Openness and Inequality in Developing Countries: a New Look at the Evidence

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Document de travail de la série

Etudes et Documents

E 2007.09

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CERDI - UMR CNRS 6587 - Université Clermont 1

mai 2007
49 p.

Abstract

Integration to world markets is expected to help developing countries to access prosperity. At the same time, increasing opportunities to trade are likely to affect income distribution and whether or not increasing openness to trade is accompanied by a reduction or an increase inequality is highly controversial. This paper brings new evidence on this issue in using a data set covering a large sample of developing countries and a model with improved controls for omitted variables and a new index of trade openness. Trade liberalization increases inequality in countries that relatively well-endowed in capital. Our model assumes that it might be fruitful to breakdown unskilled labor into non-educated and primary-educated as suggested by Wood (1994). The results show that trade liberalization increases inequality in highly educated abundant countries whereas it decreases inequality in primary educated abundant countries. However it increases inequality in non educated abundant countries, suggesting that this part of population does not benefit from trade openness since it is not included in export oriented sectors.

JEL classification: F11, F16, D3

Keywords: International Trade, Income Distribution, Poverty

1 Introduction

Integration to world markets is expected to help developing countries to access prosperity. At the same time, increasing opportunities to trade are likely to affect income distribution and whether or not increasing openness to trade is accompanied by a reduction or an increase inequality is highly controversial. Indeed, in a recent review of the literature, Anderson (2005) concludes that the evidence is very mixed "Recent years have witnessed many empirical studies on the effects of openness on inequality in developing countries. On the one hand, several detailed time-series studies of individual middle income developing countries have shown that increased openness has raised the relative demand for skilled labor. On the other hand, cross-country econometric evidence suggests that increased openness has had little impact on overall inequality in developing countries. This is a puzzle, because we would expect a rise in the relative demand for skilled labor to increase overall inequality, all else being equal."

Two mains approaches have been used extensively study the relationship between trade and inequality. One relies on wage difference in manufacturing industry and consists in time series studies by country. While these studies have the advantage to be adessed to the underlying factor proposition of the Hecksher Ohlin Samuelson (HOS) model used in the debate, they do not take into account the effects of commodity price changes on purchasing power and are confined to a sector which often represents a small sector of the economy in low income countries. Moreover, these studies usually account only for two factors, skilled and unskilled labor, without including the well being in the global economy and concern only middle income developing countries.

The second approach, which we adopt here, uses a measure of inequality on global income, the Gini coefficient, and consists in panel studies. While this approach, in considering global income, includes more than two factors production, and extends the traditional HOS model, it seems to us more appropriate to analyze inequality in developing countries since it includes all the population. Moreover it allows including low income countries.

Under this approach the investigation aims to determine if trade openness effectively decreases inequality in developing countries relative to developed countries. However, developing countries no longer form a homogenous group of countries merely better endowed in unskilled labor. Hence recent studies test the impact of trade according to relative endowment in unskilled labor, skilled labor, physical capital and land. They are more in line with international trade theories.

In this study we extend previous analyses that have relied only on two sorts of labor factor (skilled and unskilled) since we distinguish between two sorts of unskilled labor, non educated and primary educated, arguing that the impact of trade openness according to human capital is a non linear relationship. Indeed, with three types of labor (no education, basic and highly skilled), Wood (1994) argues that openness in poor countries might increase inequalities by helping those with basic education and leaving even further behind those with no education. Only when the poor become reasonably skilled, can the low deciles share begin to benefit from increased labor demand. Milanovic's (2002) analysis is similar; studying the impact of trade openness on deciles, according to the mean income of countries, he finds that for low income countries it is the rich who benefit from openness, as mean income level rises, (for countries like Colombia, Chile) the relative income of poor and middle class increase compared to the rich during the trade liberalization. Trade openness does not benefit the

poorest deciles in poor countries (who have no education) but to the poorest deciles in middle income countries (who have basic education). More recently Bensidoun et al. (2005) find that international trade raises income inequalities for countries with a no educated share greater than 30%.

Several other factors may contribute to the difference between the usual findings and ours.

(i) Differences in the sample of countries: several studies restrict attention to considerably smaller and possibly a non representative sample of countries compared to the 75 which appear in our database and provide 360 observations on five years average periods. It seems more representative since it includes more observations concerning developing countries than developed countries.

(ii) Differences in the measure of trade openness: in order to cover a large period (for which tariffs are not available), several studies focus on the output ratio for which a large part is only linked to structural factors in the country and does not indicate the change in prices. Others use the Sachs-Warner index which has been criticized for proxying the overall policy environment rather than openness. Since we are interested in the outwardness of countries in terms of both imports and exports (and their ability to access to developed country markets) we avoid also the tariffs measure which captures only the protection from imports and which does not cover a large period. We use a new measure of adjusted trade openness based on a gravity model as Hiscox and Kastner (2002).

(iii) Differences in econometric specification and technique: we correct for heteroskedasticity and we include country fixed effects in our estimation to control for countries heterogeneity, contrary to most previous studies which used OLS estimator. Trying to explain cross-country differences in levels of inequality is not easy, since a number of factors cannot be properly

taken into account. As a consequence, econometric estimates are likely to be flawed with omitted variable bias. In addition, the interesting issue from a policy perspective is not whether countries with different degrees of openness exhibit different levels of inequality, but rather whether an increase in a country's trade openness is associated with an increase or a decrease in inequality. Even from a theoretical perspective, the predictions of the HOS framework do not refer to cross-country comparison of levels of inequality, but rather to their changes as countries open up to trade.

To anticipate our results, we find that trade openness raises income inequalities both for non educated abundant countries and for highly educated abundant countries. Inversely trade liberalization decreases inequality for countries well endowed in primary educated labor. These results confirm Wood (1994) framework. The policy implication of these results is to know how trade can lead to decreasing income inequalities in developing countries: implement basic education in order that all workers benefit from trade openness. Workers in developing countries need to acquire a reasonable level of skill to benefit from trade liberalization. Our results suggest that countries with at least 20% of primary educated labor will have decreasing inequalities during their liberalization, whereas countries with at least 20% of no educated labor will have increasing inequalities. In addition, once we control for country specificity we find also that trade increase income inequalities in capital abundant countries which support the HOS model.

The paper is organized as follows. Section 2 describes the empirical approach. Section 3 presents the construction and the robustness of our policy trade index in a gravity model, and section 4 presents the results and section 5 concludes.

2 Empirical approach

2.1 Usual test

Several studies (Table 1) test the hypothesis that greater openness reduces inequality in developing countries. To do so these studies introduce multiplicative variable between openness $Open_i$ and level of development Y_i (quantitative: income per capita, or qualitative: dummy for OECD country). Hence they test if the impact of openness differs according to the level of development. They add also other control variables Z_i (education, civil liberties…) (equation 1.1).

$$INEQ_{it} = \beta_0 + \beta_1 Y_{it} + \beta_2 Open_{it} + \beta_3 (Open_{it} * Y_{it}) + \beta_4 Z_{it} + \varepsilon_{it} \quad (1.1)$$

This hypothesis is derived from the basic HOS with two factors in which developing countries have an abundant supply of unskilled labor relative to skilled labor and developed countries have an abundant supply of skilled labor relative to unskilled labor. The support for the hypothesis is that β_1 is negative and β_2 is positive.

Table 1: Studies on Openness and Inequality

Study on Gini	Sample	Measure of openness	Effect of openness on inequality
Edwards 1997	43 countries in 1970 and 1980 by decade averages First difference	Tariffs, Sachs - Warner, Adjusted Trade	=0 for developed countries =0 for developing countries
Savvides 1998	34 countries on 1978-1994 in two periods First difference	Tariffs and NTBs, Sachs -Warner	=0 for developed countries >0 for developing countries
Li, Squire and Zou 1998	49 countries on 1960-1990 5 years period average OLS	X/GDP	=0
Higgins & Williamson 1999	85 countries on 1960-1990 Decades averages OLS and Fixed Effect	Tariffs, NTBs, Sachs-Warner, Adjusted Trade	<0 for developed countries in OLS <0 for developing countries in OLS =0 for developed countries in FE =0 for developing countries in FE
Barro 2000	84 countries on 1960-1990 OLS and Fixed Effect	Adjusted Trade	<0 for developed countries in OLS >0 for developing countries in OLS >0 for countries in FE
Calderon and Chong 2001	102 countries on 1960-1995 5 years period average GMM	Trade to Gdp ratio, Sachs-Warner,	<0 for developing countries =0 for developed countries
Ravallion 2001	50 countries on 1947-1994 5 years period average OLS	X/GDP	<0 for developed countries >0 for developing countries
Rama 2001	97 countries on 1960-1990 period average OLS	X+M/PIB	>0 for countries <0 for skill intensive countries
Dollar and Kraay 2002	92 countries on 1950-1999 Fixed Effect	Trade to Gdp ratio, Adjusted Trade, Sachs-Warner, Tax on imports	=0 for developed countries =0 for developing countries
Milanovic 2002	83 countries in 1988, 1993 and 1998 OLS and GMM	Trade to Gdp ratio	>0 for poor countries <0 for middle income countries
Lundberg et Squire 2003	38 countries on 1960-1994 5 years period average OLS and TSLS	Trade to Gdp ratio, Sachs-Warner	>0

Results (Table 1) are sometimes in accordance with the prediction (Calderon and Chong 2001), often non significant (Edwards 1997, Li, Squire and Zou 1998, Higgins and Williamson 1999, Dollar and Kraay 2002) or strictly contrary to the model (Savvides 1998, Barro 2000, Ravallion 2001, Rama 2001 and Milanovic 2002). We observe also that studies in OLS find

mainly a result that does not support the HOS theorem whereas studies with fixed-country effects find no significant results.

2.2 *Heterogeneity among developing countries*

We need to account for heterogeneity among developing countries. Being a developing country does not mean having a comparative advantage in unskilled labor. Wood (1997) explains that trade liberalization occurred in Latin American countries when they were less competitive for unskilled labor compared to Asian countries. Harrison and Hanson (1999) study the pattern of trade liberalization in Mexico in the 1980s. They conclude that tariffs fell most in sectors which had a higher share of unskilled worker, which explains the rise in wage inequality. In fact, protection was skewed towards low-skilled sectors prior to the reform, since Mexico did not have a comparative advantage in unskilled workers.

