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# Does wealth inequality reduce the gains from trade?*

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**Abstract**

Panel data on 54 developing countries between 1960 and 2000 are used to investigate how the impact of opening to trade on economic growth is affected by wealth inequality. The results suggest (a) that opening to trade tends to accelerate growth but (b) that the addition to growth depends inversely on the level of wealth inequality prior to opening. These findings confirm the general importance for rapid growth in developing countries of reducing inequalities of opportunity.

Keywords: growth, inequality, openness, trade, developing countries.

JEL Classification: F1, O1.

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## 1 Introduction

The links between inequality and growth and between trade and growth have attracted much attention from economists. Many papers have addressed these two issues separately (for instance, Attanasio and Binelli, 2003; Krueger and Berg, 2003). Other papers have asked whether greater openness to trade has increased inequality in developed and developing countries (Anderson, 2005; Goldberg and Pavcnik, 2007). Morrissey *et al.* (2002) link all three issues, concluding that the interaction between income inequality and trade liberalisation has no effect on growth.

A neglected aspect, however, has been the effect of inequality on the extent of the gains from trade. Inequality of wealth and asset ownership, in particular, has been argued to affect the incentives of and constraints on economic actors, especially poor ones. Variation among countries in the distribution of wealth could thus plausibly be hypothesised to affect both the benefits and the costs of opening to trade and therefore to be a cause of variation in the growth outcomes of trade reforms. The objective of this paper is to refine and test that hypothesis.

The model developed in this paper focuses on the fact that people at the lower end of the distribution of wealth ownership have very limited access to credit. While credit market imperfections have been analysed extensively in the inequality and growth literature[1], they have played little role in studies of the effects of trade liberalisation (McCulloch *et al.*, 2002) and even less in the literature on trade and growth. Thus, this paper also highlights new aspects of the role of financial

[1]Inequality has also been found to affect growth through the political economy, social and political instability and health channels, however this last one is more debated in the literature (see Deaton, 2001).

development.

The main findings are as follows: opening to trade leads to faster economic growth. But the addition to growth depends inversely on the level of wealth inequality at the beginning of the liberalisation process. The suggested reason is that in countries with more wealth inequality fewer people are able, by borrowing, both to take advantage of the opportunities created by trade liberalisation and to adjust to the economic disruption that it causes.

Section 2 sets out a simple model of the relationship between the distribution of wealth and the outcome of trade liberalisation. Section 3 explains the methodology used to test this theory. Sections 4 and 5 present and discuss the data, the results and some robustness checks. Section 6 concludes.

## 2 Theory

In what follows, we present a model in which capital-market imperfections restrict borrowing and lending. As shown in the literature on inequality and growth, this implies that when the individual production function is concave, greater inequality in the distribution of wealth results in a lower aggregate level of output and, in an endogenous growth model, a lower rate of growth. The novelty of this paper is to extend this framework to compare how economies with different degrees of wealth inequality fare following a trade liberalisation. Because, in a more unequal economy, more individuals will be below a certain threshold level of wealth, the net benefits of opening to trade will be lower. This implies that trade liberalisation will exacerbate the differences in output levels or growth rates among countries with different levels of inequality, even though all countries individually will gain from the liberalisation.

**Closed-economy model**

Our model follows Aghion *et al.* (1999). Aggregate output $y$ does not depend, as in the standard model, merely on the aggregate stock of capital $k$, i.e. $y_t = f(k_t)$, where this stock is the simple sum of the capital stocks of all producers, $k_t = \sum_i k_{i,t}$. Instead, aggregate output is the sum of the output generated by each producer, $y_t = \sum_i y_{i,t}$, which in turn depends on her own capital stock, $y_{i,t} = f(k_{i,t})$. With capital-market imperfections, $f(\sum_i k_{i,t})$ and $\sum_i f(k_{i,t})$ are different, which implies that the distribution of wealth affects the aggregate level of output.

Aghion *et al.* consider an economy in which all agents are identical except for their ownership of wealth. Agent $i$, where $i \in [0, 1]$, invests an amount of broadly defined capital $k_{i,t}$ at time $t$. The definition of capital is widened to include those cumulable factors of production whose markets are imperfect, and therefore human capital particularly. This is used in production according to

$$y_{i,t} = A_t k_{i,t}^{\alpha}, \tag{1}$$

where $0 < \alpha < 1$, implying that the productivity of individual investments decreases with the scale of the investment. $A_t$ is the level of technical knowledge available in period $t$ and common to all individuals. The premise, as in Grossman and Helpman (1991), is that knowledge is non-rivalrous and is also non-excludable in many respects. Aghion *et al.* endogenise the level of technology by assuming learning-by-doing and knowledge spillovers. While the former concept implies that the more one produces, the more one learns, and hence the greater the level of technical knowledge, the latter implies that the more learning one agent does, the greater the return from the overall level of technical knowledge for every agent in the economy. These two assumptions are summarised in the following equation,

$$A_t = \int_0^1 y_{i,t-1} \, \mathrm{d}i = y_{t-1}. \tag{2}$$

Thus, the stock of knowledge at any time depends on past aggregate production. The rate of growth for the closed economy (superscript $c$) between period $t-1$ and period $t$ is given by

$$g_t^c = \ln \frac{y_t}{y_{t-1}} = \ln \frac{\int_0^1 A_t k_{i,t}^{\alpha} \, \mathrm{d}i}{A_t} = \ln \int_0^1 k_{i,t}^{\alpha} \, \mathrm{d}i. \tag{3}$$

Therefore, the rate of growth depends on the distribution of individual investments. The more concentrated these are on a few large investments, the lower is the growth rate. Growth would be faster with a larger number of smaller investments.[2]

To see how these investments are determined, consider that there is one composite good, made up of a continuum of unspecified goods $j \in [0, 1]$, that can be used as both capital and consumption good. There is a continuum of infinitely-lived individuals $i$ and no population growth. The utility of each individual is

[2]This result is the consequence of decreasing returns to scale to individual investments, while increasing returns to scale at the aggregate level imply a growth effect rather than the classical level effect.

given by

$$U_{i,t} = \sum_{t=0}^{\infty} \beta^t \ln c_{i,t}, \tag{4}$$

where $c_{i,t}$ denotes consumption of individual $i$ at time $t$ and $0 < \beta < 1$ is the discount factor. Individuals differ in their initial endowments of wealth, $w_{i,t}$, which are randomly determined at birth, with mean 1.[3] At any time, each individual can consume her endowment or invest for future consumption, where production and technology follow the process described in the previous paragraph. It is this investment that enables the economy to grow, so that the more is invested (or, equivalently, the less is consumed), the faster will be the economy's growth.

In the absence of capital-market imperfections, all agents invest where $k_{i,t} = k_t^\star$, i.e. to the point where the marginal product of capital is equal to the rate of interest. This is possible because agents with different endowments can lend and borrow capital freely. As a result, aggregate output and growth do not depend on the distribution of wealth. Conversely, when individuals cannot borrow nor lend because of capital-market imperfections, individual investments are simply a fraction of individual wealth, $k_{i,t} = s \cdot w_{i,t}$.[4] Individual outputs are then given by $y_{i,t} = A_t(s \cdot w_{i,t})^\alpha$, and the rate of growth is determined by the distribution of endowments,

$$g_t^c = \alpha \ln s + \ln \int_0^1 w_{i,t}^\alpha \,\mathrm{d}i. \tag{5}$$

[3]This normalisation implies that the growth rate $g$ does not depend on the unit of $k$.

[4]This is the result of a dynamic programming exercise in which each individual maximises utility subject to the individual production function. If the discount factor, $\beta$, and the returns to the individual capital investments, $\alpha$, are assumed to be equal for all individuals and constant over time, the savings rate, $s$, can be treated as a parameter. Mathematical derivations are provided in the Appendix.

It is clear from equation (5) that Aghion *et al.*'s model predicts that when there are decreasing returns to individual investments, greater inequality in initial endowments and, therefore, in individual investments implies lower aggregate output and a lower rate of growth for a given aggregate amount of investment.

**Effects of openness**

We now move beyond Aghion *et al.*, to analyse the effects of trade liberalisation in this model, and in particular to show how the gains from trade and the adjustment costs of trade are intertwined.[5] The context is a general neoclassical model of trade with $m$ factors and $j$ goods. Ordering the $j$ goods by factor intensity and following the theorem of comparative advantage, as specified by Dixit and Norman (1980), one can predict which country will produce and export which goods depending on their relative costs of production. As a corollary, trade allows a country not to produce a range of the unspecified goods $j$ at high cost and instead to import them more cheaply.

The gains from trade are a result of broadly defined structural change, i.e. the displacement of existing inputs, outputs, techniques and even firms by new and better ones (McCulloch *et al.*, 2002). Such gains from greater openness, defined as the reduction in barriers to cross-border economic interactions, are particularly important for developing countries because their goods and technologies are often far inside the world frontier. Some of these structural changes involve the replace-

[5] Ventura (1997) builds a model where more openness to trade increases growth by combining a weak form of the factor-price-equalization theorem developed by Trefler (1993) with the Ramsey model of economic growth. The result is that international trade converts excess production of goods into exports, instead of falling prices. This model has features that complicate its expansion to include heterogeneity in terms of individuals' levels of wealth and it makes predictions about the Stolper-Samuelson and Rybczynski effects that go beyond the aim of this paper.

ment of production for the domestic market by imports (and a corresponding shift of domestic production capacity into exports). This is the classic source of gains from trade through intersectoral reallocation and is reflected in changes in trade flows.

