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Globalization, Literacy Levels, and Economic Development

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Abstract

This paper estimated models for GDP growth rates, poverty levels, and inequality measures for the period 1990–2000 using data on 54 developing countries at five-yearly intervals. Issues of globalization were investigated by analysing the differential effects of the countries' exports and imports and by postulating trans-logarithmic models that allow for non-linear effects of literacy levels and measures of openness. The main findings were that literacy rates affected growth rates in a quadratic manner and countries with higher literacy were more likely to benefit from globalization. Second, the model for growth rates showed non-linear and differential effects of the export/GDP and import/GDP ratios. Third, the models indicated that population health indicators such as life expectancy were important predictors of GDP growth rates. Fourth, models for poverty measures showed that poverty was not directly affected by globalization indicators. Finally, the model for Gini coefficients indicated significant effects of 'medium' and 'high' skilled labour work force, with higher proportions of high-skilled labour implying greater inequality.

Keywords: globalization, economic development, education, endogeneity, inequality, poverty, non-linearities, trade

JEL classification: C33, C5, I3, O11, O5

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1 Introduction

The recent trends in globalization reflected in the increased production of goods and services across the globe and have important implications for policymakers in developing and developed countries. While the conventional economic analysis such as the Heckscher–Ohlin model implies benefits of cheap labour in developing countries, production of goods and services demanded by developed countries entails the availability of at least a semi-skilled labour force and industrial infrastructure that are often inadequate in developing countries especially in Africa. While unskilled labour can produce agricultural commodities, such exports are hampered due to subsidies and protection programmes for agriculture in developed countries. Because countries such as Japan and China have succeeded in producing goods requiring advanced technology, it is of interest to investigate the effects of variables such as education, population health, exports, imports, and foreign investment on economic growth in developing countries. Moreover, since poverty has not declined in many developing countries despite greater economic integration, it is important to analyse the effects of variables reflecting globalization on measures of poverty and inequality (e.g. Dollar and Kraay, 2004; Harrison, 2005).

Further, analyses of time series data on a small group of countries such as those in East Asia (Kim and Lau, 1994) and China (Ravallion, 2004) can provide insights into the effects of factors such as foreign investment and trade on economic development. However, many developing countries have poor educational and healthcare infrastructure and there are lags between investments in education and health, and the availability of a skilled labour force (Bhargava, 2001a). Moreover, increased life expectancy enables countries to reap the benefits of such investments over long time spans (Bhargava et al., 2001). Thus, high literacy levels can enhance the benefits of globalization though the time profiles of imports and exports may have differential effects on economic development (e.g. Santos-Paulino and Thirlwall, 2004). For example, it may be necessary for developing countries to import technology and to have a relatively skilled labour force that can compete in producing goods demanded in developed countries. Thus, panel data on developing countries with differing levels of education, population health, and economic environments can provide insights for formulating trade and development policies.

A shortcoming in analysing aggregate panel data on countries is that observations on many important variables are often missing especially for developing countries. Moreover, while databases have recently begun compiling variables on alternative indicators of globalization, corruption, and political freedom (e.g. Rodriguez and Rodrik, 2000; Winters, 2004), it is essential to incorporate the gradual effects of education and health on economic growth rates. These problems are compounded by the fact that health and demographic variables are often compiled via surveys by agencies such as the World Bank (2005) only at a few time points; the observations in remaining periods are projections from statistical models. Similar issues arise for measures of poverty and inequality where the numbers of observations are further reduced. Finally, there are complexities in creating comparable data series for even the basic variables such as GDP levels; it is desirable to use GDP series based on exchange rates and on purchasing power parity (PPP) that is assessed via the costs of purchasing a similar basket of goods in countries. The stochastic properties of GDP series can differ partly

due to exchange rate fluctuations though GDP growth rates separated by five-year intervals can circumvent some of the econometric problems (Bhargava, 2001b).

The structure of this paper is as follows. The data are briefly described in Section 2. The analytical framework is developed in Section 3.1 and some econometric issues are addressed in Section 3.2. The empirical results for growth rates in 54 developing countries in 1990, 1995, and 2000 are presented in Section 4.1 using exchange rate and PPP based GDP series. The results from models for poverty and inequality using data in 1990 and 2000 are presented in Sections 4.2 and 4.3, respectively. The conclusions are summarized in Section 5.

