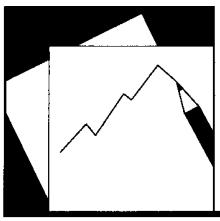
WP/08/185



IMF Working Paper

Rising Income Inequality: Technology, or Trade and Financial Globalization?

Florence Jaumotte, Subir Lall,
and Chris Papageorgiou

INTERNATIONAL MONETARY FUND

 WP/08/185

IMF Working Paper

Research Department

Rising Income Inequality: Technology, or Trade and Financial Globalization?

Prepared by Florence Jaumotte, Subir Lall, and Chris Papageorgiou[1]

Authorized for distribution by Jörg Decressin

July 2008

Abstract

We examine the relationship between trade and financial globalization and the rise in inequality in most countries in recent decades. We find technological progress as having a greater impact than globalization on inequality. The limited overall impact of globalization reflects two offsetting tendencies: whereas trade globalization is associated with a reduction in inequality, financial globalization—and foreign direct investment in particular—is associated with an increase. A key finding is that both globalization and technological changes increase the returns on human capital, underscoring the importance of education and training in both developed and developing countries in addressing rising inequality.

JEL Classification Numbers: F13, G32, O11, O15, O16, O33

Keywords: Income inequality, mechanisms, trade globalization, financial globalization, technological progress, FDI.

Author's E-Mail Address: fjaumotte@imf.org, slall@imf.org, cpapageorgiou@imf.org

[1]We thank Nancy Birdsall, Francois Bourgignon, Stijn Claessens, Daniel Cohen, Timothy Callen, Charles Collyns, Angus Deaton, Jörg Decressin, Gordon Hanson, Simon Johnson, Ayhan Kose, Petia Topalova, Shang-Jin Wei and seminar participants at the Federal Reserve Board, Getulio Vargas Foundation, Sao Paolo, IMF, Indian Council for Research and on International Economic Relations, Paris School of Economics, New Economic School, Moscow for their comments on earlier versions. We are particularly grateful to Shaohua Chen for generously providing extensive inequality data and suggestions. Stephanie Denis and Patrick Hettinger provided excellent research assistance.

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Even though average economic well-being has increased considerably over time, the degree of inequality in economic outcomes over the past three decades has increased as well. Economists continue to grapple with the reasons for this trend. But as best we can tell, the increase in inequality probably is due to a number of factors, notably including technological change that seems to have favored higher-skilled workers more than lower-skilled ones. In addition, some economists point to increased international trade and the declining role of labor unions as other, probably lesser contributing factors.

Ben S. Bernanke - June 4, 2008
Speech at Harvard University

I. INTRODUCTION

Rising inequality across most countries over the past two decades poses one of the greatest challenges to economic policymakers in both developed and developing countries. While improvements in technology, liberal market-oriented reforms and the integration of countries from the former Soviet bloc into the global economy have led to an unprecedented level of integration of the world economy—surpassing the pre-World War I peak—the benefits of the rising incomes and aggregate GDP growth rates associated with globalization have not been shared equally across all segments of the population. Indeed, income inequality has risen in most countries and regions over the past two decades, including in developed countries which were thought to have reached levels of prosperity where inequality would level off as predicted by the Kuznets hypothesis. Since this period has also been associated with unprecedented trade and (more recently) financial integration, much of the debate on rising inequality has focused on the role that globalization—especially of trade—has played in explaining inequality patterns.

Understanding the causes of inequality is fundamental to devising policy measures that can allow the rising prosperity of recent decades to be shared more broadly than has been evident so far. Reducing inequality remains important not just from the point of view of achieving a more egalitarian distribution of income and addressing the welfare and social concerns that widening disparities in income raise. To the extent that rising inequality may reflect a lack of economic opportunity, it may itself limit the growth potential of economies by not allowing all economic agents to fully exploit the new opportunities created by globalization and limiting the productive capacity of an economy by not matching capital and labor as efficiently as possible. Moreover, to the extent that economies are periodically subject to shocks of various kinds that limit growth in the short term, greater inequality makes a greater proportion of the population vulnerable to poverty. Finally, rising inequality if not addressed

can also lead to a backlash against economic liberalization and protectionist pressures, limiting the ability of economies to benefits from globalization.[2]

In this paper, we examine the role of globalization in affecting the distribution of income within countries.[3] Our main objectives are to document the patterns of trade and financial globalization over the last two decades and to identify and estimate the role of the different channels through which globalization affects the distribution of income. While there is by now a well developed and extensive body of work investigating the effects of globalization on growth and output volatility (see Prasad et al., 2007, and Kose et al., forthcoming, for a comprehensive review of this literature), there has been surprisingly little on the potential effect of globalization on income inequality.

This paper aims to fill this gap by making a contribution along several new dimensions: To start with, the paper examines the impact of both trade and financial globalization, whereas the limited existing literature thus far has focused only on trade (see Goldberg and Pavcnik, 2007, for a survey of country-specific evidence) with little attention paid to financial globalization (exceptions are Behrman, Birdsall and Szekely, 2003, and Claessens and Perotti, forthcoming). In addition, the paper looks at the various subcomponents of trade and financial globalization, including for example exports of manufacturing vs. agriculture, and portfolio debt and equity flows vs. foreign direct investment (FDI). It should be expected that different subcomponents of globalization affect inequality differently. Finally, for our cross-country analysis we employ a new dataset on income inequality that produces greater methodological consistency in survey-based inequality measurements across countries and over time.

Our main findings are as follows. The available evidence suggest that income inequality has risen in most countries and regions over the past two decades, although there are exceptions, and the data are subject to substantial limitations. Nevertheless, at the same time average real incomes of the poorest segments of the population have increased across all regions and income groups. Our analysis finds that increasing trade and financial globalization have had separately identifiable and opposite effects on income distribution. Trade liberalization and export growth are found to be associated with lower income inequality, while increased financial openness is associated with higher inequality.

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[2]There exist voluminous theoretical and empirical literatures on the effects of income inequality. Some of the most influential theoretical contributions include, Alesina and Rodrik (1994), Benabou (1996), Galor and Moav (2004), Galor and Zeira (1993), Greenwood and Jovanovic (1990), Kremer and Chen (2002), and Persson and Tabellini (1994). Prominent contributions from the empirical side include Alesina and Perotti (1996), Barro (2000), Forbes (2000), Perotti (1996), Roine and Waldenström (2008), Piketty (2003), Piketty and Saez (2003), and Sylwester (2000).

[3]Milanovic (2005) and World Bank (2007) review patterns of global income inequality i.e. income inequality across the world's citizens, and its relation to globalization. Policy implications for individual countries of such analyses are less clear beyond those that seek to improve a country's long term rate of growth.

However, their combined contribution to rising inequality has been much lower than that of technological change, both at a global level and especially markedly in developing countries. The spread of technology is, of course, itself related to increased globalization, but technological progress is nevertheless seen to have a separately identifiable effect on inequality.[4] The disequalizing impact of financial openness—mainly felt through foreign direct investment (FDI)—and technological progress appear to be working through similar channels by increasing the premium on higher skills, rather than limiting opportunities for economic advancement. Consistent with this, increased access to education is associated with more equal income distributions on average.

The rest of the paper is organized as follows. Section 2 examines the patterns in inequality and globalization across a broad range of developed and developing countries over the past two decades, and discusses the unique inequality dataset that is used in the empirical estimation that follows in Section 3. The empirical section discusses the model specifications and results of the empirical analysis. Section 4 discusses the implications of the empirical findings with particular emphasis on plausible mechanisms responsible for the rising income inequality. Section 5 concludes.

II. A Look at Cross-Country Trends

This section reviews the evidence on inequality and globalization over the past two decades, and how they have evolved across income groups.

A. Income Inequality

Cross-country comparisons of inequality are generally plagued by problems of poor reliability, lack of coverage, and inconsistent methodology. We rely on inequality data from the latest World Bank *Povcal* database constructed by Chen and Ravallion (2004, 2007) for a large number of developing countries. This database uses a substantially more rigorous approach to filtering the individual income and consumption data for differences in quality than other commonly used databases, which rely on more mechanical approaches to combine data from multiple sources and render them somewhat less reliable for cross-country studies.[5] The *Povcal* database has been supplemented with data from the Luxembourg Income Study (LIS) database, which provides high-quality coverage for advanced economies, and the resulting full sample allows for more accurate within- and cross-country comparisons than

[4]While recent work (e.g. Fogel, 2004) shows that technology reduces prices of consumption goods that primarily favors the welfare of the poor, it is not clear that this channel results in lower real income inequality because technology reduces prices of other goods, including durables that would tend to favor the welfare of the middle- and high-income classes.

[5]This database is available via the Internet at iresearch.worldbank.org/PovcalNet. Other databases include, for example, Deininger and Squire (1996) and the World Income Inequality Database (2005), which includes an update of the Deininger-Squire database; the Luxembourg Income Study; and a large number of data series from central statistical offices and research studies.

are available elsewhere. Given limitations of data availability, the analysis in this chapter uses inequality data based on both income and expenditure surveys. Mixing these two concepts makes a comparison of levels of inequality across countries and regions potentially misleading. Given the difficulty in comparing inequality levels across countries, this section discusses them briefly and focuses instead on changes, while the empirical analysis relies solely on changes in inequality to avoid the biases inherent in level estimations.

