

*Explaining the Evidence on Inequality and Growth:
Informality and Redistribution**

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Abstract

This paper constructs a simple model that can account for both the negative relationship between growth and income inequality observed in the cross-country data and the positive relationship observed within countries over time. The model employs a dual-economy structure with formal and informal sectors. Growth is driven by formal sector human capital spillovers. Restrictive institutions impose barriers to formality that reduce the growth rate and increase inequality. Redistributive taxation lowers inequality but blunts the incentive to accumulate, lowering growth. Institutional structures vary more across than within countries. Consequently, variations in institutional barriers to formality may account for the negative relationship between growth and inequality found in the cross-country data. Variations in the intensity of redistribution may account for the positive relationship observed within countries over time.

Key Words: Growth, Inequality, Dualism, Informal Sector, Institutions

JEL Codes: O41, O17, D31

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Section I. Introduction

The empirical work on income inequality and economic growth finds, alternately, that they are positively related, negatively related and not related. The profusion of conflicting evidence leads Banerjee and Duflo (2000, page 17) to ask rhetorically, “Is there anything then, apart from the obvious fact of disagreement, that we can take away from this body of evidence?” This paper argues that rather than being an obvious fact, the disagreement apparent in the empirical work on inequality and growth is illusory. What has been interpreted as contradictory evidence on “the relationship” between

growth and inequality is, in fact, consistent evidence on two separate relationships, one across countries and the other over time.

The current confusion over the empirical evidence has its roots in a theoretical literature that tends to treat either growth or inequality as exogenous. One line of research follows Kuznets' (1956) emphasis on the dynamics of dualistic development.¹ In these models, the evolution of inequality is investigated while modern sector expansion, a proxy for rising income levels, is treated as automatic. The other line of research follows Kaldor (1956) in investigating the channels through which the initial distribution of income might influence subsequent accumulation and growth.² As Lundberg and Squire (2003, p. 326) note, "Neither approach is particularly convincing from a theoretical standpoint: the evolution of growth and inequality must surely be the outcome of similar processes."

This paper employs an alternative theoretical framework in which both inequality and growth are endogenous functions of underlying policy variables. This adds a degree of conceptual freedom to the frameworks described above, making it relatively straightforward to develop a model that accounts for the empirical record in a coherent and consistent fashion. Indeed, I describe a set of sufficient conditions for a family of models capable of doing so. I also develop one such model in detail as an illustration.³

A major implication of the paper is that there may not be *any causal relationship* between inequality and growth. If this is true, then there is not a meaningful answer to

¹ See, for example, Knight (1976), Robinson (1976), Bourguignon (1990) and Rauch (1993).

² This literature explores a variety of mechanisms through which inequality might influence growth, including its impact on fiscal policy (Persson and Tabellini 1994, Alesina and Rodrik 1994, Bourguignon and Verdier 2000, Benabou 2000), socio-political instability (Alesina and Perotti 1996), and misallocations of credit (Piketty 1997, Aghion and Bolton 1997). See Barro (2000) for a recent overview.

the question that has occupied so much of the recent work in this area, Persson and Tabellini's (1994) query, "Is inequality harmful for growth?" It may be more useful to ask instead, "Are the particular conditions that determine the level of inequality in a given country good or bad for growth?"

This attempt to refocus the debate on particular policy instruments will appeal to researchers who found themselves uneasy with the idea that anything one does to reduce income inequality will necessarily increase, or decrease, growth. Depending on the instrument in question, the impact on growth may be positive or negative. In addition, the direct effects of a policy change on growth may swamp any indirect effect operating through its impact on inequality.

The next section describes the primary "stylized facts" of growth and inequality and outlines the characteristics of a family of models consistent with these facts. The third section selects a particular member of this family for further investigation, and the fourth section solves the model and discusses its relationship to the evidence. The final section concludes.

Section II. Stylized Facts and a Family of Models

Fact 1: Across countries, growth and inequality vary inversely.

³ To the best of my knowledge, Lundberg and Squire (2003) is the only other paper to treat both growth and inequality as endogenous. They critique, rather than explain, the existing empirical literature and do not develop a theoretical model.

The first stylized fact is supported by cross-country growth regressions in which initial inequality is negatively and significantly related to subsequent growth.⁴ That is, more equal economies grow faster. *Figure 1* displays this relationship. The line shows the best fit of an OLS regression of the average growth rate, 1975-1995, on initial income inequality, as measured by the Gini coefficient in 1975 and initial income. While I argue against interpreting this as a causal relationship, the two variables are strongly related. An increase in the Gini of one standard deviation, 9.68, is associated with a fall in the average growth rate of more than one percent per year.

Despite the large number of studies that find support for this stylized fact, it should not be interpreted as a causal relationship. Several researchers have found that this relationship is not robust, being sensitive to the inclusion of additional explanatory variables, such as regional dummy variables (Deiniger and Squire, 1998) and measures of fertility (Barro 2000, de la Croix and Doepke 2003). Furthermore, as Forbes (2000) points out, cross-country growth regressions are particularly prone to omitted variable bias. In particular, she notes that omitted variables that are “positively correlated with inequality and negatively correlated with growth” will negatively bias the coefficient on initial inequality (page 870).

