Land Inequality and Economic Growth:
A dynamic panel data approach

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1. Introduction

The relationship between inequality and economic growth has been subject to considerable debate in development circles. Following the seminal work of Kuznets (1955), a growing empirical literature addresses the linkages between income inequality and economic growth. While most studies consider inequality detrimental for growth, some recent findings point towards a possible positive relationship. Such differences are strongly determined by the type of indicators and the estimation procedures that are used.

Almost all studies that explore the relationship between inequality and growth rely on measures of income inequality rather than asset distribution as an explanatory variable. This is troublesome since the theoretical relationship between inequality and growth is better explained by assets distribution than by income. Inequality in assets is likely to reduce growth prospects due to insecure property rights or social polarization that reduce investment prospects. Asset redistribution in the form of land or education reforms can also play an important role in improving growth performance. For policy purposes, it makes a large difference whether inequality of income or inequality of assets is the underlying factor of registered differences in economic growth.

Most current studies rely on cross-sectional evidence rather than on panel data analysis and may thus provide biased results. The results obtained from this data can hardly be considered as adequate structural estimates, given the presence of country-specific attributes such as initial factor endowments or the country's particular history. Moreover, when panel data have been used to test the relationship between income inequality and growth, it sometimes show the disappearance of the traditional negative effect, thus giving policy makers an argument to focus on growth-enhancing policies without worrying about distributional issues.

This article provides a theoretical discussion and some novel empirical tests to understand the relationships between assets distribution and economic growth. We explore the channels through which these processes are linked, paying particular attention to the role of human capital. In addition to traditional approaches that refer to credit market imperfections and investment constraints, we incorporate some new arguments that link inequality of assets with delayed growth trough weak property rights institutions.

In order to avoid the methodological problems stated before, we assembled a new panel database that includes observations for more than 30 countries over the last three decades. The data include a time-varying variable for the Land Gini index over this period that will enable us to overcome the limitations of previous studies that included only a time-invariant measurement. A system GMM estimator as proposed by Arellano and Bover (1995) is used to generate truly unbiased and consistent regression estimates.

The article is structured as follows. First we present a review of the different theoretical models that explain the implications of asset inequality for economic growth. Hereafter, we outline the econometric estimation procedure. Next, we present the results of our estimation. We conclude with some implications for policy and further research.

2. Inequality and Growth

The recent literature on the relationship between inequality and growth distinguishes two broad types of approaches that focus on particular channels through which these processes are linked. Following Dominicis et al. (2005) we refer to these approaches as the 'political economy' models and the 'socio-political instability' models. In political economy models, inequality affects taxation through the political process by which individuals can choose the tax rate directly or via electing governments with certain redistributive policies (Alesina and Rodrik 1994, Persson and Tabellini 1994). If inequality determines the extent of redistribution, it will then have an indirect effect on the economy's rate of growth. In very unequal societies we would expect then that more voters will prefer larger redistribution. If redistribution reduces the incentives to invest, and hence the growth rate, it is to expect then that more equal societies will grow faster.[1]

More extended political economy models with capital market imperfections include credit constraints that prevent the poor from undertaking profitable investments. A more egalitarian wealth distribution can help to overcome asset thresholds and might result in higher aggregate investment in physical or human capital. As Stiglitz (1969) pointed out, when there are decreasing returns to capital and capital markets are imperfect, aggregate level of output may be affected by the wealth distribution. Aghion et al. (1999) used an endogenous growth model where redistributing wealth from the rich to the poor (whose marginal productivity of investment is relatively high) increases aggregate productivity and therefore growth. Under such conditions, asset redistribution creates investment opportunities in the absence of well-functioning capital markets, which in turn will enhance aggregate productivity and growth.

Socio-political instability approaches devote more attention to the role of social stability and property rights. Through its impact on economic efficiency, the distribution of assets can affect the cost of market exchange, the incentives to invest, the levels of violence, and the societies' ability to respond to exogenous shocks (Deininger and Olinto

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[1] Although these models account for the negative correlation between inequality and growth, some empirical studies found a positive rather than a negative effect of redistribution on growth (Easterly and Rebelo, 1993). When redistribution measures such as the tax rate or the level of social spending are regressed on measures of inequality, the coefficients are either insignificant or have a sign opposite to what theory predicts (Perotti 1996; Lindert 1996).