Based on observed movements in Gini coefficients shown in the top panel of Figure 1, inequality has risen in all but the low-income country aggregates over the past two decades, although there are significant regional and country differences.[6] In addition, while inequality has risen in developing Asia, emerging Europe, Latin America, the Newly Industrialized Economics, and the advanced economies over the past two decades, it has declined in some sub-Sahara African countries. The middle panel of Figure 1 illustrates that among the largest advanced economies, inequality appears to have declined only in France, whereas among the major emerging market countries (bottom panel), trends are more diverse, with sharply rising inequality in China, little change in India, and falling inequality in Brazil.[7]

Perhaps a more detailed picture of inequality is revealed by examining income shares for different country groups, presented in Figure 2. Overall, changes in income shares by quintile (successive subsets with each containing 20 percent of the population) across income levels mirror the evidence on inequality from Gini coefficients. However, the data show that rising Gini coefficients are explained largely by the increasing share of the richer quintiles at the expense of middle quintiles, whereas the income share of the poorest quintile (1) changes little. Furthermore, looking at average income levels across quintiles, real per capita incomes have risen across virtually all income and regional groups for even the poorest quintiles (Figure 3 shows per capita income by quintile in selected regions). Across all income levels, the evidence therefore suggests that in an absolute sense the poor are no worse off (with the exception of a few post-crisis economies), and in most cases significantly better off, during the most recent phase of globalization.

In summary, two broad facts emerge from the evidence. First, over the past two decades, income growth has been positive for all quintiles in virtually all regions and all income groups during the recent period of globalization. At the same time, however, income inequality has increased mainly in middle- and high-income countries, and less so in low-income countries. This recent experience seems to be a change in course from the perceived general decline in inequality in the first half of the twentieth century It must be emphasized, however, that comparison of inequality data across decades is fraught with difficulty, in view of numerous caveats about data accuracy and methodological comparability.

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[6]Income country groups are defined in the appendix.

[7]In a recent paper, Harjes (2007) finds that while summary measures of income distributions based on disposable income also suggest that inequality has increased in most industrialized countries, this development was very uneven and much less pronounced in euro-area countries.

B. Trade Openness, Financial Openness and Technological Progress

World trade, measured as the ratio of imports plus exports over GDP, has grown five times in real terms since 1980, and its share of world GDP has risen from 36 percent to 55 percent over this period (top panel of Figure 4). A similar picture emerges when trade openness is measured using tariff rates (bottom panel of Figure 4). Trade integration accelerated in the 1990s, as former Eastern bloc countries integrated into the global trading system and as developing Asia—one of the most closed regions to trade in 1980—progressively dismantled barriers to trade. However, it is noteworthy that all groups of emerging market and developing countries, when aggregated by income group (or by region), have been catching up with or surpassing high-income countries in their trade openness, reflecting the widespread convergence of low- and middle-income countries' trade systems toward the traditionally more open trading regimes in place in advanced economies.

Financial globalization has also proceeded at a very rapid pace over the past two decades. Total cross-border financial assets have more than doubled, from 58 percent of global GDP in 1990 to 131 percent in 2004. The advanced economies continue to be the most financially integrated, but other regions of the world have progressively increased their cross-border asset and liability positions (top panel of Figure 5). However, *de jure* measures of capital account openness present a mixed picture, with developing economies showing little evidence of convergence to the more open capital account regimes in advanced economies, which have continued to liberalize further (bottom panel of Figure 5).[8]

Of note, the share of FDI in total liabilities has risen across all emerging markets—from 17 percent of their total liabilities in 1990 to 38 percent in 2004—and far exceeds the share of portfolio equity liabilities, which rose from 2 percent to 11 percent of total liabilities over the same period. Reduced government borrowing needs have also contributed to changing liability structures, with the share of debt in total liabilities falling across all emerging market and developing country regions. Not surprisingly, the share of international reserves in cross-border assets has also risen, reflecting the accumulation of reserves among many emerging market and developing countries in recent years.

At the same time technological development, as measured (in our study) by the share of information and communications technology (ICT) capital in the total capital stock, has risen rapidly over the past 20 years across all income levels (Figure 6). This is quite important in our analysis as technological progress is going to play a key role in explaining much of the observed rise in cross-country inequality. An important point to note here is that in recognizing that technology is interconnected with globalization, we use ICT capital produced domestically as a proxy of technology to distinguish between the two effects. Clearly this does not completely make our measures of globalization (trade, financial)

[8]Both de facto and de jure measures have advantages and disadvantages, and are typically seen as complements rather than substitutes in empirical studies. See Kose et al. (forthcoming) for a discussion.

exclude technology but rather we separate a large portion of technology proxied with ICT capital.

III. EMPIRICAL ANALYSIS

In this section we investigate how much of the rise in inequality seen in developing and high-income countries in recent decades can be attributed to increased globalization, and how much to other factors, such as the spread of technology and domestic constraints on equality of opportunity.

A. Specification

In contrast to most existing studies that focus on income inequality in particular country or region,[9] this paper focuses on the within-country variation in inequality and controls for differences in levels across countries. It thereby explicitly addresses the lack of cross-country comparability of levels of income- and expenditure-based measures of inequality.[10] The analysis relates the Gini coefficient to various measures of globalization and a number of control variables including technological progress. Globalization measures distinguish between trade and financial openness and include both "de facto" and "de jure" measures. Specifically, trade openness is measured by the (unweighted) *average tariff rate* ("de jure" measure), and the *ratios of both non-oil exports and non-oil imports to GDP* ("de facto" measures). Financial openness is measured by the Chinn-Ito index of *capital account openness* ("de jure" measure), the *ratios of various types of financial liabilities (foreign direct investment, portfolio equity, and debt) to GDP* and the *stock of foreign direct investment assets expressed as a percentage of GDP* ("de facto" measures). The latter, which is closely associated to offshore outsourcing, may be particularly relevant to measure the impact of globalization on inequality in advanced countries, while its value is minimal for most developing and emerging market countries.

The analysis also includes a number of control variables that can be important in determining how inequality changes in countries over time and that have seen significant changes in recent years. These include *technological development*, measured by the share of ICT capital in the total capital stock, *access to education*, measured by the average years of education in the population ages 15 and older, and the share of this population with at least a secondary education, s*ectoral share of employment*, measured by the shares of employment in agriculture and in industry, and *domestic financial development*, measured by the ratio of private credit to GDP.

To the extent that technological change favors those with higher skills and exacerbates the "skills gap," it could adversely affect the distribution of income in both developing and

[9]See Goldberg and Pavcnik (2007) for a survey of theoretical and empirical research on the distributional effects of globalization in specific countries.

[10]An additional advantage of focusing on within-country variation is to reduce the risk of omitted variable bias.

advanced economies by reducing the demand for lower-skill activities and increasing the premium for higher-skill activities and returns on capital (see, for example, Birdsall, 2007). As shown in Figure 6, ICT capital has risen rapidly over the past 20 years across all income country groups.

For a given level of technology, greater access to education would be expected to reduce income inequality by allowing a greater share of the population to be engaged in high-skill activities. Both educational variables considered in the analysis have tended to increase across all regions, but with considerable cross-country variation.

In developing countries, a move away from the agricultural sector to industry is expected to improve the distribution of income by increasing the income of low-earning groups. Similarly, increase in the relative productivity of agriculture is expected to reduce income disparities by increasing the income of those employed in this sector.[11] The sectoral distribution of employment is measured by the shares of employment in agriculture and in industry.

Even though financial development may reduce income inequality by increasing access to capital for the poor, this depends on the quality of institutions in a given country. In the context of weak institutions, the benefits of financial deepening may accrue disproportionately to the rich which have higher collateral and/or income, further exacerbating initial inequality in access to finance.

The empirical analysis is based on the following specification:[12]

$$\ln(GINI) = \alpha_0 + \alpha_1 \ln\left(\frac{X}{Y}\right) + \alpha_2 \ln\left(\frac{M}{Y}\right) + \alpha_3 (100 - TARIFF) + \sum_{i=1}^{3} \beta_i \ln\left(\frac{L_i}{Y}\right) + \beta_4 \ln\left(\frac{A}{Y}\right) + \beta_5 KA_{OPEN} +$$

$$+ \gamma_1 \ln\left(\frac{K_{ICT}}{K}\right) + \gamma_2 \ln\left(\frac{CREDIT}{Y}\right) + \gamma_3 POP_{SH} + \gamma_4 \ln H + \gamma_5 \ln\left(\frac{E_{AGR}}{E}\right) + \gamma_6 \ln(\frac{E_{IND}}{E}) + \varepsilon,$$

where X and M are non-oil exports and imports, Y is real per capita GDP, $TARIFF$ is the average tariff rate, A and L are financial assets and liabilities, respectively, KA_{OPEN} is the capital account openness index, K_{ICT} is ICT capital, K is physical capital, $CREDIT$ is credit to the private sector by deposit money banks and other financial institutions, POP_{SH} is the share of population aged 15 and over with secondary or higher education, H is average years of education in the population aged 15 and over, E_{AGR} and E_{IND} are employment in agriculture and industry, and E is total employment.

[11] In this context, greater flexibility in labor markets that facilitates a move away from low-return occupations to those where opportunities are better can also be expected to improve the distribution of income (see Topalova, 2007).

[12] Using the logarithm of the Gini (rather than the Gini itself) makes this bounded variable behave more like a normally-distributed variable and hence more amenable to ordinary least squares estimation. Robustness of the results was confirmed also using a logistic transformation of the Gini coefficient (making the variable completely unbounded).

The sample of countries for which all variables used in the regressions were available consists of 51 countries, of which 20 are advanced and 31 are developing and emerging market countries, and the period covered is 1981–2003.[13,14] For the estimation, the left- and right-hand-side variables are demeaned using country-specific means in order to focus on within country changes instead of cross-country level differences. In addition, time dummies are included to capture the impact of common global shocks such as business cycles or growth spurts. The resulting model is estimated using ordinary least squares with heteroskedasticity-consistent standard errors. The robustness of this specification was tested in various ways, including instrumental variable techniques (see section 3.3).