Fact 2: *Within countries, growth and inequality vary directly.*

The second stylized fact is supported by Li and Zou (1998) and Forbes (2000). These studies use panel estimation techniques (fixed effects and general method of

⁴ See for example Alesina and Rodrik (1994), Persson and Tabellini (1994), Clarke (1995), Perotti (1996). Benabou (1996) provides a summary of the cross-country evidence.

moments, respectively), and find that within countries growth rises with inequality. These findings are important because their use of country-specific intercepts controls for the effect of time-invariant omitted variables that may bias the cross-country results as noted above. Forbes' (2000) treatment is particularly compelling, considering a variety of data, sampling and specification issues and isolating omitted variable bias as the primary source of the difference in outcome, rather than data quality or choice of ancillary variables.

Figure 2 illustrates this relationship using 5 yearly data from 1970 to 1995 and controlling for initial income and country and period fixed effects. Once again, while caution is necessary in interpreting this finding, growth and inequality are clearly strongly related. For a given country, a standard deviation increase in inequality is associated with a 1.88% increase in the average growth rate.

Fact 3: Inequality varies vastly more across than within countries.

Li, Squire and Zou (1998) report that inequality is relatively constant within countries during the post-war period. Indeed, using Deininger and Squire's (1996) "high-quality" data set, Li et al. find that "about 90% of the total variance in the Gini coefficients can be explained by variation across countries, while only a small percentage of the total variance is due to variation over time" (p. 26-27). As the authors note, this finding implies that inequality is primarily determined by factors that differ across space rather than time.

Fact three has two implications for how relative weights we give the first two. First, the inference that the determinants of inequality vary primarily across space, rather than time, supports Forbes (2000) contention that the negative relationship between income inequality and economic growth found in cross-country growth regressions may be time-invariant omitted variables may drive. On the other hand, it suggests that the positive relationship between inequality and growth within countries found using panel methods, while arguably based on superior econometric techniques, is in fact only a small part of the overall story. The big story lies in the effects of the omitted variables.

A Family of Models

This subsection describes a set of assumptions that collectively constitute sufficient conditions for a model that is able to account for the three stylized facts noted above. Since these assumptions are general in nature, they may be thought of describing a family of “endogenous inequality-endogenous growth” models that is broadly consistent with the empirical evidence.⁵ This family is described by reduce-form equations for equilibrium growth and inequality.

Let the growth rate and Gini coefficient be given respectively by $g = g(X, Y)$ and $G = G(X, Y)$, where X and Y are sets of exogenous policy variables. These functions conform to the following assumption:

Assumption 1: For all $x \in X$, $g_x / G_x < 0$. That is, a change in x moves growth and inequality in opposite directions.

⁵ Banerjee and Duflo (2000) argue that the findings of the cross-country and panel studies are consistent with a political economy model in which growth falls in response to a change in inequality. There is no reason to think of their explanation as competing with the one proposed here. Their model does not attempt to account for our third stylized fact, the greater variation in inequality across than within countries.

Assumption 2: For all $y \in Y$, $g_y / G_y > 0$. That is, a change in y moves growth and inequality in the same direction.

Assumption 3: The elements of X vary substantially across countries but are relatively constant within countries over time, while the elements of Y vary either primarily over time or relatively equally in both dimensions.

Assumption 4: The elements of X rather than Y are the “primary determinant” of inequality, in the sense that variations in X are responsible for most of the observed variation in inequality.

Assumptions 1 and 3 support the first stylized facts. If the elements of X are omitted, cross-country growth regressions will report an inverse relationship between growth and inequality. Similarly, assumptions 2 and 3 support the second stylized fact. Since X is relatively stable within countries over time, the results using panel methods will be driven by variations in Y , which generate a positive relationship between growth and inequality. Assumptions 3 and 4 support the third stylized fact: inequality varies more across than within countries.

Note that no assumption is made here about a direct impact of inequality on growth or vice-versa. With growth and inequality treated as endogenous variables, a direct relationship between them is not necessary to account for the stylized facts noted above. As a result, our assumptions imply that both cross-country and panel regressions are mis-specified in that the impact of inequality on growth is driven by omitted variables. However, it should be stressed that the assumptions listed above are only one

set of possible sufficient conditions. There is, in particular, no reason to rule out a “small” positive effect of inequality on growth.⁶

Section IV: Variable Selection – Restrictive Institutions and Redistribution

As the discussion above suggests, it should be possible to find several variables that satisfy the conditions set on X and Y . This supposition is supported by Lundberg and Squire (2003). They find that increases in education and decreases in inflation and land inequality are associated with desirable changes in both growth and inequality, as required for elements of X in assumption 1. Alternately, changes in the Sachs-Warner index of openness and the Gastil index of civil liberties involve a growth-inequality trade-off, as required for elements of Y in the second assumption (p. 338-9). They do not, however, consider whether the variables examined adhere to Assumptions 3 and 4, so it is unclear whether these variables can explain the relative variation of inequality across and within countries or the apparent contradiction in the evidence to date.