1999). Inequality can also create barriers that affect the cost of social interaction and economic exchange (Collier 1998; Temple 1998). Finally, inequality can be associated with violence and crime which will affect growth through the direct damage, the need to spend resources on preventive measures, and the impact on property rights and investment incentives (Bourguignon 1998, Knaack and Keefer 1995).

In a recent study, Keefer and Knack (2002) argue that social polarization – measured by the inequality on land holdings – affects the likelihood of extreme policy deviations, making property rights less secure and thus negatively affecting growth. Once controlling for this indirect effect of inequality on growth, the direct link is likely to diminish. In a similar vein it can be argued that not only inequality of assets can create a negative impact in growth, but also the degree of tenure security over those assets and the property right system in a country will influence investments and growth. Studies that address the relationship between institutions and growth (Rodrik, 2000) argue that secure and stable property rights are a key incentive to invest.[2] A clear specification of land rights play also a crucial role in correcting financial market imperfections, given their collateral function.[3] Moreover, securing land property rights will be a key to reduce transaction cost in factor markets and thus improve economic efficiency and economic growth (Lipton 1974, Deininger et al. 2003; Byamugisha, 1999).

Most studies that analyze the systematic relationship between inequality and growth are based on rather simple measures of income inequality. Using cross-country data they find a negative relationship between income inequality and growth (Alesina and Rodrik, 1994; Persson and Tabellini, 1994). When a variable for initial land inequality is included it is

[2] The World Bank report by Deininger and Binswanger (1999) provides a comprehensive summary.
[3] Various studies have found that although land titles are a *necessary* condition they are not *sufficient* for getting access to (formal sources of) credit. See for example Boucher et al. (2004) and Van Tassel (2004).

negatively associated to growth. An important extension to these approaches would be to examine the dynamic relationship between changes in asset distribution and economic growth.

Recently, new and larger data sets have become available that allow the incorporation of more sophisticated panel techniques. Studies by Forbes (1998) and Li and Zou (1998) using fixed-effects estimators to control for country-specific characteristics and dynamic GMM estimators to correct for endogeneity suggest that the negative relationship between inequality and growth weakens considerably and may actually be reversed.[4]

Various studies reviewed the consistency of these results using different specifications of income inequality (Gini coefficients, quintile shares, income ratios), different country samples and time periods[5]. Dominicis et al. (2005) used meta-analysis procedures to review existing evidence from 21 studies and conclude that inequality affects growth in a different way in higher and less developed countries.

A number of these recent contributions examine the possibility that - in line with the theoretical models discussed above - it is less inequality of income but unequal distribution of assets that may cause the reduction in countries' growth rates (Deininger and Squire 1998; Birdsall and Londoño 1998; Keefer and Knack 2002). However, empirical evidence has been largely based on cross-sectional country level data rather than panel data analysis. Due to differences in the variables used (income vs. assets distribution) or the methods applied (cross-section vs. panel data), the empirical literature showed ambiguous predictions regarding the possible impact of inequality on growth.

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[4] Such positive effects of inequality on growth might be explained by the higher savings amongst rich households and the possibilities to overcome sunk costs in large investment projects.

[5] Galor and Moav (2004) provide evidence that the distribution-growth relationship depends on the development stage of a country, with more inequality at early stages of industrialization and more equality after people start to invest in education.

The study conducted by Deininger and Olinto (1999) is an attempt to overcome these limitations by putting together a comprehensive panel data set with asset inequality between countries. They use a GMM estimator approach to examine the robustness of the income-growth relationship, including Gini coefficients to account for the initial land distribution (for the period 1960-70). This study not only identifies a significant negative impact of income and asset inequality on growth rates, but also analyzes some of the channels through which this effect takes place.