B. Results

The estimation of the model for the whole sample of countries shows that three components of globalization have a significant impact on inequality (column 1 of Table 1). Interestingly, trade and financial globalization appear to have opposite effects: an increase in the export-to-GDP ratio is found to reduce inequality as does a reduction in average tariff rates, while on the financial side, the stock of inward FDI (expressed as a ratio to GDP) increases inequality. These effects which are significant at the 5 percent level proved very robust to a number of sensitivity tests (see section 3.3). The model re-estimated dropping the insignificant measures of globalization constitutes our benchmark model (column 2 of Table 1). The coefficient on exports implies that a one standard deviation increase in the export-to-GDP ratio from its sample mean would reduce the Gini by 3.4 percent. Similarly, a one standard deviation decrease in tariffs would reduce inequality by 1.7 percent while a one standard deviation increase in inward FDI would increase inequality by 2.7 percent. In order to better understand the inequality-reducing impact of exports, the export-to-GDP ratio is split by sector of origin (agriculture, manufacturing and services) (column 3 of Table 1). We find that it is the agricultural component of exports that is especially important to reduce inequality. The effects of agriculture, manufacturing, and services exports are statistically not significantly different from one another, but agricultural exports have the largest coefficient and are statistically significant. The coefficient on exports thus seems to reflect the fact that in many developing countries a lot of the poor are still employed in the agricultural sector, so that an improvement in the export prospects of this sector tends to reduce inequality. Tariff reductions on average also seem to benefit the poor relatively more than the rich, suggesting that on average they affected goods which are disproportionately consumed by the poor and/or formal sectors where the better-off part of the population is employed. The inequality-raising impact of inward foreign direct investment, although puzzling at first, appeared to make a lot of sense upon examination of data on the sectoral composition of FDI. These

[13]See the appendix for a list of countries included in the estimation.

[14]Since income and consumption surveys are not conducted annually, the estimations use an unbalanced panel with observations included only for years for which actual data are available. No extrapolation was used.

suggest indeed that FDI mostly takes place in relatively higher skill- and technology-intensive sectors, and thereby increases the demand for and wages of more skilled workers.

Most of the control variables are also found to be statistically significant and—except for the education variables—these estimates are generally robust. First, technological progress and domestic financial deepening both significantly increase inequality.[15] These effects are in line with the discussion above that technological progress increases the demand for skilled workers and that the benefits of enhanced financial deepening may disproportionately accrue to the rich, which have more collateral and/or income. The coefficient on technological progress is significant at the 5 percent level in the benchmark model while that on domestic financial deepening is significant at the 1 percent level. The coefficients suggest that a one standard deviation increase in these variables from their mean level would increase inequality by 1.7 percent in the case of technological progress and by 2.6 percent in the case of domestic financial deepening.

Second, the share of agriculture employment tends to increase inequality, while the share of industry employment reduces it. This is consistent with the idea that labor shifts from agriculture to industry raise the productivity of the agricultural sector where most poor are employed and decrease productivity in industry. Replacing the employment shares by measures of labor productivity in agriculture and industry (column 3 of Table 1) confirms that this is the channel at work. These results are in line with the importance of agricultural exports to reduce inequality (see above). The coefficients on the agricultural and industry employment shares are significant respectively at the 5 and 1 percent levels in the benchmark model. A one standard deviation reduction in the agriculture employment share reduces inequality by 3.3 percent, while a one standard deviation increase in the industry employment share reduces it by 2.3 percent.

Finally, the regression coefficients on education suggest that an increase in the average years of education in the population reduces inequality, presumably because it enables more people to benefit from the opportunities offered by technological progress and foreign direct investment. For a given average level of education, however, a larger dispersion as measured by the share of the population with secondary or higher education tends to increase inequality. Depending on the regression, these coefficients are sometimes imprecisely estimated. This is likely reflecting overlap between some control variables. For instance, when the sectoral employment shares are excluded from the regression (column 5 of Table 1), the coefficients on the education variables are very significant. To some extent, the share of employment in industry captures the effect of higher education since the two are likely correlated.

[15]There was no evidence of a threshold effect by income level for the result on domestic financial deepening, suggesting that the type of financial system, that is, based on relationship or arm's length, may be a more important determinant of equality of access to finance.

C. Robustness

The reported results were confirmed for robustness in several ways. In order to address concerns that inequality may itself influence globalization variables, the export-to-GDP ratio and the ratio of the inward stock of FDI to GDP (the two significant "de facto" measures) were instrumented using their lagged value, the export-weighted real GDP of trade partners (a measure of the demand for the country's exports), and a distance-weighted sum of industrial countries' FDI assets (a measure of the supply of FDI).[16] The results proved robust to endogeneity (column 6 of Table 1) and other robustness tests, such as dropping one country at a time from the sample, dropping one variable at a time from the regression, and running the regressions including GDP per capita as an explanatory variable. The GDP per capita variable was excluded in the reported estimations in order to estimate the full effects of the variables of interest, including their effect through higher overall growth. Other possible explanatory variables (democracy, constraints on the executive, flexibility of regulations, real exchange rate, and terms of trade) were initially included, but their effects were not robustly estimated.[17]

To gain further insight into the impact of globalization on inequality, the empirical model was also estimated using the income shares of the five quintiles of the population as dependent variables (Table 2). Most of the results from the estimations using Gini coefficients are confirmed, although the estimates at the quintile level are less precise for tariff liberalization and technological progress. In line with the changes observed in the income shares of quintiles, the effects on the bottom four quintiles are qualitatively similar and in the opposite direction from that on the richest quintile. Export growth is associated with a rise in the income shares of the bottom four quintiles and a decrease in the share of the fifth (that is, the richest) quintile. Similarly, a reduction in the share of agricultural employment (which raises the sector's productivity of labor) is also associated with a rise in the income share of the bottom four quintiles, whereas it has the opposite effect on the income share of the richest quintile. The benefits of tariff reduction are mostly concentrated in the income shares of the three bottom quintiles, offset by a decrease in the income share of the top quintile. In contrast, financial globalization, technological progress, and greater financial deepening benefit mainly the income share of the richest 20 percent of the population.

We also explored the possibility of heterogeneous effects of globalization, technological progress, and other variables across country groups (Table 3); results are, however, more tentative as the number of observations used for identification of group-specific effects is much smaller. The first obvious distinction of interest is between advanced countries on the one hand and emerging and developing countries on the other hand. A differentiated effect

[16]The validity of these instruments was confirmed using the Anderson and Hansen tests.

[17]Although government social spending and transfers, migration, and remittances may potentially have important additional effects on the observed inequality outcomes, comprehensive data were not available across many countries and therefore not used in estimation.

was allowed for each control variable and each component of trade and financial openness, including two new variables, the share of export destined to developing countries and the share of imports originating in developing countries (these variables were not significant when the full sample was used).

While maintaining common time dummies, interaction terms between the other regressors and a dummy for advanced countries were included to measure the difference between the effects for advanced countries and the estimated average effect for the full sample. A joint test that all the differences are zero was rejected, due mostly to different effects (for advanced and developing countries) of the FDI (stock) asset-to-GDP ratio and to a lesser extent of the debt liabilities-to-GDP ratio and the share of imports originating in developing countries. While these three variables are insignificant for the full sample (and particularly for developing countries), they are significantly different from zero for advanced countries. The estimation indicates that FDI assets increase inequality in advanced countries, while debt and the share of imports from developing countries contribute to reduce it.

Another distinction of interest is between different developing regions: the main two developing regions represented in the sample are developing Asia and Latin America (only a few African and Middle Eastern countries are included due to data limitations). Due to the even smaller sample sizes involved for these subgroups, a differentiated effect by developing region (developing Asia, Latin America, and other) was tested only for the export-to-GDP ratio, the stock of inward FDI (as a share of GDP) and the technological progress variables. A joint test that all differences are zero was rejected, due to the different effect of technological progress in developing Asia and Latin America. The disequalizing effect of technological progress is stronger in Asia than on average in the full sample and weaker in Latin America (actually insignificantly different from zero). This possibly reflects the greater share of technology intensive manufacturing in Asia than in Latin America.

IV. DISCUSSION

Based on the estimated models, the contributions of the various factors to the change in the Gini coefficient can be calculated as the average annual change in the respective variable multiplied by the corresponding coefficient estimate. The results of the previous section's empirical analysis imply that the main factor driving the recent increase in inequality across a very broad range of countries has been technological change.

Technological progress alone explains nearly 0.35 percent of the 0.45 percent annual average increase in the Gini coefficient from the early 1980s (top panel of Figure 7). Globalization and financial deepening together contributed another 0.1 percent a year. The estimations suggest that increased access to education and a shift in employment away from agriculture contributed 0.1 percent a year towards a reduction in the Gini coefficient. The small net adverse impact of globalization on inequality is a result of two offsetting forces. While the globalization of trade has in the aggregate tended to reduce inequality, financial globalization, and foreign direct investment in particular, has tended to exacerbate the trend towards rising inequality.

The results of estimations run separately for developed (middle panel of Figure 7) and developing countries (bottom panel of Figure 7) suggest that the impact of globalization on inequality differs between these two groups of countries. Among developed countries, where the Gini coefficient has risen by an average of 0.6 percent every year over the sample period, the adverse impact of globalization is somewhat larger than that of technological progress. Among developing countries, however, where the Gini coefficient has risen by about 0.3 percent a year on average, technology has been the main driving force while globalization has in fact provided a small counterweight by tending to reduce inequality.

What explains the above patterns in inequality, as well as the marked differences between developed and developing countries? To answer this question, it is useful to look at the channels through which globalization and technology operate in terms of their impact on the distribution of income.

The beneficial effects of trade on inequality in developing countries are particularly noticeable for agricultural exports, given agriculture still employs a large share of the workforce. Opening up of trade in agriculture, increases the income of those who are dependent on agriculture for their livelihood in developing countries. Moreover, the shift of underemployed agricultural workers to manufacturing or services also increases the relative productivity of agriculture, raising the income of those who continue to remain dependent on agriculture, and are typically among the lowest earning workers in developing countries. A reduction in tariffs is also associated with a reduction in inequality by allowing cheaper imports to substitute for more expensive domestically produced consumption and intermediate inputs, consistent with the predictions of the Stolper-Samuelson hypothesis.