The Choice of Y – Redistributive Taxation

Clarity of intuition guides our choice of Y as redistributive taxation. Proportional income taxation coupled with uniform transfers redistributes income progressively, reducing the inequality of post-transfer income. Income taxes also reduce the return to capital, blunting the incentive for accumulation and reducing the growth rate. In a simple

⁶ Such an effect might be driven, for example, by the influence of inequality on the aggregate saving rate, as suggested by Kaldor (1956), though the evidence on this is mixed, e.g. Schmidt-Hebbel and Serven (2000) and Smith (2001).

model, variations in the income tax rate result in a positive relationship between inequality and growth: higher tax rates correspond to greater equality and slower growth.

Despite the simple intuition, the argument that redistribution blunts growth is controversial. With frictionless capital markets, taxes on capital income will decrease growth by distorting investment decisions (Alesina and Rodrik 1994, Persson and Tabellini, 1994). However, with capital market imperfections, redistribution or the public provision of education may allow the poor to overcome constraints, increasing the growth rate.⁷ Moreover, the balance of the empirical evidence suggests that transfers increase growth; see Benabou (1996) for an overview. Perotti (1996) for example reports that growth rates are increasing for a variety of variables measuring tax rates and explicitly redistributive expenditures, a finding that is “difficult to rationalize with most of the existing theories.” (page 171).

Though this gap between theory and empirics is troubling, it may be accounted for by a corresponding gap between redistribution and its empirical proxies. Alesina and Rodrik (1994, p. 479) suggest that, properly measured, redistribution includes elements not captured by tax rates or welfare spending, such as labor law, minimum wages, trade policy and the structure of government spending. Indeed, this list might be expanded to include inflationary spending, the maintenance of multiple exchange rates, corruption, favoritism in government contracts, and some portion of the wage bills of state-owned enterprises. As Alesina and Rodrik (1994, p. 479) note, “It would be an almost impossible task to construct a meaningful cross-country index for the totality of such

⁷ For a sampling of this literature, much of which endogenizes tax rates, see Perotti (1993), Aghion and Bolton (1997), and Benabou (2000), and Bourguignon and Verdier (2000). Saint Paul and Verdier (1996) critiques the political economy literature on inequality, redistribution and growth. Benabou (1996) provides a comprehensive overview of the issues involved and empirical findings.

measures.” With this consideration in mind, we assume the intensity of redistribution to have the intuitive negative relationships with growth and inequality.

The Choice of X - Restrictive Institutions

The choice of X is motivated primarily by Sokoloff and Engermann’s (2000) study of relative development in North and South America. Sokoloff and Engermann argue that factor endowments and the resulting level of economic and political inequality at the time of colonization led to divergent paths of institutional and economic development. In particular, high initial inequality “contributed to the evolution of institutions that protected the privileges of the elites and restricted opportunities for the broad mass of the population to participate fully in the commercial economy” (p. 221). Sokoloff and Engermann suggest that the effect of these restrictive institutions was to increase inequality while retarding development: “Members of the elites were better able to maintain their elite status over time, but at the cost of society not realizing the full economic potential of disadvantaged groups” (p. 228-230).

As required by Assumption 3, most of the variance in restrictive institutions is likely to be across rather than within countries, at least over the lengths of time typically investigated in growth empirical exercises. Indeed, institutional persistence is a central theme in the work on institutions and growth. North (1990) attributes institutional stability to increasing returns, broadly construed, which generates multiple stable institutional equilibria. Acemoglu, Johnson and Robinson (2001) provide empirical support for a high degree of institutional persistence and suggest a number of mechanisms that could lead to institutional persistence, including sunk costs,

complementarities with existing investments, and continuity of the size or identity of local elites. Complementarities between formal institutions and highly persistent informal institutions may also contribute to institutional stability.

Assumption 1 requires that a change in X move growth and inequality in opposite directions. The idea that institutional quality affects economic growth is so well established as not to require further comment, e.g. Knack and Keefer (1995), Mauro (1995), Rodrik (2000), Acemoglu, Johnson and Robinson (2001) and Easterly (2001), but the idea of a link between restrictive institutions and inequality is new.⁸

Engermann and Sokoloff (1997) find that restrictive institutions manifest themselves through an influence on land tenure and settlement, the provision of public education, the regulation of financial organizations, and restrictions on political participation. This list fits well with empirical evidence presented by Li et al. (1998), who find that a large proportion of the variation in income inequality is accounted for by variations in land inequality, financial development, educational attainment and civil liberties. Engermann and Sokoloff's list also accords nicely with a number of themes in the theoretical literature. Unequal access to credit plays a critical role in the literature on inequality and capital market imperfections. This literature also stresses the importance of an equitable distribution of land, an important source of collateral, and publicly funded education as means to overcome credit constraints. Finally, an important line of the research on political economy and inequality, e.g. Benabou (2000), Bourguignon and

⁸ The restrictiveness of institutions is likely to capture institutional variation along a somewhat different dimension than that implied by "institutional quality," which is often treated as synonymous with the protection of property rights. For example, the abolition of slavery in the US both reduced barriers to non-elite economic participation and violated previously protected property rights. In practice, however, elements of high quality institutions such as an independent judiciary and the rule of law require an egalitarianism that is likely to be incompatible with highly restrictive institutions, suggesting that institutional quality and restrictiveness will be negatively correlated.

Verdier (2000) and Acemoglu and Robinson (2000), gives a central role to unequal or restricted political participation.

