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Dimensions of Land Inequality and Economic Development

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Abstract

There are several theories linking land inequality with aspects of economic development. Empirical work on these theories has attempted to establish a relationship between land inequality and institutions, financial development, and education. This research, though, has relied on measures of land inequality that capture only inequality within the class of landholders, ignoring completely the issue of landlessness. This omission raises suspicion about the usefulness of those empirical results. We use a new measure of the breadth of landholdings across the agricultural population to address this issue. We test the proposed relationships regarding land inequality and development using the new measure. The regressions fail to find significant and robust relationships between land inequality of either type and institutions or financial development. We do find that lower land inequality across agricultural populations, but not inequality within the landholding class, is associated with greater public provision of education.

JEL Classification Numbers: I2, O0, O11, O13, O16, Q15

Keywords: Agricultural inequality, land inequality, institutions, financial development, and education provision

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I. INTRODUCTION

Land plays a central role in the economies of developing nations and has therefore played a central role in many theories attempting to explain the relative success of these nations in increasing incomes over time. Within these theories, it is the distribution of land that receives the most attention. The distribution of land is assumed to alter the incentives such that elements of the economy – educational, institutional, or financial – do not develop optimally and lead to lower levels of income. Of particular note is that in most of these theories, it is the dichotomy between landless and landed people that drives the theory, not the distribution of land within the landed class.

A concern with this empirical work is that the index of land inequality used is normally a Gini coefficient measuring the distribution of land within the group of landed people. Indeed, the most widely used cross-country measure in the literature is that of Deininger and Squire (1998), which only covers landholders. Using only such Gini coefficients in regressions, though, presumes that there is no variation between countries in landlessness. This is very restrictive and may produce spurious relationships between the Gini and the chosen dependent variable, falsely indicating that land inequality has significant effects on institutions, finance, or education.

This paper introduces an additional measure of land inequality that captures specifically the level of landlessness within countries. Using this new measure of land inequality we examine several proposed theories relating land inequality and development. Our results show no link running from land inequality to institutions and financial development, contrary to what was found previously. This does not invalidate theories predicting these links, but does raise questions as to their overall significance in cross-country development. The evidence does indicate a negative relationship between land inequality and education, though only for land inequality across agricultural populations and not inequality, within the landholding class.

The paper proceeds as follows. Section 2 discusses the main theories regarding land inequality and development we consider, including the associated empirical work. Section 3 discusses measuring land inequality and introduces our new measure of landlessness. Section 4 presents our empirical results and, Section 5 concludes.

II. Land Distribution and Development

A. Institutions

Engerman and Sokoloff (1997) and Sokoloff and Engerman (2000) (ES) have argued that the levels of inequality in Latin America at the dawn of colonization directly led to that regions' poor economic performance in later years. They observe that the geographic conditions in Latin America were conducive to economic activities– such as mining and sugar production– which relied on plantation or slave labor. The resulting inequality of resources in turn led to the development of institutions geared toward protecting the interests of the elites. These institutions proved detrimental to modern economic growth. They contrast Latin America's experience with that of North America. In North America, the climate was most favorable to small-scale family farms, as opposed to large plantations. This led to relatively low levels of inequality and, hence, to the development of institutions that later fostered high economic growth.

Easterly (2002) proposes that these relationships hold more broadly across time periods and regions. He finds that commodity endowments predict the middle class share of income and that the middle class share of income predicts development and proposes that this is consistent with the Engerman and Sokoloff case for inequality leading to bad institutions. Easterly and Levine (2003) (EL) finds that geographic conditions affect growth only through institutions. However, neither of these papers directly examines the role of agricultural inequality.[2] This is a significant omission, given that the Engerman and Sokoloff hypothesis rests substantially on the role of the agricultural sector in colonial Latin America. Indeed, continuing into the second half of the twentieth century, agricultural production accounts for a substantial fraction of total production in most developing countries, particularly the poorest. If the Engerman and Sokoloff hypothesis can indeed be applied more broadly, then we would expect to observe a strong relationship between agricultural inequality and institutions. Moreover, we would expect, a priori, that such relationships would persist across time; that is to say, if high land inequality at some earlier period caused bad institutions today, then presumably this inequality will have likewise continued to the present, baring some other effect that would require explanation.

B. Financial Markets

The development literature has long discussed the connections between agricultural inequality and financial markets. A review by Deininger and Binswanger (1997) discusses the most commonly cited of these connections. Most of the emphasis has been placed on how land inequality results from (or persists because of) poor financial development. With absent or limited markets for risk and credit, distress sales of land due to price shocks can concentrate land holdings. In addition, land concentration may be optimal because farm workers are able to pass off production risk onto the landowner when appropriate markets are absent.

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[2]Easterly and Levine (2002) do mention agricultural inequality briefly and report not finding it to be significantly related to other variables. These findings are consistent with our results, as will be seen below.

The nature of agriculture itself – covariance of income and information asymmetries – delays the development of financial markets (Binswanger, 1986). In addition, land inequality could be a potential drag on credit and insurance markets. Concentration of land implies fewer potential users of credit or insurance products, reducing the incentives to provide those services. Perhaps a more compelling association is one discussed by Deininger and Binswanger (1997), that the concentration of land is associated with a rural elite that can easily take collective action to skew the economic environment in their favor. This may cause the provision of credit to be dominated by the government and not by private markets, retarding the growth of the overall financial sector.

In this paper we explore if these relationships documented in the micro development literature extend to a broad macroeconomic perspective. Levine (1997) shows the importance of financial development for economic growth of the overall economy. The existence (or not) of an independent relationship between land inequality and financial development could have implications for the importance of land inequality in the differential paths of development taken by countries. To our knowledge, there has not been a previous attempt to relate financial development to land inequality on a cross-country basis.