However, many of the structural changes are ‘behind the border’, involving a wide range of shifts in product mix, techniques and industrial structure that increase productivity without directly affecting on trade flows. In some cases, these shifts even prevent changes in trade flows, as with ‘defensive innovation’, suggested by Wood (1994) and formally analysed by Acemoglu (1999), Neary (2002) and Thoenig and Verdier (2003). The increase in competition from foreign firms following a trade liberalisation may lead home firms in import-competing sectors to invest in more efficient techniques and capital in order to keep foreign goods out of the domestic market. Greater openness generates more structural change and more gains than would be predicted simply from increases in trade flows.

The link from medium- to long-run faster growth following trade liberalisation is then provided by knowledge spillovers, as described above. In a more open economy, these spillovers could also include such things as technological transfer and learning from imports. For instance, Ben-David and Loewy (2000) argue that the extent of the international transmission of knowledge between two countries is determined by the level of their trade.

The gains from trade through structural change can be summarised in the following extension of equation (2) above

$$A_t = (1 + \gamma\delta) y_{t-1}, \tag{6}$$

where $\gamma$ is the ratio ($> 1$) of the productivity of new activities to that of old activities, which is assumed for simplicity to be the same for all sorts of structural change, and $\delta$ is the proportion of domestic production that is affected by structural change as a result of greater openness. For any given $\gamma$, which can vary among countries, the gains from trade increase with $\delta$.

**Inequality and investment**

We assume that agents affected by any structural change following a trade liberalisation at time $t$, who are a proportion $\delta$ of all agents by construction, are required to invest a lump-sum amount $f$ to acquire the information and know-how needed to switch production and, thus, to reap the benefits of trade liberalisation.[6] Because capital-market imperfections restrict borrowing and lending, individuals must finance these lump-sum investments from their endowments. They thus have to choose whether to invest in reaping the gains from greater openness, taking into account that this would reduce their wealth to $w_{i,t} - f$ or simply to use all of their endowments $w_{i,t}$ for consumption.[7]

Given the capital-market imperfections, this choice will depend on the individual's level of wealth. To discover exactly how it depends on wealth, we use dynamic optimisation to calculate the level of consumption with and without the lump-sum investment – assuming $A_t$ is constant because an individual does not internalise spillovers (details are provided in the Appendix). Comparing the two optimal levels of consumption yields the cut-off level of wealth, $\hat{w}_{i,t}$, at which an

[6] For sensible results, $f$ must be smaller than the average level of wealth $\bar{w}_t$.

[7] Since this is a lump-sum investment, it only affects the decision of whether to invest or not, but, conditional on investing, it does not change the returns to $k_{i,t}$, so that the proportion of (net of lump sum) wealth invested is still $s$, as in the original model.

individual is indifferent between investing and not investing in new information and know-how, which is

$$\hat{w}_{i,t} = \hat{f} = \frac{f}{1 - \frac{1-\beta}{1-\beta\alpha}}. \tag{7}$$

The cut-off level of wealth is unsurprisingly an increasing function of $f$. Also unsurprisingly, $\hat{f}$ is a decreasing function of $\beta$, because greater patience (a higher $\beta$) makes investment more attractive relative to current consumption. It is less obvious why $\hat{f}$ is an increasing function of $\alpha$, but this can be understood in terms of substitution and income effects. A higher $\alpha$, on the one hand, implies that future consumption is cheaper relative to present consumption, but, on the other hand, implies that the discounted future income stream is higher. Since agents cannot borrow or lend and, thus, cannot take advantage of the substitution effect, the income effect has to prevail, which reduces the incentive to invest.

The distribution of wealth is assumed to be such that a proportion $\lambda$ of individuals affected by structural change – and hence a proportion $\delta\lambda$ of the population – has a level of wealth below $\hat{f}$, and will thus choose not to invest. This proportion $\lambda$ will be greater, *ceteris paribus*, in countries with greater inequality of initial wealth endowments. Agents affected by structural change who have a level of wealth above $\hat{f}$ – a proportion $\delta(1-\lambda)$ of the population – will make the lump-sum investment of $f$ and invest a proportion $s$ of their remaining wealth in order to reap the benefits of trade liberalisation. Agents who are not affected by the structural changes, a proportion $1-\delta$ of the population, do not need to make the lump-sum investment to enjoy the benefits of trade liberalisation and will keep investing a proportion $s$ of their wealth.

**Open-economy model**

Combining these new elements with the model in equation (5), the growth rate in the open economy (superscript $o$) becomes

$$g_t^o = (1 + \gamma\delta) \left[ \alpha \ln s + (1 - \delta) \ln \int_0^1 w_{i,t}^{\alpha} \, \mathrm{d}i + \delta \ln \int_{\hat{f}}^1 (w_{i,t} - f)^{\alpha} \, \mathrm{d}i \right]. \qquad (8)$$

This extended model predicts not only that less unequal closed economies grow faster, but also that economies with lower inequality will grow faster after opening to trade because larger proportions of their populations will be able and willing to invest in new productive activities. In addition, open economies will grow faster than closed economies, provided that the net gain from trade is positive. Assuming that $\delta$ is randomly distributed across the population, the net gain from trade can be easily calculated: the costs from opening to trade are given by the proportion $\delta\lambda$ of the population that ceases to invest and produce, while the rest of population gains higher returns on their investment given by $(1 + \gamma\delta)$. Thus, the net gain is equal to $[(1 + \gamma\delta)(1 - \delta\lambda) - \delta\lambda]$, which is larger when $\lambda$ is smaller, i.e. the less unequal is the distribution of endowments. The net gain from trade is positive so long as the productivity differential is large enough to outweigh the adjustment costs (which need not always be the case).

To summarise, the model implies that trade liberalisation will trigger adjustment processes resulting in faster or slower growth depending on the initial distribution of wealth.[8] This is obviously not the only mechanism by which trade

[8] This paper does not take into account Stolper-Samuelson feedback effects from trade to income inequality, because what matters is wealth rather than income inequality. Also, this paper excludes the existence of further feedback effects running from income to wealth inequality because they are only visible in the very long run, as suggested by Wood and Ridao-Cano (1999).

reform could affect growth, but the extent to which it can explain differences in the growth response to trade liberalisation is what we will now try to assess.

## 3 Econometric specification

The method to be applied is cross-country and panel data regressions. In particular, panel data may provide valuable insights by exploiting the time-series nature of the relationship between trade, growth and wealth inequality and allowing us to control for the endogeneity of the explanatory variables.

Serious criticisms have been aimed at growth regressions (eg. Hausmann *et al.*, 2005). This paper analyses only one of the many possible influences on growth, but cannot entirely escape these criticisms. Errors of omission could be particularly important, especially with regard to measures of institutions, as stressed for example by Rodrik *et al.* (2004). Thus, an important part of this paper will be to run a series of robustness checks taking these issues into account.

The dependent variable is the growth rate of per capita output. Independent variables include two alternative measures of openness to trade, a measure of the inequality of wealth (land ownership inequality) and interactions between openness and wealth inequality. The regressions also control for the amount of land per person and the average level of education (a proxy for human capital), both measured at the beginning of each period to avoid endogeneity.[9] Investment is not included, because of its endogeneity and its close accounting relationship with growth. To include investment, moreover, would cause the regressions to miss the

[9] In our robustness checks, we also include interactive variables between our measures of openness and land per capita, but this does not change our main results and, thus, this is not discussed further.

point of this paper, which is that inequality of wealth ownership lessens the effect of trade on growth by reducing investment (see Frankel and Romer, 1999). Also, this paper does not consider any convergence effects both because this is not a feature of our theoretical model and because per capita GDP at PPP at the beginning of the period is not significant in our regressions neither with Pooled OLS nor with difference and system GMM estimators. A further measure of wealth inequality, education inequality was used in preliminary empirical work but has not been included because of its almost perfect collinearity with the level of education (the correlation, $\rho$, is at least $-0.92$ for all the periods considered).[10,11]

Initial estimating equations for the cross-section and panel data would thus be respectively:

$$g_i = a + b_1 o_i + b_2 l_i + b_3 h_i + b_4 \sigma_i + b_5 o_i \sigma_i + e_i \tag{9}$$

$$g_{it} = a + b_1 o_{it} + b_2 l_{it} + b_3 h_{it} + b_4 \sigma_{it} + b_5 o_{it} \sigma_{it} + b_6 yr_t + u_i + e_{it} \tag{10}$$

where $g$ is the growth rate of per capita output, $o$ is a measure of openness to trade, $l$ is the average amount of land per person, $h$ is the average level of education, $\sigma$ is the distribution of land, $o \cdot \sigma$ is the interaction between openness to trade and the distribution of land, $yr$ are the period dummies for the panel data, $e$ is the error term (for the panel data it is the time-variant part of the error), $u$ is the time-invariant part of the error term for the panel data and the subscript $i$

[10] Education inequality was measured by the Gini coefficient at the beginning of each period and taken from Thomas *et al.* (2002).