Some developing countries are also well-endowed in natural resources, often not equitably distributed in the population. Therefore the increase in the returns from this factor during trade liberalization could benefit few owners (Bourguignon and Morrisson 1990). Moreover the natural resource exploitation requires physical capital but not human capital. Therefore the exploitation of such comparative advantage could lead countries to neglect the construction of a sufficient human capital stock that could provide enough skilled workers during the emergence of the manufacturing industry (Leamer and al. 1999). Finally if trade liberalization encourages specialization towards primary commodities, it will increase the volatility of developing countries terms of trade, with the poor being more vulnerable to these shocks than the rich (Birdsall, 2002). This is the case especially for Latin American countries. Hence, as Spilimbergo and al (1999) and Fisher (2001) in Table 2, we test the

hypothesis that the effect of greater openness on overall inequality vary, depending on factor endowments: in physical capital relative to labor, RE_i^K , in skilled labor relative to labor, RE_i^S , and in natural resources relative to labor, RE_i^T (equation 1.2).

$$INEQ_{it} = \beta_0 + \beta_1 Open_{it} + \beta_2 RE_{it}^K + \beta_3 RE_{it}^T + \beta_4 RE_{it}^S + \beta_5 Open_{it} * RE_{it}^K + \beta_6 Open_{it} * RE_{it}^T + \beta_7 Open_{it} * RE_{it}^S + \beta_8 Z_{it} + \varepsilon_{it} \quad (1.2)$$

Since physical capital and natural resources are likely to be concentrated in the hand of few people because there is no natural upward limit to their accumulation we expect a positive sign of β_2 and β_3 as well as β_6 and β_7. In return, other factors such as human capital cannot be as concentrated because of the natural limit in the amount of education that an individual can accumulate, so we expect a negative sign for β_4. However an increase in its returns due to an increase in trade openness would increase income inequality since it concerns the richest people: β_7 positive.

Table 2: Studies using Factor Endowment

Bourguignon and Morrisson 1990	35 developing countries in 1970 OLS	Tariffs on manufactured goods	<0 for developing countries
Leamer, Maul, Rodriguez and Schott 1999	84 countries in 1980 and 1990 decade averages	Net export ratios for specific products	>0 for primary products <0 for manufactured products
Spilimbergo, Londono Szekely 1999	34 countries on 1962-1994 OLS	Adjusted trade, Sachs Warner, black market premium	<0 for unskilled intensive countries <0 for capital intensive countries =0 for land intensive countries (<0 for LDC)
Fisher 2001	66 countries on 1965-1990 5 years period average Fixed Effect	Sachs-Warner	<0 for unskilled intensive countries <0 for capital intensive countries =0 for land intensive countries

Regarding results (Table 2), in both cases, openness leads to more inequality and trade effects undo the direct effects of endowments (i.e. interaction coefficients have an opposite sign compared to direct effects). Some results are opposite to what the simple HOS framework would predict. In particular, both Spilimbergo and al. (1999) and Fisher (2001) find that the effect of openness decreases inequality as countries' endowment of capital increases, and that the effect of openness is unaffected by countries' endowments of arable land per capita. However there is also qualified support for the HOS hypothesis. In particular, they also both find that openness increases inequalities as countries' endowment of human capital increases.

2.3 Different skill categories

However we can be skeptic about the theoretical relationship between openness in human capital abundant countries and income inequalities. For Wood (1994), with three types of labor, the distributional impact of trade in developing countries is complex. A large part of the labor force in poor countries does not have any education, even basic, and is employed in the traditional craft sector or in non-tradable activities (e.g. services). It is strongly questionable whether their output corresponds to tradable goods, as far as manufacturing industries are concerned. Moreover their mobility toward the "modern" sector is hindered by the lack of basic education. Even in an economy where the export-oriented manufacturing sector is intensive in low-skilled labor, such non-educated workers are thus unlikely to receive any direct benefit from the development of the export sector or from an increase in the price of exports. The positive impact on the relative price of unskilled labor, admittedly considered as the abundant factor for developing countries, might thus be restricted, in practice, to a fraction of unskilled workers only, namely those enjoying at least basic education, and

likely to work in the "modern" sector. As soon as the share of no-educated labor in the labor force is large enough, the alleged positive impact of trade openness on unskilled (but somewhat educated) labor does not reduce inequalities. On the contrary, the deterioration of the relative position of non-educated workers would increase income inequalities. Hence openness to trade in poor countries might increase inequalities by helping those with basic education and leaving even further behind those with no education.

The study by Bensidoun and al. (2005) tests the assumption that the share of non educated labor could explain why trade liberalization increase income inequalities in some developing countries. They firstly show that, on average, international trade led to a widening of income inequality both in poor and rich countries, and to a reduction in middle-income countries. In their model, exporting firms require at least some education from their workers that trade does not directly benefit workers without any education, so that international trade leads to rising inequalities for countries with a high share of no educated people. However they say nothing about primary educated labor and the highly skilled labor, and they do not measure the trade policy but only the change in the factor content of trade flows.

2.4 Differences in natural resource abundance

As to remaining endowments, Wood (2003) suggests that arable land per worker (as in Spilimbergo and al. (1999), Fisher (2001) or Leamer and al. (1999)) is not sufficient to encompass natural resources and suggests using land per worker. Whereas arable land per worker captures factor intensities in the production of food and raw materials, it does not include mining and fuel which are the less equally-distributed resources. This may explain why several studies find that endowments in arable land increases inequality during trade liberalization (e.g. Spilimbergo et al. (1999) and

Perry and Olarreaga (2006)). Our preferred specification uses an indirect measure of endowments in mining and fuel captured by net exports if those products, next to the measure of arable land.

3 Measure of openness through a gravity model

3.1 Which sort of index for openness?

The simplest approach is to use the ratio of total trade (exports plus imports) to total output for each economy as a measure of trade policy "openness." This has the advantage of being easily computed from available data for a broad range of nations over long periods of time, and it may be an appropriate indicator of an economy's overall exposure to international markets, but it is a poor measure of comparative trade policy orientation. A great deal of the cross-national variation in the extent to which nations trade is due to geographical factors, such as their distance from major markets, and their size. Existing measures of the degree to which governments restrict trade generally fall into two types: measures of the incidence of trade restrictions and measures of their effects on outcomes.

Incidence-type measures assess the height or coverage of various tariff and non-tariff trade distortions. Unfortunately, the average tariff is not a very reliable comparative measure of trade restrictions since it cannot simply be assumed that the same tariff levied on different products and in different economies will have the same restrictive effect (i.e., that import elasticities are identical across all products and economies and the structure of protection in each economy is inconsequential). Moreover, the data are

not available through a large period and to use it would lead us to restrict our period under analysis to 1980-2000. Most importantly, of course, tariff-based measures ignore non-tariff forms of protection, which have become increasingly important as policy instruments for governments in both advanced and developing economies (Kee, Nicita and Olarreaga (2004)). Finally, in using tariffs we only include the unilateral liberalization side, i.e. the fact that a country liberalizes the importations. And in a context of trade liberalization for developing countries we are interested in their access to other markets through their exports. Recently, Mayer and Zingaro (2004) show that the access to developed countries was heterogeneous among developing countries.

Given the severe problems associated with measuring and comparing tariffs and NTBs, several analysts have relied instead upon outcome-based indicators of trade restrictions. Some have focused on price outcomes as Edwards (1993) and Dollar (1992). But alternative sources of variation in black-market currency prices and goods prices pose major problems for these measures, and reliable comparative data on prices of both types are quite limited. Outcome-type measures assess the difference between some quantities and the outcomes that would be predicted in the absence of trade restrictions. These measures capture also the implicit protection through substitutes (including domestic policies adopted) of standard trade policy measures that governments use after commitment to tariff levels in international agreements.

There have been very few attempts to adjust openness measures to take into account cross-national differences in geographical variables and resource endowments. Most notably Leamer (1988) has estimated net exports for 53 nations in 182 commodity categories in 1982 as a function of each nation's relative endowments of different types of factors of

production and computed a measure of trade openness for each nation by summing the deviations between predicted and actual net exports across commodity categories. The approach is extremely data intensive, however, and even so the model produces such large residuals when used to predict export flows that Leamer himself finds it difficult to attribute them wholly to trade barriers (1988). Pritchett (1996) has tried a slightly different approach, estimating the ratio of trade to GDP as a function of population, area, and GDP per capita for 93 nations in 1985, using the residuals as a measure of trade openness. Spilimbergo, Londono, and Szekely (1999) have created a similar measure by estimating total trade as a percentage of GDP for a panel of 34 nations between 1965 and 1992 using population, income, distance from major markets, and the distinctiveness of each nation's factor endowments relative to world endowments, on the right-hand side.

While these are useful extensions of Leamer's approach that account for more of the variables (apart from policy) that explain trade flows, it seems a major less efficient to apply the gravity model to predict aggregate openness ratios for each country rather than applying it to bilateral trade flows where it has proven to be very effective. This approach was firstly used by Hiscox and Kastner (2002) for 82 countries between 1960 and 1992 in a model where they included income, distance and the difference in factors endowments. We extend their measure by including more countries on a larger period and in accounting for size of countries, difference in human capital and mineral/fuel resources endowments and remoteness.

3.2 A Gravity model to measure Openness

The basic gravity model posits that the volume of trade between two nations is an increasing function of the incomes of those nations and a

decreasing function of the distance between them. It is well known that richer countries tend to be more open, while larger countries tend to be less open. Although we include other variables, including whether the countries share a common border and/or a common language are often added to the model. The model has proved to be an extremely effective framework for gauging what patterns of trade are normal or natural among nations (Frankel and Wei 1993, Baier and Bergstrand 2001). Frankel and Romer (1999) use it to estimate the natural openness in a country. By implication, the model should also be able to help us in identifying abnormal or distorted patterns of trade and estimating the extent to which these are due to the trade policies of particular nations. The basic form of the gravity model can be expressed in log-linear form as

$$\ln\left(\frac{(M+X)_{ijt}}{Y_{it}}\right) = \alpha_{it} + \beta_1 \ln Y_{jt} + \beta_2 \ln(P_{it} * P_{jt}) + \beta_3 Dist_{ijt} + \beta_4 Z_{ij} + \varepsilon_{it} \qquad (2.1)$$

Where $(M+X)_{ijt}$ represents total trade flow between country i and j, Y_{it} and Y_{jt} denote national income, P_{it} and P_{jt} are total population, $Dist_{ijt}$ is the distance between economic centers of each country. Z_{ij} represents dummies including whether the countries share a common border and/or a common language, are landlocked or exporter of oil.

