | -0.015** (0.006) |
| 2 | Impnov85 | 0.005 (0.004) | 0.0016** (0.0007) | Skills65 | -0.072 (0.0084) | -0.015** (0.008) |
| 3 | Impnov85m | 0.001 (0.0007) | 0.0025** (0.001) | Skills65 | -0.013* (0.008) | -0.016** (0.008) |
| 4 | Impnov85a | 0.0027 (0.003) | 0.0095** (0.004) | Skills65 | -0.011 (0.007) | -0.012 (0.008) |
| 5 | Impnov85r | 0.0002 (0.0017) | 0.009* (0.0049) | Skills65 | -0.011 (0.008) | -0.017* (0.010) |
| 6 | Impnov82 | 0.0005 (0.0004) | 0.0012** (0.0005) | Skills65 | -0.012 (0.0078) | -0.014* (0.0079) |
| 7 | Impnov82m | 0.0004 (0.0007) | 0.0024** (0.0011) | Skills65 | -0.011 (0.0079) | -0.015* (0.0084) |
| 8 | Impnov82a | 0.0004 (0.0027) | 0.0091** (0.0043) | Skills65 | -0.011 (0.0079) | -0.013 (0.0084) |
| 9 | Impnov82r | 0.0021** (0.0008) | 0.0038** (0.0016) | Skills65 | -0.012 (0.0074) | -0.013* (0.0075) |
| 10 | Tars85 | 0.0005* (0.0002) | 0.001** (0.0004) | Skills65 | -0.013* (0.008) | -0.016** (0.008) |
| 11 | Tars85m | 0.0002 (0.0004) | 0.002** (0.001) | Skills65 | -0.012 (0.0082) | -0.019** (0.009) |
| 12 | Tars85a | 0.0001 (0.0017) | 0.005 (0.0028) | Skills65 | -0.011 (0.008) | -0.013 (0.008) |
| 13 | Tars85r | 0.003*** (0.001) | 0.003** (0.0013) | Skills65 | -0.011 (0.007) | -0.011* (0.007) |
| 14 | Tars82 | 0.0003 (0.0002) | 0.001** (0.0004) | Skills65 | -0.012 (0.008) | -0.015* (0.008) |
| 15 | Tars82m | 0.0003 (0.0004) | 0.002** (0.001) | Skills65 | -0.011 (0.008) | -0.017* (0.009) |
| 16 | Tars82a | 0.001 (0.0014) | 0.004 (0.003) | Skills65 | -0.009 (0.008) | -0.014 (0.009) |
| 17 | Tars82r | 0.002*** (0.002) | 0.002** (0.001) | Skills65 | -0.012 (0.007) | -0.012* (0.007) |
| Trade Policy Variables | | | | | | |
| Tariffs | | | | | | |
| 18 | Tariffs | -0.001 (0.0013) | -0.007 (0.005) | Skills65 | -0.018 ** (0.009) | -0.025** (0.012) |
| 19 | Owti | -0.054 (0.059) | -0.255* (0.132) | Skills65 | -0.011 (0.008) | -0.013 (0.009) |
| 20 | Txtrdg | 0.110 (0.493) | 3.825 (2.971) | Skills65 | -0.009 (0.015) | -0.005 (0.026) |
| 21 | Totimpv85 | -0.001 (0.0004) | -0.002** (0.001) | Skills65 | -0.009 (0.008) | -0.011 (0.008) |
| 22 | Totimpv85m | -0.001 (0.0004) | -0.002** (0.001) | Skills65 | -0.010(0.008) | -0.012 (0.009) |
| 23 | Totimpv85a | -0.001* (0.001) | -0.002** (0.001) | Skills65 | -0.010 (0.008) | -0.011 (0.008) |
| 24 | Totimpv85r | -0.0003 (0.001) | -0.003* (0.001) | Skills65 | -0.010 (0.008) | -0.005 (0.010) |
| Non Tariff Barriers | | | | | | |
| 25 | Owqi | -0.038 (0.039) | -0.297 (0.289) | Skills65 | -0.011 (0.001) | -0.016 (0.012) |
| 26 | Nontar85 | -0.0003 (0.0004) | -0.002* (0.001) | Skills65 | -0.011 (0.009) | -0.021* (0.012) |
| 27 | Nontar85m | -0.0003 (0.0003) | -0.002* (0.001) | Skills65 | -0.010 (0.008) | -0.023* (0.013) |
| 28 | Nontar85a | -0.0003 (0.0003) | -0.003 (0.002) | Skills65 | -0.012 (0.008) | -0.033* (0.019) |
| 29 | Nontar85r | -0.0003 (0.0003) | -0.001* (0.001) | Skills65 | -0.010 (0.008) | -0.010 (0.008) |
| Composite Measures | | | | | | |
| 30 | Open80s | -0.043 (0.035) | 0.127 (0.161) | Skills65 | -0.002 (0.008) | -0.010 (0.015) |
| Measures based on residuals | | | | | | |
| 31 | Leamer82 | -0.064 (0.063) | -0.058 (0.222) | Skills65 | -0.005 (0.010) | -0.010 (0.011) |
| 32 | Grmb | -0.001 (0.001) | -0.001 (0.001) | Skills65 | -0.010* (0.005) | -0.011** (0.005) |
| 33 | Grma | -0.001 (0.001) | -0.001 (0.001) | Skills65 | -0.010* (0.005) | -0.010** (0.005) |
| Price Based Measures | | | | | | |
| 34 | Black | 0.023* (0.014) | 0.024 (0.048) | Skills65 | -0.011 (0.007) | -0.011 (0.007) |