For developed countries, imports from developing countries are associated with a reduction in inequality. To the extent that noncompeting imports are available more easily and at a lower price, the effective income of poorer segments of the population are increased allowing them to consume more than previously. Moreover, lower paying low-end manufacturing jobs are substituted by higher paying service sectors in the expanding retail and consumer finance sectors. As might be expected, imports from other advanced economies do not have the same beneficial impact on inequality because higher-end imports are likely to affect higher paying domestic employment that may not be readily substituted by new service sector employment opportunities. Higher end imports can also be expected to form a small component of the consumption basket of the poorer segments of the population.

In both developed and developing countries, financial globalization—and foreign direct investment in particular—are associated with increases in income inequality. In both groups of countries, inward FDI is associated with rising inequality, while in developed countries outward FDI also has an additional negative impact. What explains this pattern? From the point of view of the host country, FDI tends to take place in higher skill and higher technology sectors. As a result, while FDI increases employment and income, this tends to favor those who already have relatively higher skills and education. In developed countries, FDI often goes into skill intensive and high technology sectors, raising the incomes of those who are better educated and tend to already have higher incomes, further exacerbating income inequality. In developing countries, the bulk of FDI goes into low-end manufacturing

and natural resource sectors, increasing employment opportunities and income for those who have higher skills than for example agricultural workers. As result, in both developing and developed countries, inward FDI increases the relative demand for higher skilled workers. Outward FDI in developed economies predictably tends to increase inequality by reducing employment opportunities in relatively lower skill sectors.

The impact of technology on inequality is closely related to that of foreign direct investment. Technological progress, in both developed and developing countries, increases the premium on skills and tends to substitute away low-skill inputs (Birdsall, 2007). Technological progress thus increases the relative demand for higher skills, thereby exacerbating inequality in income. In developed countries, the use of technology is widespread in both manufacturing and services, affecting a substantial segment of the economy. Among developing countries, the adverse effect of technology on income inequality is more evident in Asia than in Latin America. Manufacturing is a greater share of the economy in many Asian countries than in Latin American countries, and impact of new technology affects a greater share of the population in the former.

The adverse impact of financial deepening on inequality suggests that while overall financial deepening is associated with higher growth, a disproportionately larger share of increased finance goes to those who already have higher incomes and assets which can serve as collateral. The better off are thus able to take greater advantage of increased finance to further increase their income and earnings potential.

Overall, the results suggest that both globalization and technology tend to increase the returns to skills in both developed and developing countries. While incomes have increased across all segments of the population in virtually all regions and countries, the incomes of the already well off have increased by disproportionately more during the recent era of globalization. Greater access to education and training can increase the share of the population that can take advantage of the opportunities to improve living standards from both globalization and technology. The results of this paper confirm that while these two important factors have made a positive contribution to income, not just at the aggregate level but even at the level of different subgroups of the population, better access to education and training could allow the undeniably positive benefits of globalization and technology to be shared more broadly. In the same vein, broader access to finance would also benefit the poorer segments of the population, and it is not just aggregate financial deepening but how broadly it is available that matters.

The results of the analysis provide empirical support to the notion expressed by Bernanke that technological change played a major role in increasing inequality, while globalization played a smaller role. At the same time, our findings are at odds with arguments made by several economists that the increase in international trade contributes to the rise in inequality.[18]

[18]See Bernanke (2008).

The research presented in this paper could be extended along several dimensions. First, it is important to examine the impact that government policies, and fiscal policies in particular, have on the distribution of income. While one can conjecture that certain types of redistribution policies could ameliorate the adverse distribution of income, to date no comprehensive database of government policies across countries exists that would allow for an empirical examination of the impact of government policies. A second line of enquiry would be to examine the impact of FDI in different sectors, where the distributional consequences might be expected to vary. Finally, the impact of technological progress can expected to vary by sector and type of technology. This too, is however, limited by the availability of comprehensive data across countries and over time, suggesting that extensions of this type would have to be limited to a single country or a relatively small group of countries.

V. CONCLUSION

Estimates using a new and more reliable dataset on inequality and detailed measures of globalization suggest that the observed rise in inequality across both developed and developing countries over the past two decades is largely attributable to the impact of technological change.[19] The contribution of increased globalization to inequality has in general been relatively minor. This reflects two offsetting effects of globalization: while increased trade tends to reduce income inequality, foreign direct investment tends to exacerbate it. Both globalization and technological progress tend to increase the relative demand for skills and education. While incomes have increased across all segments of the population in virtually all countries in the sample, incomes of those who already have higher levels of education and skills have risen disproportionately more.

The implication of these findings is that broader access to education will allow a greater segment of the population to take advantage of the opportunities from globalization and technological change. While these changes have increased incomes across countries and helped reduce poverty, the benefits would be even greater, allowing for a faster reduction in poverty, if the distribution of skills became more equal. This suggests that the returns to investment in education for all countries has risen in the recent era of globalization.

[19]The dataset used in the study is available in its entirety by the authors upon request.

APPENDIX I. VARIABLE DEFINITIONS AND DATA SOURCES

This appendix provides further details on the construction of the variables and the data sources used in this chapter.

Gini Index

The primary source for the Gini index data is the World Bank *Povcal* database. For Mexico and Poland, the consumption-based Gini indices and quintile income shares were extrapolated historically for the period prior to 1992—for which only income-based measures are available—by assuming that the changes in consumption-based measures are identical to the observed changes in income-based measures that are available for that period. A similar process was applied to Peru's data prior to 1990, applying the changes in the observed consumption-based measures for earlier years to the income-based Gini index available from 1990 onward. For Argentina and Uruguay, the data cover only urban areas because of the high rate of urbanization in these two countries. For China and India, data with full country coverage (combining urban and rural data from the World Bank *Povcal* database) were provided by Shaohua Chen of the World Bank. When *Povcal* data were not available (mainly for advanced economies), the data from the Luxembourg Income Study were used, as provided in the World Income Inequality Database, Version 2.0b, May 2007 (WIDER).

These data are mostly available only until 2000. The following other sources were also used to increase coverage for advanced economies: data for Australia are from the Australian Bureau of Statistics; data for Germany are from the Deutsches Institüt für Wirtschaftsforschung; data for France are from the European Commission; household inequality data for Hong Kong SAR are from the Hong Kong Census and Statistics; household inequality data for Singapore are from Ong Whee Sze (2002); household Gini index data for Japan are from Shirahase (2001); income share data for Japan measuring household consumption inequality and excluding agricultural households are from the Family Income and Expenditure Survey provided by the Japanese Statistics Bureau (all included in WIDER); and household inequality data for Korea were provided by Professor Kyungsoo Choi of the Korea Development Institute. The regressions used only actual (not interpolated) observations.

Trade Globalization

De facto trade openness is calculated as the sum of imports and exports of (non-oil) goods and services over GDP. The data are from the World Economic Outlook database (April 2007). Sectoral trade data on agriculture, manufacturing, and services are from the World Bank's World Development Indicators database (April 2007). De jure trade openness is calculated as 100 minus the tariff rate, which is an average of the effective tariff rate (tariff revenue/import value) and of the average un-weighted tariff rate. The data are from a database prepared by IMF staff. Each component of the implied 100 minus tariff rate is interpolated linearly for countries with data gaps less than or equal to seven missing observations between 1980 and 2004. When data for either component (the effective tariff

rate or the average un-weighted tariff rate) are shorter than for the other, the shorter series is extrapolated using the growth rate of the longer series. Finally, for countries with only one of the two components, only the available one is used.

Financial Globalization

De facto financial openness is calculated as the sum of total cross-border assets and liabilities over GDP. Data on financial globalization are from the "External Wealth of Nations Mark II" created by Lane and Milesi-Ferretti (2006). The components of de facto financial openness in percent of GDP include (for both assets and liabilities) (1) FDI, (2) portfolio equity, (3) debt, (4) financial derivatives, and (5) total reserves minus gold (assets only). De jure financial openness refers to the capital account openness index (KAOPEN) from Chinn and Ito (2006). The index is based on principal components extracted from disaggregated capital and current account restriction measures in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*.

Capital Stock and ICT Capital

Fajnzylber and Lederman (1999) is the source of the capital stock series for the entire economy. This data set extends the capital stock series estimated by Nehru and Dhareshwar (1993) by adding the annual flow of gross fixed capital formation and assuming a 4 percent depreciation rate of the preexisting stock of capital. Fajnzylber and Lederman (1999) was further updated to recent years using the same methodology. Jorgensen and Vu (2005) provides series on IT investment using national expenditure data for computer hardware, software, and telecommunications equipment. A perpetual inventory method applies varying depreciation rates to estimate the IT capital stock. This method assumes a geometric depreciation rate of 31.5 percent and a service life of seven years for computer hardware, 31.5 percent and five years for software, and 11 percent and 11 years for telecommunications equipment.

Private Credit

Each country's financial depth is estimated by its ratio of credit to the private sector by deposit money banks and other financial institutions to GDP. The source is the Financial Structure database prepared by Beck, Demirgüç-Kunt, and Levine (2000) and revised in March 2007. Data for China are based on IMF staff calculations.

Education

Data on educational attainment of the population ages 15 and older are from the Barro-Lee (2000) data set. The series used are the average schooling years in the population, and the share of the population with secondary and/or higher education.

Sectoral Employment

Data on employment shares in agriculture and industry are from the World Bank's World

Development Indicators database (April 2006). The shares are interpolated linearly for countries with data gaps of seven or fewer missing observations between 1980 and 2005. For Bolivia, data are from the International Labor Organization's LABORSTA database for 1988–2001 and from the Instituto Nacional de Estadística for 2002–05. For Ecuador, data for 1988–2005 are from the International Labor Organization's LABORSTA database. For Morocco, data for 1999–2002 are from the Direction de la Politique Economique Générale. For Paraguay, data for 1991–2005 are from the Departamento de Cuentas Nacionales y Mercado Interno, Gerencia de Estudios Económicos. For China, data for 1980–2004 are from the National Bureau of Statistics. For India, data for 1980–2004 are taken from the National Sample Survey Organization. For Taiwan Province of China, data for 1980–2005 are from the CEIC database.