We further explore what we consider two critical limitations of the former analysis. The first one is related to the use of a proper database, while the second one deals with potential gaps in the theoretical approach. While Deininger and Olinto (1999) recognize that inequality of assets is likely to be more stable inter-temporally than the distribution of income, they implicitly assume that asset distribution remains unchanged over a long time period. Moreover, it is less appropriate to use a time-invariant land Gini coefficient for the 1960-70 period as main variable, since many countries made important land distribution reforms precisely right after that decade.[6] The collection of new information about land Gini distribution for several countries and different time periods allows us to analyze how changes in this variable - and not only their initial level – affect the relationship with growth.

The theoretical gap mentioned above refers to the weak explanations that are usually offered regarding the potential direct effects of assets inequality on growth, controlling for the investment effect. It is argued that what could be behind this finding is either an "incentive effect" or a "social capital" effect, whereby inequality would increase the cost of social and economic interaction, including the ability to maintain rule of the law

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[6] This is the case for example in many Latin American countries that present the most unequal distribution of land in the sample used for the Deininger & Olinto study.

in an unbiased way. Following this argument, and in line with the recently forwarded theoretical arguments regarding the linkages between property rights, inequality of assets, and growth, we need to test if - once controlling for the stability of property rights in each of the countries - the direct effect of assets inequality on growth is still maintained.

3. Econometric Estimation and Data Specification

We start from the usual equation in the empirical analyses of the determinants of growth:

$$(1) \qquad (y_{it} - y_{it-1}) = \alpha \, y_{i\,t-1} + \beta' X_{it-1} + \delta' Z_i + \varepsilon_{it}$$

where y_{it} denotes the logarithm of per-capita GDP of country i in period t, X_{it-1} is a vector of country-specific time-varying variables affecting growth, and Z_i is a vector of country specific time-invariant variables, and ε_{it} is an error term that captures the effect of time-invariant and time-varying unobserved country characteristics. The disturbance term ε_{it} can be divided in a country-specific time-invariant effect u_i and the time-variant disturbance e_{it}. We assume that $Cov(e_{it}, u_i)=0$ and $Cov(e_{it}, e_{is})=0$, for any $t \neq s$. Eq. (1) becomes then:

$$(2) \qquad (y_{it} - y_{it-1}) = \alpha \, y_{i\,t-1} + \beta' X_{it-1} + \delta' Z_i + u_i + e_{it}$$

The OLS estimation of the parameters in equation (2) is likely to be biased and inconsistent for two reasons: First, by construction y_{it-1} is correlated with the country-specific effect u_i, and second, it is likely that some of the variables in vectors X_{it-1} and Z_i are also correlated with that error component. Second, asset inequality can be correlated to factor endowment, and conditioned by the country-specific history which are unobservable characteristics measured by u_i.

The usual solution to this lack of orthogonality with panel data is to estimate the specified parameters by applying OLS to the "within groups" transformation, or "first differencing" left and right-hand-side variables in (2). In this particular case, however, estimation of equation (2) by “fixed effects” would create some other problems. First, given the dynamic nature of the model, the first difference of y_{it-1}, defined as $\Delta y_{it-1} = y_{it-1} - y_{it-2}$ is by construction correlated to the first difference of the error component e_{it}, given by $\Delta e_{it} = e_{it} - e_{it-1}$. Second, even though X_{it-1} is uncorrelated by assumption to the error component e_{it}, X_{it} is likely to be contemporaneously correlated to e_{it}, which implies that ΔX_{it-1} will be correlated to Δe_{it}. Therefore, the OLS estimator of α and β obtained by regressing Δy_{it} on Δy_{it-1} and ΔX_{it-1} will be biased and inconsistent. Since the first difference of Z_i is zero, we would not be able to identify their parameters using fixed effect estimation methods.

The lack of identification for the time-invariant variables when the within transformation is adopted can be solved by employing the IV estimator proposed by Hausman and Taylor (1981). For the lack of orthogonality between Δy_{it-1}, ΔX_{it-1} and Δe_{it}, inherent to dynamic panel data models, Arellano and Bond (1991) formulate a consistent and unbiased GMM estimator which uses twice lagged y_{it} and X_{it} as instruments. An extension of this model proposed by Arellano and Bover (1995) provides a unifying GMM framework that can be generalized for the estimation of Hausman and Taylor type models, as well as dynamic panel data models. In addition of using instruments in levels for the equations in first differences, we also use instruments in first differences for the equation in levels, which allow us to estimate a “system GMM” instead of only a “differences GMM” model as the one proposed by Arellano and Bond (1991). With this addition we can estimate the parameters in the levels equation that explain a substantial part of the total variation in the data.