2 The data

The data used in the analysis were taken for the years 1985, 1990, 1995, and 2000 primarily from the World Development Indicators 2005 (WDI2005) (World Bank, 2005a). The *per capita* GDP series in constant US$2000 and that using an index of PPP were available in WDI2005; the data on exports and imports expressed as percentages of the GDP were also from the WDI2005. Other measures of globalization such as foreign direct investment and capital flows were available in WDI2005 though these variables were mainly insignificant predictors of growth rates, and poverty and inequality measures, and hence are not discussed further in the paper.

The adult literacy rates available in WDI2005 were compiled by UNESCO and were available for more countries than, for example, education variables such as the percentages of labour force with primary, secondary and tertiary education; literacy rates were used in the analysis. Similarly, life expectancy data were taken from the WDI2005; the use of five-yearly data minimized some of the problems such as the projection of these variables from statistical models. The education series constructed by Barro and Lee (2000) and the census data from various countries were used to create the series for the proportions of labour force with ‘low’, ‘medium’ and ‘high’ skill levels (Docquier and Marfouk, 2006). Overall, for estimating the model for GDP growth rates, complete observations were available for 54 developing countries (excluding those in the Middle East with oil reserves) in four time periods.

The data on poverty measures in WDI2005 were often missing for developing countries in the three time periods (1990, 1995, and 2000). Thus, poverty measures based on consumption surveys in developing countries, percentages of people below the poverty line (‘headcount ratio’) and the mean distance below poverty line expressed as a proportion of poverty line (‘poverty gap’) were taken from a World Bank website (World Bank, 2005b). For minimizing the numbers of missing observations, the data for 1990 and 2000 available on 36 countries were analysed. Last, the data on Gini coefficients reflecting inequality were taken from UNU-WIDER (2005) for the years 1990 and 2000; these years were again selected to minimize missing observations and the data were available for 35 developing countries.

3 The analytical framework

3.1 Analysing the effects of globalization on growth rates, poverty, and inequality measures

With globalization, developing countries are likely to see an increase in their exports and imports and greater opportunities to produce finished goods that enhance economic productivity. While microeconomic data are useful for analysing the effects of greater trade on economic well-being of population groups, it is difficult to monitor large numbers of households employed in different sectors of the economy for long time periods. Moreover, the effects of globalization may be more visible in the data at regional levels especially in large countries such as China where economic activity has been concentrated in certain geographical regions. However, aggregate data on GDP growth rates reflect the overall economic activity and can provide broad insights into the effects of globalization.

While countries such as Japan and South Korea have benefited from globalization, the initial literacy levels attained by the population were high. Apart from natural resources such as oil and minerals, an increase in production of goods demanded in developed countries entails a mix of production technology with skill levels of the labour force. Moreover, domestic agriculture may not benefit directly from globalization since technology transfer such as improved variety of seeds are achieved via agricultural institutes supported by international agencies. In addition, the exports of agricultural commodities to developed countries are restricted. By contrast, the quality of products such as textiles and clothing in developing countries has improved in part by importing machinery and the employment of skilled labour. Similarly, the availability of high skilled labour in countries such as India has raised productivity levels in the information and technology sectors and has had spin offs in the production of goods and services.

At a general level, one is likely to see beneficial effects of globalization in countries with a skilled labour force though the time profile of the development processes are likely to differ. Some developing countries, for example, might initially become exporters of low-priced garments though with the import of technology, they can compete with producers in developed countries. While disaggregated data on exports and imports are seldom available, empirical analyses can model the potential synergisms between literacy levels and the imports and exports of developing countries. Such interactions have not been explored in the previous literature in part because there has been less emphasis on the value added by skilled labour. Instead, the exploitation of cheap unskilled labour was emphasized. In fact, unskilled labour such as that engaged in food production on small farms may require protection if food prices fall due to better technologies for food storage and distribution. One might see some of these effects in analyses of poverty and inequality measures at the country level. The preceding discussion is reflected in the empirical models outlined below.

3.1.1 The models

The empirical model for GDP growth rates using exchange rate (or PPP) based series is given by

$$\begin{aligned}(\text{GDP growth rate})_{it} &= a_0 + a_1(\text{East Asia})_i + a_2(\text{Latin America})_i \\ &+ a_3(\text{South Asia})_i + a_4 \ln(\text{Literacy rate})_{it-5} + a_5[\ln(\text{Literacy rate})_{it-5}]^2 \\ &+ a_6 \ln(\text{Export/GDP})_{it-5} + a_7[\ln(\text{Export/GDP})_{it-5}]^2 + a_8 \ln(\text{Import/GDP})_{it-5} \\ &+ a_9[\ln(\text{Import/GDP})_{it-5}]^2 + a_{10} \ln(\text{Medium skill/Total labour})_{it-10} \\ &+ a_{11} \ln(\text{Life expectancy})_{it-5} + a_{12} \ln(\text{GDP})_{it-5} + u_{1it}\end{aligned}$$