Picking a Single Element of X: Barriers to Formality

The discussion above suggest that, as a group, restrictive institutions are a plausible candidate for the set of variables X: they are relatively stable within countries over time, positive related to inequality, and negatively related to growth. As enumerated above, however, restrictive institutions are too diverse in their effects to be addressed in a single model. For this reason I focus on a particular form of restriction which has not received attention in the recent growth-inequality literature: regulatory barriers to formal sector participation.

The pioneering work of Hernando de Soto (1990) provides a contemporary account of the impact of restrictive institutions on informal sector participation. De Soto documents the various regulatory and bureaucratic barriers encountered in an attempt to register a small (fictitious) business in Peru. His conclusion that regulation and red tape pose a significant barrier to formal sector participation is compelling: the cost of complying with existing regulations equaled 28 times the monthly minimum wage.

A number of cross-country studies provide evidence in support of de Soto's hypothesis. Djankov, La Porta, Lopez-de-Silanes and Shliefer (2002) find that regulatory barriers to entry, as measured by the number of procedures and time and cost of compliance, is positively related to informal sector size and employment. They also find that the intensity of regulation is negatively correlated with measures of good governance typically used as measures of institutional quality, for example constraints on executive

power. Further evidence linking regulation to informality is reported by Johnson, Kaufman and Zoido-Lobaton (1998), Johnson, Kaufman and Shliefer (1997) and Botero et al. (2003).

The intuitive link between informality and inequality, suggested by terms such as “underemployment” and “marginality,” has not been extensively researched. However, two recent papers by Rosser, Rosser and Ahmed (2000, 2003), report a positive relationship between levels and changes in income inequality and informal sector share in transition economies. Ahmed, Rosser and Rosser (2004) extend this analysis, finding that the informal sector share is a significant determinant of income inequality in a sample of 52 countries.

With its focus on the relationships between institutions, informality, inequality and growth, this paper is related to several lines of research. A number of papers have investigated the relationships between institutions, inequality, and growth, but their emphasis has been on how inequality influences institutions, e.g. Easterly (2001), Glaeser, Scheinkman and Shliefer (2003), Keefer and Knack (2002). Here, causation runs in the opposite direction, from institutions to inequality. Furthermore, none of these papers considers the link between institutions and informality.

The model is also related to the growing literature on informality.⁹ A central issue in this literature is the role of taxation in informality. Unlike the model presented here, however, in most of this literature tax revenues fund productive public goods rather than redistribution, e.g. Johnson et al. (1997) and Dessy and Palange (2003), and links to inequality and growth are not explored. Closer to our model is Loayza (1996), which investigates the relationships between taxation, regulation and inequality in an

endogenous growth model. A key difference is that in Loayza's model taxation funds public goods rather than redistribution. As a result, taxation and regulation have similar effects on inequality, with the result that this model is incapable of explaining the apparently contradictory evidence noted in the first two stylized facts, that growth and inequality vary inversely across countries and directly within them. The development of a model that accounts for both relationships is the primary contribution of this paper.

Section IV: Formal Model

In arguing for a link between informality and inequality, this paper follows in the development economics tradition established by Kuznets (1965) and Lewis (1954) of treating inequality as a manifestation of economic dualism. I depart from this literature, however, in a number of ways. Most importantly, I treat growth as endogenous, rather than tracking the changes in income inequality that would result from modern sector expansion. More specifically, I formalize the proposition that the formal sector is the "engine of growth." The growth rate of the economy becomes a function of modern sector participation and thus of the extent of dualism. Second, dualism is expressed in the formal-informal distinction, which operates along legal and technological dimensions. In particular, informality results from policy-induced distortions, specifically regulations restricting formal sector access (De Soto, 1990).

⁹ See Schneider and Enste (2000) for a recent review.

Production and Income

Agents are distributed uniformly on the unit continuum and indexed by $i \in [0, 1]$. Agent i is endowed with h_i units of human capital and i units of “ability.” The salient characteristics of ability are that it is inherited and cannot be accumulated. (The model changes very little if we call this resource “land.”) The distribution of ability defines a natural level of income inequality that would prevail in the absence of distortions.

Agent i may produce in the formal (F) or informal (I) sector with outputs given by

$$(1) \quad z_i = \begin{cases} A_{Fi} h_i^\alpha & i \in F \\ A_{Ii} h_i^\alpha & i \in I \end{cases}$$

where subscripts I and F indicate an agent’s sector, the A ’s are productivity parameters, $\alpha \in (0, 1)$, and I and F are the sets of informal and formal sector participants.

The productivity parameters reflect the impact of formal sector human capital spillovers. Identifying spillovers with the formal sector acknowledges that, in practice, the formal sector employs more intensively those types of capital generally associated with spillovers: human and knowledge capital. More able agents and formal sector participants are better able to capture these spillovers and, thus, enjoy productivity premia.¹⁰ The productivity parameters take the form:

$$(2) \quad \begin{aligned} A_{Fi} &= A_i \equiv [H_F i]^{1-\alpha} \\ A_{Ii} &= \gamma A_i, \quad \gamma < 1 \end{aligned}$$

where H_F is total formal sector human capital.¹¹ The spillover effect in (2) formalizes the idea that the formal sector is the “engine of growth.”