We composed a new data set on the distribution of operational holdings of agricultural land from the decennial FAO World Census of Agriculture and other sources for 35 countries. For each country, this information has been recovered for three different periods over time: 1960-1970, 1971-1980, and 1981-1990, giving us a total of 105 observations in the panel. We complement the data with measures of real GDP per capita and the share of investment in GDP from the Penn-Word data set, data on human capital stock taken from Barro and Lee (2000), and finally a time-invariant variable containing a measurement of the "rule of law" for the 1980 decade taken from the ICRG (International Country Risk Guide) law and order rating.[7]

The panel data (see Annex 1) show that land Gini coefficients do not only vary across countries but also show considerable change over the studied time period. For example, the average Gini coefficient for the initial period is 0.6 and for the final period 0.62, both with standard deviations of 0.16. The average difference between the Gini of the initial period for all countries and that of the final period is 0.015 (standard deviation 0.06).

4. Results

The growth regression results are presented in Tables 1 and 2 for different specifications of the equation. As we can observe in column 1, the coefficient for the land Gini distribution is negative and significant, thus confirming the hypothesis that both the level and the change towards a more equal distribution of land have an important positive effect on the GDP growth of a country.

>> INSERT Table 1 <<

A very interesting result derived from column 3 is that once we include the interaction term between human capital and land distribution, the configuration of the inequality effect on growth changes dramatically. The coefficient for land distribution is now positive but insignificant, the education effect becomes significant, and the interaction

[7] Since lagged variables are used as instruments for the estimation, the equation in levels for the earliest period (1970) as well as the last difference equation including periods (1980-1970) cannot be estimated and

term is negative and significant. This result gives support for the hypothesis that even though human capital investments are very important for enhancing growth, countries with highly unequal levels of asset distribution tend to face a reduced effectiveness of their educational policies. Putted in another way, we could argue that efforts for land redistribution should be implemented together with improvements in education in order to have a decisive impact on economic growth. This argument has been frequently forwarded in explaining the differences between land redistribution policies in Asian countries compared to the ones in Latin America.

>> INSERT Table 2 <<

Column 1 in Table 2 examines whether there is an independent effect of the asset distribution once we include the investment variable in the model. As we can see, the investment coefficient is possible and significant as expected, but the land distribution coefficient remains significant and negatively related to the growth rate. However, its magnitude has been reduced with more than 40 percent compared to the model where it was the only regressor included. The independent effect of land distribution remains negative and significant even when human capital is added to the model (column 2).

Finally, we tested whether this apparent direct effect of inequality on growth is maintained once a measurement for the country's political stability is included. Some authors argue that the main effect of inequality on growth is through its indirect effect on the security or stability of property rights. This implies that once controlling for the Rule of Law, the coefficient of land distribution should decrease or even turn insignificant.[8] As the

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are used only as instruments. The "System GMM" estimation of eq. (2) thus includes two equations for the regression in levels and other two for the regression in first-differences.

[8] Using a cross-section database Keefer and Knack (2002) find that, when an index for property rights is added to the growth equation, the land inequality coefficient is reduced in one third, even though still negative and significant.

index for Rule of Law that we are using is highly correlated with the level of GDP (correlation of 0.7) we include it alone and also as an interaction with the initial level of GDP for each decade. Column 3 shows that the index for Rule of Law has indeed a direct and positive impact on growth. While its addition to the equation turned the coefficient for the investment share insignificant, the direct negative impact of land distribution remains unaffected. The last column in Table 2 incorporates the human capital variable. Once we add this control the main effect is an important reduction in the coefficients for land distribution (from 0.07 in the previous equations to 0.056) and for the investment share (from 0.029 in equation 2 to 0.019), which is now again significant.

5. Discussion

Using for the first time a panel data set with changes in land distribution over time and between countries we have been able to provide confirmation for the hypothesis that asset distribution is a major determinant of economic growth. Apart from a direct effect we also show that land inequality creates a barrier to the effectiveness of educational policies. Moreover, our results provide support for the hypothesis that security of property rights is an important factor in shaping the relationship between assets inequality and growth.