$$(i=1, ..., N; t=1, 2, 3) \qquad (1)$$

The model in equation (1) included three indicator variables for the geographical regions, i.e. the means of the variables were assumed to be different in East Asia, Latin America and South Asia, with the coefficients interpreted with reference to countries in Africa. The model in equation (1) was the general formulation containing export/GDP and import/GDP ratios and enabled testing of the null hypothesis that these variables can be combined as the trade/GDP ratio (see below). While the non-linearities with respect to literacy rates were taken into account in the models, interaction terms such as those between literacy rates, and export/GDP and import/GDP ratios were invariably insignificant and were dropped from the models to reduce multi-collinearity. Note that the models were in the spirit of the earlier work by Barro and Sala-i-Martin (1995) in that the lagged values of the explanatory variables were included. Moreover, life expectancy and GDP levels were treated as endogenous variables due to previous findings (Preston, 1976; Bhargava et al., 2001).

A simple random effects formulation for the errors affecting the models is given by

$$u_{lit} = \delta_i + v_{it} \qquad (2)$$

where δ_i were country-specific random effects that were distributed with zero mean and finite variance and v_{it} were independently distributed random variables with zero mean and finite variance. However, equation (2) was a special case of the general assumption invoked in the analysis that the variance covariance matrix of u_{lit} was positive definite (Bhargava, 1991). The methods for testing parameter restrictions and exogeneity null hypotheses are briefly explained in Section 3.2.

The model for the poverty headcount or poverty gap is given by

$$\begin{aligned}(\text{Poverty measure})_{it} &= b_0 + b_1(\text{East Asia})_i + b_2(\text{Latin America})_i \\ &+ b_3(\text{South Asia})_i + b_4 \ln(\text{Literacy rate})_{it-10} + b_5 \ln(\text{Export/GDP})_{it-10} \\ &+ b_6 \ln(\text{Import/GDP})_{it-10} + b_7 \ln(\text{Low skill/Total labour})_{it-10} \\ &+ b_8 \ln(\text{GDP})_{it-10} + b_9 \ln(\text{GDP growth rate})_{it-10} + u_{2it}\end{aligned}$$

$$(i=1, ..., N; t=1, 2) \qquad (3)$$

The non-linearities with respect to literacy rates and export/GDP and import/GDP ratios were not evident in these models perhaps due to the reduction in numbers of countries and time observations. The role of GDP growth rates for reducing poverty has been emphasized in the literature and it was useful to employ the GDP series based on exchange rates and PPP. While exogeneity null hypotheses were tested for the lagged

GDP levels and growth rates, dynamic models were also estimated for poverty measures dropping the lagged GDP variable. The errors (u_{2it}) were assumed to be randomly distributed with a bi-variate distribution though without restricting the variance covariance matrix.

Last, the model for Gini coefficient is given by

$$\begin{aligned}(\text{Gini coefficient})_{it} &= c_0 + c_1(\text{East Asia})_i + c_2(\text{Latin America})_i \\ &+ c_3(\text{South Asia})_i + c_4 \ln(\text{Literacy rate})_{it-10} + c_5 \ln(\text{Export/GDP})_{it-10} \\ &+ c_6 \ln(\text{Import/GDP})_{it-10} + c_7 \ln(\text{Medium skill/Total labour})_{it-10} \\ &+ c_8 \ln(\text{High skill/Total labour})_{it-10} + c_9 \ln(\text{GDP})_{it-10} \\ &+ c_{10} \ln(\text{GDP growth rate})_{it-10} + u_{3it}\end{aligned}$$

$$(i=1, \ldots, N;\ t=1, 2) \qquad (4)$$

The inclusion of the proportions of labour force with medium and high skill levels was likely to capture the effects of different income shares on inequality. As in the model for poverty measures, the variables reflecting non-linearities with respect to literacy rates and export/GDP and import/GDP ratios were not significant predictors of the Gini coefficients.

3.2 The econometric framework

The methodology used for estimation of static random effects models for GDP growth rates in situations where some of the explanatory variables are endogenous was developed in Bhargava (1991). Let the model be given by

$$y_{it} = \sum_{j=1}^{m} z_{ij}\gamma_j + \sum_{j=1}^{n_1} x_{1ij}\beta_j + \sum_{j=n_1+1}^{n} x_{2ijt}\beta_j + u_{it} \qquad (5)$$

where z's are time invariant variables, x_1 and x_2 are, respectively, exogenous and endogenous time varying variables. In the models estimated for GDP growth rates, the indicator variables for East Asia, Latin America and South Asia were time invariant explanatory variables. Time varying regressors consisted of (lagged) literacy rate, export/GDP and import/GDP ratios with their respective squared terms, ratio of medium skill to total labour, life expectancy, and GDP levels.