Formal sector income is subject to proportional taxation at rate τ . Tax revenues are distributed uniformly, with each agent receiving a transfer x . Agent i 's income is given by

$$(3) \quad y_i = \begin{cases} \gamma A_i h_i^\alpha + x & i \in I \\ (1 - \tau) A_i h_i^\alpha + x & i \in F \end{cases} .$$

If the tax rate is sufficiently high to completely offset the formal sector productivity premium, then all agents opt for informality. With no formal sector, the model produces a degenerate outcome in which the productivity parameter A_i is uniformly zero for all agents. This level of taxation would be hard to support as a political equilibrium. To avoid this outcome, we assume that the tax rate is upwardly bounded $\tau < 1 - \gamma \equiv \tau_{max}$, so that the formal sector enjoys a net productivity premium: $(1 - \tau) A_{Fi} > A_{Ii}$.

The size of the transfer is found by integrating tax revenues across formal sector participants,

¹⁰ A formal sector productivity premium may reflect scale economies (Dessy and Pallage, 2003) or superior access to productive public goods, such as contract enforcement services (Loayza 1996, Johnson et al. 1997).

¹¹ If as proposed by Lucas (1988) spillovers reflect average rather than total human capital, then the addition of a less able worker to the formal sector will reduce the size of the spillover, lowering growth. The drawback of formulation used here is that it generates scale effects. The scale effect may be neutralized by assuming the relevant measure of scale is the size of a representative urban economy, rather than the national economy.

$$(4) \quad x = \int_{i \in F} \tau A_i h_i^\alpha di.$$

Regulatory Barriers and Sectoral Participation

We model the regulatory barriers very simply. It is assumed that an agent is only allowed to participate in the formal sector if her earnings (income less transfers) exceed some threshold level. Because we want sectoral participation to be constant in the steady state, we assume this threshold is defined as a fixed fraction $\beta < 1$ of the (pretax) earnings of the ablest individual. Higher levels of β correspond to greater barriers to formality.

The requirement for formal sector participation is thus

$$(5) \quad w_{Fi} > \beta w_1,$$

where the earnings are given by $w_{Fi} = y_{Fi} - x$.¹² Since (5) implies the most able agent is always a formal sector participant, in the future we will omit the subscript “F” in referring to her, e.g. $y_1 \equiv y_{F1}$.

This manner of modeling regulation corresponds to several common regulatory structures. First, formal sector participation may be limited by minimum wage legislation. Agents whose market determined wage would fall below this level are barred from formal sector employment. With a Cobb-Douglas production technology, there is a

¹² Note that sectoral participation is not sensitive to the tax rate. Dessy and Pallage (2003) show the tax rate has an ambiguous effect on sectoral participation. In addition, Johnson et al. (1997) find that informality among transition economies is related to perceptions of “tax fairness” but not statutory tax rates.

direct relationship between a minimum wage and the minimum income restriction used here. Second, many less developed countries employ minimum capital requirements for registering a new firm (see World Bank, 2004, 118-20). As shown below, in the steady state formal sector capital and earnings are linear in agent ability, making capital and earnings restrictions equivalent. Finally, formal sector employment may be rationed by educational attainment, which may be viewed as a form of minimum capital requirement.

Dynamic Structure

The model employs a non-overlapping generations structure. Relative to other dynamic structures, this sharpens the analysis in the presence of multiple equilibria. Each agent lives for one period and has one child. Children inherit their parent's ability, implying that ability uniquely identifies families as well as particular agents. The utility of generation t of agent i is

$$(6) U_{i,t} = \ln(c_{i,t}) + \varepsilon \ln(c_{i,t+1})$$

where $c_{i,t}$ is the agent's own consumption, $c_{i,t+1}$ is the child's, and $\varepsilon > 0$ is a measure of parental affection. The evolution of human capital obeys $h_{i,t+1} = y_{i,t} - c_{i,t}$ and utility maximization implies

$$(7) 1 + g_{i,t} = \frac{c_{i,t}}{c_{i,t-1}} = \varepsilon r_{i,t}$$

where $r_{i,t}$ is the return to human capital.

Human Capital and Income in the Steady State

In the steady state a family's return to human capital is constant across generations, and human capital and income grow at a common rate. Differentiating sectoral incomes from (3) with respect to human capital and substituting for sectoral productivity parameters given by (2), agent i 's return to human capital is given by

$$(8) \quad r_i = \begin{cases} \alpha\gamma[H_F i]^{1-\alpha} h_i^{\alpha-1} & i \in I \\ \alpha(1-\tau)[H_F i]^{1-\alpha} h_i^{\alpha-1} & i \in F \end{cases}$$

For agent i 's income to grow at a constant rate, her return to human capital must be constant. In either sector, this condition requires that the agent's human capital must grow at the same rate as the formal sector capital stock. It follows that for every agent to experience steady state growth, all agents' human capital must grow at the same rate as H_F . This implies that the return to capital is uniform across agents: for all $i, j \in [0, 1]$, $r_i^{ss} = r_j^{ss}$. Choosing $j = 1$, this condition allows us to express agent i 's steady state human capital as a function of that of the most able agent:

$$(9) \quad h_i^{ss} = \begin{cases} a(\tau) i h_1^{ss} & i \in I \\ i h_1^{ss} & i \in F \end{cases}$$

where $a(\tau) = \left[\frac{\gamma}{1-\tau} \right]^{\frac{1}{1-\alpha}} < 1$.