In order to evaluate the distorting effects of each country's policies in each year we include a country year dummy α_{it} for country i in year t. The country-year dummy variables stand in for the (unmeasured) relative openness of trade policy orientations. A similar approach has been used to gauge the effects of regional trade agreements on trade flows by using dummy variables for pairs of nations in the same regional bloc as a proxy for regionally specific discriminatory policies. Here the set of estimated

coefficient α_{it} provides the amount of trade flows due to distorting effects of each country's policies in each year when compared to the mean for the entire sample.

A key problem here is that we cannot distinguish between the effects of changes in trade policies and other changes, specific to particular importing countries in particular years, that also affect trade flows and are not accounted for in the model. The Heckscher-Ohlin (HO) model of trade suggests that trade flows should vary with the character of each nation's factor endowments relative to that of its trading partners. That is why we include variables that represent differences in factor endowments between countries. Moreover since we use the index in a second step (impact of trade openness on income inequalities) where those factor endowments variables are included we have to include them in this first step.

$$\ln\left(\frac{(M+X)_{ijt}}{Y_{it}}\right) = \alpha_{it} + \beta_1 \ln Y_{jt} + \beta_2 \ln(P_{it} * P_{jt}) + \beta_3 Dist_{ijt} + \beta_4 \ln K_{ijt} + \beta_5 \ln N_{ijt} + \beta_6 \ln T_{ijt} + \beta_7 \ln H_{ijt} + \beta_8 Z_{ij} + \varepsilon_{it} \quad (2.2)$$

Where K_{ijt}, N_{ijt}, T_{ijt} and H_{ijt} are differences in factor endowments between countries *i* and *j* in physical capital per labor, mineral/fuel resources per labor, arable land per labor and human capital per labor.

We include also remoteness since a country's trade with any given partner is dependent on its average remoteness to the rest of the world (Anderson and Van Wincoop 2003). Hiscox and Kastner (2002) did not account for this multilateral resistance to trade. For example, Australia and New Zealand trade more with each other than they would if other large

markets were nearby[1]. Studies that do not control for remoteness produce biased estimates of the impact of trade policy on trade. Let R_i and R_j, denote the remoteness of j and i, equal to GDP-weighted of distance.

$$\ln\left(\frac{(M+X)_{ijt}}{Y_{it}}\right) = \alpha_{it} + \beta_1 \ln Y_{jt} + \beta_2 \ln(P_{it} * P_{jt}) + \beta_3 Dist_{ijt} + \beta_4 \ln K_{ijt} + \beta_5 \ln N_{ijt} + \beta_6 \ln T_{ijt} + \beta_7 \ln H_{ijt} + \beta_8 \ln(R_{it} * R_{jt}) + \beta_9 Z_{ij} + \varepsilon_{it} \quad (2.3)$$

The data set is a panel of bilateral trade flows for 91 countries over the period 1960-2000 taking five years average periods to exclude problems of volatility. The data on trade flows come from Andrew Rose (2004) based on the CD Rom "Direction of Trade" from IMF. The measure of income is the real GDP in 1995 dollar from WDI (2004). The distance's measure comes from CEPII. The measure on capital per worker comes from Easterly and Levine (1999) and Kraay and al. (2000), the measure on arable land par person comes from WDI (2004) and the average years of schooling in the population over 15 years old comes from the Barro and Lee (2000) database. The measure for mining and fuel resources is the index from Isham and al. (2005) base on net exports share on fuels and minerals (see Appendix).

To check the robustness of our approach, we also estimate the model on imports to country *i* from *j* and on exports to country *i* to *j*. So we have three estimations in OLS (Table 3) where the first column deals with total trade flows (imports and exports), column (2) deals with exports flows and column (3) with imports flows.

[1] Austria and Spain trade less each other than Australia and New Zealand although they are separate by equal distance, because they have other closer market around them.

The model performs well, variables are almost all significant and give expected results. The income of partner country is strongly positively significant and close to 1. The sign concerning the size of countries and the distance are strongly negatively significant. The estimated coefficients for each endowment variables correspond broadly to theoretical expectations. This shows us the importance of these determinants in trade patterns. The trade flows are always lead by differences in factor endowments. For the three estimations, we extract the estimated coefficient for the set of country-year dummy variables α_{it}. These estimated coefficients are reported as differences from the sample mean intercept. To the extent that other determinants are controlled for, these estimates represent the estimated amounts (in logs) by which real trade flows are altered by unobservable aspects (i.e., policies) of the importing country *i* in year *t,* compared to the mean country-year, all else equal. Large positive values represent relatively open trade policy orientations, while large negative values represent relatively closed or protectionist policy orientations.

Table 3 : Gravity model : Estimate of Openness

	Trade (Xij+Mij)/GDPi		**Export Xij/GDPi**		**Import Mij/GDPi**	
	1		**2**		**3**	
Income of country j	0.9159	157.43	0.8966	130.18	1.0444	154.98
Population of country i and j	-0.1095	-11.52	-0.0643	-5.65	-0.1640	-14.94
Distance between i and j	-1.2357	-87.84	-1.3229	-80.69	-1.2867	-76.66
Diff in Ar.Land per labor ratio	0.1651	22.27	0.1446	16.06	0.2094	22.30
Diff in Min-Oil per labor ratio	0.0359	4.37	0.0447	4.72	0.0173	1.78
Diff in Capital per labor ratio	0.0305	3.68	0.0322	3.23	0.0244	2.69
Diff in Education per labor ratio	0.0933	4.45	0.1008	4.39	0.0823	3.33
Remoteness of country i and j	0.5132	11.44	0.2649	4.81	0.9743	18.15
Common Border	0.3833	6.58	0.4348	6.32	0.5356	7.86
Colonial relationship	1.1872	27.72	1.3090	25.90	1.2707	25.71
Common colonist	0.8158	17.16	0.7295	13.35	0.8405	15.45
Common Language	0.4094	16.56	0.4540	15.72	0.4268	14.84
Current colonial relation	0.5259	3.02	0.5503	2.36	0.6753	3.30
Landlockness	-0.0237	-0.93	-0.2162	-7.10	-0.2167	-6.87
Island	-0.4578	-12.60	-0.6110	-16.05	-0.2050	-4.89
R^2	0.74		0.65		0.66	
Observations	36 096		39 867		39 867	

The t- student appear in bracket

3.3 Robustness test of the gravity-based index

The new estimates compare very favorably with alternative measures of trade policy orientations. Table 4 reports coefficients of correlation with the most commonly used measures of trade openness or protection over all samples for which these alternatives are available. We choose the usual trade ratio(X+M)/PIB, the weighted tariffs from WDI (2004), the tax on inputs and capital from Barro and Lee (2002). We add outcome-based indicators of trade restrictions, Leamer (1988), Dollar (1992), Prichett (1996), Spilimbergo and al. (1999) and Hiscox and Kastner (2002).

We include our three measures of the index from the estimations in Table 3, on the total trade (row 6), on import (row 7) and on exports (row 8).

Table 4: Correlation of gravity-based index with other indexes

		Tariffs World Bank	Tariffs Barro Lee	Index Leamer	Index Dollar	(X+M)/ GDP	Index Prichett	Index Spilimb	Hiscox Karstner
1	Observations	241	109	38	123	241	241	241	241
2	(X+M)/GDP	-0.17*	-0.32*	0.77*	0.16	1.00			
3	Index Prichett	-0.01	-0.09	0.42	0.03	0.63	1.00		
4	Index Spilim	-0.14	-0.22	0.40	0.07	0.56*	0.81*	1.00	
5	Hiscox Karstner	0.46*	0.55*	-0.58	-0.25	-0.39*	-0.11	-0.15	1.00
6	**Index Trade**	**-0,43***	**-0,41***	**0,71***	**0.24**	**0.52***	**0.39***	**0.44***	**-0.47***
7	**Index Import**	**-0.52***	**-0.45***	**0.39**	**0.20**	**0.27**	**0.06**	**0.23***	**-0.62***
8	**Index Export**	**-0.45***	**-0.25***	**0.73***	**0.04**	**0.43***	**0.29***	**0.30***	**-0.39***

*means significant at 1%.

Our measure of trade openness on imports (row 7) is strongly negatively correlated with the tariffs barriers in imports (column 1, 2 and 8). The measure of openness in exports (row 8) is strongly positively correlated with outward oriented index (column 3 to 7). Measure of openness based on total trade (row 6) usually has the highest correlation with the other indices. The country case studies in Annex 4 show us the change in index (Index Trade) , ranked from 0 to 10, through time for different countries. We observe the increase in trade openness for Latin American countries since 1990 as well are their lag compared to East Asian countries (except for Chile which had liberalized sooner).Singapore and Hong Kong reach the highest scores and we observe the increase in trade liberalization for Korea in the seventies. For the further parts of the study we will keep the "Index Trade" measure which we will call thus Trade Openness Index (TOI).

4 Trade openness and income inequality

4.1 Data and econometric specifications

Gini coefficients come from the Wider (2004) database. We use dummy variables to control the sources of data: gross income or net income, income or expenditure and households or individuals[2]. Factor intensity in a country is often measured as factor intensity in a sector, by a ratio of the factor on labor. Indeed, it is more suitable to use a ratio of per capita endowment of a factor in the country on the world per capita endowment in this factor as we deal about relative advantage in factor endowment. We use the formula constructed by Spilimbergo and al. (1999). The ratios are weighted by the degree of openness to account for the endowments of closed countries that do not compete in the world markets with other factors (see annex). We include the Kuznets curve with the income per capita in parity purchase power in linear and squared form. We exclude countries from ex-USSR. The sample for our preferred approach, where we need at least two observations per country to use fixed country effects, concerns 71 countries for 307 observations (51 developing countries give 208 observations and 20 developed countries give 99 observations) in five years averages on 1970-2000 (Annex 1).