[11] This high correlation is due to the fact that, unlike for other factors of production, individuals can hold only up to a certain amount of formal education. This implies that as a country experiences an expansion of average levels of education, this benefits more those individuals with lower levels of education, which implies, in turn, that inequality in educational attainment decreases.

represents each country while $t$ stands for each time period.

Estimating these initial equations by OLS and, for the panel data, pooled OLS (POLS) poses several problems. Firstly, our measure of land inequality is collinear with the average amount of land per capita ($\rho = 0.55$). Using a weighted Gini coefficient of land inequality – multiplying land inequality by land per capita for each country – eliminates this problem. Moreover, this weighted measure of land inequality gives more weight to those countries where land inequality relative to other wealth inequalities matters more, i.e. those developing countries where land is more abundant and, therefore, a more important factor of production.

Secondly, as noted already, the omission of institutional variables may lead to omitted variable bias. However, regional dummy variables will be included to take into account regional institutional characteristics and, thus, reduce this problem. In addition, we control in further regressions for country's institutional characteristics, using two measures of institutions, including the settlers' mortality rate, developed by Acemoglu *et al.* (2001) as an instrument for investment-discouraging institutions.

Thirdly, there is an extensive empirical literature on the endogeneity of some of the regressors used in this paper, and, in particular, measures of openness and the level of education. The trade dependency ratio, $tdr$, is alleged to be affected by endogeneity bias mainly because of reverse causality (faster growth, *ceteris paribus*, implies a higher level of income, which may stimulate a disproportionately higher level of trade). Reverse causality is also a cause of endogeneity bias when estimating the effect of education on growth. Moreover, Frankel and Romer (1999) criticise the Sachs-Warner Index for endogeneity on omitted-variable grounds (countries with free-market trade policies may also have free-market domestic policies that increase growth). While this source of bias is mitigated by the inclusion of regional fixed effects, we test the extent of this problem while performing our robustness checks.

In addition, and particularly for purposes of estimating the present model, the trade dependency ratio is affected by attenuation bias related to measurement error. More specifically, changes in the trade dependency ratio are a noisier measure – i.e. measured with greater error – than changes in the Sachs-Warner Index of the true extent of structural change caused by trade barrier reduction. One reason for this is the defensive investment argument outlined in Section 2: trade flows reflect only part of the full structural change caused by a reduction in trade barriers, and a part whose relative importance is likely to vary among countries and time periods. Another reason is that the trade dependency ratio can vary as a result of shocks that are unrelated (or not closely related) to structural change, such as fluctuations in export or import prices (eg. an export commodity price boom will push the ratio up) and movements of exchange rates (eg. the impact effect of a devaluation is to raise the measured ratio of trade to GDP even if no real variable alters). Thus, the trade dependency ratio is a downward-biased measure of the true extent of structural change and one should expect the Sachs-Warner Index and its interaction with land inequality to have larger effects on growth.

To correct the endogeneity biases, we use an instrumental variable (IV) estimator for the panel data with the lagged values of the endogenous variables as instruments. This approach cannot be employed for the cross-section data, which will be analysed using OLS to provide a starting point for the analysis of the coefficients. For the IV approach to work, the instruments, i.e. the lagged values of the measures of openness and the level of education, need to be both informative and valid. For the instruments to be informative, all that is required is that they are correlated with the endogenous variables. This is definitely the case since the correlation values are above 0.8 for all the variables and periods considered. For the instruments to be valid, they must also be uncorrelated with the residual in the main equation determining growth. This seems to be the case because, from a purely historical perspective, there should be no reverse causality from growth at time $t$ to any of these variables at $t-1$, provided that there is negligible serial correlation in the error term. However, the model as specified below is exactly identified and, thus, it will not be possible to test for the validity of the instruments used.

The final estimating equations for the cross-section and panel data are thus respectively:

$$g_i = a + b_1 o_i + b_2 w\sigma_i + b_3 h_i + b_4 o_i \sigma_i + b_5 r_i + e_i \tag{11}$$

$$g_{it} = a + b_1 o_{it} + b_2 w\sigma_{it} + b_3 h_{it} + b_4 o_{it}\sigma_{it} + b_5 r_i + b_6 yr_t + u_i + e_{it} \tag{12}$$

where $w\sigma$ is the weighted distribution of land and $r$ represents the dummy variables for geographical regions.

The choice of estimators will be OLS for the cross-sectional analyses, but is more complex for the panel data. The underlying endogeneity assumption that leads us to the use of IV can be tested with the Hausman specification test. Yet, the estimators for the panel data will differ in terms of the underlying assumptions about the error terms. While random effects (RE) estimators assume that the unobserved effects are not correlated with the regressors, fixed effects (FE) estimators assume that they are correlated and, therefore, eliminate these unobserved effects by differentiation. Once again, the Hausman specification test will be used to examine whether FE or RE should be preferred. However, if the time-invariant part of the error term is indeed uncorrelated with the regressors, RE will be efficient only when the variance of this time-invariant part of the error term is different from zero, meaning that there is serial correlation. Otherwise the POLS estimator should be preferred because, unlike the RE estimator, it does not require the regressors to be strictly exogenous. In this case, the Breusch-Pagan Lagrange multiplier test can be used to investigate the presence of serial correlation.

## 4 Data sources and description

The data cover 54 developing countries, chosen according to the availability of reliable data, and listed in the Appendix. The analysis is limited to developing countries because, as observed in Section 2, developing countries are more likely to benefit from structural change because they usually are further inside the world production frontier, and also because developed countries have been open to trade according to the Sachs-Warner Index for a long time and, thus, one would need to go much further back in history to find some different evidence (consistently with these reasons for their exclusion, the inclusion of developed countries yields less clear econometric results). The period in both the cross-section and panel data analyses is 1960-2000, divided into 5- and 10-year sub-periods in the panel data. Table 1 provides the definitions and sources of variables and table 2 presents summary statistics for the cross-section (averaging across all years) and the panel data.

The growth rate of per capita real GDP (*growth*), in percentage terms, is

**Table 1:** Description and source of variables.

| | Description | Source |
|---|---|---|
| growth | Growth rate of pc real GDP, annual %, period average | Penn World Table |
| swi | Sachs-Warner Index, period average | Wacziarg & Welch, 2003 |
| tdr | Trade dependency ratio, period average | Penn World Table |
| land | Average area of land per person, initial level | Frankema, 2006 |
| educ | Average schooling years for pop. over 15, initial level | Barro & Lee, 2001 |
| landgini | Gini coefficient for land distribution, initial level | Frankema, 2006 |
| wlandgini | Weighted landgini, initial level, landgini×land | Derived |
| swiland | Interaction between landgini and swi | Derived |
| tdrland | Interaction between landgini and tdr | Derived |

**Table 2:** Summary statistics for cross-section and panel data, 1960-2000.

| | **Cross-section** | | | | **10-year Panel** | | | | **5-year Panel** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D. | Min. | Max. | Mean | S.D. | Min. | Max. | Mean | S.D. | Min. | Max. |
| growth | 2.08 | 1.66 | -0.70 | 6.72 | 2.08 | 2.63 | -3.80 | 16.96 | 2.08 | 3.35 | -6.55 | 31.02 |
| swi | 0.38 | 0.29 | 0 | 1 | 0.38 | 0.44 | 0 | 1 | 0.38 | 0.46 | 0 | 1 |
| tdr | 0.33 | 0.21 | 0.06 | 1.11 | 0.33 | 0.25 | 0.04 | 2.17 | 0.33 | 0.26 | 0.03 | 3.00 |
| land | 0.02 | 0.02 | 0.00 | 0.08 | 0.02 | 0.02 | 0.00 | 0.13 | 0.02 | 0.02 | 0.00 | 0.14 |
| educ | 2.85 | 1.71 | 0.12 | 7.25 | 3.90 | 2.08 | 0.12 | 9.93 | 4.04 | 2.11 | 0.12 | 10.56 |
| landgini | 63.48 | 16.49 | 29.10 | 90.90 | 63.48 | 16.38 | 29.10 | 90.90 | 63.48 | 16.36 | 29.10 | 90.90 |
| wlandgini | 1.03 | 1.20 | 0.00 | 5.84 | 1.12 | 1.37 | 0.00 | 8.33 | 1.12 | 1.36 | 0.00 | 8.85 |
| swiland | 24.25 | 18.98 | 0 | 71.40 | 24.25 | 29.72 | 0 | 86.50 | 24.25 | 31.33 | 0 | 90.90 |
| tdrland | 19.84 | 12.13 | 4.68 | 57.32 | 19.84 | 14.34 | 1.73 | 114.84 | 19.84 | 14.79 | 1.12 | 159.05 |

Note: Cross-section (N=54); 10-year period Panel data (N=216, n=54, T=4); 5-year period Panel data (N=432, n=54, T=8).

measured by the average value of the annual growth rates in the relevant period and is taken from Heston *et al.* (2006) (Penn World Table). This variable is comparable across periods and countries as it is measured at PPP.

Two measures of openness are used. The first one is the Sachs and Warner (1995) Index (*swi*), which is equal to 0 if the country is closed and 1 if it is open. The assessment of openness takes into account tariff rates, coverage of non-tariff barriers, black market exchange rate premium, state monopoly of exports, and socialist system. The data are average values in each period, from Wacziarg and Welch (2003). The second measure of openness to trade is the trade dependency ratio (*tdr*) – which is equal to the sum of exports and imports divided by PPP GDP. This variable is also taken from Heston *et al.* (2006).