C. Education

The third hypothesis considered connects land inequality to the provision of education in a country. The ES framework is extended by Mariscal and Sololoff (2000) into a study of education across the New World from 1800–1925. They find that differences in inequality are significant in explaining differences in public provision of education across the New World – even if the United States and Canada are excluded from the analysis. The hypothesis they explore is that greater land inequality creates collective action problems within the political units responsible for education funding.

In separate work, Galor, Moav, and Vollrath (GMV) construct a more explicit economic model that focuses on the incentives of landowners in the public provision of education. Landowners are reluctant to fund education because they find the higher wages outweigh the benefits; education being assumed to have a smaller complementarity with agriculture than with manufacturing. They predict that the more unequal the land distribution the more resistant the actual landowners will be to agreeing to taxes which pay for education.[3].

Both of these theories posit a relationship between land inequality and the public provision of education. They differ in an important way from theories relating inequality to individuals ability to attain education (see Chatterjee, 1991, and Tsiddon, 1992). Inequality in land or income may be sufficient to prevent those at the bottom end of the scale from affording education, lowering the overall education attainment in an economy.

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[3]In addition to the two works described, Bourguignon and Verdier (2000) suggest that inequality in wealth influences education - although they do not specifically address land inequality. They hypothesize that education is restricted by the elite to preserve their political dominance of the economy.

Empirical evidence of these relationships is limited. Deininger and Squire (1998) show that land inequality - as measured by the Gini coefficient *within* landholders - is negatively related to levels of education attained. This result, though, cannot distinguish which of the two mechanisms are at work. Is the relationship because of poor public provision of educational resources or because of limited access to education based on available assets, or as is most likely, both? In addition, their analysis misses out on a significant component of land inequality - the distribution of land *across* the agricultural population. We will examine one of these two mechanisms, namely that the public provision of education is limited by land inequality.

III. MEASURING LAND INEQUALITY

One of the contributions of this paper is to construct a new measure of inequality in landholdings which includes the landless. Previous work (Deininger and Squire, 1998) has focused on the inequality of land holdings *within* the group of landowners, measured by a Gini coefficient. This measure misses the important inequalities *across* the land-holders and the landless in a country. To give a stark example, imagine that there were only two people who owned all the land in a country of one hundred people If they each owned half the land, the Gini coefficient within the land-holders would be zero - perfect equality. This misses the inequality implied by the fact that only 2% of the people in this country own land.

The data concerning land holding size and distribution come from the World Census of Agriculture series produced by the UN's Food and Agriculture Organization (FAO). The FAO provides a common framework within which individual countries perform agricultural census's approximately every ten years. The country results are collected by the FAO into a summary census. One of the primary advantages of the FAO census is that the data are collected under a consistent set of criteria, resulting in numbers which are comparable across countries.

To create a more complete picture of land inequality, we construct a measure of inequality across the agricultural population. *Agricultural population per holding* divides the total agricultural population by the total number of holdings, both as reported by the FAO. This captures how widespread holdings are *across* the relevant population. It has a simple interpretation as the average number of people working on any single holding. Together with a normal Gini coefficient on the inequality *within* holdings we have a more complete picture of the extent of land inequality.

Table 1 presents summary statistics by decade of agricultural population per holding (referred to as AgPop/Hold hereafter). It can be seen that there is an decrease in the average over time - or inequality has been decreasing. Some of the decrease from 1980 to 1990 is due to the inclusion of former Communist countries with very low reported agricultural populations per holding.

For the purposes of this paper, we would like a single measure of AgPop/Hold. A problem with constructing such a single measure is that not every country did an agricultural census in each decade. If we simply averaged values for each country, then those with census results only from early periods would be biased upward compared to those with later observations. To remedy this, we construct a measure of AgPop/Hold for the 1960-70 period only. To minimize the bias but maximize the number of data points we take the latest available observation for a country from either 1960 or 1970. That way we include countries with census results from only 1960, only 1970, or both. This method gives us a measure of sample of AgPop/Hold with 97 observations, a mean of 6.94 and a standard deviation of 4.46. For the regressions in this paper, we consider the log of this variable.

To complete the measurement of land inequality we still must obtain an index of within land-holding inequality. Deininger and Squire (1998) created such an index, using the same FAO census data sources we utilized for the AgPop/Hold measure. We extended the dataset provided by the authors to include twelve additional observations. The Deininger and Squire data plus our observations give us our *landholding Gini coefficient*.[4].

As noted above the FAO census does not cover the same countries in every year This gives a relatively small number of land-holding Gini's for any given FAO census. When we look at the data on the Gini coefficients, though, we see that they tend to be very stable over time, in contrast to the AgPop/Hold measure. Table 2. shows the summary statistics of the Gini coefficients in each census. It can be seen that the measures are very consistent across time in mean and variance.

In the interest of maximizing coverage again, we construct a single land-holding Gini coefficient for each country. It is simply the latest available Gini observation for that country. For example, if country A has a Gini calculated for 1950, 1960, and 1980, we will utilize their 1980 value. This measures gives us a Gini coefficient with 127 observations, a mean of 0.62 and a standard deviation of 0.19. Of these observations, 53 are from 1990, 26 from 1980, 33 from 1970, and 15 from 1960.

There is a potential upward bias in the landholding Gini coefficient. Differences in holding sizes based on differences in climate zone or soil quality within a country will raise the measured Gini coefficient for that country. For example, in the United States, Wyoming is home to large cattle ranches spanning hundreds or thousands of acres. By contrast, Vermont is a state populated with small dairy farms. Measured individually, the two states may have identical Gini coefficients, yet when we aggregate them together the overall Gini coefficient would necessarily increase due to the difference in average farm size. This problem will be more pronounced the more varied the geographic conditions are within a country. We cannot correct for this problem with our available data. However, our AgPop/Hold measure does not suffer from the same bias; we believe the results obtain using this measure in addition to the Gini are much more informative.