As seen in (9), in both sectors the steady state level of human capital is linear in ability, with the human capital of the most able agent ($i = 1$) serving as a reference point. Equation (9) also implies that informal sector production is less human capital intensive than formal sector production. For a given level of ability, informal sector participation lowers an agent's steady state human capital, $a(\tau) < 1$, a result that follows directly from the formal sector's net productivity premium. Note that a rise in the tax rate reduces this premium and consequently reduces the gap between formal and informal sector human capital, $a'(\tau) > 0$.

Each agent assumes that the stock of formal sector human capital is unaffected by her decisions, she treats the evolution of the sectoral productivity parameters as given in making her own accumulation decisions. Abstracting for the moment from sectoral participation decisions, diminishing marginal private returns to human capital drive an essentially neoclassical convergence process. It is the convergence of each individual's human capital to its steady state level, rather than the existence of an efficient capital market, that equalizes the return to human capital across individuals in the steady state. *Figure 3* illustrates sectoral returns to capital and steady state human capital for a representative agent i .

Substituting (9) into (3), we can derive steady state incomes of formal and informal sector participants. In each sector, steady state income levels are linear in ability:

$$(10) \quad y_i^{ss} = \begin{cases} a(\tau)w_1^{ss}i + x & i \in I \\ w_1^{ss}i + x & i \in F \end{cases}$$

Equation (10) employs, as a useful benchmark, the most able agent's steady state earned income, $w_1^{ss} = (1 - \tau)H_F^{1-\alpha}h_1^{ss}$. Using this benchmark facilitates the relative income comparisons that underlie measures of inequality. In particular, (10) indicates that relative incomes are determined by 1) ability, 2) transfer size, 3) sectoral participation, and 4) the sectoral productivity gap, which is reflected in $a(\tau)$.

Sectoral Participation in the Steady State

We have yet to determine in which sector each agent participates in the steady state. As noted above, sectoral participation influences relative incomes and, consequently, inequality. In addition, because the return to human capital depends on the size of the formal sector human capital spillover, sectoral participation outcomes affect the equilibrium growth rate as well.

The existence of a formal sector productivity premium ensures that formality is preferred by all agents and is in fact chosen provided current income is sufficiently high, as described by (5). What complicates the determination of steady state sectoral participation is that current income may depend on the participation outcomes of earlier generations, and thus on the initial distribution of human capital.

For some families, steady state sectoral participation does not depend initial conditions. Regardless of initial conditions, a family with sufficiently low ability, $i < \beta$, will be unable to sustain formality because its steady state formal sector earnings will fall

below the threshold defined by (5). Similarly, a family with sufficiently high level of ability, $i > \beta/a(\tau)$, will eventually accumulate sufficient capital to join the formal sector: in the steady state even its informal sector earnings exceed the threshold. For families with ability levels that fall between these two critical values, steady state sectoral participation depends on the distribution of initial human capital endowments.

Because both growth and inequality depend on sectoral participation, the model indicates a role for history, or initial conditions, in determining the current pattern of growth and inequality across countries. This “path dependence” is widely recognized in the literature, and our focus here is on the role of policy, rather than history, in accounting for the empirical record. In keeping with this limited objective, we restrict our attention in what follows to initial allocations of human capital that highlight the role of policy.

We assume the initial allocation of human capital obeys

$$(11) \quad h_{i,0} = \psi(i)h_{1,0},$$

where $\psi(i) \in [i,1]$, for $i \in [0,1]$. This restriction implies that for each family, initial human capital is greater (relative to h_1) than steady state human capital, so that families approach their steady state level of human capital from above. This, in turn, ensures that families of intermediate ability are steady state formal sector participants. It follows that steady state sectoral participation is given by

$$(12) \quad \begin{aligned} I^{ss} &= \{i: 0 \leq i < \beta\} \\ F^{ss} &= \{i: \beta \leq i \leq 1\} \end{aligned}$$

Given sectoral participation patterns, we may now calculate the steady state levels of formal sector human capital and transfers:

$$(13) \quad H_F^{ss} = \int_{\beta}^1 i h_1^{ss} di = \frac{1-\beta^2}{2} h_1^{ss}$$

$$(14) \quad x^{ss} = \int_{\beta}^1 \tau \left[\frac{1-\beta^2}{2} \right]^{1-\alpha} h_1^{ss} i di = \int_{\beta}^1 \frac{\tau}{1-\tau} w_1^{ss} i di = \frac{\tau}{1-\tau} \left[\frac{1-\beta^2}{2} \right] w_1^{ss}.$$

Growth and Policy

Combining (13) with (7) and (9), the steady state growth rate may be expressed as a function of our two policy variables:

$$(15) \quad g(\beta, \tau) = \varepsilon \alpha (1-\tau) \left[\frac{1-\beta^2}{2} \right]^{1-\alpha} - 1$$

Both higher tax rates and higher barriers to formality slow growth

$$(16) \quad \begin{aligned} g_{\tau} &= -\varepsilon \alpha \left[\frac{1-\beta^2}{2} \right]^{1-\alpha} < 0 \\ g_{\beta} &= -\varepsilon \alpha (1-\alpha) (1-\tau) \beta \left[\frac{1-\beta^2}{2} \right]^{-\alpha} < 0 \end{aligned}$$

An increase in taxes slows growth by reducing the after-tax return to capital. Greater barriers to formality reduce the number of formal sector participants, lowering the formal sector knowledge spillovers and reducing growth.