***, **, * denotes significance at 1%, 5 % and 10% levels respectively .Standard errors are presented in parenthesis.

Figure 4



Skills versus Skill Bias Technical Change

Figure 4 shows two graphs. The first one illustrates a simple relationship between skill levels in 1999 and wage inequality, and suggests that countries with higher stocks of skilled labour will have less inequality. The second graph has a different measure of skills (based on predicted values by regressing *skill99* on FR trade shares; or those skills which can be measured in relation with trade), conversely suggests that skill accumulation due to greater global integration raises wage inequality. It implies that the skills that accrue directly through the processes of trade, contribute to wage inequality. This is in line with Tinbergen's (1975) arguments, and the earlier discussion regarding the dual role of skilled human capital in the economy.

In order to examine the dual (positive and negative) impact of skilled labour stocks on the skilled-unskilled labor wage differential, it is necessary to modify the basic 'wage inequality model' by introducing an interaction term between skills and some selected openness and trade policy measures.

Conceptually speaking, the present wage inequality framework should contain:

$$Inequality = f[(Skills_i(openness), Skills_i(skills_0))] \quad (9)$$

(+) (-)

$$Inequality = f[(Skills_i(tradepolicy), Skills_i(skills_0))] \quad (10)$$

(+) (-)

Skills which depend on *Initial* skill endowments have a negative effect on wage inequality in Eqs (9) and (10). The skills that accrue through trade liberalization exacerbate inequality.

The econometric form of the modified wage inequality model is:

$$THEIL_{3i} = \lambda_1 + \Omega_1 Interaction(OPEN \times Skills99)_i + \rho_1 Skills99_i + \varepsilon_{5i} \quad (11)$$

$$THEIL_{5i} = \lambda_3 + \Omega_3 Interaction(TP \times Skills99)_i + \rho_3 Skills99_i + \varepsilon_{7i} \quad (12)$$

Skills99 represents skill endowments in 1999; a point in time when earlier trade liberalization had had time to play a role in skill accumulation in developing countries through technology transfer. Hence *skills99* would depend on initial skill levels and trade. To isolate the effect of trade from initial skill endowment effect in *skills99*, we need to first find instruments which can separately explain *skills99* in terms of trade and initial skill levels. Mamoon (2008) finds that drop out rates (*Drop*) and schooling days in a year (*Schday*) exogenously determine average years of schooling for 1999 (*Skills99*). Here, we can instrument *Skills99* with *Drop80* and *Schday*. Such exercise will enable us to explain *Skill99* only with reference to initial endowments. To capture the effect of trade on *Skill99*, we first interact *Skills99* with some selected proxies of openness and trade policy to form *Interaction (OPENxSkills99)* and *Interaction (TPxSkills99)*. Following the observation made in figure 4 and to ensure that only trade can explain this interaction term, we instrument it on FR (1999) bilateral trade shares (*Lfrkrom*) and distance from the equator. The interaction terms capture the effect of skills on inequality, while taking into account the extent to which each developing country has integrated with world markets. In the first stage *Interaction (OPENxSkills99)*, *Interaction (TPxSkills99)* and *Skills99* would be regressed over all four instruments identified above.

$$Interaction(OPEN \times Skill99)_{2i} = \partial_1 + \theta_1 FR_i + \kappa_1 Drop80_i + \gamma_1 Schday_i + \ell_1 Disteq_i + \varepsilon_{9i} \quad (13)$$

$$Interaction(TP \times Skill99)_{2i} = \partial_2 + \theta_2 FR_i + \kappa_2 Drop80_i + \gamma_2 Schday_i + \ell_2 Disteq_i + \varepsilon_{10i} \quad (14)$$

$$Skill99_{2i} = \partial_3 + \theta_3 FR_i + \kappa_3 Drop80_i + \gamma_3 Schday_i + \ell_3 Disteq_i + \varepsilon_{11i} \quad (15)$$

Here FR_i stands for predicted trade shares from gravity equations computed by Frankel and Romer (1999), *Drop80* stands for dropout rates in 1980, *Schday* represents schooldays in a year whereas *Disteq_i* (distance from the equator) is a proxy for geography.