The combination of land-holding Gini and AgPop/Hold gives a more accurate picture of land inequality in a country: both within the body of landholders and across the agricultural population. Figure 1 shows a scatter plot of the two measures against each other (AgPop/Hold is in logs). The

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[4]The twelve additional countries we use are Algeria, Central African Republic, Chad, Chile, Cameroon, Republic of Congo, Gabon, Ghana, Haiti, Morocco, Nicaragua, and Rwanda.

figure includes only countries that will be utilized in the regressions that follow.[5] As can be seen, they are not necessarily tightly related (correlation of only 0.036 and very insignificant), indicating that countries with low *within* inequality may indeed by relatively unequal in land distribution *across* the agricultural population. If one looks in particular at the upper left corner, we see that countries like Cameroon, Mali, Chad, and Senegal have very low land-holding Gini coefficients but have relatively high levels of population per holding. If we look at the right-hand side of the figure, we see how the United States and Australia can differ so much in their inequality from countries like Brazil and Mexico, despite having similar land-holding Gini coefficients. The United States. and Australia have much lower levels of agricultural population per holding.

IV. Empirical Results

Using these two measures, the land-holding Gini and AgPop/Hold, we now turn to examining the relationship between land inequality and three broad factors which have been used in the literature to explain development and growth: institutions, financial development and education.

A. Dependent Variables

Institutions are considered very broadly, and are measured by an index constructed by Kaufman, Kraay, and Zoido (1999a) and Kaufman, Kraay and Zoido (1999b). This index averages six components of institutional development: voice and accountability, political stability, government effectiveness, regulatory burden, rule of law, freedom from graft. The data are obtained directly from Easterly and Levine (2003).

Our measures of financial development comes from *Financial Structure and Economic Growth*, edited by Levine and Demirguc-Kunt (2001). This volume includes a large dataset of financial, institutional and general economic variables for a number of countries. Of the many measures available in this dataset, we select four for use here. These four are chosen both because they represent the general size and development of the financial sector, and because they have wide coverage. The variables are all averages over the 1980-95 period:

- *Liquid liabilities* (as a share of GDP)
- *Central Bank Assets* (as a share of GDP)
- *Deposit Money Bank Assets* (as a share of GDP)
- *Bank Credit* (as a share of GDP)

For education we use the Barro and Lee (1994) cross-country dataset. As we are interested in the investments in education by countries, we use a measure of *education expenditure*. Specifically, we use the recurring education expenditures as a percent of GDP, taking the average values in five year periods running from 1960 to 1985.

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[5]Data for a the full range of countries is available from the authors upon request.

B. Additional Controls

The sample covers former colonies only, similar to Easterly and Levine (2003). Therefore, almost all OECD countries are excluded. Agriculture in OECD countries in the post-war period has represented a small and diminishing share of output. In addition, agriculture in the OECD is characterized by a political system geared towards inflating agricultural output through subsidies and trade protection. Many of these policies have the potential to distort the size of agricultural holdings. For these reasons we believe that agricultural land inequality in the OECD is not informative to the questions here.

We do, however, include the former British colonies Australia, Canada, New Zealand, and the United States. We include a *British Settlement Dummy* in our set of explanatory variables (coded as 1 for these four countries and 0 for all others) to attempt to control for omitted factors that may differentiate these OECD countries from the rest of the sample.

Log of *income per capita* is included as an obvious control for overall development. We use log real GDP per capita in 1995, obtained from Easterly and Levine (2003) for the regressions on institutions and financial development, as those measures are taken from a similar period. For the education analysis, we use log GDP per capita from the Summers and Heston version 5.5 dataset for the years 1960, 1965, 1970, 1975, and 1980.

In addition to using income per capita levels, we consider a set of controls that have been proposed as significant determinants of institutions. These variables are obtained directly from Easterly and Levine (2003) and are:

- *Settler Mortality* - attempting to capture the inherent disease environment
- *Latitude* -absolute value of the latitude, included to capture in a crude way how "tropical" a country is
- *Landlocked* - dummy variable for access to the ocean

These controls, among others, are found to have statistically significant relationships with institutions. They mainly serve as proxies for income per capita, but are theorized to have direct effects on institutions (Acemoglu, Johnson and Robinson, 2001) as well. We feel that financial development and education provision are similar elements of social infrastructure along with institutions, and so we include these controls in our analysis to allow our research to be comparable with previous work.

The final piece of data used in the paper are a set of *crop and mineral dummies* compiled by Easterly (2002). These indicate if a country produced any of the following commodities over a period in the late 1990's: bananas, coffee, copper, maize, millet, rice, silver, sugarcane, rubber, and wheat. These dummies are used as a simple way to capture the endowments of the various countries in the sample, and will be used as instruments later in the paper. Note that all but two of these instruments are agricultural in nature.

C. Land Inequality and Institutions

We begin by looking at simple OLS specifications for institutions that include the measures of land inequality. Table 3 reports results using the land-holding Gini and AgPop/Hold as explanatory variables in two specifications for institutions. These two specifications will be used throughout the paper. The first is shown in column (1) and includes the measures of land inequality as well as income per capita in 1995 and the dummy variable for the British settlements. The second specification in column (2) replaces the income measure with three measures used by EL as determinants of the institutional environment - settler mortality, latitude, and a dummy for being landlocked. The results in Table 3 show that there is no simple relationship of AgPop/Hold with institutions, and that any overall relationship between the land-holding Gini and institutions is positive if it exists. None of these results are supportive of the general ES hypothesis.