The amount of land per person (*land*) is calculated at the beginning of each period by dividing the total amount of land (*area*), measured in thousands of hectares and taken from Frankel and Romer (1999), by the total population (*pop*), measured in thousands of people and taken from Heston *et al.* (2006). The level of education (*educ*) is calculated as the average years of schooling for the population over the age of 15, measured at the end of the year preceding the beginning of each period to avoid problems of endogeneity, and is taken from Thomas *et al.* (2002), who, in turn, make use of the Barro-Lee dataset (2001).

The distribution of land (*landgini*), which is used as a proxy for wealth inequality, is measured by the Gini coefficient at the beginning of the whole period, which implies that in the panel data the same observation is repeated for each period, and is taken from Frankema (2006). This is preferred to Deininger and Olinto (2000) because of its broader country coverage and to Vollrath and Erickson (2007) because it calculates the land Gini coefficient in a way that is more comparable with other studies.[12]

As mentioned in Section 3, the average level and the measure of dispersion for land are combined in the final specification to give weighted Gini coefficients for land distribution. One thus obtains the following variable, the weighted Gini coefficient for land distribution (*wlandgini*) measured at the beginning of each period

[12] Using land inequality as a proxy for wealth inequality may be criticised on the grounds that, if a country is made up of heterogeneous lands in terms of productivity, under competitive land rental market and free entry, this will result into land inequality but no wealth inequality because lower-productivity lands will give rise to larger holdings (Eastwood *et al.*, 2004). While this problem can be solved by regressing land inequality on average farm size, taken from Vollrath (2007), and then using the residuals of such regression, in our sample we do not find any significant relationship between these two variables and, thus, we consider this as a marginal issue.

and obtained by multiplying the Gini coefficient for land distribution (*landgini*) and the average amount of land per person (*land*).

Finally, the interactive variables between our measure of wealth distribution and the two different measures of openness to trade are calculated simply by multiplying land inequality by each measure of openness to trade. In this case, the land distribution variable is not the weighted one because using the unweighted measure of distribution allows us to make more meaningful calculations of the relationship between trade, inequality and growth. This yields the following variables: the interaction between the Gini coefficient for land and the Sachs-Warner Index (*swiland*) and the interaction between the Gini coefficient for land and the constructed trade dependency ratio (*tdrland*).

Figures 1 and 2 plot the general relationships between the variables of interest, distinguishing between low and high inequality countries. To allocate each country to one of the two groups, all countries are ranked according to their Gini coefficients on land distribution (as set out in the Appendix).

Both figures refer to the cross-sectional data and show the association between growth over the period 1960-2000 and the average value of the Sachs-Warner Index or of the trade dependency ratio, respectively, over the same period. The slopes of the best-fit lines relating growth and openness are slightly steeper for those countries that have low land inequality than for those with high land inequality. The intercepts of the lines are also higher for those countries that have lower land inequality. This suggests that openness to trade has a larger positive effect on growth in countries with lower land inequality. This effect is present for both measures of openness to trade.

**Figure 1:** Association between growth and openness (*swi*).

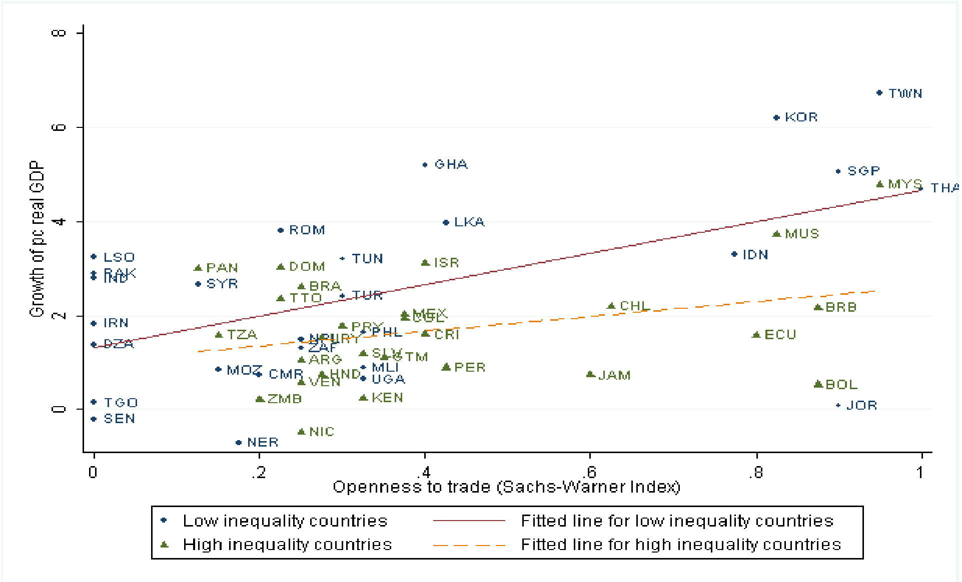
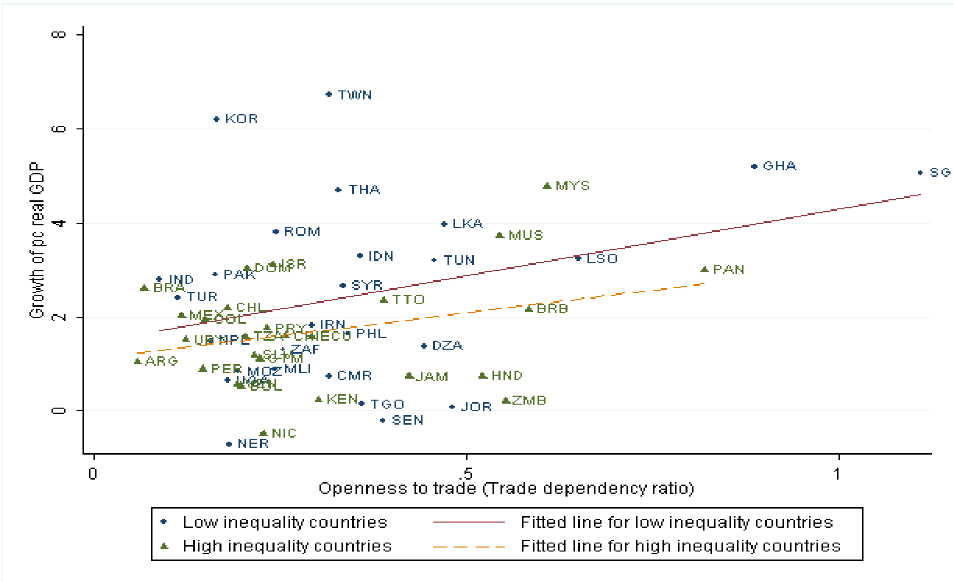



**Figure 2:** Association between growth and openness (*tdr*).




In both graphs, one can easily spot the 'Asian Tigers', as they are among the most open economies and with the highest growth rates. Eliminating South Korea and Taiwan from these graphs does not change the general pattern of the best-fit lines. The difference between the slopes of the low- and high-inequality countries becomes smaller, but this exclusion is probably misleading because these are countries that before opening to trade pursued those policies – land reforms and increasing access to education (see, for instance, Frankema, 2006 and Galor *et al.*, 2004 for the case of South Korea) – that according to the present model would increase the growth potential of an open economy.

In the following section, we analyse the relationship between openness, inequality and growth using more formal and rigorous statistical analysis to make sure that what we observe in the above graphs is not caused by other variables. As we will see, regression analysis confirms the general results obtained from informal graphical analysis.

## 5 Openness, inequality and growth: empirical results

As predicted, the initial specification in equations (9) and (10) is not helpful: it generates non-credible coefficients, probably because of the problems of endogeneity.[13] The preferred specification, as discussed in Section 3, is equations (11) and (12) for the cross-section and panel data respectively. Table 3 shows the results obtained by estimating these equations. In each of the three pairs of columns, the first is based on the Sachs-Warner Index of openness, and the second on the trade dependency ratio.

While for the cross-section we use the OLS estimator with robust standard errors to deal with possible non-normal error terms and heteroscedasticity, the final choice for the panel data is more complex. Firstly, using the FE and RE

[13]The results obtained by estimating our growth model in its initial specification are available upon request.

estimators, the Hausman specification test shows that we cannot reject the null hypothesis that the coefficients are systematically similar.[14] This implies that the unobserved fixed effect is not correlated with the regressors and, thus, that the RE and the POLS estimators are to be preferred to FE. Secondly, using the POLS and RE estimators, the Breusch-Pagan Lagrange multiplier test shows that we cannot reject the null hypothesis that the variance of the time-invariant part of error term is equal to zero, i.e. there is no serial correlation. This implies that while both estimators are consistent, the POLS estimator is more efficient and thus to be preferred. Thirdly, using the IV POLS and POLS estimators for all the panel data specifications, the Hausman specification test rejects the null hypothesis, implying that both the measures of openness and education are endogenous. As a result of these tests, table 3 includes only the results using the IV POLS estimator because it should be consistent and efficient.[15]

### Interpretation of results

All the specifications are significant as a whole, as shown by the F-statistics. The regressions fit well, especially in cross-section, with more than 50 per cent of the variation in growth explained by the relevant variables. There are differences between the results obtained with the Sachs-Warner Index and with the trade dependency ratio, which are in line with the expectation that the latter understates the true extent of structural change. These differences arise statistically from the low correlation of the two openness variables – 0.25, 0.17 and 0.15 for the

[14] One needs to notice that the null hypothesis may not be rejected because of the high standard errors associated to the coefficients calculated under the FE estimator. Yet, taking into account the steps taken to eliminate the endogeneity problems associated with this paper, it is plausible that the null hypothesis under consideration should not be rejected.