We present different econometric specifications. Firstly we present the OLS estimations on pooling frequently used in this empirical literature to get the same results than Spilimbergo and al. (1999). Secondly, in order to account for the panel dimension of our panel and for the

[2] Some records are based on expenditure surveys and other on income surveys, and we know that inequality in income is highest than inequality in expenditures.

heteroskedasticity[3] we report panel-corrected standard errors. But trying to explain cross-country differences in levels of inequality is not easy, since a number of factors cannot be properly taken into account. Fiscal redistribution, ethno linguistic fragmentation or distribution of factor ownership, for instance, are not well documented for most countries. As a consequence, econometric estimates are likely to be flawed with omitted variable bias. In addition, the interesting issue from a policy perspective is not whether countries with different degrees of openness exhibit different levels of inequality, but rather whether an increase in a country's trade openness is associated with an increase or a decrease in inequality. Hence, thirdly we use a within-estimator and we include country-specific effects to account for countries' heterogeneity. However, this will lead us to loose some information notably concerning the effect of factors endowments.

We use lagged variable concerning openness and interaction of openness with endowments to control for endogeneity between trade policy and income distribution. Lundberg and Squire (2003) argue that Dollar and Kraay (2002) dismiss endogeneity concerns when they affirm that the share of income accruing to the poor is unlikely to have any influence on policies that affect the overall growth rate[4]. In fact, Persson and Tabellini (1994) find that the position of the median voter, relative to the mean of the income distribution, is a good predictor of the demand for policies that can influence growth or distribution. In such a case, these

[3] The Breusch Pagan test and the White test indicate heteroskedasticity in the error process ($\sigma^2_{it} \neq \sigma^2$). We carried out our estimates using two estimators: the standard heteroskedasticity-consistent White (1984) estimator and the panel-corrected standard errors (PCSEs) estimator proposed by Beck and Katz (1995) which is shown to be as good or slightly superior to the robust estimator in Monte-Carlo studies for small samples (see Beck and Katz (1996, table 2). Since both estimators give very similar results, in subsequent tables we only report results based on PCSEs.

[4] "Since these other policies and institutions are changing over time, their influence on the included variables cannot be removed simply by differencing" [Lundberg and Squire (2003), p. 340]

policies, including openness, are correlated with the error term. Moreover all this lagged variables need times to affect income distribution. So we lag also the endowment variables all the more so since they can be affected also by income inequality notably concerning human capital endowment. Since we use a generated variable (i.e. the policy trade index), we have to recalculate all the standards errors of the variables, we use the bootstrap technique to estimate standard errors and to construct confidence intervals[5].

Finally, while the possibility of a spurious relation still persists, one of the strong candidates for the observed relation would be that changes in inequality due to a successful stabilization policy would be attributed to increased openness because of a positive correlation between trade liberalization and concurrent stabilization policies (trade liberalization often occurs during periods of systemic reforms including macro stabilization). We include the inflation to capture effects of macro stabilization not due to trade openness.

4.2 Extensions of previous results

For the sake of comparison (and to see what is driving the difference in results), we start in table 5 with a replication of the estimates carried out by Spilimbergo et al. (1999) on our data set by using their openness index (equation 1.2).

[5] For a generated variable, the confidence interval in the second step is not correct as it refers to the first step. So we built a sampling distribution based on the initial sample from which repeated sample are drawn to obtain a correct distribution and correct standards errors.

$$INQ_{it} = D_i + \alpha_1 \overline{Y}_{it} + \alpha_1 \overline{Y^2}_{it} + \beta_1 Open_{it} + \sum_{f=1,3} \phi_f RE_{ift} + \sum_{f=1,3} \phi_{2f} (Open_{it} * RE_{ift}) + \sum_l \delta_l Z_{it} + \sum_{k=1,3} \gamma_k DS_{ikt} + e_{it} \quad \text{i=1,....,75 ; t=1,...,8} \tag{3.1}$$

In (3.1), the index of inequality is regressed on a set of country dummies D_i, on income per capita measured in PPP, $\overline{Y}_{it}$, on its squared form $\overline{Y^2}_{it}$ (for Kuznets relation) , on trade openness $Open_{it}$ and on relative endowment RE_{ift} in three factors, human capital (ED/L), arable land (AT/P) and physical capital (K/L). We test the impact of trade openness $Open_{it}$ according to relative endowment RE_{ift} in the three factors.

We add dummy variables, DS_{ikt}, to control for the source of inequality data (dummy variables for gross vs. net income, income vs. expenditure, and households vs. individuals), and on a set of control variables, Z_{it}. All the variables are expressed in logarithms. As mentioned above, all data are five year averages (this helps to control for autocorrelation and measurement error), giving us eight observations across time. The sample is restricted to observations which provide both Spilimbergo and al. Index (SI) and our Trade Openness Index (TOI) in order to get the same sample of observations and we drop countries which have less than two observations to get the same sample between OLS and within estimators .

The first column in table 5 implements the specification with an OLS estimator in pooling and with their adjusted trade ratio (SI) we add dummies for Latin American countries and African countries which present high Gini values. All the OLS estimations present robust standard errors. As expected we find their results: trade openness raises inequality for skilled abundant countries (as in HOS framework) but decreases inequality for capital and natural resources abundant countries which does

not support the HOS framework. In column (2) we use lagged variables to control for endogeneity and the previous results remain. In the column (3), we add dummy variables to control for data sources. This reduces some coefficient values concerning interaction, but all remain significant.

Column (4) present the within estimator and column (5) introduces the panel corrected standard errors to correct for heteroskedasticity in our coefficient and not only in our variances. We see that except for the human capital endowment, none of previous results holds, particularly the effect for capital abundant countries which seemed so robust without accounting for countries heterogeneity. Columns (6) and (7) present our own trade policy indicators (TOI), and in column 7 we include inflation. The results show that our index does not confirm previous results since the index of openness is no longer associated with income inequality. Thus table 5 tells us that accounting for heterogeneity across countries changes the results and the measure of openness is crucial in the interpretation of the results. The results do not confirm earlier findings (e.g. Dollar and Kraay (2002), Edwards (1997)), since a reduction in inflation does not reduce significantly inequality. The Kuznets relation is not stable across specifications, the turning point is very weak in OLS specifications (around 2 500$ per capita) and most reliable in fixed effects (around 9 000$).

Table 5: Inequality and Openness: comparison across openness Indices

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	OLS	FE	FE(PCSE)	FE(PCSE)	FE(PCSE)
Index of openness	SI	SI	SI	SI	SI	TOI	TOI
	Ln Gini	Ln Gini	Ln Gini	Ln Gini	Ln Gini	Ln Gini	Ln Gini
Ln GDP/capita	0.5121b	0.6572a	0.7779a	0.5582c	0.5582b	0.7507b	0.7556b
	(2.21)	(3.36)	(3.84)	(1.87)	(2.53)	(2.48)	(2.49)
Ln (GDP/capita)²	-0.0329b	-0.0422a	-0.0499a	-0.0302c	-0.0302b	-0.0407b	-0.0408b
	(2.50)	(3.73)	(4.27)	(1.80)	(2.43)	(2.26)	(2.27)
Ln AT/P_{t-5}	0.0381	0.0720b	0.0775a	-0.0009	-0.0009	-0.0383	-0.0387
	(1.34)	(2.49)	(2.75)	(0.01)	(0.02)	(0.52)	(0.52)
Ln K/L_{t-5}	0.1995a	0.2014a	0.1635a	-0.0325	-0.0325	-0.0070	-0.0103
	(3.57)	(4.15)	(3.16)	(0.69)	(0.86)	(0.18)	(0.25)
Ln ED $/L_{t-5}$	-0.2763a	-0.3157a	-0.2319a	-0.3580a	-0.3580a	-0.2390a	-0.2384a
	(2.87)	(5.22)	(3.76)	(5.28)	(6.97)	(3.22)	(3.22)
$Ouverture_{t-5}$	0.0200a	0.0150b	0.0152b	0.0157	0.0157b	-0.0186c	-0.0187c
	(3.14)	(2.32)	(2.31)	(1.48)	(2.01)	(1.69)	(1.70)
Ln AT/P_{t-5}*Ouv_{t-5}	-0.0065c	-0.0117a	-0.0114a	-0.0043	-0.0043	0.0059	0.0059
	(1.74)	(2.93)	(2.86)	(0.59)	(0.78)	(0.74)	(0.75)
Ln K/L_{t-5}*Ouv_{t-5}	-0.0307a	-0.0314a	-0.0231a	0.0009	0.0009	0.0017	0.0019
	(3.52)	(4.47)	(3.05)	(0.15)	(0.20)	(0.19)	(0.22)
Ln ED/L_{t-5}*Ouv_{t-5}	0.0381b	0.0507a	0.0315a	0.0477a	0.0477a	0.0327c	0.0329c
	(2.37)	(4.52)	(2.60)	(3.56)	(5.01)	(1.91)	(1.92)
Ln Inflation							0.0080
							(0.81)
Gross/Net Income			0.0476b	0.0050	0.0050	0.0013	0.0015
			(2.37)	(0.19)	(0.28)	(0.07)	(0.08)
Income/Expenditure			0.0816a	0.0843a	0.0843a	0.0839a	0.0877a
			(3.33)	(2.68)	(3.15)	(3.25)	(3.14)
Households/Individuals			0.0361c	0.0361b	0.0361a	0.0345b	0.0346b
			(1.95)	(2.20)	(2.80)	(2.47)	(2.48)
SSA	0.2910a	0.2869a	0.2525a				
	(12.06)	(13.17)	(10.71)				
LAC	0.2915a	0.2954a	0.3039a				
	(8.22)	(9.16)	(10.14)				
Fixed Effects	No	No	No	Yes	Yes	Yes	Yes
Constant	1.5394	1.0134	0.4593	0.6791	0.6791	0.3310	0.2845
	(1.52)	(1.19)	(0.52)	(0.50)	(0.67)	(0.26)	(0.22)
Observations	304	333	333	333	333	333	333
R-squared	0.58	0.60	0.64	0.20			
				(0.88*)			
Number of countries	75	77	77	77	77	77	77

All the estimations present robust standard errors. Absolute value of z statistics in parentheses

c significant at 10%; b significant at 5%; a significant at 1%. * with fixed country effects

4.3 Adding different skill categories and accounting for mineral/fuel resources

Land and Natural Resources

Arable land per person (AT/P) is not a good proxy for natural resources as it does not include endowments in mining and fuels resources, which are theoretically more unequally distributed than arable land. This might explain why previous studies do not find that openness increases inequality for natural resources abundant countries since they used arable land to measure it. Hence Wood (2003) suggests to use land (T/P) and not arable land (specific to agriculture) in order to include mineral and fuel resources. An alternative is to use the index from Isham and al. (2005) based on net exports shares to approximate the endowment in mining and fuels resources (MF/L). We use arable land on labor force (AT/L) and not population as done in previous studies.