The results above indicate that there is no simple relationship between land inequality and institutions, but that may be a result of the endogeneity of land inequality or from measurement error in the land inequality variables. To address both of these potential problems, we adopt instruments used by Easterly (2002). These instruments are natural endowments as measured by the crop and mineral dummies Easterly constructs. The crop/mineral dummies are assumed to influence both the land-holding Gini and the AgPop/Hold in a country directly. ES discuss in their work how the different types of crops grown in the New World heavily influenced the style of agriculture, the use of slaves, and the land distribution. We also assume that the endowments did not impact institutions directly, but rather only through their impact on land inequality.

The results of the first-stage regressions are shown in Table 4. Columns (1) and (2) are the results for the two measures of inequality using the specification including income. Columns (3) and (4) report results using the specification including settler mortality, latitude, and landlocked status. In each column, in addition to the estimates and t-statistics for each crop/mineral dummy, we show the p-value for the F-test of the combination of all the crop/mineral dummies. The test is significant at 10% for both measures of inequality, regardless of specification. These first-stage regressions are very similar to the first-stage results in the subsequent sections of the paper in which the sample size shrinks due to lack of data for some countries. The first stage regressions are always consistent to at least 10%, with the precise p-value reported in the tables showing the final stage of the 2SLS regressions.

Table 5 reports the results of two-stage least squares regressions using the crop/mineral dummies as instruments for the land-holding Gini and AgPop/Hold. Both columns (1) and (2) show there is no significant relationship from land inequality to institutions. These results are in line with Easterly (2002), who finds no significance of the land-holding Gini on measures of institutions. Easterly does not include any measure of inequality across the agricultural population, and his sample includes most of the OECD. As can be seen, neither methodology gives evidence that supports the idea that land inequality influences the institutions present in a country.

D. Land Inequality and Financial Development

Having examined the relationship of land inequality and institutions, we now turn to financial development. Financial development can be considered another variety of institution. Social and political structures which are considered good institutions (protection of private property and rule of law, for example) are crucial in the operation of a financial sector. The measures of institutions and liquid liabilities are correlated at 0.59 at a highly significant level (the p-value is less than 1/1000th of a percent). As such, we look at similar explanatory variables for liquid liabilities as we did for institutions to see if the relationships are similar.

Table 6 presents OLS specifications for the four different financial indicators: liquid liabilities, central bank assets, money deposit bank assets, and bank credit (all measured as a percent of GDP). Examining AgPop/Hold across the specifications, we see that there is some possible correlation with liquid liabilities (column (2)) and with central bank assets (columns (3) and (4)). In both cases increasing land inequality across the agricultural population is negatively related to the measure of financial depth.

However, if we turn to the land-holding Gini, we see a general lack of association with financial indicators, except for central bank assets as a percent of GDP. In this case, as with institutions, there is a positive association of land inequality to the measure of financial development. Taken as a whole, the OLS results in Table 6 seem to show only a weak relationship between land inequality and financial development.

The literature on land inequality and financial development does suggest that the two might be endogenous related. In addition, there is potential measurement error in the land inequality variables that may be biasing the results. We therefore use the same instrumenting strategy as we did with institutions to address these problems. Table 7 presents the results with both AgPop/Hold and land-holding Gini instrumented on the crop/mineral dummies.

The pattern of relationships described above is nearly identical to the OLS estimates. The AgPop/Hold measure is significantly related to the size of the central bank in relation to GDP. The more unequal the distribution of land along this dimension, the smaller the central bank in relation to the economy. This may be reflecting an interesting economic relationship, but at this point it may also be a function of the small sample size and the particular countries in the sample. Further research is necessary to make that determination. We have no indication from our reading of the literature, though, why this relationship would be present.

The land-holding Gini is partially significant in column (5) in Table 7, explaining deposit bank assets. It is insignificant in all other specifications. For both dimensions of land inequality-inequality across agricultural populations and inequality within land holders- there is no persistent significance across measures of financial development. We find scant evidence at the macroeconomic level that land inequality and financial development are linked together.

E. Land Inequality and Education Expenditure

The final hypotheses we explore are the ones relating land inequality to the provision of education. We look at specifications that use the education expenditure - measured as a share of GDP - as the dependent variable. We chose this variable because it more accurately captures the overall commitment to education in a country than measures such as total human capital or enrollment rates. Our test, then, is a test of whether land inequality is related to the public provision of education, not a test of how inequality affects individuals ability to obtain education[6]. This is done precisely to test the predictions of the ES and GMV theories, which relate solely to the public provision of education.

Table 8 shows OLS regressions for each time period for which we have an observation on education expenditure, using log income per capita from the beginning of that period (e.g. for the 1970-74 education expenditure we use 1970 GDP as a control) and the British settlement dummy. Regressions using the longer run variables like settler mortality show similar results and are not reported.

We see that there is a significant relationship of the AgPop/Hold measure to expenditure on education in the three periods covering 1965-1979. Higher land inequality across the agricultural population is associated with lower education spending. The inequality within the land-holding group is not significant. What is interesting is the lack of significance on the income variable as well. There is no strong link between income and the share of income spent on education, giving some evidence that education is not a luxury good.

Given similar concerns with measurement error and endogeneity as above, we turn now to the same instrumenting strategy taken before for institutions and financial development. We use the crop/mineral dummies as instruments for land inequality in two-stage least squares regressions. Table 9 shows the results of these regressions in columns (1) through (5). We see evidence of attenuation bias when we compare the OLS estimates to these regressions. If we look at regressions (1) through (3) which cover the period 1960-75 we see that there is a significant effect of AgPop/Hold on the level of education expenditures in a country. This conforms with the predictions of both ES and those of GMV. There is no evidence that the within inequality measured by the land-holding Gini has any significance.