There is evidence that suggests unequal investments in higher education are important determinants of increasing inequalities in developing countries (Barro

1999). We want to know whether it is overall low education levels which are driving wage inequality in developing countries or it is that within education sector, it is higher level of education which is more closely related with skill bias technical change. According to Acemoglu (1999), trade induced skill bias technical change causes higher wage inequalities in developing countries through a wage premium effect induced towards higher levels of education. (Acemoglu, 2001)

Here we are not only to test for effect of international trade on average levels of skills (*skill99*) but also on higher levels of skills (*Hyr99*). This provides us with additional interaction terms based on later category of skill levels. The latter category offers more-specific information about the relationship between inequality and higher levels of education. Equations (13), (14) and (15) would remain the same in the right hand side for higher skills (*Hyr99*). Only change in the left hand side would be that *Hyr99* would be used instead of *Skills99*. The same change is due in equations (11) and (12).

Table 5 *1st Stage Regression results for Instrumental variables*

| First Stage Results: Interactions Between Openness/ Trade Policy and average Skills | | | | | | | | | | | |
|---|---------------------|----------------------|----------------------|---------------------|---------------------|----------------------|---------------------|----------------------------|--------------------|-----------------------|---------------------|
| | Lcopen × Skill99 | Impen85 × Skill99 | Impen82 × Skill99 | Tars85 × Skill99 | Tars82 × Skill99 | Tariffs × Skill99 | Owti × Skill99 | Totimpv 85 × Skill99 | Owqi × Skill99 | Nontar85 × Skill99 | Skill90 |
| Lfrkrom | 3.718 (2.43)** | 110.70 (3.82)** | 139.72 (3.67)** | 164.63 (3.18)** | 196.251 (2.96)** | -16.769 (-1.86)* | -0.547 (-3.2)*** | -75.181 (-3.6)*** | -0.243 (-0.94) | -70.47 (-2.7)*** | 0.0144 (0.04) |
| Drop80 | -0.203 (-3.7)*** | -2.918 (-2.7)*** | -3.356 (-2.54)** | -5.865 (-3.8)*** | -6.242 (-2.7)*** | -0.115 (-0.32) | -0.004 (-0.65) | -0.0063 (-0.01) | -0.0037 (-0.39) | -0.796 (-0.69) | -0.039 (-3.2)*** |
| Schday | -0.029 (-0.45) | 1.26 (1.00) | 1.208 (0.72) | 0.947 (0.42) | 1.152 (0.39) | 0.5491 (1.10) | -0.001 (-0.18) | -0.247 (-0.27) | 0.0005 (0.05) | 0.464 (0.36) | -0.006 (-0.45) |
| Disteq | 0.063 (0.61) | 0.063 (0.03) | -1.161 (-0.46) | -1.875 (-0.54) | -3.391 (-0.77) | 1.164 (2.02)** | 0.009 (0.84) | 1.603 (1.20) | 0.017 (1.04) | 1.853 (0.98) | 0.034 (1.50) |
| N | 64 | 55 | 54 | 55 | 53 | 47 | 54 | 52 | 54 | 52 | 64 |
| F-statistics | 6.42*** | 7.35*** | 7.18*** | 6.36*** | 5.72*** | 2.30* | 3.14** | 4.34*** | 0.68 | 2.60*** | 4.15*** |
| R-square | 0.30 | 0.37 | 0.37 | 0.34 | 0.32 | 0.18 | 0.21 | 0.27 | 0.05 | 0.18 | 0.219 |

| First Stage Results: Interactions Between Openness/ Trade Policy and Higher Skills | | | | | | | | | | | |
|--|--------------------|--------------------|--------------------|---------------------|--------------------|--------------------|---------------------|-------------------------|--------------------|---------------------|--------------------|
| | Lcopen × Hyr99 | Impen85 × Hyr99 | Impen82 × Hyr99 | Tars85 × Hyr99 | Tars82 × Hyr99 | Tariffs × Hyr99 | Owti × Hyr99 | Totimpv 85 ×Hyr99 | Owqi ×Hyr99 | Nontar85 × Hyr99 | Hyr99 |
| Lfrkrom | 0.1859 (1.22) | 6.635 (4.00)** | 7.940 (3.82)** | 9.539 (13.2)** | 10.976 (3.12)** | -16.04 (-1.78)* | -0.026 (-2.32)** | -3.87 (-2.33)** | -0.007 (-0.38) | -3.210 (-1.52) | 0.00001 (0.00) |
| Drop80 | -0.0061 (-1.12) | -0.109 (-1.79)* | -0.115 (-1.60) | -0.229 (-2.11)** | -0.229 (-1.88)* | -0.085 (-0.24) | -0.0003 (-0.08) | 0.032 (0.50) | -0.0001 (-0.16) | 0.036 (0.45) | -0.0009 (-0.73) |
| Schday | -0.001 (-0.11) | 0.135 (1.82)* | 0.174 (1.85)* | 0.121 (0.92) | 0.204 (1.28) | 0.746 (1.42) | -0.0002 (-0.35) | -0.01 (-0.14) | -0.0001 (-0.14) | 0.006 (0.06) | -0.0005 (-0.32) |
| Disteq | 0.012 (1.17) | 0.138 (1.24) | 0.145 (1.05) | 0.137 (0.67) | 0.151 (0.64) | 1.072 (1.85) | 0.001 (0.91) | 0.103 (0.94) | 0.0005 (0.41) | 0.152 (1.10) | 0.004 (1.47) |
| N | 62 | 54 | 53 | 54 | 52 | 46 | 53 | 51 | 53 | 51 | 62 |
| F-statistics | 1.31 | 7.09*** | 7.00*** | 5.06*** | 5.12*** | 2.28* | 1.87 | 2.00 | 0.11 | 1.14 | 0.87 |
| R-square | 0.08 | 0.37 | 0.37 | 0.29 | 0.30 | 0.18 | 0.13 | 0.15 | 0.009 | 0.09 | 0.05 |