Different skill categories

Our model assumes that it might be fruitful to break-down unskilled labor into non-educated and primary-educated as suggested by Wood (2002) and done recently in Bensidoun et al. (2005) in a slightly different context.[6] This leads us to a specification in which we replace the index of human capital (ED/L) (average years of schooling) endowment by different categories of skill level. We include no-educated (NO-ED/L) (those that have never been to school and those that have not completed primary school), based-educated (BS-ED/L) (primary-school completion and those that have not completed secondary school) and highly educated (SK-ED/L) (beyond secondary education). Our preferred specification includes the three

[6] They did not test the impact of trade liberalization but the impact of trade flows, and they just test for the no educated category. Moreover their sample is more restricted concerning the developing countries (it did not include sub Saharan African countries).

categories in only one estimation in using a pair of ratios: (SK-ED/BS-ED) and (SK+BS)/NO-ED.

So we re-estimate equation 3.1 by adding an index of endowments in mining and fuels (MF/L) and three different levels of education: (NO-ED/L), (BS-ED/L) and (SK-ED/L).

$$INQ_{it} = D_i + \alpha_1 \overline{Y}_{it} + \alpha_1 \overline{Y^2}_{it} + \beta_1 Open_{it} + \sum_{f=1,6} \phi_f RE_{ift} + \sum_{f=1,6} \phi_{2f} (Open_{it} * RE_{ift}) + \sum_{l} \delta_l Z_{it} + \sum_{k=1,3} \gamma_k DS_{ikt} + e_{it} \qquad i=1,....,75 \; ; \; t=1,....,8 \tag{3.2}$$

Results with the 'augmented' endowment specification are reported in table 6. In column 1 we include labor with no education (NO-ED)/L. The results show that trade liberalization increases income inequality more for countries abundant in NO-ED. The threshold indicates that this effect occurs in countries with more than 68% to 50% of no-educated labor (the variation in the threshold is due to the variation in world endowment through time, see figure 1). The results also suggest that trade liberalization raises inequality more for capital abundant countries, which conforms to HO predictions, again a result that eluded previous studies.

As expected, replacing in column 2 (NO-ED)/L by the primary-educated ratio, (BS-ED)/L, reverses the results: trade liberalization decreases inequality for primary-educated abundant countries if indeed they represent a large share of poor. Here the threshold effect appears when the share of primary educated labor is greater than 20%. Again, as expected by HO theory, trade liberalization increases inequality in capital abundant countries. Robustness to HO predictions still holds when one replaces the primary educated, (BS-ED)/L, by the highly-educated, (SK-ED)/L, in column 3 as trade liberalization increases inequality in highly-

Table 6: Inequality, skill categories and openness

	1	2	3	4	5
	FE(PCSE) Ln Gini	FE(PCSE) Ln Gini	FE(PCSE) Ln Gini	FE(PCSE) Ln Gini	FE(PCSE) Ln Gini
Ln $(AT/L)_{t-5}$	-0.0328	-0.0497	-0.0623	-0.0721	-0.0444
	(0.43)	(0.64)	(0.83)	(1.00)	(0.58)
Ln $(MF/L)_{t-5}$					-0.3582a
					(3.30)
Ln $(K/L)_{t-5}$	-0.0103	0.0033	0.0295	0.0199	-0.0279
	(0.30)	(0.10)	(0.87)	(0.51)	(0.64)
Ln $(NO\text{-}ED/L)_{t-5}$	-0.1076				
	(1.35)				
Ln $(BS\text{-}ED/L)_{t-5}$		0.0284			
		(0.58)			
Ln $(SK\text{-}ED/L)_{t-5}$			-0.0262		
			(0.75)		
Ln $(SK+BS/NO\text{-}ED)_{t-5}$				0.0401	0.0146
				(1.13)	(0.39)
Ln $(SK\text{-}ED/BS\text{-}ED)_{t-5}$				-0.1208a	-0.0672
				(3.06)	(1.57)
$Openness_{-5}$	-0.0069	-0.0131	-0.0141	0.0026	0.0034
	(0.70)	(1.31)	(1.33)	(0.46)	(0.51)
Ln $(AT/L)_{t-5}$*Op_{t-5}	0.0085	0.0095	0.0108	0.0121	0.0077
	(1.10)	(1.16)	(1.34)	(1.59)	(0.94)
Ln $(MF/L)_{t-5}$*Op_{t-5}					0.0616b
					(2.45)
Ln $(K/L)r_{t-5}$*Op_{t-5}	0.0123c	0.0110c	-0.0026	0.0082	0.0129c
	(1.81)	(1.76)	(0.34)	(1.09)	(1.79)
Ln $(NO\text{-}ED/L)_{t-5}$*Op_{t-5}	0.0274c				
	(1.77)				
Ln $(BS\text{-}ED/L)_{t-5}$*Op_{t-5}		-0.0163c			
		(1.74)			
Ln $(SK\text{-}ED/L)_{t-5}$*Op_{t-5}			0.0146c		
			(1.72)		
Ln $(SK+BS/NO\text{-}ED)_{t-5}$*$Op_{t-5}$				-0.0171b	-0.0118c
				(2.02)	(1.87)
Ln $(SK\text{-}ED/BS\text{-}ED)_{t-5}$ *Op_{t-5}				0.0263b	0.0170b
				(2.54)	(1.97)
Ln Inflation	0.0025	0.0042	0.0060	-0.0061	-0.0035
	(0.26)	(0.41)	(0.61)	(0.64)	(0.35)
Gross/Net Income	0.0033	0.0034	-0.0057	0.0051	0.0063
	(0.18)	(0.19)	(0.31)	(0.31)	(0.37)
Income/Expenditure	0.0459a	0.0480a	0.0519a	0.0392a	0.0414a
	(3.16)	(3.47)	(3.66)	(2.92)	(2.78)
Households/Individuals	0.0886a	0.0874a	0.0955a	0.0708a	0.0811a
	(3.52)	(3.30)	(3.84)	(2.87)	(3.04)
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	307	307	307	307	282
Number of countries	71	71	71	71	66

c significant at 10%; b significant at 5%; a significant at 1%

educated abundant countries, though significance is decreased probably because of the high correlation (of 0.83) between high-skill educated (SK-ED) and capital (K/L). Here it seems that trade openness increases inequalities for countries with more than 10 to 30% of highly educated people, but the threshold is not robust enough to be reliable.

As shown in table 6, a convenient way to include these three levels of education is in ratio form: (SK-ED)/(BS-ED) and (SK+BS)/(NO-ED)[7]. We expect that during a trade liberalization, countries with a relatively (to the sample average) strong endowment in (SK-ED)/(BS-ED) to experience an increase in inequality, while, after having controlled for skill endowments, we would expect that countries relatively well-endowed in (SK+BS)/(NO-ED) would experience a decrease in inequality during a trade liberalization. Though weaker, the pattern of results still holds when we include two kinds of skills , (SK+BS)/(NO-ED) and (SK-ED)/(BS-ED) in column 4 both of which enter with the expected signs (a strong endowment in (SK-ED)/(BS-ED) is associated with more inequality while the opposite holds for (SK+BS)/(NO-ED). In column 5, we reintroduce (AT/L) but add mining and fuel (MF/L). With this preferred specification, trade liberalization does not impact on income inequality in countries well-endowed in arable land while it increases inequality in countries well endowed in mining and fuel, results echoing those Perry and Olarreaga (2006).

The figure 1 shows us the evolution of threshold values through time based on specification in columns 1, 2 and 3. Effectively since the world endowment change during the period under cover, the share of non educated (NO-ED), primary educated (BS-ED) and highly educated (SK-ED) that leads to a change in the impact of trade openness on specialization

[7] Thanks to Adrian Wood for this suggestion.

and factors returns move through time[8]. Here we see that in the sixties trade liberalization decreases inequalities for countries having less than 68% of non educated people, or about less than 10% of highly educated people or more than 20% of primary educated people. In the nineties, with the improvement in access to education, trade liberalization increases inequalities in countries with a share of no educated higher than 50%[9], or a share of highly skilled workers higher than 30%, the threshold value concerning the primary educated share remains constant through time.

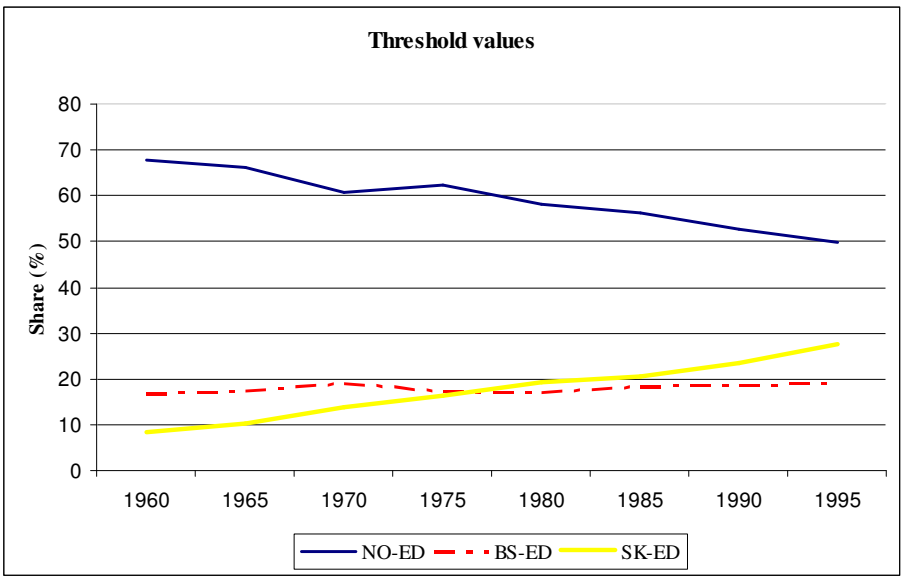

Figure 1: Evolution of threshold values

Using the specification in column 5, we now provide a quantification of an increase in endowment and an increase in openness. Table 7a shows us the percentile distribution of relative endowments in factors (a value of 1 implies that the endowment of the country is equal to world endowment, see annex 5a for full results).