As the time periods progress, though, the significance of AgPop/Hold disappears. It appears that whatever strong effects land inequality has on education are mitigated through time.[7] We have information on AgPop/Hold from the later FAO censuses in 1980 and 1990. This data was not included in the AgPop/Hold number because of the large secular increase in AgPop/Hold across countries in 1980 and 1990. We can, though, create another index of AgPop/Hold using only the later, 1980 and 1990 data.

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[6]We obtain similar results if we use primary or secondary enrollment rates.

[7]Note, though, that we are using AgPop/Hold measured in the early part of the period, namely 1960-70 as our explanatory variable.

Using this second index of AgPop/Hold, we take some liberties with timing and re-run the educational expenditure regressions for the 1975-79 and 1980-84 time periods. The results are in columns (6) and (7) in Table 9. The sample is much smaller (only 24 countries), but the results confirm the earlier findings. AgPop/Hold have significant impacts on the educational expenditures as a percent of GDP in these countries. Whereas before inequality across the agricultural population was found to have limited effect on institutions and financial development, it apparently has strong impacts on the educational commitment of countries. Again, these results confirm the hypotheses of both the ES and GMV papers.

V. Conclusion

In this paper we have tested hypotheses regarding the relationships between land inequality and institutions, financial development, and public education provision. We have examined land inequality *within* landholders, as well as introducing a new measure of land inequality *across* agricultural populations. The former is the land inequality Gini, while the later is the agricultural population divided by the total number of holdings. We have argued that both of these measures used together describe land inequality more completely than the Gini alone.

Engerman and Sokoloff (1997) argue that historical inequality led to the development of poor institutions in Latin America. Easterly (2002) extends this hypothesis beyond colonial Latin American using modern worldwide data and demonstrates that *income* inequality, instrumented by geographic endowments, does foster poor institutions. We, on the other hand, find no relationship between land inequality and institutions. Our results are not necessarily inconsistent with their findings. However, all of these results taken together indicate that the relationship between geographic endowments and income inequality do not operate through land inequality, a conclusion that we find surprising.

Furthermore, we fail to find a relationship between land inequality and financial development. This is in contrast with the microeconomic literature linking the two. If their relationship is as pervasive and important as the literature suggests, one would have expected evidence for that relationship in cross-country analysis.

Finally, we do find evidence for a relationship between high land inequality *across* agricultural populations and low levels of education provision. These findings are consistent with the Galor, Moav, and Vollrath (2003) hypothesis relating land inequality to the willingness of elites to finance public education. They are also consistent with the arguments of Engerman and Sokoloff (1997) and Mariscal and Sokoloff (2000) that nineteenth century inequality in Latin America led to lower levels of education.

These results show that the empirical significance of theories relating land distribution and economic development must be very carefully considered. Of great importance is actually measuring land distribution correctly – specifically including data that captures the variation in landlessness across countries. Future work on land inequality and development should be held to this standard of testing.

References

Acemoglu, Daron, Simon Johnson and James A. Robinson, 2001, "The Colonial Origins of Comparative Development: An Empirical Investigation," *American Economic Review,* Vol. 91, No. 5, pp. 1369-1401.

Barro, Robert and Jong-Wha Lee, "Sources of Economic Growth," *Carnegie-Rochester Conference Series on Public Policy,* Vol. 40, pp. 1-46.

Binswanger, Hans P. and Mark R. Rosenzweig, 1986, "Behavioural and Material Determinants of Production Relations in Agriculture," *Journal of Development Studies,* Vol. 22, No. 3, pp. 503-39.

Bourguignon, Francois and Thierry Verdier, 2000, "Oligarchy, Democracy, Inequality, and Growth," *Journal of Development Studies,* Vol. 62, No. 2, pp. 285-313.

Chatterjee, Satyajit, 1991, "The Effect of Transitional Dynamics on the Distribution of Wealth in a Neoclassical Capital Accumulation Model," Federal Reserve Bank of Philadelphia Working Paper 91-22.

Deininger, Klaus and Hans Binswanger, 1997, "Explaining Agricultral and Agrarian Policies in Developing Countries," *Journal of Economic Literature,* Vol. 35, No. 4, pp. 1958-2005.

Deininger, Klaus and Lyn Squire, 1998, "New Ways of Lookng at Old Issues: Inequality and Growth," *Journal of Development Economics,* Vol. 57, No. 2, pp. 259-870.

Easterly, William, 2002, "The Middle Class Consensus and Economic Development," *Journal of Economic Growth,* Vol 6, No. 4, pp. 317-335.

Easterly, William and Ross Levine, 2003, "Tropics, Germs and Crops: The Role of Endowments in Economic Development," *Journal of Monetary Economics,* Vol. 50, No. 1.

Engerman, Stanley L. and Kenneth L. Sokoloff, 1997, "Factor Endowments, Institutions, and Differential Paths of Growth Among New World Economies: A View from Economic Historians of the United States," in Stephen Harber, ed., *How Latin America Fell Behind* (Palo Alto: Stanford University Press).

Galor, Oded, Omer Moav and Dietrich Vollrath, 2003, "Land Inequality and the Origin of Divergence and Overtaking in the Growth Process: Theory and Evidence," *Brown Economics Working Paper.*

Kauffman, Daniel, Aart Kraay and Pablo Zoido, 1999a, "Aggregating Governance Indicators," World Bank Research Paper No. 2195.

Kauffman, Daniel, Aart Kraay and Pablo Zoido, 1999b, "Governance Matters," World Bank Research Working Paper No. 2196.

Levine, Ross, 1997, "Financial Development and Economic Growth: Views and Agenda," *Journal of Economic Literature,* Vol. 35, No. 2, pp. 688-726.

Levine, Ross and Asli Demirguc-Kunt, eds., 2001, *Financial Structure and Economic Growth: A Cross-Country Comparison of Banks, Markets, and Development,* (Cambridge: MIT Press).