[15] All the other estimations are available upon request.

**Table 3:** The determinants of growth (equations (11) and (12)).

| | 40-year period | | 10-year period | | 5-year period | |
|---|---|---|---|---|---|---|
| Estimation | CS (OLS) | CS (OLS) | IV-POLS | IV-POLS | IV-POLS | IV-POLS |
| swi | 5.13*** | | 6.11*** | | 4.52*** | |
| | (1.85) | | (1.68) | | (1.28) | |
| tdr | | 3.52** | | 2.37* | | 6.73 |
| | | (1.76) | | (1.33) | | (4.90) |
| educ | 0.26*** | 0.31*** | 0.20* | 0.34** | 0.13 | 0.16 |
| | (0.10) | (0.10) | (0.12) | (0.13) | (0.09) | (0.15) |
| wlandgini | -0.34*** | -0.35*** | -0.19 | -0.28* | -0.31** | -0.27* |
| | (0.12) | (0.11) | (0.16) | (0.15) | (0.13) | (0.15) |
| swiland | -0.06** | | -0.06** | | -0.05** | |
| | (0.03) | | (0.03) | | (0.02) | |
| tdrland | | -0.02 | | -0.04 | | -0.04 |
| | | (0.03) | | (0.03) | | (0.06) |
| constant | 1.72** | 1.95*** | 1.96** | 3.71*** | 3.62*** | 2.46*** |
| | (0.82) | (0.39) | (0.91) | (0.83) | (0.92) | (0.76) |
| Sample size | 54 | 54 | 162 | 162 | 378 | 378 |
| F-stat | 11.00*** | 8.76*** | 16.98*** | 11.18*** | 14.31*** | 8.77*** |
| $R^2$ | 0.58 | 0.56 | 0.35 | 0.33 | 0.23 | 0.21 |

Notes: Year dummies for the panel data and regional dummies are omitted. Robust standard errors are provided in parenthesis. One, two and three asterisks indicate the coefficients significantly different from zero at 10%, 5% and 1% level respectively.

cross-section, the 10-year period panel data and the 5-year period panel data respectively. Economically, following our discussion in Section 3, the differences arise because a lowering of policy barriers to trade (a higher value of the Sachs-Warner Index) causes structural changes that are only partly reflected in larger trade flows, and because the ratio of trade to GDP varies for reasons that are only partly related to structural change. Thus, in what follows, we will concentrate on the results from the specifications using the Sachs-Warner Index, and in particular on the 10-year panel with the IV estimator.

The coefficients on the Sachs-Warner Index are positive and highly significant for all three specifications. This means that the more open a country is in terms of policies, the faster its growth, which is consistent with much of the empirical literature on the links between trade and growth. In particular, the largest coefficient is in the specification using 10-year periods, implying that when a country opens to trade the largest effects are manifest in the medium run. On this basis (IV-POLS, column 3), a country that is open according to the Sachs-Warner criterion would grow faster than one that is not by 6 percentage points every year.

Investing in more and possibly better education can also raise a country's growth performance. The effects are clearer in the longer run as one can see from the the larger and more significant coefficients with the longer time periods. This result is also in line with the empirical growth literature and it tells us that if a country managed to raise the average level of education by 1 standard deviation it would grow faster each year by 0.4 percentage points. For instance, if Mozambique had managed to narrow the difference in educational level with South Africa to half between 1960 and 2000 instead of it increasing, the growth performance of the two countries would have been similar by the end of this period.

The coefficients on weighted land inequality are negative and significant with only one exception (column 3), as predicted by an influential strand of the literature on the links between inequality and growth. If a country has a more equal distribution, it is predicted to grow faster for a number of reasons, including less distortionary redistributive politics, fewer problems with credit market imperfections that lead to credit constraints for the poor in particular, and less social and political instability. Also, the literature often emphasises that land inequality has an effect on growth over the long run, which is consistent with the higher coefficient in the CS estimations.

However, these are only the direct effects of trade and inequality on growth and this paper has argued that there are also indirect effects from openness to growth depending on the level of inequality in the country. Looking at the coefficients on the interactive term between the Sachs-Warner Index and the distribution of land, one can see that this is negative and significant in all the estimations, which means that the less unequal the country, the higher will be its growth if it opens up to trade. The size of the coefficient is similar across the time periods considered and only slightly larger for the longer periods. Therefore, according to the IV-POLS estimation using the 10-year period (column 3), the total marginal effect of the barrier measure of trade on growth is:

$$\frac{\partial growth}{\partial swi} = 6.11 - 0.06 \cdot landgini.$$

Based on these results, for example, one can partly explain why Malaysia, which has higher land inequality than South Korea, has experienced lower growth even though it opened to trade five years earlier. The difference in growth rates would have been eliminated if Malaysia had liberalised trade with land inequality similar to that of South Korea.

Using the trade dependency ratio instead of the Sachs-Warner Index, whose scales are similar as shown in table 2, education and weighted land inequality have similar coefficients, in terms of both sizes and significance. However, there are differences in the coefficients on the measure of openness and the interactive variable. The coefficients on the trade dependency ratio are always positive, albeit smaller than on the Sachs-Warner Index and insignificant in the IV-POLS estimation using 5-year periods. Economically, they are significant since an increase in gross trade flows by 1 standard deviation would lead to an increase in the growth rate of 1 percentage point. The coefficients on the interaction between the trade dependency ratio and land inequality are statistically insignificant in all cases, albeit negative and of economic significance. Based on the trade dependency ratio, the difference in growth rates would have been halved if Malaysia had opened to trade with land inequality similar to that of South Korea.

### Robustness checks

The estimated effects of trade liberalisation on growth are twice as large when we use the Sachs-Warner Index of trade openness rather than the trade dependency ratio. Also, the interaction term between the Sachs-Warner Index and land inequality is larger than the one between the trade dependency ratio and land inequality. These differences are consistent with the argument in earlier sections that the trade dependency ratio is a downward-biased measure of the true extent of structural change caused by increased openness, of which the Sachs-Warner Index is likely to be a more accurate measure. However, we also need to check that the Sachs-Warner Index results are not biased upwards for other reasons, and more generally that the results are robust.

The results do not seem to be influenced by outliers. The only countries that could be outliers in a graph of the residuals of a regression of growth on all the regressors except the interactive variable between trade openness and land inequality on this interactive variable are Ghana and Romania. Their exclusion alters the coefficients in table 3 by less than 5% and only in the cross-section results.

Next, we address the concerns about the Sachs-Warner Index. First, countries that liberalise often do so following periods of economic turmoil. Tornell (1998 in Wacziarg and Welch, 2003) showed that around 60% of episodes of economic reform, including trade reform, occur in the aftermath of a domestic political or economic crisis. This would imply that pre-reform growth could be depressed due to other factors, biasing our estimates upwards. However, this criticism does not apply to our results because we use past values of the Sachs-Warner Index as instruments for current values of this variable.

Second, trade liberalization may go hand in hand with other types of domestic and external reforms. For instance, countries carrying out programs of trade reform often enact at the same time policies of domestic deregulation and privatization, other microeconomic reforms, macroeconomic adjustment and capital market liberalisation. To the extent that this is the case, our estimates may capture the impact of these other reforms rather than trade reforms. Due to our small sample of countries, we are not able to run separate regressions with "pure" trade reformers and overall (domestic-market) reformers. Thus, we rely on Wacziarg and Welch (2003)'s results. They show that the estimate of the impact of trade liberalization for those countries that carried out trade reforms in isolation is comparable with the corresponding estimates for both those countries that also reformed their domestic sectors and the overall sample of countries. Also, using data from Bekaert *et al.* (2001), who examine the impact of capital market liberalization on economic growth in a panel context, we compare their dates on financial liberalisation with our dates of trade liberalisation. We find that out of 54 countries in our sample, only 9 of them also opened their capital markets within 10 years before or after trade liberalisation and that excluding these countries from our sample does not affect our estimates in any significant way.

The issues raised in the previous paragraph may be addressed from a different perspective. As previously discussed, the literature has often argued that changes in the Sachs-Warner Index are correlated with changes in other policies conducive to faster growth and that these, in turn, are influenced by the quality of institutions. Thus, the results obtained using the Sachs-Warner Index may be a consequence of the correlation of this variable with an omitted regressor, such as institutions. We ran all the regressions in Section 5 with the inclusion of an exogenous measure of institutional quality – the log of settlers' mortality rates, taken from Acemoglu *et al.* (2001) – and we found that this does not change our coefficients in any significant way.[16] The coefficient on the log of settlers' mortality rates is negative and significant for the 10-year period regressions, which is consistent with the literature on institutions and growth (see table 4).

These results may be criticised because we use a time-invariant measure of institutions, which could be thought of as a fixed effect in our panel data set. Thus, we ran the same regressions using a different measure of institutions, the Freedom House (2007)'s Civil Liberties Index. This is the only dataset available that goes back to 1972. The estimates on the trade openness variables and the interaction variables are not affected, but this new institutional variable does not have a significant effect on subsequent growth, even when it is instrumented on its past values as for the other variables (see table 5).