These results have two important implications for policy strategies. First, it seems clear that policies aiming at a more equal distribution of assets have to be combined with complementary measures towards educational reforms and the improvement of institutional arrangements to secure property rights. The lack of such a combined implementation of structural reforms can be one of the reasons why land reforms in several countries failed in the past to achieve the expected economic growth. Second, for developing countries that pursue market liberalization and privatization programs, it becomes of fundamental importance to remain alert that the effects of these reforms are not leading to the concentration of assets in few hands. Such unintended consequences are likely to deteriorate the country's economic performance in the long run.

In order to explore in more detail the conclusions derived from this study, some issues require further research. It would be desirable to expand the sample of countries with accurate information about (changes in) land distribution, so that more instruments can be used. Another option would be to obtain a broader measure of assets distribution (i.e. including housing and urban land ownership). It would also be important to find measures that are more directly reflecting ownership security. Many other factors - such as social interaction problems, political instability or ethnic heterogeneity - can be also playing a role but where not (yet) included in our analysis.

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Annex 1: Data base

Region	Country	Land Gini 1970	Land Gini 1980	Land Gini 1990	GDP per capita 1970	GDP per capita 1980	GDP per capita 1990	Investment 1970	Investment 1980	Investment 1990	Human capital 1970	Human capital 1980	Human capital 1990	Rule Law
East Asia & Pacific														
	FJI	0.65	0.84	0.77	2,592	3,609	3,985	0.19	0.24	0.12	4.9	5.8	6.4	-
	IDN	0.55	0.55	0.46	715	1,281	1,974	0.11	0.18	0.28	2.5	3.1	2.9	1.9
	JPN	0.47	0.52	0.59	7,307	10,072	14,331	0.40	0.34	0.39	5.1	5.4	5.5	5.0
	KOR	0.37	0.35	0.34	1,680	3,093	6,673	0.22	0.28	0.37	3.5	4.8	5.5	2.3
	PHL	0.51	0.51	0.55	1,403	1,879	1,763	0.13	0.19	0.18	3.7	4.7	5.0	1.0
	THA	0.43	0.44	0.47	1,526	2,178	3,580	0.18	0.17	0.27	3.7	3.7	4.6	3.2
East Europe & C. Asia														
	TUR	0.59	0.57	0.61	2,202	2,874	3,741	0.21	0.23	0.21	2.1	2.6	3.0	2.8
Latin America														
	BRA	0.84	0.85	0.85	2,434	4,303	4,042	0.20	0.22	0.15	2.5	2.3	3.1	3.9
	PAN	0.80	0.84	0.87	2,584	3,392	2,888	0.26	0.22	0.16	3.5	4.5	5.7	2.0
	PER	0.92	0.91	0.86	2,736	2,875	2,188	0.13	0.23	0.16	3.4	4.2	4.1	1.0
	PRI	0.79	0.77	0.77	5,780	6,924	8,972	0.32	0.16	-	-	-	-	-
	PRY	0.86	0.93	0.93	1,394	2,534	2,128	0.09	0.21	0.18	3.4	4.0	4.4	2.0
Mid-East & N. Africa														
	ISR	0.80	0.77	0.85	6,004	7,895	9,298	0.30	0.21	0.21	6.1	6.7	6.6	2.4
	PRT	0.81	0.81	0.78	3,306	4,982	7,478	0.28	0.27	0.16	2.1	2.5	3.0	5.0
North America														
	USA	0.72	0.72	0.74	12,963	15,295	18,054	0.20	0.20	0.20	5.8	5.9	5.8	5.8
South Asia														
	IND	0.62	0.61	0.58	802	882	1,264	0.13	0.14	0.16	2.0	2.4	3.0	2.4
	NPL	0.56	0.60	0.45	670	892	1,035	0.04	0.08	0.08	0.1	0.6	0.9	-
	PAK	0.51	0.52	0.57	1,029	1,110	1,394	0.10	0.09	0.10	1.0	1.1	2.1	2.0
Western Europe														
	AUT	0.70	0.69	0.65	7,510	10,509	12,695	0.28	0.28	0.26	3.6	3.7	3.6	6.0
	BEL	0.60	0.58	0.56	8,331	11,109	13,232	0.27	0.24	0.25	6.8	5.9	6.0	6.0
	CHE	0.51	0.52	0.50	12,942	14,301	16,505	0.31	0.30	0.35	5.1	5.5	5.4	5.8
	CYP	0.62	0.61	0.63	3,753	5,295	8,368	0.32	0.30	0.23	4.1	4.4	5.4	2.5
	DEU	0.51	0.52	0.68	9,425	11,920	14,341	0.32	0.27	0.26	3.6	3.7	3.7	-
	DNK	0.43	0.46	0.44	9,670	11,342	13,909	0.30	0.22	0.21	5.5	5.5	5.5	5.9
	ESP	0.84	0.85	0.86	5,861	7,390	9,583	0.28	0.24	0.29	4.1	4.0	4.2	3.8
	FIN	0.25	0.23	0.26	8,108	10,851	14,059	0.40	0.35	0.33	4.9	5.1	5.5	5.8
	FRA	0.53	0.53	0.53	9,200	11,756	13,904	0.31	0.27	0.27	4.2	4.1	4.2	5.1
	GBR	0.69	0.68	0.67	8,537	10,167	13,217	0.20	0.16	0.19	5.8	5.9	6.0	4.6
	IRL	0.49	0.49	0.48	5,015	6,823	9,274	0.27	0.27	0.23	5.0	5.2	5.4	3.9
	ITA	0.75	0.76	0.78	7,568	10,323	12,488	0.31	0.27	0.25	4.1	3.7	3.8	4.9
	LUX	0.45	0.47	0.48	9,782	11,893	16,280	0.32	0.26	0.32	-	-	-	6.0
	NLD	0.48	0.50	0.55	9,199	11,284	13,029	0.30	0.23	0.22	5.3	5.3	5.4	6.0
	NOR	0.46	0.48	0.46	8,034	12,141	14,902	0.34	0.30	0.21	5.2	5.3	6.6	6.0