Mariscal, Elisa and Kenneth L. Sokoloff, 2000, *Schooling, Suffurage and the Persistance of Inequality in the Americas, 1800-1945* (Palo Alto: Hoover Institution Press).

Sokoloff, Kenneth L. and Stanley L. Engerman, 2000, "Institutions, Factor Endowments, and Paths of Development in the New World," *Journal of Economic Perspectives,* Vol. 14, No. 3, pp. 217-32.

Tsiddon, Daniel, 1992, "A Moral Hazard Trap to Growth," *International Economic Review,* Vol. 33, No. 2, pp. 229-321.

Figure 1. Dimensions of Land Inequality

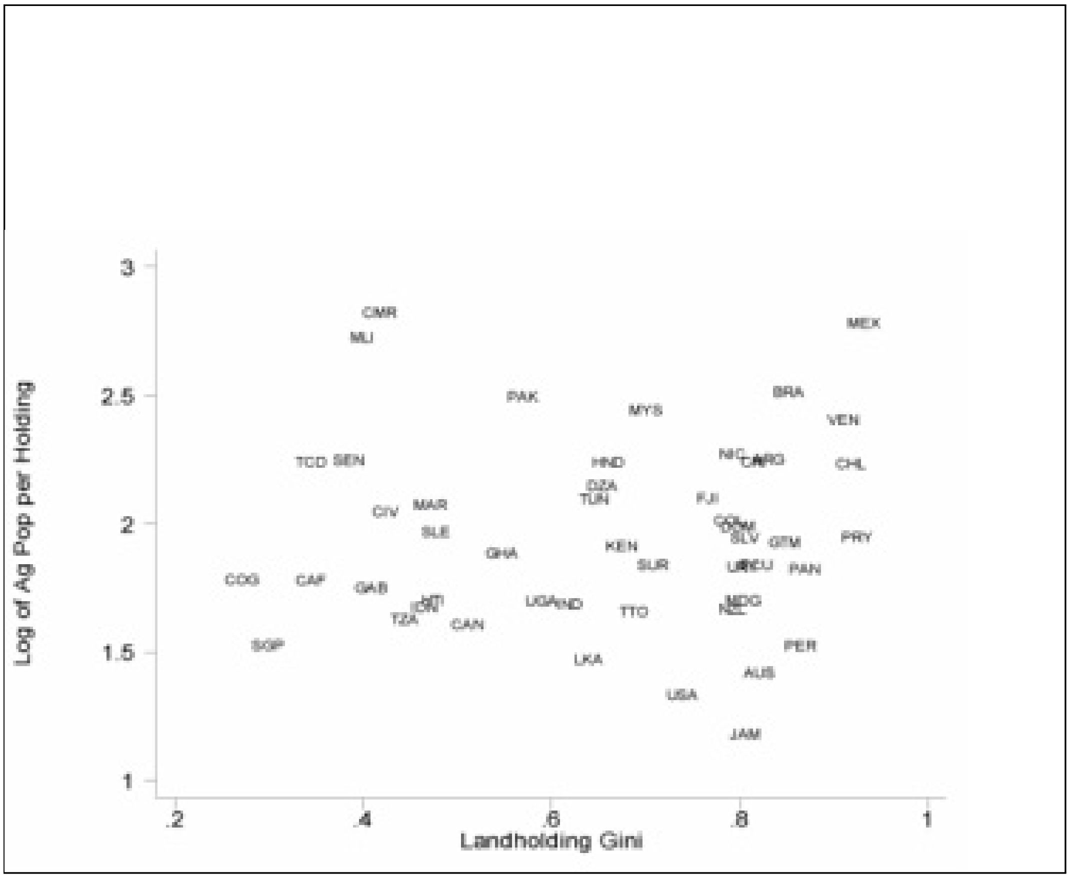

Table 1. Agricultural Population/Holdings, by Decade

Census Year	# Countries	Mean	Std Dev	Min	Max
1960	67	6.58	3.51	2.11	16.10
1970	75	6.75	4.77	1.64	28.95
1980	56	5.96	4.09	1.46	21.14
1990	66	5.17	2.67	1.44	13.06

Table 2. Landholding Gini by Decade

Census Year	# Countries	Mean	Std Dev	Min	Max
1960	75	0.60	0.20	0.22	0.94
1970	82	0.62	0.19	0.23	0.96
1980	58	0.63	0.18	0.23	0.97
1990	52	0.64	0.17	0.25	0.93

Table 3. Institutions, OLS

	(1) Institutions	(2) Institutions
Exp Variable		
Log Ag Pop per Holding	-0.042	0.005
	(0.59)	(0.08)
Land-holding Gini	0.361	0.866 **
	(0.88)	(2.34)
Log Income per Capita 1995	0.224 **	
	(3.08)	
Brit Settlement Dummy	0.951 **	1.259 **
	(3.57)	(4.61)
Log Settler Mortality		-0.041
		(0.54)
Latitude		0.829
		(1.31)
Landlock Dummy		-0.027
		(0.12)
Constant	-1.958 **	-0.739 **
	(5.26)	(1.28)
R-squared	0.662	0.609
total observations	49	49
Method	OLS	OLS

Absolute values of t-statistics are shown in parentheses.
** indicates significance at 5%
* indicates significance of 10%
All standard errors are robust to heteroskedasticity