t- Values in the parenthesis. ***, **, * denotes significance at 1%, 5 % and 10% levels respectively

Table.6
Higher Order Relevance and Exogeneity Tests for Theil99dev

| Eq | Endogenous Dependent Variable: | N | 1 st Stage heteroskedasticity-robust | Relevance | | | Exogeneity |
|---|-----------------------------------|----|---|-----------------------|---------------------------------|--|--|
| | | | | Maximal 2SLS Bias (b) | Cragg-Donald val stat. Chi-sq() | Anderson-Rubin test of joint significance of endogenous regressors F-Statistic | Sargan statistic (overidentification test of all instruments) Chi-Sq() |
| Endogenous Independent Variables: Interactions Between Openness/ Trade Policy and Average Skills for 1999 (Instruments= Disteg, Lfrkrom, Drop80, Schday) | | | | | | | |
| 35 | Interaction (Lcopen × Skill99) | 62 | Robust | 0.0005 | 17.76** | 1.91 | 2.400 (0.301) |
| 36 | Interaction (Impen85 × Skill99) | 55 | Robust | 0.0028 | 14.11** | 2.29* | 4.390 (0.111) |
| 37 | Interaction (Impen82 × Skill99) | 54 | Robust | 0.0037 | 13.46** | 1.88 | 3.316 (0.191) |
| 38 | Interaction (Tars85 × Skill99) | 55 | Robust | 0.0027 | 14.16** | 2.29* | 3.795 (0.149) |
| 39 | Interaction (Tars82 × Skill99) | 54 | Robust | 0.1699 | 5.03** | 2.28* | 5.265 (0.072)* |
| 40 | Interaction (Tariffs × Skill99) | 47 | Robust | 0.2078 | 4.55** | 2.61** | 1.105 (0.574) |
| 41 | Interaction (Owti × Skill99) | 54 | Robust | 0.0037 | 13.51** | 2.27* | 1.678 (0.432) |
| 42 | Interaction (Totimpv85 × Skill99) | 52 | Robust | 0.007 | 11.86** | 2.37* | 2.04 (0.360) |
| 43 | Interaction (Owqi × Skill99) | 54 | Robust | 0.5023 | 2.35** | 2.27* | 0.628 (0.730) |
| 44 | Interaction (Nontar85 × Skill99) | 52 | Robust | 0.0145 | 10.55** | 2.37* | 0.717 (0.698) |
| Endogenous Independent Variables: Interactions Between Openness/ Trade Policy and Higher Skills for 1999 (Instruments= Disteg, Lfrkrom, Drop80, Schday) | | | | | | | |
| 45 | Interaction (Lcopen × Hyr99) | 62 | Robust | 0.286 | 3.78** | 1.83 | 3.06 (0.215) |
| 46 | Interaction (Impen85 × Hyr99) | 54 | Robust | 0.167 | 5.06** | 2.28* | 6.295 (0.043)** |
| 47 | Interaction (Impen82 × Hyr99) | 53 | Robust | 0.1279 | 5.69** | 1.88 | 5.132 (0.076)* |
| 48 | Interaction (Tars85 × Hyr99) | 53 | Robust | 0.0033 | 13.75** | 1.83* | 3.096 (0.212) |
| 49 | Interaction (Tars82 × Hyr99) | 52 | Robust | 0.085 | 6.62** | 1.84* | 4.439 (0.110) |
| 50 | Interaction (Tariffs × Hyr99) | 46 | Robust | 0.933 | 0.43 | 2.72** | 0.040 (0.980) |
| 51 | Interaction (Owti × Hyr99) | 53 | Robust | 0.082 | 8.25** | 2.25* | 3.779 (0.286) |
| 52 | Interaction (Totimpv85 × Hyr99) | 51 | Robust | 0.395 | 2.98** | 2.34* | 2.350 (0.308) |
| 53 | Interaction (Owqi × Hyr99) | 53 | Robust | 0.955 | 0.33 | 2.25* | 0.204 (0.903) |
| 54 | Interaction (Nontar85 × Hyr99) | 51 | Robust | 0.348 | 3.29** | 2.34* | 1.059 (0.5669) |

t- Values in the parenthesis. ***, **, * denotes significance at 1%, 5 % and 10% levels respectively