[8] The impact of 20% share of no educated has not an equivalent impact concerning comparative advantage and specialization in the sixties and in the nineties.
[9] In Bendisoun and al. (2005) their threshold value concerning the share of no educated does not change through time, which is not convenient.

Table 7a: Relative Factor Endowments: percentile distribution

Obs	Percentile	(K/L)	(AT/L	(MF/L)	(SK-ED/ BS-ED)	((SK+BS)/ NO-ED)
282	25	0.34	0.47	0.73	0.64	0.53
	50	0.94	0.90	0.85	0.92	1.15
	75	2.56	1.63	1.01	1.31	2.94

Table 7b computes results concerning a change in endowments for a country relatively well open (rank 6 on our index). The first column shows a change from the endowment of the 25th percentile to the median and the second column a change from the median to the 75th percentile. As expected an increase in capital from the 25th percentile endowment to the median endowment increases the Gini coefficient by 8.60% and an increase from the median endowment to the 75th percentile endowment increases inequality by 8.47%. We obtain a similar trend concerning skilled labor relatively to based educated labor increase inequality. Finally, having less non-educated labor decreases inequality (see annex 5b for full results).

Table 7b: Factor endowment change and changes in Gini coefficient values (percentage changes)

	VAR 25-50	VAR 50-75
((SK+BS)/NO-ED)	-6.56	-8.78
(SK-ED/BS-ED)	1.49	1.46
(MF/L)	0.19	0.21
(K/L)	8.60	8.47

Notes: Percentages change in value of Gini coefficient

Table 7c quantifies the effects of a 50% **increase** in trade liberalization on Gini coefficient values for different quartiles of the distribution of endowments. As, an example, this trade liberalization

reduces the value of the Gini coefficient by 0.52% for countries in the bottom quartile of the distribution of (K/L), while it increases inequality by 0.77% for those in the top quartile. A similar pattern holds for (SK-ED)/(BS-ED), with the strongest effect for the ratio (SK+BS)/(NO-ED)). Since countries with a high share of non-educated population are also likely to be poorly endowed in capital, the two effects will tend to cancel each other (see annex 5b for full results).

Table 7c: Trade Liberalization (50%) and Inequality

Variable	Percentile	Variation 50%
(K/L)	0.25	-0.518
	0.50	0.132
	0.75	0.775
(SK-ED/BS-ED)	0.25	-0.203
	0.50	0.100
	0.75	0.398
((SK+BS)/NO-ED)	0.25	0.546
	0.50	0.090
	0.75	-0.465

4.4 Robustness checks

The results are robust when we exclude a small number of observations signalled as outliers by a test on residuals[10]. We now summarize the results of several robustness checks (to save space, results are reported in annexes). In Annex 6 we estimate simultaneously the impact of trade openness according to endowment in non educated (NO-ED) and primary educated (BS-ED) in column 1 and in primary educated and highly educated (SK-ED) in column 2. Results are conforming to our predictions. In columns 3 and 4 we test different measures of natural resources in land, namely, cereal land (CerT/L), crop land (CroT/L) and

[10] The test on studendized residuals leads us to exclude 15 observations.

forest land (Fort/L). Interestingly, distinguishing between forest-land, crop-land and cereal-land results in increasing inequality during trade liberalization for crop-land countries and forest-land countries, as suggested by the so-called staple theory of development.

In annex 7, we check whether the results are robust to other inequality indices given that different inequality measures place greater weight on different sections of the distribution—for instance, the Gini gives more weight to the middle. Rather than choosing another index, we proceed in a more general way and estimate regression using the income share of each quintile of the population instead of the Gini index, to find where exactly the changes take place. The pattern of the results still holds in this smaller sample, however results are barely significant, this is due mainly to the loose of several observations.

Regarding macroeconomic and institutional variables, we used those in Lopez (2003) (table in annex 8). Results show that original results are robust when using these controls with all the macroeconomic variables having the expected sign (e.g. an improvement in civil liberties or an increase in government expenditure decreases inequality).

In a related paper, Gourdon, Maystre and de Melo (2006), have tested a similar specification, e.g. according to different factor endowments but on a shorter period (1980-2000). For the outcome variable we have used Gini coefficient as well as deciles but with another index of trade liberalization (tariffs). I find similar results concerning capital, natural resources (arable land, fuel & mining) and education level. This is comforting suggesting that our results are not influenced by index of trade liberalization. Also our results extend over a longer time period.

5 Conclusions

There are no clear cut empirical results on the relation between trade liberalization and income inequalities in developing countries. If one were asked to point towards an emerging consensus, the answer would be that the evidence on openness and overall inequality (usually measured by the Gini coefficient) remains very mixed: many studies find no evidence of openness on inequality, or that openness increases inequality at all levels of development. More intriguing is the lack of robustness towards expectations from the standard Hecksher-Ohlin-Samuelson (HOS) trade model: conflicting evidence that greater openness reduces (increases) inequality in developing (developed) countries. Much of previous research on the correlates of inequality has established that inequality is largely determined by factors that are quite different across countries and that change only slowly within countries. Notably, the effects of changes in trade policies and of globalization more generally, have been difficult to detect.

Accordingly, this paper has focused exclusively on within-country variations to changes in trade policy while carefully disaggregating factor endowments. Overall, the results suggest that changes in inequality are correlated with changes in trade policy which are quite robust to inclusion of various controls and to changes in sample periods. Notably, the study establishes the importance of factor endowment differences, which has eluded many previous estimates.

Using a data set covering a large sample of developing countries, we show that the conditional correlation between trade liberalization and inequality has the conventional effects suggested by HOS trade theory. These results which are derived from a model with improved controls for

omitted variables (countries heterogeneity and data sources) and a new index of openness are relatively robust. Using fixed effect country to control for countries heterogeneity allows us to study the relationship in change and not in level. The interesting issue from a policy perspective is not whether countries with different degrees of openness exhibit different levels of inequality, but rather whether an increase in a country's trade openness is associated with an increase or a decrease in inequality. Using a new index is motivated by the importance of taking in account the openness in imports as well as in exports. Trade liberalization increases inequality in countries that relatively well-endowed in capital. These results are to be contrasted with Spilimbergo et al. (1999) who find the inverse effect and attribute their finding that openness decreases inequality in countries relatively-well endowed in capital to a reduction in rents deriving from the ownership of capital.

First, as suggested by factor-proportions theories of international trade, increases in inequality are positively correlated with trade liberalization in countries well-endowed in highly skilled workers and with workers that have very low education levels but decreases inequality in countries that are well-endowed with primary-educated labor. Likewise, increases in inequality are positively correlated with trade liberalization in countries relatively well-endowed in mining and fuels production, assets which are very unequally distributed. Thus, if one extends the factor-proportions theory of trade to include a non-traded sector where those with minimal education are most likely to be employed, trade liberalization in poor countries where the share of the labor force with little education (workers that have not finished primary school) is high is likely to associated with increases in inequality as has often pointed out by critics of globalization. Trade liberalization is also associated with increases in inequality in capital-abundant and high-skill abundant countries so that

trade liberalization only reduces inequality in countries abundant in unskilled labor.

Second, the results on the pattern of signs are quite robust, and the addition of control variables yields plausible results. Controlling for the sources of income distribution data is always significant along expected lines. Finally, a reduction in macroeconomic instability (proxied by a reduction in inflation) also reduces within-country inequality.

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APPENDICES

A.1: *List of countries included in the sample 1970-2000*

	Countries	Number of observations
Latin America	Argentina	6
	Bolivia	3
	Brazil	6
	Chile	6
	Colombia	6
	Costa Rica	6
	Dominican Rep.	5
	Ecuador	3
	El Salvador	4
	Guatemala	4
	Guyana	2
	Honduras	3
	Jamaica	5
	Mexico	5
	Nicaragua	2
	Paraguay	2
	Peru	5
	Trinidad & Tobago	5
	Uruguay	3
	Venezuela, RB	6
Total	**20**	**87**
Developed Countries	Australia	5
	Austria	2
	Canada	6
	Cyprus	2
	Denmark	4
	Finland	5
	France	6
	Greece	5
	Ireland	5
	Italy	6
	Japan	6
	Netherlands	5
	New Zealand	5
	Norway	7
	Portugal	5
	Spain	6
	Sweden	5
	Switzerland	2
	United Kingdom	6
	United States	6
Total	**20**	**99**

	Countries	Number of observations
Africa and Middle East	Algeria	2
	Botswana	3
	Cameroon	2
	Egypt, Arab Rep.	2
	Ghana	3
	Iran, Islamic Rep.	4
	Israel	3
	Jordan	4
	Kenya	4
	Lesotho	3
	Malawi	4
	Mauritius	2
	Senegal	3
	Sierra Leone	2
	South Africa	6
	Tunisia	6
	Uganda	3
	Zambia	4
	Zimbabwe	2
Total	**19**	**62**
Asia	Bangladesh	5
	China	4
	Fiji	2
	Hong Kong	6
	India	5
	Indonesia	4
	Korea, Rep.	6
	Malaysia	5
	Pakistan	6
	Philippines	5
	Singapore	6
	Sri Lanka	6
	Thailand	6
Total	**13**	**66**