Table 4. Agricultural Inequality and Instruments

Exp Variable	(1) Log Ag Pop per Holding	(2) Land-holding Gini	(3) Log Ag Pop per Holding	(4) Land-holding Gini
Log Income per	0.123	0.100 **		
Capita 1995	(1.17)	(4.14)		
Brit Settlement	-1.942 **	-0.190	-1.471 **	-0.035
Dummy	(3.42)	(1.46)	(2.83)	(0.28)
Log Settler			-0.038	-0.063 **
Mortality			(0.36)	(2.48)
Latitude			-1.301	0.361
			(1.15)	(1.30)
Landlock Dummy			0.008	-0.032
			(0.03)	(0.42)
Banana Dummy	0.291	-0.028	0.353	-0.045
	(1.08)	(0.47)	(1.24)	(0.65)
Coffee Dummy	-0.257	0.201 **	-0.529	0.181 **
	(0.89)	(3.02)	(1.68)	(2.34)
Copper Dummy	0.326	-0.075	0.385	-0.063
	(1.05)	(1.06)	(1.21)	(0.80)
Maize Dummy	1.058	0.020	0.997	-0.101
	(1.27)	(0.11)	(1.17)	(0.48)
Millet Dummy	0.191	-0.038	0.040	-0.121 **
	(0.76)	(0.67)	(0.18)	(2.21)
Rice Dummy	-1.154	0.135	-1.161	0.302
	(1.56)	(0.80)	(1.53)	(1.63)
Silver Dummy	0.218	0.068	0.280	0.051
	(0.77)	(1.06)	(0.95)	(0.70)
Sugarcane Dummy	0.335	-0.035	0.317	0.003
	(0.64)	(0.29)	(0.58)	(0.03)
Rubber Dummy	-0.026	-0.122 **	-0.036	-0.059
	(0.12)	(2.46)	(0.16)	(1.07)
Wheat Dummy	0.283	0.131 **	0.308	0.122 **
	(1.47)	(2.95)	(1.50)	(2.44)
Constant	0.619	-0.328	2.133 **	0.601 **
	(0.60)	(1.39)	(2.34)	(2.70)
R-squared	0.434	0.634	0.436	0.585
Crop/Mineral Dummy F-test p value	0.093	0.010	0.099	0.020
total observations	49	49	49	49
Method	1st Stage	1st Stage	1st Stage	1st Stage

Absolute values of t-statistics are shown in parentheses.
** indicates significance at 5%
* indicates significance of 10%

Table 5. Institutions, 2SLS

Exp Variable	(1) Institutions	(2) Institutions
Log Ag Pop per Holding	0.142	0.060
	(0.75)	(0.35)
Landholding Gini	-0.571	-0.462
	(1.02)	(0.95)
Log Income per Capita 1995	0.289 **	
	(2.73)	
Brit Settlement Dummy	0.931 **	1.096 **
	(2.29)	(3.10)
Log Settler Mortality		-0.147 *
		(1.86)
Latitude		0.906
		(1.29)
Landlock Dummy		-0.092
		(0.51)
Constant	-2.195	0.519 **
	(5.16)	(0.69)
total observations	49	49
1st Stage F-test p-values		
Log pop per Hold	0.027	0.067
Land-hold Gini	0.000	0.002
Method	2SLS	2SLS

Absolute values of t-statistics are shown in parentheses.
** indicates significance at 5%
* indicates significance of 10%
All standard errors are robust to heteroskedasticity

Endogenous:	Log Ag Pop per Holding and Land-holding Gini
Incl Exogenous	Income, Neo-Europe, Settler Mort, Latitude, Landlock
Excl Exogenous	Dummies for bananas, coeffee, copper, maize, millet, rice, silver, sugarcane, rubber, and wheat

Table 6. Financial Development, OLS

Exp Variable	All measured as share of GDP (1) Liquid Liabilities	(2) Liquid Liabilities	(3) Central Bank Assets	(4) Central Bank Assets	(5) Dep Bank Assets	(6) Dep Bank Assets	(7) Bank Credit	(8) Bank Credit
Log Ag Pop	-0.021	-0.058 **	-0.026 *	-0.041 **	0.006	-0.003	0.009	0.003
per Holding	(0.66)	(2.33)	(1.70)	(1.84)	(0.18)	(0.13)	(0.26)	(0.10)
Landholding	-0.043	-0.184	0.164 **	0.083	-0.195	-0.158	-0.154	-0.117
Gini	(0.24)	(1.36)	(2.25)	(1.00)	(1.46)	(1.17)	(1.20)	(0.88)
Log Income per	0.034		-0.049 **		0.067 **		0.058 **	
Capita 1995	(0.86)		(2.74)		(2.35)		(2.18)	
Brit Settlement	0.162	-0.020	0.028	-0.105 *	0.131	0.102	0.123	0.110
Dummy	(1.30)	(0.22)	(0.55)	(1.68)	(1.27)	(0.97)	(1.27)	(1.09)
Log Settler		-0.133 **		0.015		-0.079 **		-0.063 **
Mortality		(3.09)		(0.49)		(2.46)		(2.01)
Latitude		-0.104		0.078		0.102		0.092
		(0.43)		(0.45)		(0.52)		(0.47)
Landlock		-0.122 **		-0.111 **		-0.152 **		-0.110 *
Dummy		(2.84)		(3.88)		(3.32)		(2.45)
Constant	0.162	1.222 **	0.422 **	0.073	-0.091	0.749 **	-0.105	0.588 **
	(0.76)	(3.84)	(3.53)	(0.30)	(0.56)	(3.34)	(0.69)	(2.68)
R-squared	0.211	0.507	0.261	0.163	0.405	0.475	0.383	0.421
total observations	42	42	42	42	42	42	42	42
Method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS

Absolute values of t-statistics are shown in parentheses.
** indicates significance at 5%
* indicates significance of 10%
All standard errors are robust to heteroskedasticity