APPENDIX II. INCOME COUNTRY GROUPS AND ESTIMATION SAMPLE

Income country groups: Aggregates by income level use the following countries: The groups are low income, $875 or less; lower-middle income, $876–$3,465; upper-middle income, $3,466–$10,725; and high income, $10,726 or more. Taiwan Province of China is included in the high-income group.

Countries used in estimation: The sample of countries for which all variables used in the regressions were available consists of 51 countries, of which 20 are advanced economies and 31 are developing economies. Based on data availability, the following countries are included:

- **Advanced economies:** Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Israel, Italy, Japan, Korea, the Netherlands, Norway, Singapore, Spain, Sweden, the United Kingdom, and the United States.

- **Developing economies:** Argentina, Bangladesh, Bolivia, Brazil, Chile, China, Costa Rica, Ecuador, Egypt, El Salvador, Ghana, Guatemala, Honduras, India, Indonesia, the Islamic Republic of Iran, Kenya, Malaysia, Mexico, Pakistan, Panama, Paraguay, Peru, the Philippines, Sri Lanka, Thailand, Turkey, Uganda, Uruguay, Venezuela, and Zambia.

Table 1: Income inequality panel regressions
(dependent variable: natural logarithm of Gini)

Model Specification	Full Model	Benchmark Model	Sectoral Exports	Sectoral Productivity	Excluding Sectoral Empl. Shares	IV Estimation
Trade globalization						
Export-to-GDP ratio	-0.066	-0.057		-0.048	-0.056	-0.055
	(2.18)**	(2.56)**		(2.15)**	(2.41)**	(2.16)**
Agricultural exports			-0.03			
			(2.49)**			
Manufacturing exports			-0.002			
			(0.10)			
Service exports			-0.006			
			(0.38)			
Import-to-GDP ratio	0.011					
	(0.38)					
100 minus tariff rate	-0.002	-0.002	-0.003	-0.002	-0.003	-0.003
	(2.27)**	(2.52)**	(2.71)***	(2.61)***	(2.50)**	(2.98)***
Financial globalization						
Ratio of inward FDI stock to GDP	0.039	0.040	0.038	0.035	0.039	0.029
	(2.92)***	(3.01)***	(3.06)***	(2.57)**	(2.96)***	(2.03)**
Ratio of inward portfolio equity stock to GDP	-0.0001					
	(0.15)					
Ratio of inward debt stock to GDP	0.002					
	(0.12)					
Ratio of outward FDI stock to GDP	0.0005					
	(0.39)					
Capital account openness index	-0.001					
	(0.17)					
Control variables						
Share of ICT in total capital stock	0.032	0.031	0.027	0.030	0.033	0.047
	(1.87)*	(1.98)**	(1.62)	(2.03)**	(2.01)**	(3.16)***
Credit to private sector (percent of GDP)	0.049	0.051	0.049	0.050	0.042	0.041
	(3.38)***	(3.49)***	(3.81)***	(3.54)***	(3.06)***	(2.58)***
Population share with at least a secondary education	0.003	0.003	0.002	0.004	0.004	0.002
	(1.42)	(1.47)	(0.77)	(1.82)*	(2.08)**	(0.84)
Average years of education	-0.219	-0.216	-0.182	-0.328	-0.359	-0.16
	(1.17)	(1.20)	(1.00)	(1.84)*	(1.91)*	(0.87)
Agriculture employment share	0.05	0.05	0.052			0.058
	(2.00)**	(2.05)**	(2.21)**			(2.49)**
Industry employment share	-0.102	-0.095	-0.098			-0.096
	(2.50)**	(2.78)***	(2.26)**			(2.90)***
Relative labor productivity of agriculture				-0.037		
				(1.67)*		
Relative labor productivity of industry				0.128		
				(3.03)***		
Observations	288	288	284	279	288	285
Adjusted R-squared (within)	0.29	0.30	0.31	0.32	0.27	
Anderson Test						188.1
p-value						[0.00]
Hansen Test						2.01
p-value						[0.37]

Notes: Heteroskedasticity-robust t-statistics are in parentheses; *denotes significance at the 10 percent level, ** denotes significance at the 5 percent level, and *** denotes significance at the 1 percent level. All explanatory variables are in natural logarithm, except the tariff measure, the capital account openness index, and the population share 5 percent level, and *** denotes significance at the 1 percent level. All explanatory variables are in natural logarithm, except the tariff measure, the capital account openness index, and the population share. All explanatory variables are in natural logarithm, except the tariff measure, the capital account openness index, and the population share with at least a secondary education. The left- and right-hand-side variables are demeaned using country-specific means (equivalent to doing a panel estimation with country fixed effects) and the equations include time dummies. FDI = foreign direct investment; ICT = information and communications technology.

Table 2: Quintile income shares regressions

(dependent variable: quintile income share)

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Test all coefficients equal to zero [p-value]
Export-to-GDP ratio	0.439	0.631	0.690	0.492	-2.220	
	(2.47)**	(3.52)***	(3.68)***	(2.58)***	(3.57)***	[0.02]**
100 minus tariff rate	0.021	0.020	0.017	0.013	-0.070	
	(2.16)**	(2.04)**	(1.67)*	(1.32)	(2.12)**	[0.28]
Ratio of inward FDI stock to GDP	-0.400	-0.385	-0.326	-0.163	1.241	
	(3.91)***	(3.74)***	(3.02)***	(1.48)	(3.47)***	[0.00]***
Share of ICT in total capital stock	-0.177	-0.223	-0.218	-0.207	0.830	
	(1.32)	(1.65)*	(1.54)	(1.44)	(1.77)*	[0.59]
Credit to private sector (percent of GDP)	-0.373	-0.625	-0.709	-0.437	2.136	
	(3.30)***	(5.47)***	(5.94)***	(3.59)***	(5.39)***	[0.00]***
Population share with at least a secondary education	-0.035	-0.025	-0.028	-0.003	0.094	
	(1.76)*	(1.26)	(1.31)	(0.16)	(1.35)	[0.14]
Average years of education	1.844	1.041	1.020	0.128	-3.99	
	(1.11)	(0.62)	(0.58)	(0.07)	(0.69)	[0.80]
Agriculture employment share	-0.460	-0.789	-0.981	-0.568	2.777	
	(1.76)*	(2.98)***	(3.55)***	(2.02)**	(3.02)***	[0.00]***
Industry employment share	1.081	0.866	0.603	0.084	-2.623	
	(3.07)***	(2.43)**	(1.62)	(0.22)	(2.12)**	[0.09]*
Observations	271	271	271	271	271	
R-squared	0.34	0.36	0.33	0.18	0.35	

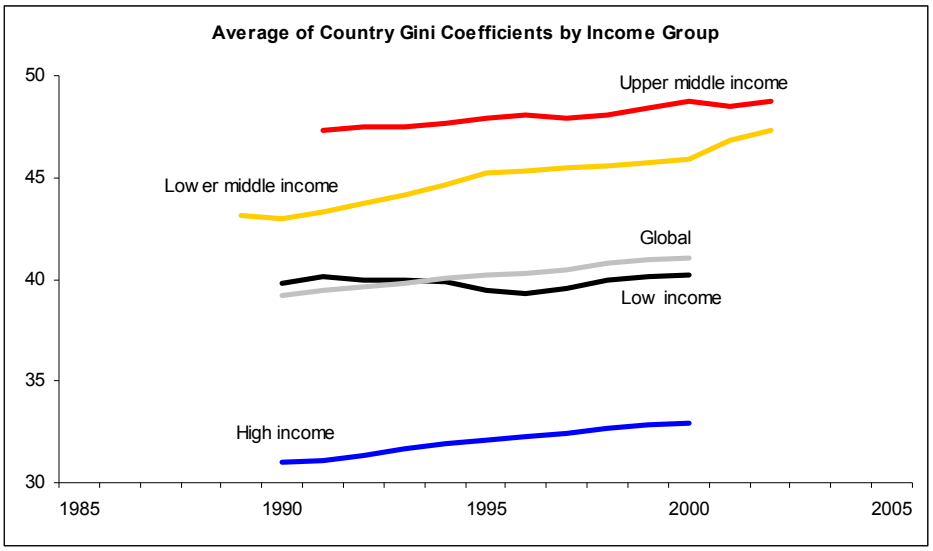
Notes: T-statistics are in parentheses; * denotes significance at the 10 percent level, ** denotes significance at the 5 percent level, and *** denotes significance at the 1 percent level. All explanatory variables are in natural logarithm, except the tariff measure and the population share with at least a secondary education. The left- and right-hand-side variables are de-meaned using country-specific means (equivalent to doing a panel estimation with country fixed effects), and the equations include time dummies. The equations are estimated jointly using the seemingly unrelated regressions estimator. FDI = foreign direct investment; ICT = information and communications technology.