To investigate *integration*, six definitions of openness: *Lcopen*, *Impnov85*, *Impnov82*, *Tars85* and *Tars82* and five different proxies of trade policy namely *Tariffs*, *Owti*, *Totimpov85*, *Owqi*, and *Nontarr87* are used (see summary statistics provided in table 2 for details about the variables).

Table 5 provides results for the 1st stage. FR bilateral trade shares (*Lfrkrom*) and (*Drop80*) significantly explain the endogenous regressors. F-statistic is less than 10 in all cases; violating Cragg-Donald rule of thumb. However, we are dealing with 4 instruments and thus a first order tests are insufficient and higher order asymptotic tests are required. Table 6 shows that higher order Crag Donald F-Statistics, which also corresponds to 2SLS bias, do relatively better in case of *Skills99* than in case of *Hyr99*. Largely for *Skills99*, 2SLS bias has been 0 or close to it. Only for equation 43, higher order asymptotes show a large 2SLS bias in favour of OLS. For *Hyr99*, 2SLS bias is large enough to fail the test for at least 4 equations (50, 52, 53 and 54). Over identification problem is not present for most of the equations for the interaction terms of *Skills99* or *Hyr99*. Good results for higher order asymptotic tests establish the statistical validity of the model while heteroskedasticity robust IV estimates are obtained for the second stage. The omitted variable bias has thus been addressed in all regression equations.

Table 7 presents results for *Interaction (OPEN×Skills99)*, *Interaction (TP×Skills99)* and *Skills99*. Interaction terms always enter wage inequality significantly at 5% and 10% levels of significance. *Interaction(OPEN× Skills99)* is positively related with wage inequality whereas *Interaction (TP×Skills99)* is negatively related with wage inequality confirming the presence of skill bias technical change for developing countries where skill demand has resulted in payment of skill premiums causing wages of skilled (educated) to rise at greater rates than the wages of unskilled (uneducated). 1st column shows that *Skills99* are negatively related with wage inequality. Remember *Skills99* have been instrumented by *Drop80* and *Schday*, and thus represents post reform skills which only depend on the initial skills that have been prevailing in developing countries. Results confirm that countries that have integrated to world markets with skills (levels of education) that were homogenously distributed among the population have witnessed a fall in wage inequality. However for other measures of openness and trade policy, *Skills99* have been insignificant. That may be due to the reason that other trade proxies represent the importing sector. For most developing countries, importing sector is more closely related with the manufacturing sector and the technical bias effect of trade would be more prominent in importing sectors. Importing sectors employ more skilled labour. For such cases interaction terms are over riding explanatory power of results with respect to *Skills99*.

Table 7
Interactions between Openness/Trade Policy and Average Skills

| Independent Variables | Dependent Variable: Theil99dev | | | | | | | | | |
|-----------------------------|--------------------------------|--------------------|--------------------|--------------------|-------------------|--------------------|--------------------|--------------------|-------------------|--------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Interaction Terms | | | | | | | | | | |
| Lcopen × Skill99 | 0.0062 (2.25)** | | | | | | | | | |
| Impen85 × Skill99 | | 0.0002 (1.67)* | | | | | | | | |
| Impen82 × Skill99 | | | 0.00013 (1.64)* | | | | | | | |
| Tars85 × Skill99 | | | | 0.00012 (1.87)* | | | | | | |
| Tars82 × Skill99 | | | | | 0.0001 (1.64)* | | | | | |
| Tariffs × Skill99 | | | | | | -0.002 (-1.82)* | | | | |
| Owti × Skill99 | | | | | | | -0.053 (-1.9)** | | | |
| Totimpv85 × Skill99 | | | | | | | | -0.001 (-2.1)** | | |
| Owqi × Skill99 | | | | | | | | | -0.087 (-1.30) | |
| Nontar85 × Skill99 | | | | | | | | | | -0.002 (1.96)** |
| Average Skills, 1999 | | | | | | | | | | |
| Skills99 | -0.0279 (-1.80)* | -0.0034 (-0.27) | -0.001 (-0.05) | -0.005 (-0.41) | -0.002 (-0.17) | 0.031 (1.09) | 0.013 (1.24) | 0.011 (0.95) | 0.021 (0.16) | 0.018 (1.25) |
| N | 64 | 55 | 54 | 55 | 53 | 47 | 54 | 52 | 54 | 52 |
| F | 2.42* | 1.46 | 1.45 | 1.80* | 1.42 | 1.56 | 2.14* | 2.48** | 0.98 | 2.15* |
| R2 | 0.63 | 0.51 | 0.53 | 0.52 | 0.52 | 0.18 | 0.42 | 0.48 | 0.32 | 0.28 |

t- Values in the parentheses.***, **, * denotes significance at 1%, 5 % and 10% levels respectively
Standard errors are corrected for as run Durbin-Wu-Hausman test (augmented regression test) for endogeneity (see Davidson and MacKinnon, 1993)