Third, following Rodríguez and Rodrik (1999)'s arguments, we test whether the results obtained with the Sachs-Warner Index are driven mainly by the black market exchange rate premium and the state monopoly of exports components. Thus, we construct an additional dummy variable equal to 1 if a country in a certain year has a black market exchange rate premium less than 20% – which is

[16]Due to the lack of availability of the log of settlers' mortality rates for some countries, the comparison is done with a set of regressions using only 40 countries. The only coefficient that changes significantly is the one on average educational attainment, which becomes much smaller and insignificant in all the regressions, which implies that the quality of institutions affects people's ability to acquire skills through the formal educational system.

**Table 4:** The determinants of growth, including institutions (1).

| | **40-year period** | | **10-year period** | | **5-year period** | |
|---|---|---|---|---|---|---|
| Estimation | CS (OLS) | CS (OLS) | IV-POLS | IV-POLS | IV-POLS | IV-POLS |
| swi | 5.45*** | | 5.37*** | | 5.34*** | |
| | (1.40) | | (1.20) | | (0.88) | |
| tdr | | 3.80*** | | 2.83*** | | 6.17 |
| | | (1.30) | | (1.00) | | (4.33) |
| educ | 0.08 | 0.05 | -0.06 | 0.05 | 0.05 | -0.14 |
| | (0.13) | (0.11) | (0.19) | (0.13) | (0.12) | (0.25) |
| lnmortality | -0.34 | -0.43* | -0.61** | -0.60* | -0.30 | -0.42 |
| | (0.28) | (0.24) | (0.27) | (0.33) | (0.29) | (0.28) |
| wlandgini | -0.33** | -0.20* | -0.16 | -0.15 | -0.33** | -0.01 |
| | (0.13) | (0.12) | (0.17) | (0.15) | (0.16) | (0.24) |
| swiland | -0.06*** | | -0.04* | | -0.05*** | |
| | (0.02) | | (0.02) | | (0.02) | |
| tdrland | | -0.02 | | -0.01 | | 0.01 |
| | | (0.03) | | (0.02) | | (0.06) |
| constant | 3.05** | 2.98** | 5.13*** | 4.75*** | 4.56*** | 3.18 |
| | (1.41) | (1.30) | (1.55) | (1.61) | (1.17) | (1.96) |
| Sample size | 40 | 40 | 120 | 120 | 280 | 280 |
| F-stat | 8.89*** | 7.88*** | 11.64*** | 8.70*** | 15.16*** | 5.96*** |
| $R^2$ | 0.42 | 0.47 | 0.36 | 0.30 | 0.20 | 0.19 |

Notes: Year dummies for the panel data are omitted. Robust standard errors are provided in parenthesis. One, two and three asterisks indicate the coefficients significantly different from zero at 10%, 5% and 1% level respectively.

the cutoff point considered by Sachs and Warner (1995) – and 0 otherwise. The exchange rates are taken from Global Financial Data (2008). We then take period averages and add this new variable and its interaction with land inequality to our original set of regressions both with and without the Sachs-Warner Index and its interaction with land inequality. We find that the estimates on these last two variables are not affected and that the new variables have much lower and insignificant coefficients on their own (see table 6). Regarding the other components of the Sachs-Warner Index, neither the state monopoly of exports – which was mainly used by Sub-Saharan African countries during the 1980s – nor the socialist system dummies could be driving the results because we include in all the

Table 5: The determinants of growth, including institutions (2).

| | 40-year period | | 10-year period | | 5-year period | |
|---|---|---|---|---|---|---|
| Estimation | CS (OLS) | CS (OLS) | IV-POLS | IV-POLS | IV-POLS | IV-POLS |
| swi | 5.19** | | 6.01*** | | 5.07*** | |
| | (2.00) | | (1.79) | | (1.43) | |
| tdr | | 3.48* | | 2.58** | | 2.96** |
| | | (1.78) | | (1.24) | | (1.37) |
| educ | 0.26** | 0.33** | 0.20 | 0.35** | 0.17 | 0.28* |
| | (0.11) | (0.13) | (0.13) | (0.15) | (0.1) | (0.14) |
| cli | -0.01 | 0.01 | -0.03 | -0.10 | -0.05 | -0.16 |
| | (0.18) | (0.15) | (0.15) | (0.16) | (0.15) | (0.16) |
| wlandgini | -0.34** | -0.36*** | -0.16 | -0.23 | -0.16 | -0.20 |
| | (0.14) | (0.13) | (0.17) | (0.15) | (0.15) | (0.16) |
| swiland | -0.06** | | -0.06** | | -0.05** | |
| | (0.03) | | (0.03) | | (0.02) | |
| tdrland | | -0.03 | | -0.05* | | -0.05 |
| | | (0.03) | | (0.03) | | (0.03) |
| constant | 1.76 | 1.90*** | 2.03 | 3.31*** | 2.70** | 3.66*** |
| | (1.28) | (0.69) | (1.34) | (0.83) | (1.09) | (0.98) |
| Sample size | 52 | 52 | 159 | 159 | 317 | 317 |
| F-stat | 8.61*** | 6.59*** | 16.25*** | 9.90*** | 13.98*** | 8.54*** |
| $R^2$ | 0.57 | 0.51 | 0.38 | 0.34 | 0.29 | 0.24 |

Notes: Year dummies for the panel data and regional dummies are omitted. Robust standard errors are provided in parenthesis. One, two and three asterisks indicate the coefficients significantly different from zero at 10%, 5% and 1% level respectively.

regressions a Sub-Saharan African dummy and there is only one socialist country in our sample, Romania. Thus, the results need to be driven necessarily by the dummies on tariff rates and the coverage of non-tariff barriers, i.e. the main trade components of the Sachs-Warner Index.

In order to test more explicitly whether the mechanism underlying our model and results involves access to credit, we carry out an additional check. It is important to highlight that this is based on poor data because there is no available measure of access to credit by the poor and, thus, only marginally relevant proxies can be used for this purpose.

**Table 6:** The determinants of growth, including the black market exchange rate premium.

| Estimation | 40-year period<br>CS (OLS) | 10-year period<br>IV-POLS | 5-year period<br>IV-POLS |
|---|---|---|---|
| bmp | 0.27 | 1.95 | 1.07 |
| | (1.55) | (1.72) | (1.68) |
| educ | 0.25** | 0.25** | 0.16 |
| | (0.12) | (0.13) | (0.12) |
| wlandgini | -0.35*** | -0.19 | -0.31** |
| | (0.12) | (0.15) | (0.13) |
| bmpland | -0.02 | -0.02 | -0.01 |
| | (0.02) | (0.03) | (0.02) |
| constant | 3.65*** | 3.04*** | 4.42*** |
| | (1.13) | (1.17) | (1.55) |
| Sample size | 54 | 162 | 378 |
| F-stat | 6.34*** | 9.34*** | 8.81*** |
| $R^2$ | 0.51 | 0.36 | 0.21 |

Notes: Year dummies for the panel data and regional dummies are omitted. Robust standard errors are provided in parenthesis. One, two and three asterisks indicate the coefficients significantly different from zero at 10%, 5% and 1% level respectively.

We include a financial development variable in all the above regressions, by itself and combined with our interactive term between trade openness and inequality. This new interactive term is calculated in two ways. In the first case, we divide the interactive term between openness and land inequality by a continuous measure of financial development. In the second case, we replace the old interactive term by a new dummy variable that takes value 1 when a country has both high land inequality and low financial development and 0 otherwise. Three different measures of financial development, all taken from Beck *et al.* (2000), are used – the ratio of liquid liabilities to GDP, the ratio of private credit by deposit money banks to GDP, and the ratio of private credit by deposit money banks and other financial institutions to GDP. Moreover, as suggested by Levine (2005), financial development may be endogenous, so we instrument financial development by its

**Table 7:** The determinants of growth, including financial development (1).

| | 40-year period | | 10-year period | | 5-year period | |
|---|---|---|---|---|---|---|
| Estimation | CS (OLS) | CS (OLS) | IV-POLS | IV-POLS | IV-POLS | IV-POLS |
| swi | -1.37 | | 2.74 | | 1.65 | |
| | (2.32) | | (1.90) | | (1.61) | |
| tdr | | 0.05 | | 1.59 | | 2.58 |
| | | (1.13) | | (1.39) | | (2.37) |
| educ | 0.20 | 0.23 | 0.17 | 0.49** | 0.14 | -0.08 |
| | (0.22) | (0.20) | (0.21) | (0.23) | (0.18) | (0.33) |
| fin | 4.23 | 2.98 | 1.04 | -1.80 | 0.03 | 3.24 |
| | (3.21) | (1.97) | (2.01) | (1.84) | (1.51) | (1.93) |
| wlandgini | -0.25 | -0.18 | -0.17 | -0.01 | -0.22 | 0.02 |
| | (0.24) | (0.21) | (0.23) | (0.25) | (0.33) | (0.25) |
| swilandfin | 0.01* | | 0.00 | | -0.00 | |
| | (0.01) | | (0.00) | | (0.00) | |
| tdrlandfin | | 0.00* | | -0.00 | | 0.01 |
| | | (0.00) | | (0.00) | | (0.01) |
| constant | 1.22 | 1.14** | 1.89 | 2.76*** | 4.01* | 0.90 |
| | (1.93) | (0.44) | (1.46) | (0.64) | (2.07) | (0.92) |
| Sample size | 31 | 31 | 93 | 93 | 217 | 217 |
| F-stat | 8.33*** | 31.67*** | 10.09*** | 5.93*** | 6.95*** | 8.54*** |
| $R^2$ | 0.61 | 0.71 | 0.34 | 0.30 | 0.19 | 0.19 |

Notes: Year dummies for the panel data and regional dummies are omitted. Robust standard errors are provided in parenthesis. One, two and three asterisks indicate the coefficients significantly different from zero at 10%, 5% and 1% level respectively.

value in the preceding period, as was done for the other endogenous variables.