Table 3: Income inequality panel regressions (regional heterogeneity)
(dependent variable: natural logarithm of Gini)

	Advanced versus developing economies	Regional technology effect
Common Model		
Export-to-GDP ratio	-0.063	-0.071
	(2.23)**	(3.17)***
100 minus tariff rate	-0.002	-0.004
	(2.24)**	(3.53)***
Ratio of inward FDI stock to GDP	0.031	0.041
	(2.28)**	(3.03)***
Share of ICT in total capital stock	0.035	0.037
	(2.12)**	(2.11)**
Credit to private sector (percent of GDP)	0.058	0.041
	(3.94)***	(3.29)***
Population share with at least a secondary education	0.001	0.002
	(0.35)	(0.82)
Average years of education	-0.100	-0.124
	(0.54)	(0.65)
Agriculture employment share	0.074	0.052
	(2.59)**	(2.31)**
Industry employment share	-0.090	-0.139
	(2.23)**	(3.96)***
Additional variables for advanced economies		
Share of imports from developing economies	0.018	
	(0.57)	
Share of imports from developing economies *		
dummy for advanced economies	-0.104	
	(2.20)**	
Ratio of inward debt stock to GDP	0.014	
	(0.78)	
Ratio of inward debt stock to GDP *		
dummy for advanced economies	-0.083	
	(2.65)***	
Ratio of outward FDI stock to GDP	0.000	
	(0.31)	
Ratio of outward FDI stock to GDP *		
dummy for advanced economies	0.069	
	(2.68)***	
Different regional technology effect		
Share of ICT in total capital stock*		
dummy for developing Asia		0.033
		(1.99)**
Share of ICT in total capital stock *		
dummy for Latin America and the Caribbean		-0.028
		(1.91)*
Observations	282	282
Adjusted R-squared	0.32	0.35

Notes: T-statistics are in parentheses; * denotes significance at the 10 percent level, ** denotes significance at the 5 percent level, and *** denotes significance at the 1 percent level. All explanatory variables are in natural logarithm, except the tariff measure and the population share with at least a secondary education. The left- and right-hand-side variables are de-meaned using country-specific means (equivalent to doing a panel estimation with country fixed effects), and the equations include time dummies. The equations are estimated jointly using the seemingly unrelated regressions estimator. FDI = foreign direct investment; ICT = information and communications technology.

Figure 1. Income Inequality Within Income Country Groups and Selected Countries



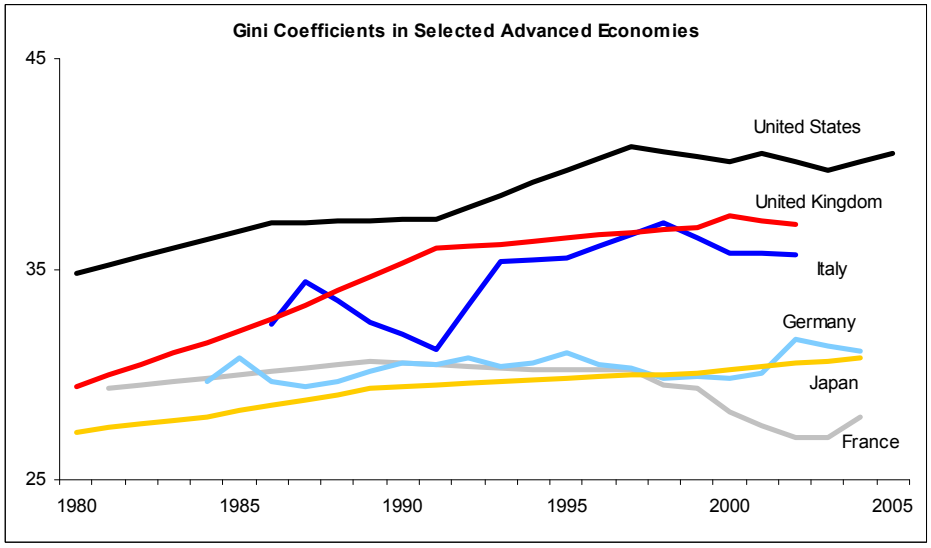
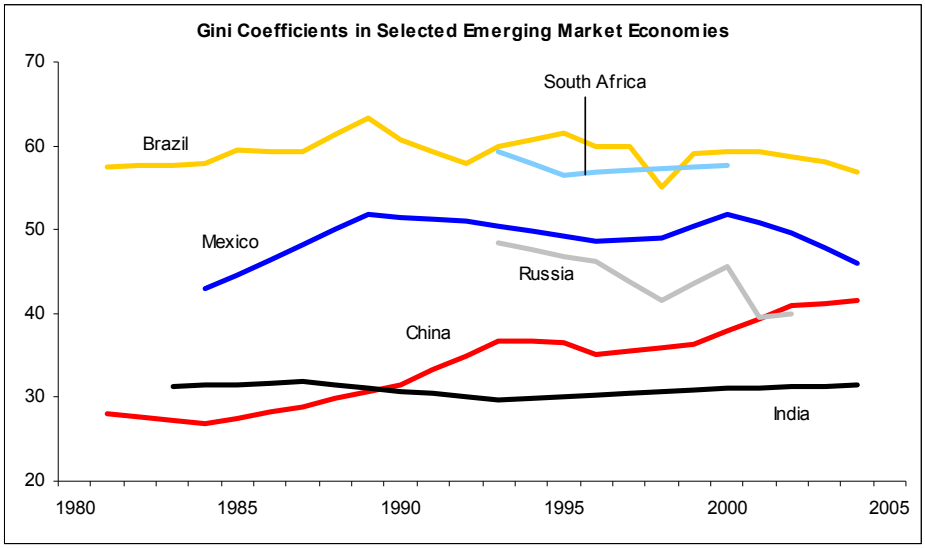
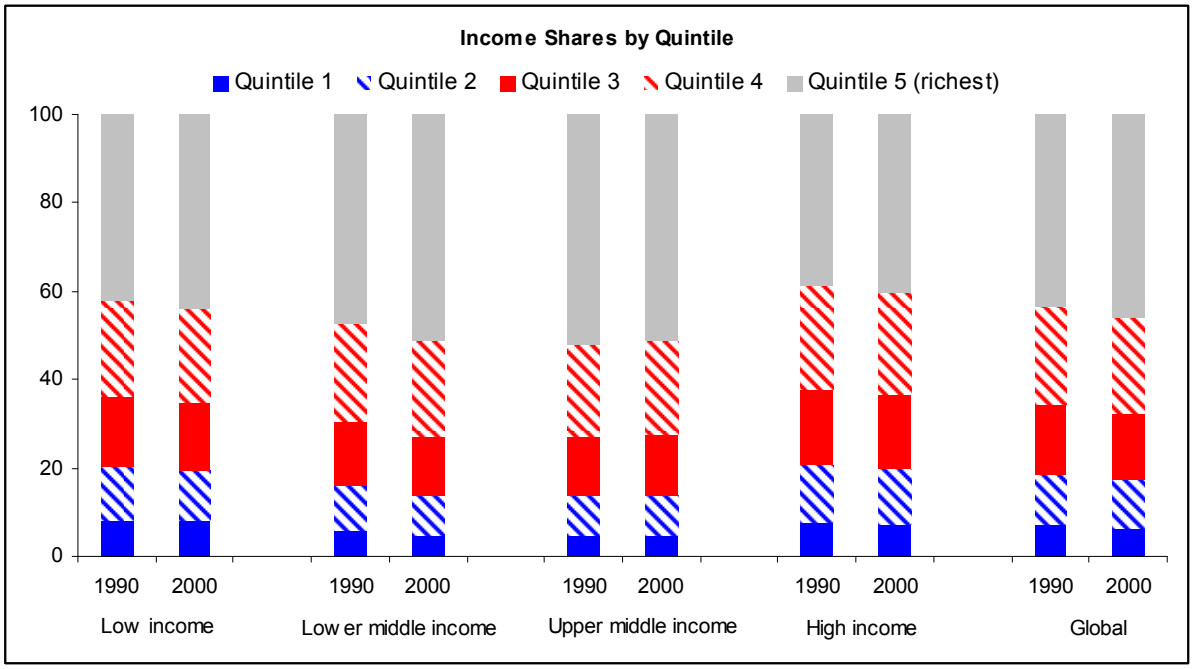


Figure 1. Income Inequality Within Income Country Groups and Selected Countries (concluded)



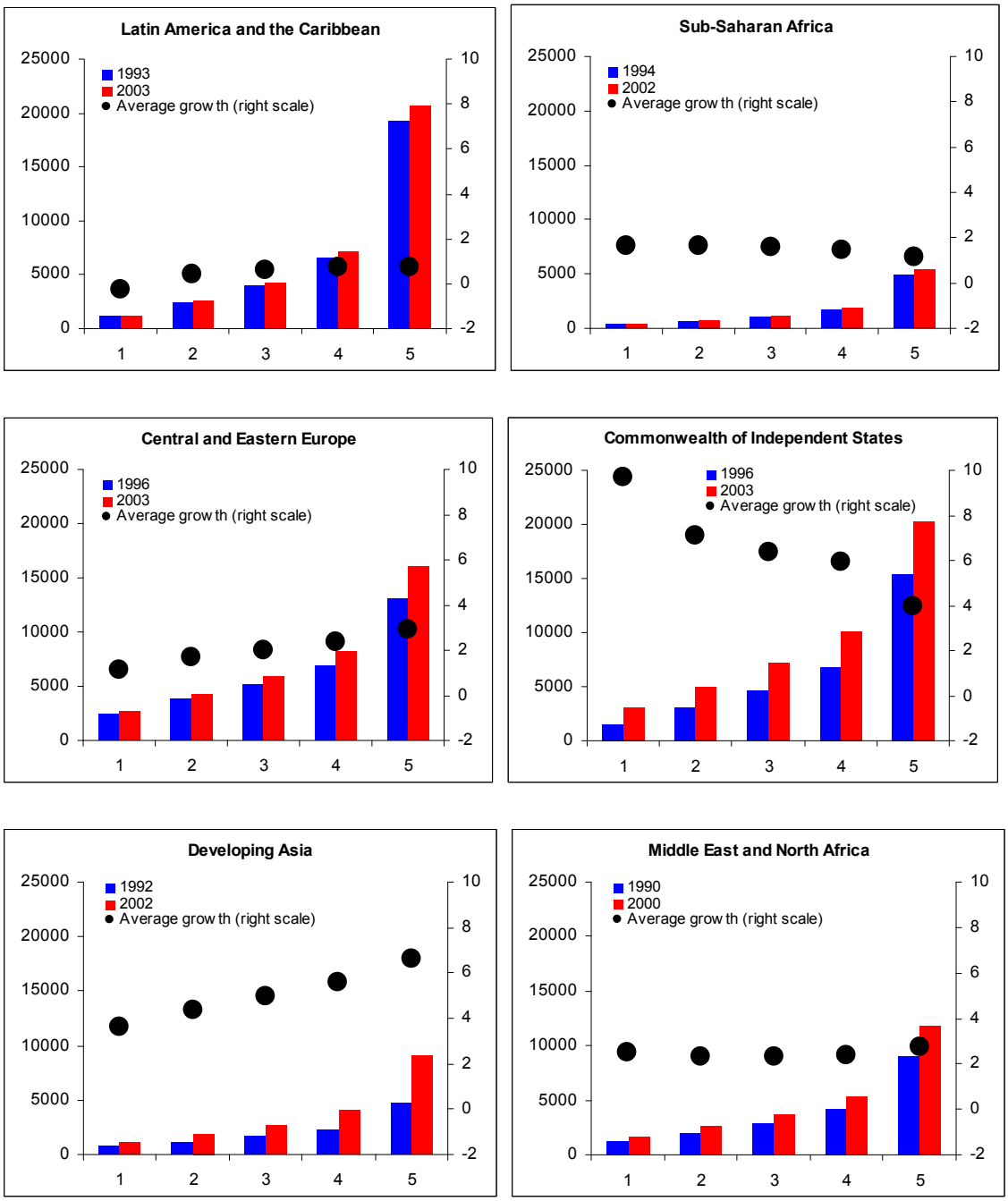
Notes: Income country groups are defined in the appendix. Trends after 2000 are based on earnings data for full-time, year-round workers. Trends for pre-1992 Germany are based on data for West Germany.