The lines in *Figure 4* show iso-growth loci in the β - τ policy space, which are defined by combinations of β and τ that generate the same rate of steady state growth. The origin corresponds to the maximum growth rate, which occurs in the absence of redistribution and barriers to formality, $g_{\max} = g(0,0) = \varepsilon\alpha / 2^{1-\alpha} - 1$. Growth is decreasing as one moves further from the origin. The slope of the iso-growth lines is given by

$$(17) \quad \left. \frac{d\beta}{d\tau} \right|_{dg=0} = -\frac{1-\beta^2}{2(1-\alpha)(1-\tau)\beta} < 0$$

Examination shows that the iso-growth lines become flatter in β and steeper in τ , which accounts for their portrayal as “bowed-out.”

Income Inequality and Policy

Income inequality is measured by the Gini coefficient. The Gini coefficient varies from zero to one, with a higher value indicating greater inequality. The Gini may be derived as the sum of the absolute value of all pairwise income differentials divided by average income. The Gini coefficient for our economy may be expressed as a function of the policy variables and model parameters:

$$(18) \quad G(\beta, \tau) = \frac{1 + 3[1 - a(\tau)]\beta^2 - 4[1 - a(\tau)]\beta^3}{6 \left[1 - [1 - a(\tau)]\beta^2 + \frac{\tau}{1 - \tau}(1 - \beta^2) \right]}.$$

Conceptually, the Gini coefficient may be thought of as the expected income difference between two individuals relative to average income (Pyatt, 1976). (For the derivation of the Gini coefficient and the following comparative static results, please see the appendix.)

Differentiating the Gini coefficient with respect to the tax rate, we find, very intuitively, that taxation reduces inequality: $G_\tau < 0$. A rise in the tax rate reduces the inequality of earnings in both the formal and informal sectors, the latter effect operating through the impact of taxes on the level of steady state informal sector human capital. Since all taxes are redistributed, taxation has no effect on average income.

Differentiating the inequality index with respect to β , we find that $G_\beta > 0$ for $\beta \leq \frac{1}{2}$. This result reflects the net impact of a number of potentially offsetting effects. For example, an increase in the informal sector. That is, a country with higher barriers to formal sector participation will have greater income inequality. An increase in the informal sector share has three separate impacts on inequality. First, it lowers average income (relative to our reference variable, h_1), increasing inequality. Second, inequality falls because incomes are more uniform in the informal than formal sector. Third, inequality is increasing in the gap between average income in each sector and in the probability that two randomly chosen individuals come from different sectors. This probability is maximized when sector employment shares are equal, or $\beta = \frac{1}{2}$, and falls thereafter as the informal sector expands.

Taken together, these comparative static imply that for $\beta \leq 1/2$, iso-inequality loci are upwardly sloping in the β - τ policy space: $\left. \frac{d\beta}{d\tau} \right|_{dG=0} = -\frac{G_\tau}{G_\beta} > 0$. These loci are

shown in *Figure 4*. Inequality rises as ones moves up the graph and to the left: $G_0 < G_1 < G_2$. In addition, the line labeled G_1 passes through the origin, implying it corresponds to the level of inequality that holds in the absence of distortions: $G_1 = G(0,0) = 1/6$.

Given the complexity of the Gini coefficient, we have little confidence in assertions regarding the shape of the iso-equality lines, other than their positive slope. In deference to our ignorance, we depict them as straight lines.

Interpretation of the Evidence on Growth and Inequality

Figure 4 summarizes the primary results of the model. It shows the co-determination of growth and inequality as functions of two underlying policy parameters, β which measures barriers to formality and τ which measures the intensity of redistribution.

Moving in the vertical direction we find that growth and inequality vary directly: lower points on the graph are associated with higher growth and lower inequality. Thus, Sokoloff and Engermann's (2000) argument that restrictive institutions have caused Latin America to have lower growth and higher inequality than the US corresponds to Latin American countries being located (on average) higher on the graph than the US, as illustrated by the points labeled "LA" and "US."

Differences in the intensity of redistribution correspond to horizontal shifts in the graph's policy space and result in direct variation between inequality and growth.

Consider the common observation, often cited as support for a positive relationship between growth and inequality, that relative to the United States, Western European countries tend to have lower inequality and lower growth rates. Noting that, while the US and Western European countries both enjoy high quality institutions, European countries tend to have more generous social welfare systems, we would locate Europe to the right of the US in the graphs policy space, for example at the point labeled “EU.”

More generally, recall that barriers to formality reflect deep institutional structures, which are assumed to vary dramatically across countries but relatively little within countries over time. As a result, cross-country regressions of growth on inequality, like that shown in *Figure 1*, will tend to be driven by the cross-country variation in restrictive institutions, and report that higher inequality is associated with lower growth. Alternately, suppose we use panel methods to consider the relationship between growth and inequality within countries over time. In this case, institutions are held constant, being absorbed into country specific intercepts. As a result, panel regressions are driven by horizontal movements in *Figure 4*'s policy space, and as a result tend to report that higher inequality is associated with higher growth.