Notes:

Land Gini: derived from FAO World Census of Agriculture (operational holdings).
GDP per capita: Obtained from the Penn-Word Table 6.1
Investment: Obtained from the Penn-Word Table 6.1.
Human Capital: Taken from Barro and Lee (2000).
Rule Law: Taken from the International Country Risk Guide (ICRG) database. Higher scores indicate "sound political institutions, a strong court system, and provisions for an orderly succession of power". Lower scores indicate "a tradition of depending on physical force or illegal means to settle claims". Index between 0-6.

Table 1: Growth regression results (land and education)

	(1)		(2)		(3)	
Initial GDP (log)	-0.014	**	-0.011		-0.006	*
	0.005		0.010		0.003	
Land Gini	-0.121	**	-0.104	**	0.103	
	0.027		0.027		0.064	
Human capital (log)			0.012		0.066	**
			0.014		0.025	
Human cap.* Land Gini					-0.111	**
					0.044	
Intercept	0.222	**	0.165	**	0.017	
	0.054		0.079		0.043	
countries	33		31		31	

** significant at 5% level, * significant at 10% level. Std errors below coefficients.

Table 2: Growth regression results (land, education, investments and Rule of Law)

	(1)		(2)		(3)		(4)	
Initial GDP (log)	-0.006		-0.006		0.007		0.0086	
	0.004		0.006		0.012		0.0152	
Land Gini	-0.070	**	-0.077	**	-0.071	**	-0.0569	*
	0.026		0.021		0.024		0.0308	
Initial investment (log)	0.023	**	0.029	**	0.009		0.0190	*
	0.010		0.008		0.007		0.0107	
Rule of Law index					0.055	**	0.0577	**
					0.019		0.0236	
Rlaw * Initial GDP					-0.006	**	-0.0064	**
					0.002		0.0029	
Human capital (log)			-0.007				0.0034	
			0.010				0.0113	
Intercept	0.044		0.040		-0.031		-0.0807	
	0.056		0.055		0.092		0.1304	
countries	33		31		29		29	

** significant at 5% level, * significant at 10% level. Std errors below coefficients.