The new coefficients on the financial development variable and on the new interactive variable have the predicted signs, positive and negative respectively, but they are not significant in any of the specifications (see tables 7 and 8). However, none of the three measures of financial development captures the financial access by poor people, which is what one would need in order to test our theory. Moreover, in contrast with the findings by Levine *et al.* (2000), financial development does not seem to cause growth because in our smaller sample of countries we do not include developed countries. This seems to suggest that financial development can affect growth only after a certain level of development is reached.

**Table 8:** The determinants of growth, including financial development (2).

| | 40-year period | | 10-year period | | 5-year period | |
|---|---|---|---|---|---|---|
| Estimation | CS (OLS) | CS (OLS) | IV-POLS | IV-POLS | IV-POLS | IV-POLS |
| swi | 2.72* | | 3.25** | | 2.09 | |
| | (1.59) | | (1.54) | | (1.31) | |
| tdr | | 3.21** | | 0.37 | | 8.97* |
| | | (1.32) | | (1.13) | | (5.22) |
| educ | 0.19 | 0.21 | 0.16 | 0.47** | 0.08 | -0.13 |
| | (0.24) | (0.23) | (0.19) | (0.22) | (0.19) | (0.36) |
| fin | -0.81 | -1.16 | 0.26 | -0.45 | -0.08 | -4.74 |
| | (2.71) | (1.97) | (1.50) | (1.29) | (1.19) | (3.35) |
| wlandgini | -0.24 | -0.19 | 0.18 | -0.01 | -0.20 | 0.01 |
| | (0.31) | (0.25) | (0.23) | (0.25) | (0.33) | (0.31) |
| dswilandfin | -1.94 | | -0.91 | | -1.84 | |
| | (1.80) | | (2.07) | | (1.25) | |
| dtdrlandfin | | -1.56 | | -0.88 | | -4.55** |
| | | (1.22) | | (1.12) | | (2.15) |
| constant | 1.67 | 2.04*** | 1.97 | 2.65*** | 3.79* | 2.94*** |
| | (1.85) | (0.55) | (1.56) | (0.47) | (2.13) | (1.02) |
| Sample size | 31 | 31 | 93 | 93 | 217 | 217 |
| F-stat | 4.01*** | 5.94*** | 10.01*** | 4.89*** | 7.29*** | 6.06*** |
| $R^2$ | 0.53 | 0.59 | 0.35 | 0.32 | 0.18 | 0.21 |

Notes: Year dummies for the panel data and regional dummies are omitted. Robust standard errors are provided in parenthesis. One, two and three asterisks indicate the coefficients significantly different from zero at 10%, 5% and 1% level respectively.

## 6 Conclusion

Drawing on theory, this paper has argued that the opportunities created in the aftermath of a trade liberalisation are missed by the poorest in society because of market failures, such as credit market imperfections. Therefore, unequal societies, especially in terms of wealth, struggle much more in terms of growth performance when the economy opens to trade. This is especially true in developing countries, where credit market imperfections are more binding. Overall the results support our hypothesis that opening to trade creates opportunities for higher growth as well as adjustment costs and that countries with higher inequality are less able to cope with these costs and to take advantage of the growth opportunities.

This is the first empirical study to analyse whether the effects on growth of opening to trade depend on the level of inequality of wealth, and in particular of assets, but it will hopefully be a prelude to others. The literature has already identified the problem. The World Bank's book *Economic Growth in the 1990s: Learning from a Decade of Reform* clearly states that "trade is an opportunity, not a guarantee" (2005: p. 133). Also, a special study by the World Trade Organization manifests some worries about neglecting the adjustment costs associated with trade liberalisation (Bacchetta and Jansen, 2003). The results of trade reforms have varied and sometimes fallen short of expectations because of failure to implement other reforms that address binding constraints to growth.

More conclusive empirical work on this issue remains to be done: country-specific studies using household surveys are needed to identify more directly the channels at work and their relative importance. Jenkins (2005) goes in this direction by analysing specific value chains in four countries, which have all become more integrated into the global economy in recent years.[17] He concludes that the effects of globalization on poverty are highly context dependent, which implies that globalisation alone will not ensure the spreading of the benefits beyond the already better-off. Drawing from the case study countries and, in particular, the experience of Vietnam in recent years, Jenkins affirms that the gains from globalisation are likely to be more widely distributed and the most disadvantaged in a better position to participate in global value chains where the initial structure of assets and entitlements is more equitable. This is indeed consistent with the

[17] The analysis of value chains is interesting insofar as they are driven by changes at the global level but have impacts at the local level in terms of employment and poverty.

theory and the results presented in this paper.

The focus of this paper has been solely on growth, but its line of reasoning may become even more important if focused on poverty. In the words of Ravallion (2003), "redressing the antecedent inequalities of opportunity within developing countries as they open up to external trade is crucial to realizing the poverty-reducing potential of globalization" (p. 20). This is confirmed by the fact that East and South-East Asian countries have been successful at eradicating poverty since they opened to trade, in contrast to Latin America, where poverty has been growing (Chen and Ravallion, 2000).

In addition, the results of this study suggest that in countries characterised by high levels of inequality in land distribution, appropriate land reforms could be considered as an important policy option, as has been argued for the case of Pakistan (Haq, 1997). However, considering the difficulties and the long history of failed attempts of such reforms (El-Ghonemy, 2003), a more sensible approach could be to improve the access of poor people to productive assets through education, health care, and microcredit schemes, and inputs, such as irrigation (Jenkins, 2005), alongside opening to trade. This would help create more opportunities for the poor and, in turn, for the whole society by giving everyone access to the growth process. By the same token, participation "with voice and choice" (Birdsall and Londoño, 1997: p. 36) of the poor can help to ensure equal access to assets that will raise incomes in developing countries, which is, ultimately, the real challenge facing policy makers striving for pro-poor growth.

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# Appendix

## A Optimal consumption path in the closed economy

Here we show the mathematical derivations behind the results in Section 2. We also prove that the growth paths found are the optimal paths given the objectives and the constraints.

Let us solve agent $i$'s problem to maximise her utility

$$U_{i,t} = \sum_{t=0}^{\infty} \beta^t \ln c_{i,t}, \tag{13}$$

subject to her budget constraint,

$$w_{i,t} = c_{i,t} + k_{i,t},$$

her production function,

$$y_{i,t} = A_t k_{i,t}^{\alpha} = w_{i,t+1},$$

and

$$w_{i,0} = \omega_i,$$

by applying the principle of optimality and, thus, the notion of dynamic programming. According to Bellman (1957), "an optimal policy has the property that, whatever the initial state and decision are, the remaining decisions must constitute an optimal policy with regard to the state resulting from the first decision."

Thus, suppose that $c^{\star}_{i,t}$ is the solution to the above problem, with associated time-path for the state variable $w^{\star}_{i,t}$, and consider the problem at time 1. Then, given that the objective function is separable across time, it is clear that the solution to the sub-problem at time 1 is just the same choice $c^{\star}_{i,t}$ with associated $w^{\star}_{i,t}$ for $t \geq 1$.

In order to find a solution for the above discrete-time problem (13) with an infinite horizon, let us drop the $i$ subscript and write the Bellman equation

$$\nu(w) = \max_{0 \leqslant c \leqslant w} \left\{ u(c, w) + \beta \nu(f(c, w)) \right\}, \tag{14}$$

where

$$u(c, w) = \ln c,$$

and

$$f(c, w) = A(w - c)^{\alpha}.$$

To solve for $\nu(\cdot)$, we apply the method of 'guess and verify' and, thus, we try

$$\nu(w) = B \ln w + C \tag{15}$$

in the right-hand side. The maximisation problem then becomes

$$\nu(w) = \max_{0 \leqslant c \leqslant w} \left\{ \ln c + \beta \left[ B \ln A \left( w - c \right)^{\alpha} + C \right] \right\}. \tag{16}$$

The first-order condition (FOC) with respect to $c$ leads to

$$\frac{1}{c} - \frac{\beta B\alpha}{w - c} = 0$$
$$c\,(1 + \beta B\alpha) = w.$$

Substitute these into the maximand to find that

$$\nu(w) = B' \ln w + C',$$

with

$$B' = 1 + \beta B\alpha \text{ and}$$
$$C' = \beta B\alpha \ln \beta B\alpha - (1 + \beta B\alpha) \ln (1 + \beta B\alpha) + \beta B \ln A + \beta C.$$