Further, one can distinguish between two sets of assumptions for endogeneity of the time varying variables x_2 such as GDP levels and life expectancy. First, x_2 may be correlated with the errors u_{it} in a general way, i.e. x_2 are fully endogenous variables; x_{2jt} must be treated as different variables in each time period. Let X_1 and X_2 be, respectively, the $n_1 \times 1$ and $n_2 \times 1$ vectors containing the exogenous and endogenous time varying variables ($n_1 + n_2 = n$), and let Z be the $m \times 1$vector of time invariant variables. We can write a reduced form equation for the fully endogenous variables X_2 as

$$X_{2it} = \sum_{j=1}^{T} F_{tj} X_{1ij} + F_t^* Z_i + U_{2it} \qquad (6)$$

where $F_{tj}(t=1,...,T); j=1,...,T)$ and $F_t^*(t=1,...,T)$ are, respectively, $n_2 \times n_1$ and $n_2 \times m$ matrices of reduced form coefficients; U_{2it} is the $n_2 \times 1$ vector of errors.

The reduced form equation (6) is a general formulation for correlation between the time varying endogenous variables and errors u_{lit} affecting model (5). For example, lagged GDP levels have often been included as an explanatory variable in models for growth rates and were treated as a fully endogenous variable (Bhargava et al., 2001). However, due to the small number of time observations, it may be difficult to achieve identification of the model parameters under the general correlation pattern.

An alternative assumption for endogeneity of variables such as GDP and life expectancy is to assume that these are correlated only with the country-specific random effects δ_i, i.e.

$$x_{2ijt} = \lambda_j \delta_i + x^*_{2ijt} \tag{7}$$

where x^*_{2ijt} are uncorrelated with δ_i, and δ_i are randomly distributed variables with zero mean and finite variance. This correlation pattern was invoked by Bhargava and Sargan (1983) in the spirit of the commonly used random effects models; endogenous variables of the type in equation (7) have sometimes been referred to as 'special' endogenous variables. Moreover, instrumental variables estimators based on differencing the variables also invoke similar assumptions (e.g. Anderson and Hsiao, 1981).

The advantage in assuming the correlation pattern (7) is that deviations of the x_{2ijt}'s from their time mean

$$x^+_{2ijt} = x_{2ijt} - \bar{x}_{2ij} (t=2,...,T; j=n_1+1,...,n; i=1,...,N) \tag{8}$$

where

$$\bar{x}_{2ij} = \sum_{t=1}^{T} x_{2ijt} / T (j=n_1+1,...,n; i=1,...,N) \tag{9}$$

can be used as $[(T-1)n_2]$ additional instrumental variables to facilitate identification and estimation (Bhargava and Sargan, 1983). Efficient Three Stage Least Squares type instrumental variables estimators were used to estimate the models in equations (1), (3) and (4) assuming the correlation patterns for x_{2jt} in equations (6) and (7) and without restricting the variance covariance matrices of the errors.

While in ordinary time series models a mis-specification test can be applied to test the over-identifying restrictions (Sargan, 1958), it is possible to test various exogeneity assumptions for explanatory variables in the panel data framework. As shown in Bhargava (1991), one can sequentially test exogeneity assumptions using statistics based on instrumental variables estimates because the correlation pattern for special endogenous variables in (7) is a special case of the general formulation (6). The sequential Chi-square test for exogeneity would first test the validity of the special correlation pattern (6). If n_2 time varying variables are postulated to be endogenous, then under the null hypothesis, the first test statistic is asymptotically distributed (for large N and fixed T) as a Chi-square variable $[(T(T-1)n_2]$ degrees of freedom. If the null

hypothesis cannot be rejected, then we can further test if the time means of x_2 given in equation (9) are uncorrelated with the random effects δ_i. The test statistic for the second set of hypotheses is asymptotically distributed as a Chi-square variable with Tn_2 degrees of freedom.