Does wage inequality in developing countries also follow the ‘Pareto principle’ where a rise in wages of ‘higher educated’ would be more than ‘only educated’? Are we capturing an element of within group inequality also when we say that wage inequality between skilled and unskilled is rising? Because a rise in within group inequality can also capture a rise in wages of skilled labour which would be disproportional to not only less educated (low skilled) but also uneducated (unskilled). Is technical bias affecting the wages of highly skilled or “the proportional rise in returns to skills is across the board (for all education levels)”? By answering these questions, we can know ‘what level of education matters most’.

Table 8
Interactions between Openness/ Trade Policy and Higher Skills

| Independent Variables | Dependent Variable: Theil99dev | | | | | | | | | |
|----------------------------|--------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|-------------------|-------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Interaction Terms | | | | | | | | | | |
| Lcopen × Hyr99 | 0.1001 (1.85)* | | | | | | | | | |
| Impen85 × Hyr99 | | 0.002 (1.34) | | | | | | | | |
| Impen82 × Hyr99 | | | 0.002 (1.35) | | | | | | | |
| Tars85 × Hyr99 | | | | 0.002 (1.67)* | | | | | | |
| Tars82 × Hyr99 | | | | | 0.002 (1.49) | | | | | |
| Tariffs × Hyr99 | | | | | | -0.004 (-0.82) | | | | |
| Owti × Hyr99 | | | | | | | -1.013 (-1.9)* | | | |
| Totimpv85 × Hyr99 | | | | | | | | -0.007 (-2.2)** | | |
| Owqi × Hyr99 | | | | | | | | | -3.221 (-0.59) | |
| Nontar85 × Hyr99 | | | | | | | | | | -0.01 (-1.89)* |
| Higher Skills, 1999 | | | | | | | | | | |
| Hyr99 | -0.408 (-1.53) | -0.056 (-0.33) | -0.093 (-0.63) | -0.067 (-0.40) | -0.106 (-0.73) | 1.066 (0.58) | 0.219 (1.17) | 0.123 (0.60) | 0.4601 (0.56) | 0.213 (0.81) |
| N | 62 | 54 | 53 | 54 | 52 | 46 | 53 | 51 | 53 | 51 |
| F | 2.63* | 0.85 | 0.98 | 1.31 | 1.14 | 0.37 | 2.06* | 2.39* | 0.19 | 2.75* |
| R2 | 0.61 | 0.54 | 0.58 | 0.54 | 0.56 | - | 0.46 | 0.48 | - | 0.21 |

t- Values in the parentheses. ***, **, * denotes significance at 1%, 5 % and 10% levels respectively
Standard errors are corrected for as run Durbin-Wu-Hausman test (augmented regression test) for endogeneity (see Davidson and MacKinnon. 1993)

We already find evidence that by ignoring ‘education for all’, developing countries have increased the wage gap among the labour force based on skill differentials. Here we examine whether skill biased technical change benefits higher levels of education more. *Interaction(OPEN×Hyr99)* and *Interaction(TP×Hyr99)* will capture the trade effect of higher education on rising skill returns in developing countries. Table 8 finds supporting evidence that higher skills are related with wage inequality in developing countries. Higher coefficients for all cases when significance is achieved (columns 1, 4, 7, 8 and 10) for ‘Hyr99 interaction terms’ in comparison to coefficients for ‘Skills99 interaction terms in table 7’ suggest that wage inequality is more sensitive towards higher levels of education.

For example we know from table 4 that with each additional year of initial levels of schooling in a country, wage inequality is expected to fall by 10 percent. In table 7, with each additional year of schooling post liberalization, wage inequality is expected to rise by less than 1 percent. However with each additional year of higher levels of schooling (post secondary) post trade liberalization can double wage inequality. This shows that wage inequality is more sensitive to higher levels of education than all levels of education. This result may also confirm then that preference to higher education in developing countries is causing distortions in labour markets where following “Pareto Principle” the labour with higher levels of education earn more than just educated while uneducated are worse off.

In this paper, our empirical frame work has actually captured the disproportional rise in returns to education (rising wage inequality) due to trade liberalization which favours education and higher levels of education even more. This is to say that we also find that returns to schooling rise with additional years of schooling and the relationship is a dynamic one to determine rising wage inequality in developing countries. Higher levels of schooling are more sensitive to wage inequality than over all levels of education.