Table 7. Financial Development, 2SLS

	All measured as share of GDP							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Liquid	Liquid	Central	Central	Dep Bank	Dep Bank	Bank	Bank
Exp Variable	Liabilities	Liabilities	Bank Assets	Bank Assets	Assets	Assets	Credit	Credit
Log Ag Pop	0.012	-0.056	-0.073 **	-0.078 **	0.013	-0.031	0.004	-0.027
per Holding	(0.20)	(1.17)	(2.08)	(1.96)	(0.25)	(0.70)	(0.08)	(0.65)
Land-holding	-0.284	-0.361	0.102	0.103	-0.375 *	-0.303	-0.317	-0.253
Gini	(1.02)	(1.65)	(0.83)	(0.77)	(1.76)	(1.40)	(1.59)	(1.17)
Log Income per	0.050		-0.033 *		0.082 **		0.074 **	
Capita 1995	(1.03)		(1.83)		(2.23)		(2.17)	
Brit Settlement	0.148	-0.043	0.042	-0.148 **	0.099	0.048	0.081	0.053
Dummy	(0.97)	(0.38)	(0.72)	(1.77)	(0.72)	(0.43)	(0.65)	(0.50)
Log Settler		-0.147 **		0.008		-0.097 **		-0.082 **
Mortality		(2.91)		(0.24)		(2.75)		(2.32)
Latitude		-0.100		0.087		0.112		0.103
		(0.43)		(0.51)		(0.57)		(0.53)
Landlock		-0.082		-0.127 **		-0.127 **		-0.088
Dummy		(1.48)		(3.25)		(2.12)		(1.49)
Constant	0.145	1.398 **	0.453	0.170	-0.092	0.985 **	-0.099	0.826 **
	(0.62)	(3.21)	(3.42)	(0.55)	(0.53)	(3.13)	(0.60)	(2.64)
total observations	42	42	42	42	42	42	42	42
1st Stage F-test p-values								
Log pop per Hold	0.027	0.071	0.027	0.071	0.027	0.071	0.027	0.071
Land-hold Gini	0.002	0.019	0.002	0.019	0.002	0.019	0.002	0.019
Method	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS

Absolute values of t-statistics are shown in parentheses.
** indicates significance at 5%
* indicates significance of 10%
All standard errors are robust to heteroskedasticity

Endc Log Ag Pop per Holding and Land-holding Gini
Incl I Income, Neo-Europe, Settler Mort, Latitude, Landlock
Excl Dummies for bananas, coeffee, copper, maize, millet, rice, silver, sugarcane, rubber, and wheat

Table 8. Education Expenditure, OLS

	Measured as percent of GDP				
	(1)	(2)	(3)	(4)	(5)
	Edu Expend	Edu Expend	Edu Expend	Edu Expend	Edu Expend
Exp Variable	1960-64	1965-69	1970-74	1975-79	1980-84
Log Ag Pop	-0.004	-0.007 **	-0.006 **	-0.006 **	-0.004
per Holding	(1.63)	(4.41)	(3.65)	(2.27)	(1.50)
Landholding	-0.005	-0.007	-0.015	-0.022	-0.007
Gini	(0.70)	(0.61)	(1.15)	(1.00)	(0.46)
Log GDP in 1st	0.001	0.003	0.006	0.006	0.006
yr of period	(0.50)	(0.96)	(1.76)	(1.07)	(1.50)
Brit Settlement	0.004	0.003	0.006	0.012	0.008
Dummy	(0.83)	(0.43)	(0.72)	(1.10)	(0.99)
Constant	0.028	0.029	0.009	0.016	0.005
	(2.27)	(1.70)	(0.42)	(0.57)	(0.24)
R-squared	0.181	0.239	0.350	0.294	0.233
total observations	43	43	43	43	43
Method	OLS	OLS	OLS	OLS	OLS

Absolute values of t-statistics are shown in parentheses.
** indicates significance at 5%
* indicates significance of 10%
All standard errors are robust to heteroskedasticity

Table 9. Education Expenditure, 2SLS

Exp Variable	Measured as percent of GDP (1) Edu Expend 1960-64	(2) Edu Expend 1965-69	(3) Edu Expend 1970-74	(4) Edu Expend 1975-79	(5) Edu Expend 1980-84	(6) Edu Expend 1975-79	(7) Edu Expend 1980-84
Log Ag Pop per Hold 60-70	-0.007 *	-0.011 **	-0.009 *	-0.006	-0.004		
	(1.78)	(2.36)	(1.87)	(1.01)	(0.63)		
Log Ag Pop per Hold 80-90						-0.017 **	-0.018 **
						(2.79)	(2.71)
Landholding Gini	-0.002	0.004	-0.013	-0.019	-0.001	-0.032	-0.002
	(0.16)	(0.24)	(0.84)	(0.80)	(0.04)	(0.62)	(0.05)
Log GDP in 1st yr of period	0.001	0.001	0.006	0.005	0.005	0.003	-0.003
	(0.28)	(0.31)	(1.63)	(0.94)	(1.05)	(0.25)	(0.34)
Brit Settlement Dummy	0.003	0.003	0.004	0.012	0.010	0.017	0.024
	(0.03)	(0.33)	(0.43)	(0.97)	(1.00)	(0.78)	(1.48)
Constant	0.033 **	0.040 **	0.013	0.017	0.008	0.063	0.086
	(2.31)	(1.97)	(0.53)	(1.02)	(0.34)	(1.32)	(2.26)
total observations	43	43	43	43	43	24	24
1st Stage F-test p-values							
Log pop per Hold	0.086	0.093	0.093	0.093	0.084	0.002	0.002
Land-hold Gini	0.001	0.001	0.001	0.002	0.002	0.038	0.000
Method	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS

Absolute values of t-statistics are shown in parentheses.
** indicates significance at 5%
* indicates significance of 10%
All standard errors are robust to heteroskedasticity

Endogenous: Log Ag Pop per Holding and Land-holding Gini
Incl Exogenous Income, Neo-Europe, Settler Mort, Latitude, Landlock
Excl Exogenous Dummies for bananas, coeffee, copper, maize, millet, rice, silver, sugarcane, rubber, and wheat