3.2.1 Some tests of parameter restrictions in non-linear models

The model in equation (1) is a general quadratic formulation that enabled testing of the null hypotheses that export/GDP and import/GDP ratios may be combined as the trade/GDP ratio. First, a trans-logarithmic formulation would allow for interaction terms between literacy rates, export/GDP and import/GDP ratios (Sargan, 1971; Christensen et al., 1973). However, since the coefficients of the interaction terms were invariably insignificant in the models for GDP growth rates, one can simplify the testing procedures for combining the export/GDP and import/GDP ratios by splitting the test procedures into two stages. In the first stage, one can test the null hypothesis that the interaction term between export/GDP and import/GDP ratios is zero. A Chi-square test statistic can be developed using the sample criteria for the exogeneity test statistics mentioned above that are asymptotically equivalent to likelihood ratio tests. Since three time observations were available for the estimation, these statistics were distributed as Chi-square variables with three degrees of freedom. In practice, however, it was not necessary to compute these statistics since the null hypotheses that the coefficients of interaction terms were zero were accepted using t-tests.

In the second stage of the tests for the model in equation (1), one can test the null hypotheses that

$$H_0 : a_6 = a_8 \text{ and } a_7 = a_9 \tag{10}$$

against the alternative hypothesis that

$$H_1 : a_6 \neq a_8 \text{ and } a_7 \neq a_9 \tag{11}$$

Because three time observations were available, the statistic for testing the null against the alternative was asymptotically distributed as a Chi-square variable with six degrees of freedom. While one can control the overall size of sequential tests (Anderson, 1971; Sargan, 1980), the above procedure was better suited for investigating the effects of imposing equality restrictions on the coefficients of export/GDP and import/GDP variables as commonly done in the trade literature.

One can compute the levels of literacy, and export/GDP and import/GDP ratios (or trade/GDP ratio) for which the derivatives of GDP growth rates with respect to these variables are zero. While these threshold levels are informative and are reported in Table 1, there are difficulties in computing their confidence intervals, i.e. the levels beyond which the overall impacts are statistically significant. Although one can develop a one sided analogue of Wald (1943) statistics for the overall effects, the problems are compounded by the modest number of the countries in the sample leading to wide confidence intervals. Thus, we mainly report the points of inflexions in Table 1 and these provide insights into the non-linearities in the relationships between GDP growth rates, literacy rates, and export/GDP and import/GDP ratios. We also present the results

for specifications that included the trade/GDP ratio and report the points of inflexion with respect to literacy rates in these models to assess the robustness of the results.

4 The results from panel data on developing countries in the period 1990–2000

4.1 Empirical results for GDP growth rates

The results for GDP growth rates based on the GDP series using constant US$2000 and PPP are presented in Table 1. In Specification 1, the export/GDP and import/GDP variables were introduced as separate explanatory variables together with their respective squared terms. These two variables were combined as the trade/GDP ratio and its square in Specification 2. Specifications 1 and 2 were non-linear in literacy rates; the points of inflexion with respect to literacy rates, and export/GDP and import/GDP ratios (or trade/GDP ratio) are reported in Table 1. The Chi-square tests for exogeneity and for testing parameter restrictions in equation (10) are also reported.

First, focusing on the results from the exchange rate based GDP series for Specifications 1 and 2, the null hypothesis that the export/GDP and import/GDP ratios can be combined as the trade/GDP ratio was firmly rejected at the 5 per cent significance level. The Chi-square statistic assumed the value 22.73 that was above the critical level of 12.6. Moreover, it was evident from the coefficients of export/GDP and import/GDP variables and their respective squared terms that these differed from the corresponding coefficients of trade/GDP ratio and its square. It would have been useful to further analyse the differential lag patterns with respect to export and import variables though this was infeasible in view of the fact that only three time observations were available for the estimation.

Second, the threshold values for the export/GDP ratio beyond which it had a positive impact on GDP growth rates in Specification 1 was 14.6 per cent; the corresponding figure for the import/GDP ratio was 36.6 per cent. By contrast, using the results from Specification 2, the point of inflexion with respect to the trade/GDP ratio was 49.8 per cent. As noted above, the patterns of imports especially those involving the transfer of advanced technology for production were likely to be important for developing countries for enhancing productivity and economic growth. Third, there were significant non-linearities in Specifications 1 and 2 with respect to the literacy rates. However, the threshold levels beyond which the effects of literacy rates on economic growth were positive were 30.4 per cent and 28.5 per cent from Specifications 1 and 2, respectively. These levels were quite nominal especially since only two countries in the sample had lower literacy rates. However, it is important to reiterate that the cut-off points at which the overall effect was *statistically* significant were difficult to compute and could be quite high.