Figure 2. Income Shares Within Income Country Groups



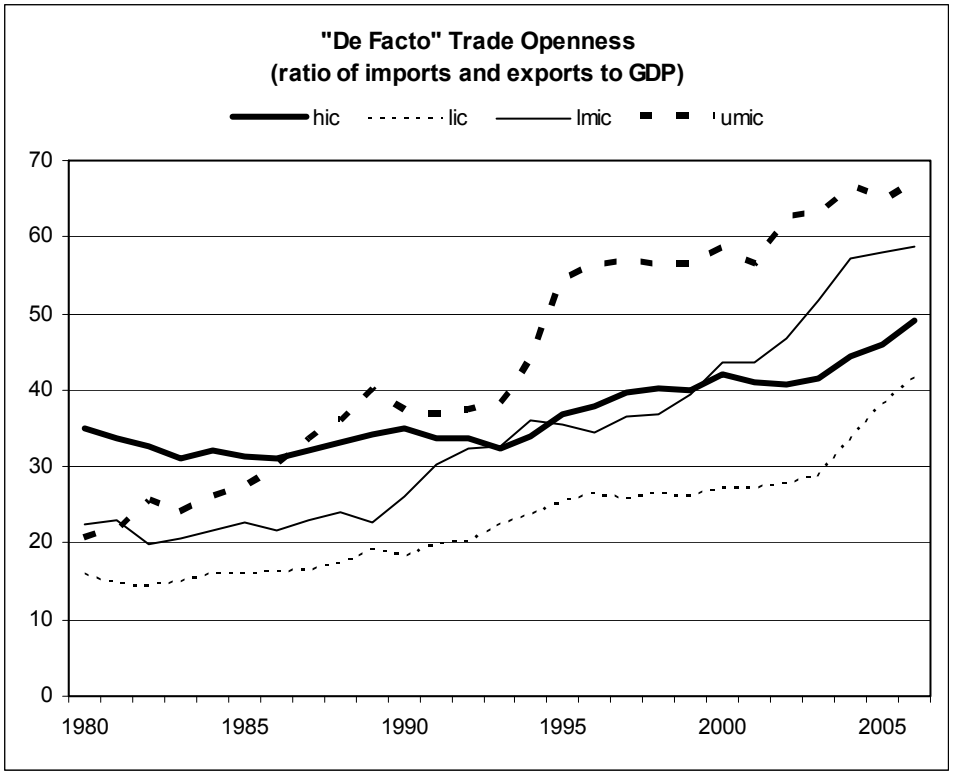
Notes: Income country groups are defined in the appendix.

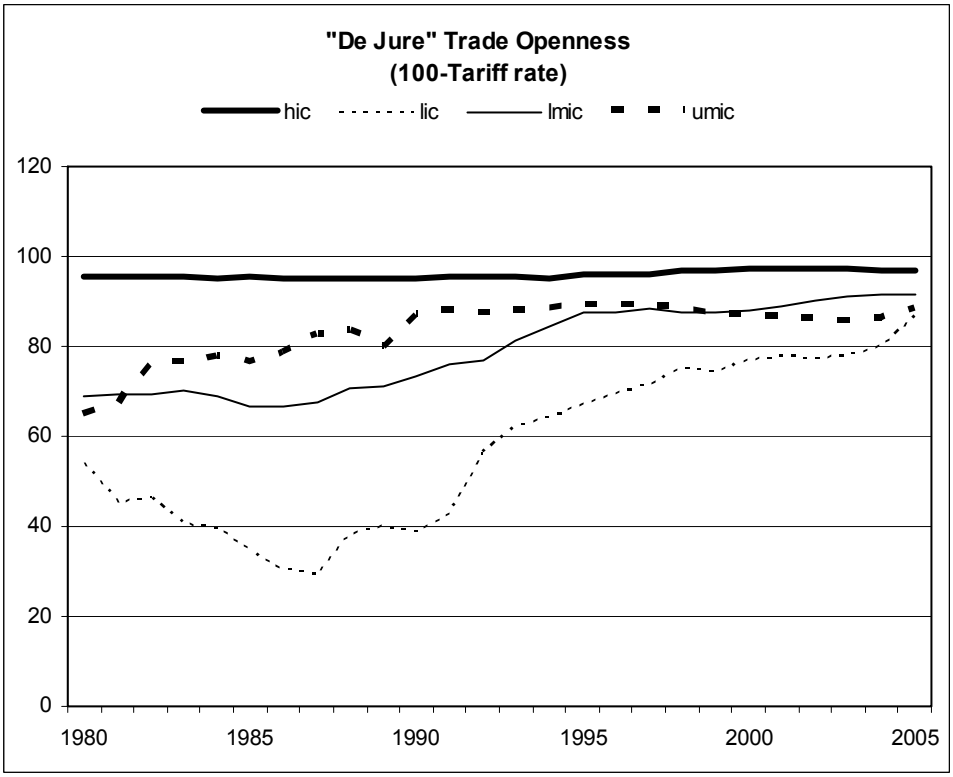
Figure 3. Income by Quintile in Selected Regions



Notes: Income or consumption share data are applied to per capita real GDP levels from PWT 6.2 to calculate per capita income by quintile.

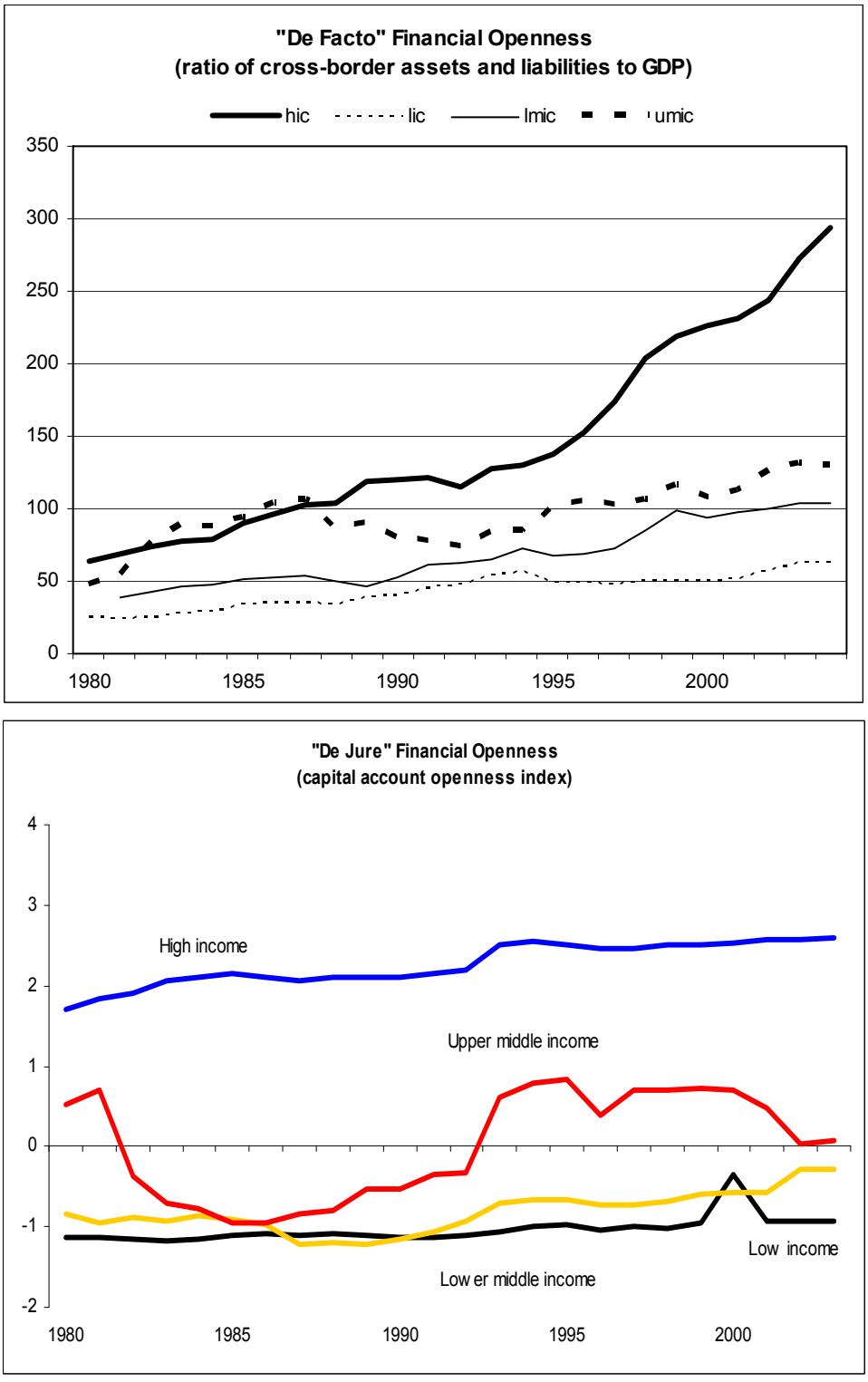
Figure 4. Trade Liberalization Within Income Country Groups