A.2: List of variables and data sources

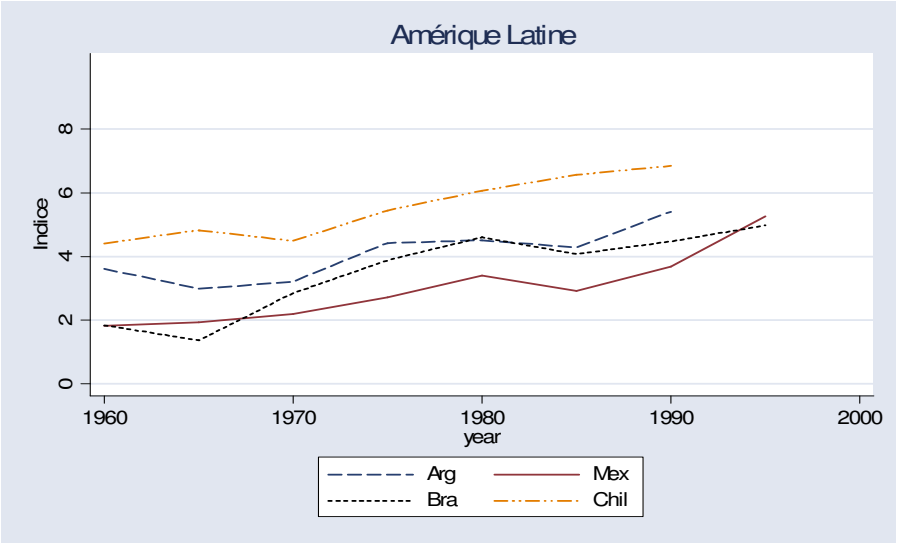
Label	Content	Sources
Gini	Gini coefficients	WIDER(2004)
GDPpc	GDP per capita in power parity purchase (PPP)	Pen WorldTables (2005)
Capital	Capital per Worker	Easterly and Levine (1999) & Kraay and al. (2000)
Arable Land	Land arable per labor force (Cereal-land; Crop-land; Forest-land)	WDI (2004)
Mining & Fuel	Index Isham and al. (2005) base on net exports	Comtrade (2002)
Education	Average years of schooling in the population over 15 years old	Barro and Lee (2000)
No Educated	Proportion of the population over 15 years (non educated (or primary not completed)	Barro and Lee (2000)
Primary (Based) Educated	Proportion of the population over 15 years primary educated (completed) (or secondary not completed)	Barro and Lee (2000)
High (Skilled) Educated	Proportion of the population over 15 years High educated	Barro and Lee (2000)
Inflation	Annual growth rate of the GDP implicit deflator. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency.	WDI (2004)
M2/Gdp	Money and quasi money comprise as % of Gdp.	WDI (2004)
Gov Expenditure	Total expenditure includes both current and capital expenditures as % of Gdp	WDI (2004)
Civil Liberties	Measure the extent to which people are able to express their opinion openly without fears of reprisals and are protected in doing so by an independent judiciary.	Freedom House
Infrastructure	Quantity (Stock); Principal component analysis on road per km², telephone lines per workers, power Gigawatt per worker Quality: waiting times for phone com., energy losses, paved road	Calderon and Serven (2004)
Tariffs	Import duties comprise all levies collected on goods at the point of entry into the country. In % of Imports	WDI (2004)
Index Dollar	Index of price distortion	Dollar (1992)
Index Pritchett	Adjusted Trade ratio: residual once we account for size and distance	Pritchett (1996)
Index Spilimbergo	Adjusted Trade ratio: residual once we account for size, distance and difference in factor endowment	Spilimbergo and al. (1999)
Index Leamer	Adjusted Net Trade ratio: residual once we account for size, distance and difference in factor endowment	Leamer (1987)
Index Hiscox & Kastner	Fixed country years effect in a gravity model once we account for size, distance and difference in factor endowment.	Hiscox & Kastner (2002)
Black market premium	Black market premium	WDI (2004)
Index Wacziarg & Welch	Index taking value 0 or 1 depending on liberalization	Wacziarg & Welch (2005)
Tax Barro & Lee	Tax on capital and input	Barro and Lee (2002)
(X+M)/Gdp	Output trade ratio	WDI (2004)

A.3: Construction of index of relative factor endowment (RE)

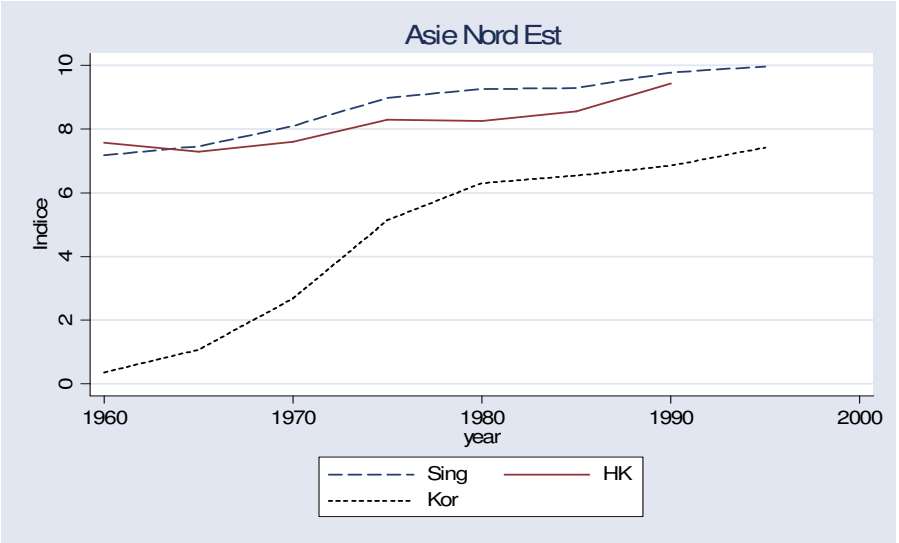
Let E_{ift} is per capita endowment of country *i* in factor *f* in year *t* and E^*_{ft} the world per capita effective endowment of country *i* in factor *f* in year *t* , computed by weighting every country's endowment by the population and by the degree of openness.

$$E^*_{ft} = \frac{\sum_i \left(E_{ift} \times pop_i \times \left(\frac{X+M}{GDP} \right)_i \right)}{\sum_i \left(pop_i \times \left(\frac{X+M}{GDP} \right)_i \right)}$$ The indicators of relative advantage is $RE_{ift} = \frac{E_{ift}}{E^*_{ft}}$

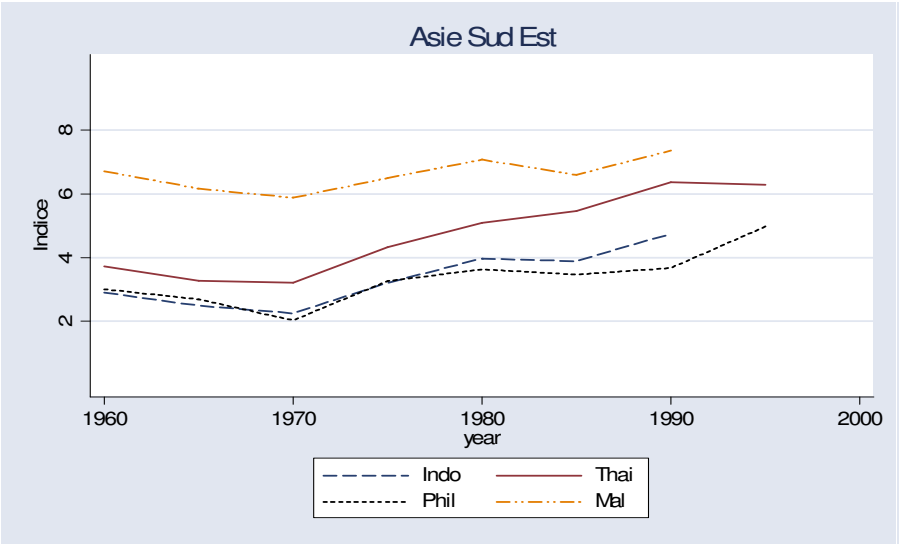
A.4: *Index of Trade Openness*



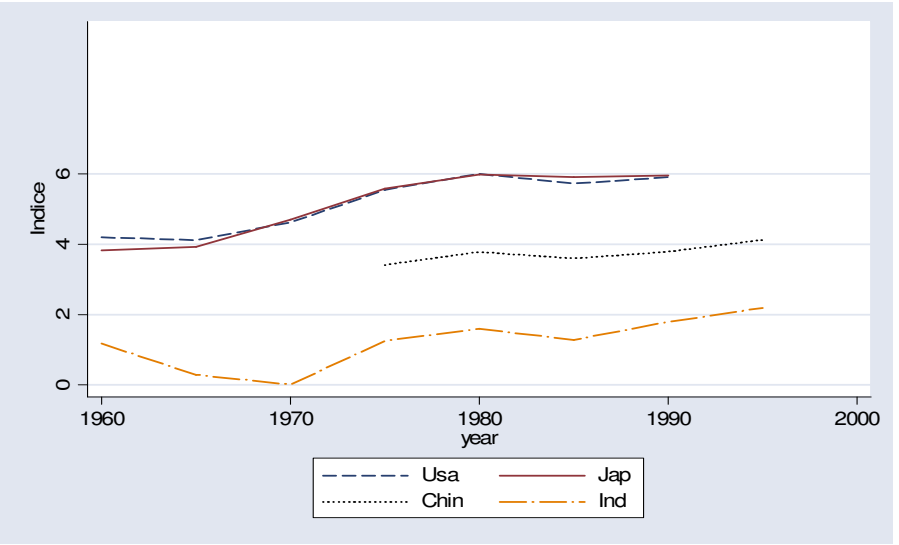
Graph 1: index for Latin American countries



Graph 2: Index for North East Asian countries



Graph 3: index for South East Asian countries



Graph 4: Index for other countries

A.5a: *Relative Factor Endowments: percentile distribution*

Obs	Percentile	(K/L)	(AT/L	(MF/L)	SK-ED/ BS-ED)	(SK+BS)/NO-ED	(NO-ED /L)	(BS-ED/ L)	(SK-ED/ L)
282	25	0,34	0,47	0,73	0,64	0,53	0,52	0,71	0,41
	50	0,94	0,90	0,85	0,92	1,15	0,93	1,01	0,97
	75	2,56	1,63	1,01	1,31	2,94	1,29	1,39	1,83

A.5b: *Tariff reduction, inequality and factor endowments (full result table 7b and 7c)*

	VAR 25-50	VAR 50-75
((SK+BS)/NO-ED)	-6.56	-8.78
(SK-ED/BS-ED)	1.49	1.46
(MF/L)	0.19	0.21
(K/L)	8.60	8.47
((NO-ED)/L)	4.61	2.16
((BS-ED)/L)	-2.94	-2.56
((SK-ED)/L)	8.39	5.44
(AT/L	0.17	0.15

Variable	Percentile	Variation 50%
(K/L)	0.25	-0.518
	0.50	0.132
	0.75	0.775
(AT/L	0.25	-0.321
	0.50	0.129
	0.75	0.358
(MF/L)	0.25	-0.773
	0.50	-0.344
	0.75	0.185
(SK-ED/BS-ED)	0.25	-0.203
	0.50	0.100
	0.75	0.398
((SK+BS)/NO-ED)	0.25	0.546
	0.50	0.090
	0.75	-0.465
((NO-ED)/L)	0.25	-1.252
	0.50	-0.437
	0.75	0.005
((BS-ED)/L)	0.25	-0.377
	0.50	-0.665
	0.75	-0.921
((SK-ED)/L)	0.25	-1.357
	0.50	-0.728
	0.75	-0.265