Fourth, the coefficients of the dummy variables for geographical regions were generally insignificant in Specifications 1 and 2. This was perhaps not surprising since GDP growth rates exhibit considerable variation over time though the use of five-yearly growth rates alleviates many problems. The coefficients of the variable for proportion of the labour force with medium skill levels were not significant in Specifications 1 and 2 for GDP growth rates. By contrast, coefficients of the lagged life expectancy and GDP

variables were highly significant. These results showed the importance of population health indicators such as life expectancy (or adult survival rates) for economic growth previously underscored by Bhargava et al. (2001). However, possible non-linearities with respect to the life expectancy variable were not evident in this sample presumably because developed countries were excluded. The coefficients of (lagged) GDP were invariably negative and significant implying conditional convergence in the growth rates though with the qualification that the equilibrium GDP levels were affected by the unobserved country-specific random effects (Bhargava, 2001b).

Last, the sequential tests for exogeneity hypotheses rejected the random effects correlation patterns in equation (7) for the life expectancy and GDP variables. These variables were treated as fully endogenous though the results for the two formulations for endogeneity in equations (6) and (7) were close. Owing to the small number of time observations available, it was better to rely on the random effects decomposition for the correlation pattern; the results for Specifications 1 and 2 assumed the special endogeneity patterns for life expectancy and GDP variables.

The second set of results in Table 1 for Specifications 1 and 2 employed the PPP based GDP series that were likely to exhibit less variation due to interpolations used to compute the PPP indices. The results were broadly similar to those obtained for the exchange rate based GDP series though there were certain differences. For example, while the points of inflexion with respect to literacy rates were similar for the two GDP series using Specification 1, the corresponding inflexion points with respect to export/GDP ratios were 14.6 per cent for the exchange rates based GDP series and 46.2 per cent for the PPP GDP series. The corresponding results for import/GDP ratios were 36.6 per cent and 21.9 per cent, respectively. The results from Specification 2 for the trade/GDP ratio for the exchange rate and PPP based GDP series were 49.8 per cent and 62.8 per cent, respectively. The points of inflexion with respect to literacy rates using Specification 2 were 28.5 per cent and 27.3 per cent, respectively, for the exchange rate and PPP based GDP series that were close. Overall, the results in Table 1 cast doubt of the usefulness of combining the exports and imports ratios as the trade/GDP ratio. Last, other indicators of globalization such as foreign direct investment and capital flows were not significant predictors of GDP growth rates partly because the numbers of countries in the sample were lower due to missing observations.

4.2 Empirical results for the two measures of poverty

The results for the percentages of people below the poverty line (headcount ratio) and the mean distance below the poverty line as the proportion of poverty line (poverty gap) in 1990 and 2000 for 36 developing countries are presented in Table 2. Similar results were obtained for the measure of poverty based on consumption surveys and hence were omitted to economize on space. The non-linearities with respect to literacy rates and export/GDP and import/GDP ratios were not apparent in these models. In fact, the coefficients of these three variables were statistically not different from zero in the specifications using the exchange rates based and PPP GDP series. By contrast, the lagged GDP levels were statistically significant predictors of the headcount ratio and poverty gap using the two GDP series. The GDP growth rates were significant predictors of the headcount ratio and the poverty gap though in the model for the poverty gap, the coefficient of the exchange rate based GDP growth rate series was not significant.

The Chi-square tests for exogeneity of the lagged GDP and growth rates series were within the confidence intervals for accepting the null hypotheses that these variables may be treated as exogenous in the models. This was in contrast with the results for GDP growth rates where the exogeneity null hypotheses for lagged GDP levels and the life expectancy variable were rejected. A possible interpretation of these findings was that while poverty was likely to be reduced by lagged GDP levels and growth rates, the factors underlying the evolution of poverty profiles were complex and entailed differential benefits of economic growth for various income groups. Such factors, in turn, need not be systematically related to the error terms affecting the lagged GDP levels and growth rates. In fact, further Chi-square tests indicated that the errors affecting GDP growth rates were less likely to be correlated with the errors affecting the two poverty measures modeled in the analysis.

4.3 Empirical results for the Gini coefficients

The results for Gini coefficients for 35 developing countries in 1990 and 2000 are presented in Table 3 using the two GDP series. In contrast with the poverty measures, the indicator variables for East Asia, Latin America and South Asia were estimated with negative and significant coefficients. Thus, there appeared to be a decline in inequality in these regions in comparison with African countries. Second, while the coefficient of the export/GDP ratio was not statistically different from zero, this was not the case for the coefficient of the import/GDP ratio that was estimated with a positive sign. These results indicated that imports were associated with higher inequality in developing countries and there may be many reasons for this finding. For example, importing goods and services needed for domestic production may initially be beneficial for the well-off and educated population sub-groups.