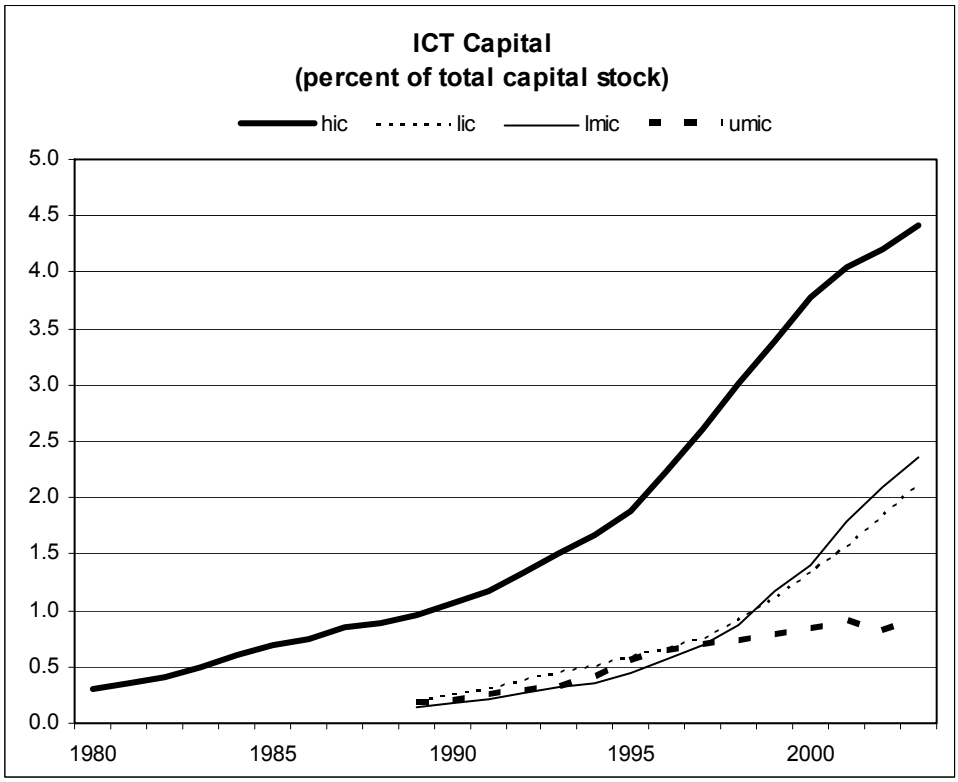
Notes: Income country groups are defined in the appendix. Tariff rates are calculated as the average of the effective rate (ratio of tariff revenue to import value) and of the average un-weighted tariff rates.

Figure 5. Financial Liberalization Within Income Country Groups



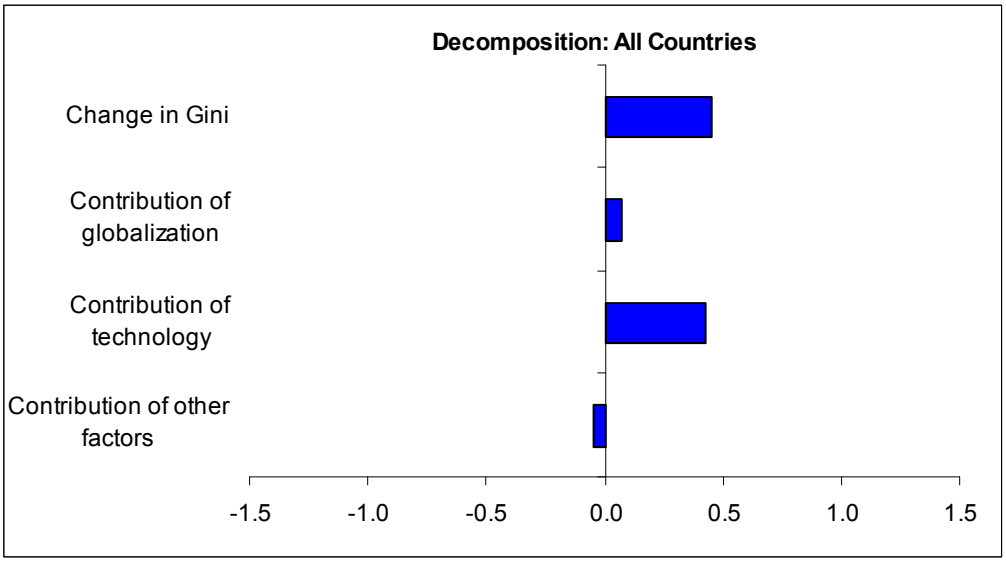
Notes: Income country groups are defined in the appendix. De jure financial openness, measuring a country's degree of capital account openness, is based on principal components extracted from disaggregated capital and current account restriction measures.

Figure 6. Technological Development Within Income Country Groups



Notes: Income country groups are defined in the appendix. ICT data are from Jorgenson and Vu (2005).

Figure 7. Decomposition of the Change in Income Inequality



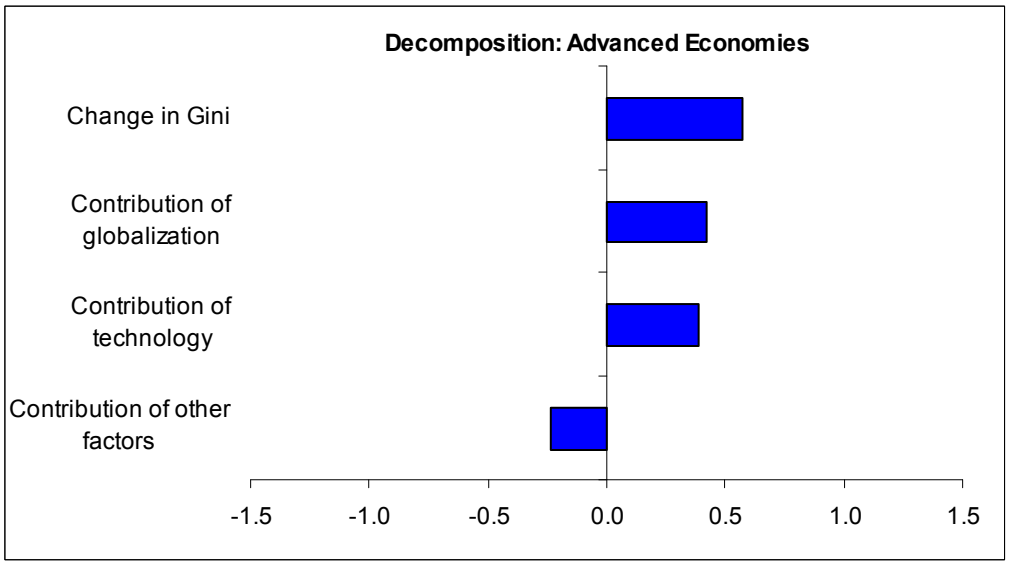
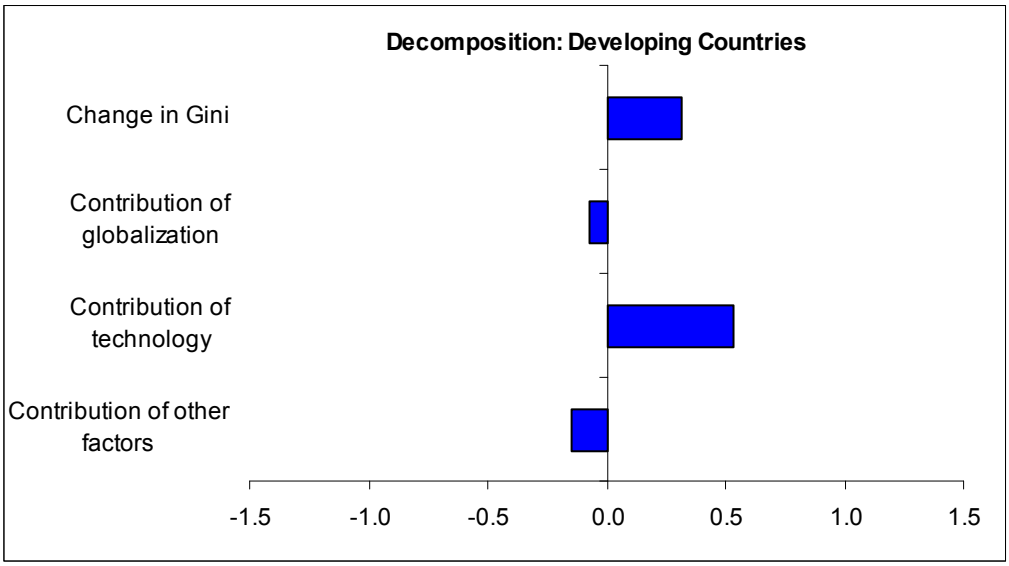


Figure 7. Decomposition of the Change in Income Inequality (concluded)



Notes: Income country groups are defined in the appendix. The contribution of each variable is computed as the annual change in the variable times the relevant regression coefficient on the variable.

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