The non linear relationship between different levels of education and its economic outcomes can also be extended to social returns to education and its potentially dual role. The different effects of different levels of education on economic development in this context are quite nicely stated by Krueger and Lindhal (2001): ‘ The social return (to education) can be higher because of externalities from education, which could occur, for example, if higher education leads to technological progress that is not captured by in the private return to that education, or if more education produces positive externalities, such as a reduction in crime and welfare participation or more informed political decisions. The former is more like if human capital (education) is expanded at higher levels of education while the latter is more likely if human capital (education) is expanded at lower levels’ (1107)

Developing countries can invest in higher levels of education to exploit social externalities which can generate and sustain technical progress amid globalization. However, social returns to education by raising overall education level may carry more deep rooted positive effects in the economy. Our results strongly support in favor of raising over all education levels in the society The education bias of trade liberalization can be exploited in favour of the poor in a country through investments in all levels of education. That is one way to make trade induced growth good for the poor.

The unequal returns to education in a dynamic trade fame work may partly explain why initial levels of education (captured by endogenously determined average years of schooling) are more closely related with good economic outcomes than higher education attainment (endogenously determined improved level of schooling) in

developing countries as also pointed out by other studies (see i.e., Krueger and Lindahl, 2001). This is not to say that basic education in itself as a target is enough. When the economy begins to trade more with the outside world, perhaps there is a need for a balanced education policy in the South. Providing the necessary higher/technical education should not, however compromise the achievement of primary education. Investing in higher education may not be as effective as investing in overall education levels of the population. Primary education is the first step towards a more skilled labour force, and it is a pro-poor policy, as the overwhelming majority of the poor remain uneducated. (Mamoon 2005)

In the immediate time frame, in order to minimize the positive effects of trade on wage inequality in developing countries, one solution is to trade among each other, where more trade may take place in low skill intensive goods but developing countries can also trade in relatively skill intensive produce. Developing countries lie in a heterogeneous plain where some may be following relatively skilled intensive (in local terms) production activities. Regional trade can absorb the negative effect of skill bias technical change. However in the longer run, investment in education sector would remain the key factor to effect wage dispersion in developing countries. More resources in education sector need to be channeled to secondary and primary education levels in addition to higher education as suggested by Acemoglu (2001).

4 Conclusions

In summary, the discussion here suggests that the earning inequalities in developing countries have two important determinants. First, there are significant entrenched inequalities in educational attainment. Second, increased international trade transforms these education inequalities into wage inequalities by favouring skilled labour over unskilled labour. In line with previous studies, this analysis found that education might be central to explaining the increasing gap in relative wages between skilled and unskilled workers in developing countries. Although the analysis supports the argument that those countries with a higher initial level of human capital do well on the inequality front, it also suggests that human capital, particularly the part related to higher education, which accrues after trade liberalization has in-egalitarian effects. Governments in developing countries tend to invest more in higher education at the cost of primary education in order to seize short-term benefits from globalization.

One reason for this bias towards higher education, in education policies in developing countries may lie in the belief that elementary education has a very limited direct role in determining growth rates. According to Barro (1999), the rate of economic growth responds more to secondary or higher education levels rather than elementary schooling. International trade in manufacturing and services is one of the key engines for growth. This often requires college graduates or those who have at least finished high school. One reason why India and China became havens for international outsourcing and trade is that they have managed to accumulate relatively

educated and skilled human capital by investing in higher education.¹ In the last two years, the United States has lost two million manufacturing jobs to China, India and other third world countries, mainly in the Far East. Consequently, in 2001, the manufacturing sector in the US shrank to just 18 per cent of GNP from 48 per cent in 1950 and it is expected to recede to just 10 or 11 per cent within the next 10 years². Forrester Research, a market research firm predicts that at least 3.3 million white-collar jobs and \$136 billion in wages will shift from the US to low-cost countries by 2015 and most of them will find their way to Indian or Chinese centers³. Countries in the South that are set to benefit most from globalization are those that transformed at least a *segment* of their labour force into a relatively skill intensive force by investing in higher education programs. Therefore, it is no surprise that in order to be competitive, many developing countries have a tendency to invest in higher education at the cost of primary education to achieve greater growth. For example, Pakistan's current education policy skews towards higher education. In fiscal year 2003, the government increased its higher education budget to Rs 5 billion from Rs 800 million five years ago—an increase of nearly 400 per cent. In 2004, the government doubled the previous year's expenditure on higher education. In contrast, the budget for primary education increased by a meager average of 4 per cent per annum for the last few years. This apparent pro-growth higher education policy of Pakistan at the expense of primary education may very well accelerate growth, but it excludes the poor and unskilled and will likely lead to increased wage and income disparities in the country.