Third, while the ratio of medium skill to total labour was estimated with a negative and significant coefficient in the models using the two GDP series, the ratio of high skill to total labour was estimated with positive and significant coefficients. Moreover, the coefficient of the ratio of low skill to total labour was not a significant predictor; coefficients of GDP levels and growth rates were also not significantly different from zero. These results suggested the importance of differences in the education levels of the labour force in countries for inequality measures. Because the exports and imports of the countries and literacy rates were controlled for in the analysis, globalization may exacerbate inequality owing to skill differentials of the populations. Moreover, in view of the results in Table 1, developing countries need to invest in creating an educated labour force; educated population groups are likely to have higher life expectancy that in turn would enhance the benefits of globalization for economic growth. Last, the Chi-square test statistics for exogeneity of the GDP levels and growth rates were not significant in the models for the Gini coefficients. This was perhaps not surprising since coefficients of these variables were insignificant predictors in the models.

5 Conclusion

This paper presented analyses of GDP growth rates, poverty measures and inequality using aggregate panel data on developing countries in the period 1990–2000 during which trade levels have increased. While additional measures of globalization are being

compiled for the recent years, analyses using the data on exports and imports of the countries provided useful insights. It was seen that the effects of export/GDP and import/GDP ratios on GDP growth rates were different; studies analysing the effects of exports and imports on economic growth, poverty and inequality should not restrict these coefficients to be the same. As data on additional globalization related variables become available, researchers will be able to model the differential lag patterns in exports and imports affecting economic growth in developing countries.

Second, the importance of protecting the poor in the face of increased globalization has been emphasized in the literature. The results in this paper underscored the importance of high literacy rates and life expectancy for developing countries for reaping the benefits of globalization. With the demand in developed countries for inexpensive high quality goods rising and the import of agricultural commodities hampered by agricultural subsidies, it is evident that developing countries with educated labour force are likely to benefit from opening their markets for competing with producers in developed countries. From this viewpoint, countries especially in sub-Saharan Africa need to devise careful policies for reaping the benefits of globalization. In particular, the AIDS pandemic is reducing life expectancy and the school participation of orphaned children (Bhargava, 2005) thereby hindering the benefits of globalization.

Third, the analysis of the poverty measures showed the importance of GDP levels and growth rates for reducing poverty. However, variables such as export/GDP and import/GDP ratios were not significant predictors of poverty measures suggesting that, at least at an aggregate level, these broad indicators of globalization were not exacerbating poverty. Finally, the models estimated for inequality indicated that import/GDP ratios and the proportion of the labour force with high skill levels may exacerbate inequality. Since the diffusion of technical knowledge to developing countries and availability of an educated labour force are critical ingredients for economic growth, short run increases in inequality due to globalization may be inevitable. Overall, developing countries need to invest additional resources in education and health for creating a skilled labour force to enjoy greater benefits of globalization.

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Table 1: Efficient instrumental variable estimates from random effects models for five-yearly GDP growth rates for developing countries (1990–2000)

	Five yearly GDP growth rates (constant US$ 2000)				Five yearly GDP growth rates (PPP 2000)			
	Specification 1		Specification 2		Specification 1		Specification 2	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Constant	-0.125	0.231	0.268	0.277	-0.168	0.219	0.179	0.266
East Asia indicator variable	0.009	0.012	0.011	0.014	0.016	0.011	0.018	0.013
Latin America indicator variable	0.001	0.011	0.023	0.014	-0.014	0.009	-0.003	0.011
South Asia indicator variable	-0.013	0.012	-0.019	0.015	-0.010	0.011	-0.010	0.013
ln (literacy)$_{-5}$, %	-0.143*	0.071	-0.260*	0.088	-0.118*	0.062	-0.210*	0.077
[(ln literacy)$_{-5}$]^2	0.021*	0.010	0.039*	0.012	0.017*	0.009	0.032*	0.011
ln (Export/GDP)$_{-5}$, %	-0.054*	0.024	-		-0.046*	0.023	-	
[(ln Export/GDP)$_{-5}$]^2	0.010*	0.004	-		0.006	0.004	-	
ln (Import/GDP)$_{-5}$, %	-0.065*	0.033	-		-0.046	0.030	-	
[(ln Import/GDP)$_{-5}$]^2	0.009*	0.005	-		0.007*	0.005	-	
ln Trade/GDP)$_{-5}$, %	-		-0.148*	0.047	-		-0.118*	0.043
[(ln Trade/GDP)$_{-5}$]^2	-		0.019*	0.006	-		0.014*	0.006
ln (Medium skill/total labour)$_{-5}$	0.001	0.004	0.008	0.005	0.007	0.004	0.004	0.005
ln (Life expectancy)$_{-5}$	0.196*	0.044	0.200*	0.049	0.207*	0.043	0.219*	0.049
ln (GDP)$_{-5}$	-0.036*	0.007	-0.056*	0.008	-0.040*	0.007	-0.063*	0.009
Chi-square test for exogeneity (12 d.f.)	50.38*		50.29*		54.82*		48.11*	
Chi-square test for exogeneity (6 d.f.)	12.12*		30.45*		8.53*		25.97*	
Chi-square test for Specification 1 against 2 (6 d.f.)	22.73*				21.38*			
Literacy rate at which partial derivative = 0, %	30.4		28.5		29.1		27.3	
Export/GDP ratio at which partial derivative =0, %	14.6		-		46.2		-	
Import/GDP ratio at which partial derivative =0, %	36.6		-		21.9		-	
Trade/GDP ratio at which partial derivative =0, %	-		49.8				62.8	