The solution is found by setting $B = B'$ and $C = C'$, which implies that

$$B = \frac{1}{1 - \beta\alpha} \text{ and}$$
$$C = \frac{(1 - \beta\alpha) \ln (1 - \beta\alpha) + \beta\alpha \ln \beta\alpha + \beta \ln A}{(1 - \beta)(1 - \beta\alpha)}.$$

Using this value of $B$ in the FOC gives,

$$c\,(w) = (1 - \beta\alpha)\, w = (1 - s)\, w. \tag{17}$$

Assuming that the discount factor, $\beta$, and the returns to the individual capital investments, $\alpha$, are equal for all individuals and constant over time, $s$ also represents the savings rate for the whole economy. Since the state transition rule is

$w_{t+1} = f(w_t - c_t)$, the associated time-path of the state variable is

$$w_{t+1} = A_t (\beta \alpha w_t)^{\alpha}. \tag{18}$$

The value function $\nu^{\star}$ is the maximized value in (13), and the optimal plan is the sequence $\{c_t^{\star}\}_{t=0}^{\infty}$ that delivers the maximum. The value function satisfies the Bellman equation, so the Bellman equation gives us a necessary condition for the value function. In order to determine whether this interior path is the optimal path, then this needs to satisfy the Euler equation (EE) and the transversality condition (TC) (Dixit, 1990). In this case, we can think of the agent as choosing the value of next period's state. If the agent invests $\left(A_t^{-1} y_t\right)^{\frac{1}{\alpha}}$ this period, then she will start next period with $y_{t+1}$, having consumed $w_t - \left(A_t^{-1} y_t\right)^{\frac{1}{\alpha}}$ this period. If we write $F(w, y)$ for the single-period reward (which combines the utility function and the production function), then the Bellman equation is

$$\nu(w) = \max_{y \in Y(w)} \{F(w, y) + \beta \nu(y)\}.$$

The FOC for an interior optimum is

$$F_y(w, y^{\star}) + \beta \nu'(y^{\star}) = 0$$

and the envelope condition (EC) gives

$$\nu'(w) = F_w(w, y^{\star}).$$

Combining the FOC linking period $t$ to period $t+1$ with the EC linking period

$t+1$ to period $t+2$ gives the EE

$$F_y(w_t, w_{t+1}) + \beta F_w(w_{t+1}, w_{t+2}) = 0,$$

which must be satisfied along an interior optimal path $\{w_t^\star\}_{t=0}^{\infty}$. In words, at an optimum, the marginal disbenefit today of an increase in tomorrow's stock (entailing lower consumption today) is exactly offset by the discounted marginal benefit tomorrow of that increase (entailing higher consumption tomorrow). The TC, which is

$$\lim_{t\to\infty} \beta^t F_w(w_t, w_{t+1}) \cdot w_t = 0,$$

could serve as a check that the path (for the state variable), associated with a function that we have found by 'guessing and verification', is the optimal path and hence that the function is indeed the value function.

In this case, the single-period reward function is

$$F(w, y) = \ln\left[w - \left(A^{-1}y\right)^{\frac{1}{\alpha}}\right].$$

We found a solution in equation (15) to the Bellman equation, with associated time-path of the state variable (18). Given that

$$\begin{aligned} F_w(w, y) &= \frac{1}{w - (A^{-1}y)^{\frac{1}{\alpha}}} \text{ and} \\ F_y(w, y) &= -\frac{\alpha^{-1}A^{-\frac{1}{\alpha}}y^{\frac{1-\alpha}{\alpha}}}{w - (A^{-1}y)^{\frac{1}{\alpha}}}, \end{aligned}$$

it is easy to show that the EE and the TC are both satisfied along this path. Hence $w^\star_{t+1} = A_t \left(\beta\alpha w^\star_t\right)^\alpha$ along the optimal path, and the function $\nu$ that we found is the value function $\nu^\star$.

# B Optimal consumption path in the open economy

Following a trade liberalisation at time $t$, the proportion $\delta$ of agents facing the structural adjustment will need to re-optimise in order to choose the optimal consumption-investment plan that gives them the highest utility, while the remaining agents will continue to consume and invest along the path $w^\star_{t+1} = A_t \left(\beta\alpha w^\star_t\right)^\alpha$ found previously.

Thus, taking into account both options, each agent in the proportion $\delta$ of the population chooses the value of consumption that gives her the maximum utility,

$$U^o_{i,t} = \arg\max\left\{U^{o,1}_{i,t}; U^{o,2}_{i,t}\right\}, \tag{19}$$

where the first utility level, $U^{o,1}_{i,t}$, is the outcome of the agent making the lump-sum investment, $f$, and then enjoying the opportunities from greater openness to trade, taking into account that the new level of wealth will be equal to $w_{i,t} - f$. The second utility level, $U^{o,2}_{i,t}$, is the outcome of the same agent simply using her original endowments $w_{i,t}$ for consumption for the whole period following the trade liberalisation.

This maximisation problem can be dealt with by solving separately the two sub-problems by dynamic programming and, then, by comparing the two optimal levels of consumption. Thus, for the first optimisation sub-problem, agent $i$'s problem is to maximise her utility

$$U_{i,t}^{o,1} = \sum_{t=0}^{\infty} \beta^t \ln c_{i,t}, \tag{20}$$

subject to her budget constraint,

$$\tilde{w}_{i,t} = w_{i,t} - f = c_{i,t} + k_{i,t},$$

her production function,

$$y_{i,t} = A_t k_{i,t}^{\alpha} = w_{i,t+1},$$

and

$$w_{i,0} = \omega_i.$$

For the second optimisation sub-problem, agent $i$'s problem is to maximise her utility

$$U_{i,t}^{o,2} = \sum_{t=0}^{\infty} \beta^t \ln c_{i,t}, \tag{21}$$

subject to her budget constraint,

$$w_{i,t} = c_{i,t} + k_{i,t} \Rightarrow w_{i,t+1} - w_{i,t} = -c_{i,t},$$

and

$$w_{i,0} = \omega_i.$$

Using the notion of dynamic programming described in the Appendix A and dropping the $i$ subscript for convenience, we can calculate the optimal plans in the two sub-problems. In the first case, we find that

$$c^\star = (1 - \beta\alpha)\,\tilde{w}. \tag{22}$$

Since the state transition rule is $w_{t+1} = f(\tilde{w}_t - c_t)$, the associated time-path of the state variable is

$$w_{t+1} = A_t\left(\beta\alpha\tilde{w}_t\right)^\alpha. \tag{23}$$

On the other hand, in the second case, we find that

$$c^\star = (1 - \beta)\,w. \tag{24}$$

Since the state transition rule is $w_{t+1} = w_t - c_t$, the associated time-path of the state variable is

$$w_{t+1} = \beta w_t. \tag{25}$$

It is also easy to show that the EE and the TC are satisfied along both these paths.

In order to see which consumption plan gives agent $i$ the highest utility level, we compare the two optimal levels of consumption in order to find the cut-off level of wealth, $\hat{w}_{i,t}$, that makes an agent indifferent between investing in new information and know-how, $f$, or not. Agents will invest as long as

$$(1-\beta\alpha)\left(w_{i,t}-f\right)>(1-\beta)\,w_{i,t} \text{ or } \left(1-\frac{1-\beta}{1-\beta\alpha}\right)w_{i,t}>f.$$

This implies that the cut-off level of wealth is

$$\hat{w}_{i,t}=\hat{f}=\frac{f}{1-\frac{1-\beta}{1-\beta\alpha}}, \tag{26}$$

and that agents with a level of wealth at the time of the trade liberalisation below $\hat{w}$ will not be willing to invest any longer because the lump-sum investment $f$ is larger than the present value of all future gains in terms of consumption.

By taking the first derivative of this equation for the cut-off level of wealth with respect to $f$, $\alpha$ and $\beta$, one can derive its properties. Thus, the cut-off level of wealth is an increasing function of $f$ and $\alpha$ and a decreasing function of $\beta$. This implies that, if $f$ or $\alpha$ increase or $\beta$ decreases, fewer agents will have a high enough level of wealth to invest following a trade liberalisation.

# C List of countries

Algeria, Argentina, Barbados, Bolivia, Brazil, Cameroon, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Ghana, Guatemala, Honduras, India, Indonesia, Iran, Israel, Jamaica, Jordan, Kenya, Republic of Korea (South Korea), Lesotho, Malaysia, Mali, Mauritius, Mexico, Mozambique, Nepal, Nicaragua, Niger, Pakistan, Panama, Paraguay, Peru, Philippines, Romania, Senegal, Singapore, South Africa, Sri Lanka, Syrian Arab Republic, Taiwan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Uruguay, Venezuela, Zambia.

## D Low- and high-inequality developing countries

Countries ranked as low inequality: Algeria, Cameroon, Ghana, India, Indonesia, Iran, Jordan, Republic of Korea (South Korea), Lesotho, Mali, Mozambique, Nepal, Niger, Pakistan, Philippines, Romania, Senegal, Singapore, South Africa, Sri Lanka, Syrian Arab Republic, Taiwan, Thailand, Togo, Tunisia, Turkey, Uganda. Countries ranked as high inequality: Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Israel, Jamaica, Kenya, Malaysia, Mauritius, Mexico, Nicaragua, Panama, Paraguay, Peru, Tanzania, Trinidad and Tobago, Uruguay, Venezuela, Zambia.