A.6: *Different Measure for Human Capital and Land resources*

	(1)	(2)		(3)	(4)
	Ln Gini	Ln Gini		Ln Gini	Ln Gini
Ln $(K/L)_{t-5}$	-0.0358	-0.0561	Ln $(MF/L)_{t-5}$	-0.3926a	-0.3820a
	(0.46)	(0.72)		(3.46)	(3.18)
Ln $(AT/L)_{t-5}$	-0.0056	0.0240	Ln $(CerT/L)_{t-5}$	0.0637	0.0772
	(0.16)	(0.67)		(1.01)	(1.21)
			Ln $(CroT/L)_{t-5}$	-0.0287	-0.0324
				(0.60)	(0.72)
Ln $(NO\text{-}ED/L)_{t-5}$	-0.1453		Ln $(ForT/L)_{t-5}$		0.0893
	(1.29)				(1.51)
Ln $(BS\text{-}ED/L)_{t-5}$	-0.0408	0.0511	Ln $(SK+BS/NO\text{-}ED)_{t-5}$	-0.0198	0.0079
	(0.42)	(0.67)		(0.53)	(0.21)
Ln $(SK\text{-}ED/L)_{t-5}$		-0.0361	Ln $(SK\text{-}ED/BS\text{-}ED)_{t-5}$	-0.0765c	-0.0806c
		(1.07)		(1.66)	(1.74)
$Openness_{t-5}$	-0.0067	-0.0131	$Openness_{t-5}$	0.0048	-0.0021
	(0.65)	(1.25)		(0.50)	(0.20)
Ln $(K/L)_{t-5}*Op_{t-5}$	0.0088c	0.0097c	Ln $(MF/L)_{t-5}*Op_{t-5}$	0.0804a	0.0807a
	(1.80)	(1.85)		(2.83)	(2.67)
Ln $(AT/L)_{t-5}*Op_{t-5}$	0.0115	-0.0012	Ln $(CerT/L)_{t-5}*Op_{t-5}$	0.0036	-0.0041
	(1.64)	(0.15)		(0.36)	(0.38)
			Ln $(CroT/L)_{t-5}*Op_{t-5}$	0.0138c	0.0139c
				(1.75)	(1.84)
Ln $(NO\text{-}ED/L)_{t-5}*Op_{t-5}$	0.0345c		Ln $(ForT/L)_{t-5}*Op_{t-5}$		0.0097
	(1.71)				(1.62)
Ln $(BS\text{-}ED/L)_{t-5}*Op_{t-5}$	-0.0129	-0.0136c	Ln $(SK+BS/NO\text{-}ED)_{t-5}*Op_{t-5}$	-0.0008	-0.0081
	(1.31)	(1.70)		(0.09)	(0.91)
Ln $(SK\text{-}ED/L)_{t-5}*Op_{t-5}$		0.0169b	Ln $(SK\text{-}ED/BS\text{-}ED)_{t-5}*Op_{t-5}$	0.0207c	0.0212c
		(1.96)		(1.76)	(1.77)
Ln Inflation	0.0020	0.0050	Ln Inflation	-0.0034	-0.0029
	(0.20)	(0.50)		(0.33)	(0.26)
gross/net income	0.0040	-0.0052	gross/net income	0.0067	-0.0037
	(0.22)	(0.28)		(0.39)	(0.23)
income/expenditure	0.0446a	0.0529a	income/expenditure	0.0375b	0.0486a
	(3.15)	(3.80)		(2.46)	(3.23)
Households/individual	0.0854a	0.0942a	Households/individual	0.0878a	0.0853a
	(3.18)	(3.60)		(3.34)	(3.18)
Fixed effects	Yes	Yes	Fixed effects	Yes	Yes
Observations	307	307	Observations	270	270
Number of countries	71	71	Number of countries	64	64

A.7: *Inequality, different skill categories and openness: results by Quintile*

	(1)	(2)	(3)	(4)	(5)	(6)
	lnQuint1	lnQuint2	lnQuint3	lnQuint4	lnQuint5	Gini
Ln $(AT/L)_{t-5}$	-0.3706c	-0.1123	0.0249	0.0730	0.0082	-0.0471
	(1.91)	(0.97)	(0.35)	(1.45)	(0.15)	(0.59)
Ln $(MF/L)_{t-5}$	0.1428	0.0084	0.0775	-0.0417	-0.0100	-0.1939
	(0.42)	(0.04)	(0.54)	(0.52)	(0.09)	(1.62)
Ln $(K/L)_{t-5}$	0.2331	-0.0575	0.0002	-0.0261	-0.0066	0.0421
	(1.58)	(0.70)	(0.00)	(1.05)	(0.18)	(0.79)
Ln $(SK+BS/NO-ED)_{t-5}$	0.0522	-0.0440	-0.0254	0.0060	0.0046	0.0005
	(0.57)	(0.63)	(0.60)	(0.19)	(0.14)	(0.01)
Ln $(SK-ED/BS-ED)_{t-5}$	-0.1358	0.0611	-0.0298	-0.0219	0.0402	-0.1679a
	(1.07)	(0.60)	(0.41)	(0.48)	(1.02)	(3.47)
Openness $_{t-5}$	0.0250	0.0095	0.0049	-0.0172c	0.0051	-0.0010
	(0.92)	(0.46)	(0.37)	(1.66)	(0.53)	(0.07)
Ln $(AT/L)_{t-5}$*Op_{t-5}	0.0320	-0.0065	0.0053	-0.0117c	0.0030	0.0105
	(1.07)	(0.38)	(0.58)	(1.77)	(0.38)	(0.98)
Ln $(MF/L)_{t-5}$*Op_{t-5}	-0.0479	-0.0115	-0.0288	0.0026	0.0156	0.0366
	(1.61)	(0.24)	(0.91)	(0.14)	(1.67)	(1.35)
Ln $(K/L)r_{t-5}$*Op_{t-5}	-0.0597b	0.0051	-0.0138	0.0025	0.0072	0.0147
	(2.10)	(0.29)	(1.64)	(0.51)	(1.04)	(1.44)
Ln $(SK+BS/NO-ED)_{t-5}$*Op_{t-5}	-0.0174	-0.0091	0.0170c	-0.0011	0.0035	-0.0128
	(0.77)	(0.53)	(1.74)	(0.16)	(0.46)	(1.19)
Ln $(SK-ED/BS-ED)_{t-5}$ *Op_{t-5}	0.0210	-0.0009	-0.0132	0.0124c	-0.0078	0.0401a
	(0.68)	(0.04)	(0.73)	(1.76)	(0.83)	(3.21)
Ln Inflation	-0.0318	-0.0236	0.0279	-0.0183	0.0088	0.0138
	(1.06)	(0.71)	(0.85)	(1.17)	(0.57)	(1.26)
household/individual	0.0095	0.0186	0.0518a	0.0540a	-0.0341a	0.0229
	(0.23)	(0.83)	(2.77)	(4.54)	(2.66)	(1.32)
Income/expenditure	0.1784	-0.1248	-0.1720b	-0.1377a	0.0742	0.1251a
	(1.12)	(1.30)	(2.43)	(3.19)	(1.49)	(4.51)
Gross/net income	-0.1779	-0.0013	-0.0366	-0.0057	0.0370	0.0088
	(1.20)	(0.02)	(1.04)	(0.24)	(1.02)	(0.52)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	217	217	217	217	217	217
Number of countries	56	56	56	56	56	56

A.8: *Adding macro and institutional variables as control*

	(1)	(2)	(3)	(4)
	Ln Gini	Ln Gini	Ln Gini	Ln Gini
Ln $(AT/L)_{t-5}$	-0.0768	-0.1231c	-0.2123a	-0.3029a
	(1.08)	(1.74)	(2.62)	(4.40)
Ln $(K/L)_{t-5}$	0.0195	0.0336	0.0347	0.0024
	(0.51)	(0.82)	(0.72)	(0.05)
Ln $(SK+BS/NO-ED)_{t-5}$	0.0331	0.0114	0.0483	-0.0575
	(0.96)	(0.32)	(0.91)	(1.17)
Ln $(SK-ED/BS-ED)_{t-5}$	-0.1212a	-0.1142a	-0.0921c	0.0275
	(2.98)	(2.65)	(1.69)	(0.42)
Openness $_{t-5}$	0.0067	0.0085	0.0154	0.0138
	(0.63)	(0.76)	(1.07)	(1.03)
Ln $(AT/L)_{t-5}$*Op_{t-5}	0.0130c	0.0194b	0.0271a	0.0381a
	(1.73)	(2.56)	(3.15)	(4.95)
Ln $(K/L)r_{t-5}$*Op_{t-5}	0.0079	0.0097	0.0135	0.0188c
	(1.09)	(1.26)	(1.41)	(1.93)
Ln $(SK+BS/NO-ED)_{t-5}$*Op_{t-5}	-0.0149c	-0.0107	-0.0204c	0.0066
	(1.83)	(1.22)	(1.66)	(0.56)
Ln $(SK-ED/BS-ED)_{t-5}$ *Op_{t-5}	0.0259b	0.0251b	0.0215	-0.0137
	(2.50)	(2.27)	(1.61)	(0.85)
Ln Inflation	-0.0062	-0.0017	0.0038	0.0187
	(0.64)	(0.17)	(0.34)	(1.55)
Ln Civil Liberties	0.0553c	0.0548	0.0751c	0.0201
	(1.66)	(1.55)	(1.94)	(0.52)
Ln Gov. Expenditures (%Gdp)		-0.0515	-0.0117	-0.0046
		(1.45)	(0.32)	(0.14)
Infrastructure stock (index)			0.0130	0.0137
			(0.52)	(0.52)
Infrastructure quality (index)			-0.0135	-0.0182b
			(1.57)	(2.31)
Ln Financial depth (M2/Gdp)				0.0308
				(1.02)
gross/net income	0.0066	0.0152	0.0246	-0.0147
	(0.40)	(0.93)	(1.32)	(0.91)
income/expenditure	0.0399a	0.0300b	0.0414a	0.0248
	(2.96)	(2.30)	(2.61)	(1.55)
Households/individual	0.0676a	0.0870a	0.1346a	0.1513a
	(2.72)	(3.58)	(4.75)	(6.30)
Fixed effects	Yes	Yes	Yes	Yes
Observations	282	252	217	169
Number of countries	66	59	52	42