Note: There were 54 developing countries with 3 time observations (1990, 1995, 2000) used in the estimation; slope coefficients and standard errors are reported; * P<0.05.

Table 2: Efficient estimates from random effects models for two poverty measures at ten year intervals in developing countries (1990–2000)

	Using GDP levels (constant US$ 2000)				Using GDP levels (PPP 2000)			
	Poverty headcount ratio		Poverty gap		Poverty headcount ratio		Poverty gap	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Constant	9.184*	1.493	9.818*	1.810	12.095*	1.982	14.138*	2.336
East Asia indicator variable	-0.606	0.454	-1.167*	0.548	-0.492	0.463	-0.980	0.543
Latin America indicator variable	-0.023	0.376	0.270	0.458	-0.357	0.358	-0.097	0.421
South Asia indicator variable	-0.647	0.467	-1.249*	0.572	-0.678	0.481	-1.282*	0.571
ln (literacy)$_{-10}$, %	0.296	0.374	0.341	0.451	0.267	0.389	0.367	0.456
ln (Export/GDP)$_{-10}$, %	-0.044	0.325	-0.070	0.401	-0.399	0.321	-0.495	0.386
ln (Import/GDP)$_{-10}$, %	-0.275	0.260	-0.303	0.317	-0.113	0.266	-0.146	0.317
ln (Low skill/total labour)$_{-10}$	0.826	0.972	0.817	1.206	0.645	1.019	0.531	1.232
ln (GDP)$_{-10}$	-0.927*	0.202	-1.204*	0.246	-1.069*	0.262	-1.489*	0.309
ln (GDP growth rate)$_{-10}$	-7.097*	3.894	-8.301	4.800	-7.496*	3.766	-9.117*	4.580
Chi-square test for exogeneity (4 d.f.)	9.09		9.54		8.55		9.16	
Chi-square test for exogeneity (4 d.f.)	3.54		4.78		0.95		1.26	

Note: There were 36 developing countries with 2 time observations (1990, 2000) used in the estimation; slope coefficients and standard errors are reported; * P<0.05.

Table 3: Efficient estimates from random effects models for Gini coefficients at ten year intervals in developing countries (1990–2000)

	Gini coefficients			
	Using GDP levels (constant US$ 2000)		Using GDP levels (PPP 2000)	
	Coefficient	SE	Coefficient	SE
Constant	3.502*	0.442	3.337*	0.461
East Asia indicator variable	-0.341*	0.066	-0.347*	0.065
Latin America indicator variable	-0.185*	0.064	-0.170*	0.062
South Asia indicator variable	-0.341*	0.074	-0.343*	0.073
ln (literacy)$_{-10}$, %	0.027	0.108	0.025	0.110
ln (Export/GDP)$_{-10}$, %	-0.013	0.042	0.0003	0.041
ln (Import/GDP)$_{-10}$, %	0.076*	0.036	0.071*	0.035
ln (Medium skill/total labour)$_{-10}$	-0.079*	0.034	-0.081*	0.034
ln (High skill/total labour)$_{-10}$	0.067*	0.024	0.064*	0.024
ln (GDP)$_{-10}$	0.042	0.031	0.053	0.040
ln (GDP growth rate)$_{-10}$	0.170	0.462	0.207	0.433
Chi-square test for exogeneity (4 d.f.)	7.17		6.46	
Chi-square test for exogeneity (4 d.f.)	0.68		0.73	

Note: There were 35 developing countries with 2 time observations (1990, 2000) used in the estimation; slope coefficients and standard errors are reported; * P<0.05.