As noted earlier, governments in developing countries tend to focus their education policies on higher education in anticipation that this investment will yield quick dividends in the current international business environment. Although they are right, they need to realize that promoting higher education at the cost of primary education breeds greater income inequality in the absence of countervailing policies and is not pro-poor. Consequently, governments need to increase the mean level of human capital through a balanced education policy where primary education is valued as much as higher education. An equitable education policy will decrease the skilled-unskilled wage premium, as the overall supply of low skilled and uneducated workers decreases and the supply of educated workers increases, as well as give rise to general equilibrium effects that reduce wage inequality. Additionally such policies are consistent with the millennium development goals (MDGs). This researcher agrees with the recent World Development Report (2006), which suggests that wider access to education and jobs could 'level the economic playing field' and improve livelihoods.

¹ In other export areas such as textiles, which use unskilled labour intensively, these countries vast populations dictate that the skilled-unskilled premia will not narrow even if the absolute real wages of the unskilled increased.

² <http://www.freewebport.com/us/useconomy.asp>

³ <http://www.tribuneindia.com/2004/20040223/login/main1.htm>

These results also have implications for the speed at which trade policies are liberalized. Developing countries require time to adjust to an open regime because of their low-skill level stocks; the implication being that better educated nations should liberalize faster. If skill levels were homogenously distributed, free trade would lead to a more-equal and pro-poor growth. In the short-run, it may be wiser for developing economies to first look for regional trade agreements by following the model of the European Union; something that is not easy to achieve amongst poor countries who contemporaneously do not trade much with each other. But there may be potential in that direction. The rationale for regional trade is that developing countries lie in a heterogenic plain where each country is located at different rungs of the technical ladder. To climb the ladder, the more efficient way may lie in increased South-South trade rather than North-South trade in a regional framework as in the case of ASEAN (Association of South East Asian Network). Similar trade agreements would enable developing countries to liberalize their economies slowly, while at the same time enabling their workforce to ascend the skill ladder (Mamoon, 2004)

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Table 1 *List of Countries for Theil Index (Theil99developing)*

| | | | |
|------------------------------------|-----------------------------|----------------------------|--|
| Afghanistan (1988) | Ecuador (1997) | Malaysia (1997) | South Africa (1997) |
| Algeria (1997) | Egypt, (1997) | Mauritania (1978) | Sri Lanka (1994) |
| Angola (1993) | El Salvador (1997) | Mauritius (1997) | St. Vincent and the Grenadines (1994) |
| Argentina (1996) | Equatorial Guinea (1990) | Mexico (1997) | Sudan (1972) |
| Bahamas, The (1990) | Eritrea (1988) | Moldova (1994) | Suriname (1993) |
| Bahrain (1992) | Ethiopia (1997) | Mongolia (1994) | Swaziland ((1994) |
| Bangladesh (1990) | Fiji (1997) | Morocco (1997) | Syria (1997) |
| Barbados (1997) | Gabon (1994) | Mozambique (1994) | Togo (1981) |
| Belize (1992) | Gambia, The (1981) | Myanmar (1997) | Thailand (1994) |
| Benin (1981) | Ghana (1995) | Namibia (1994) | Tonga (1994) |
| Bhutan (1989) | Guatemala (1997) | Nepal (1996) | Trinidad and Tobago (1994) |
| Bolivia (1997) | Haiti (1988) | Nicaragua (1985) | Tunisia (1997) |
| Botswana (1997) | Honduras (1994) | Nigeria (1994) | Turkey (1997) |
| Brazil (1994) | Hong Kong, China (1997) | Oman (1997) | Taiwan (1997) |
| Burkina Faso (1981) | India (1997) | Pakistan (1996) | Tanzania (1990) |
| Burundi (1990) | Indonesia (1997) | Panama (1997) | Uganda(1988) |
| Cameroon (1997) | Iran, Islamic Rep (1993) | Papua New Guinea (1989) | United Arab Emirates (1985) |
| Cape Verde (1993) | Iraq (1985) | Paraguay (1991) | Uruguay(1997) |
| Central African Republic (1993) | Jamaica (1990) | Peru (1994) | Venezuela (1994) |
| Chile (1997) | Jordan (1997) | Philippines (1997) | Western Samoa (1972) |
| China (1985) | Kenya (1997) | Puerto Rico (1997) | Yemen (1986) |
| Colombia (1997) | Korea, Rep. (1997) | Qatar (1994) | Zambia (1994) |
| Congo, Rep. (1988) | Kuwait (1997) | Rwanda (1985) | Zimbabwe (1997) |
| Costa Rica (1997) | Lesotho (1994) | Saudi Arabia (1989) | |
| Cote d'Ivoire (1997) | Liberia (1985) | Senegal (1997) | |
| Cuba (1988) | Libya (1980) | Seychelles (1988) | |
| Cyprus (1997) | Macao, China (1997) | Singapore (1997) | |
| Dominican Republic (1985) | Madagascar (1988) | Somalia (1986) | |
| | Malawi (1997) | | |