A potential exception to the interpretation of the evidence given above is Barro's (2000) finding that growth and inequality are positively related in a sample of rich countries. This, however, is an exception that supports the more general rule. In particular, if developed countries are relatively similar in terms of their legal and institutional structures, then most of the variation in the β - τ policy space would be in the horizontal direction. As a result, a cross-country regression restricted to developed countries would tend to find that growth and inequality are positively related.

Section V: Conclusion

Much theoretical work begins with an account of the stylized facts to be explained. Due to conflicting evidence, this has been an awkward exercise for those attempting to explain the relationship between income inequality and growth. For example, some recent papers cite only evidence supporting a positive or a negative relationship. This paper attempts to suggest a way out, interpreting the evidence in a consistent fashion based on whether the variation observed is between or across countries.

It does so by proposing a theoretical framework in which both inequality and growth are endogenous variables, functions of more fundamental policy parameters. In doing so, we depart from the current approach of asking “Is inequality harmful for growth,” and ask instead “Is the set of policies and institutions that give rise to inequality in a given country good or bad for growth?”

Much of the energy around the issue of income inequality concerns the existence of an efficiency-equity trade-off: is it possible to do well while doing good? The model suggests that whether a trade-off exists depends on which dimension of policy one considers. Along the dimension that corresponds to variations in redistributive policy, such a trade off appears to hold. While decreasing inequality, increases in the intensity of redistributive policies will tend to blunt incentives for accumulation and slow growth. In considering the reform of policies that restrict access to the formal sector, however, no such trade-off exists. Lowering barriers to formal sector participation reduces inequality while raising income levels and growth rates.

This paper suggests that it may be fruitful to focus future research on the joint determination of inequality and growth, paying particular attention to the potential role of restrictive institutions.

Appendix

This appendix derives the equation for the Gini coefficient. To simplify the computation, we exploit similarities in steady state incomes to write:

$$y_F^{ss}(i) = (1 - \tau) \left(\frac{1 - \beta^2}{2} \right)^{1-\alpha} hi + x = wi + x$$

$$y_I^{ss}(i) = (1 - \tau)a(\tau) \left(\frac{1 - \beta^2}{2} \right)^{1-\alpha} hi + x = awi + x$$

$$x = \tau \left(\frac{1 - \beta^2}{2} \right)^{2-\alpha} h = \left(\frac{\tau}{1 - \tau} \right) (1 - \beta^2) \frac{w}{2}$$

where $w = (1 - \tau) \left(\frac{1 - \beta^2}{2} \right)^{1-\alpha} h$. Define $g(i)$ as the cumulative income of the poorest i

people, and y as average income. That is,

$$g(i) = \int_0^i y(j) dj = \begin{cases} \frac{awi^2}{2} + xi & i < \beta \\ \frac{[i^2 - (1-a)\beta^2]w}{2} + xi & i > \beta \end{cases}$$

$$y = \int_0^i y(i) di = \frac{[1 - (1-a)\beta^2]w}{2} + x$$

Recalling the Lorenz curve, the Gini coefficient may be expressed as the integral over population of population share minus income share. Then the Gini coefficient is given by

$$G = \int_0^1 i - \frac{g(i)}{y} di = \frac{1}{2} - \frac{1}{y} \int_0^1 g(i) di = \frac{y - 2 \int_0^1 g(i) di}{2y}.$$

Integrating over $g(i)$, we have

$$\begin{aligned} \int_0^1 g(i) di &= \int_0^\beta \left[\frac{awi^2}{2} + xi \right] di + \int_\beta^1 \left[\frac{(i^2 - (1-a)\beta^2)w}{2} + xi \right] di \\ &= \frac{aw\beta^3}{6} + \frac{x\beta^2}{2} + \frac{w}{6}(1-\beta^3) - \frac{(1-a)w}{2}(\beta^2 - \beta^3) + \frac{x}{2}(1-\beta^2) \\ &= \frac{w}{6} \left[1 - 3(1-a)\beta^2 + 2(1-a)\beta^3 \right] + \frac{x}{2} \end{aligned}$$

Substituting this expression, and that for average income from (A.2), into (A.3), the Gini coefficient is given by

$$G(\beta, \tau) = \frac{k(\beta, \tau)}{m(\beta, \tau)} = \frac{1 + 3[1 - a(\tau)]\beta^2 - 4[1 - a(\tau)]\beta^3}{6[1 - [1 - a(\tau)]\beta^2 + (\tau/1 - \tau)(1 - \beta^2)]},$$

which is the expression reported in the text.

The complexity of this expression makes it difficult to sign comparative statics on inequality precisely. In addition, it is well-known from work on the Kuznets hypothesis that in dual economies inequality rises and then falls as one sector's share goes from zero to one, e.g. Robinson (1976). Finding the sector share that constitutes maximum inequality involves solving a fourth order polynomial. In lieu of this, I establish a range of parameter values that constitute sufficient conditions to sign the comparative static.

The desired effects are that inequality rises in the barriers to formality and falls in the tax rate:

$$G_{\beta} = \frac{k_{\beta} - m_{\beta}G}{m(\beta, \tau)} > 0$$

$$G_{\tau} = \frac{k_{\tau} - m_{\tau}G}{m(\beta, \tau)} < 0$$

Since $G(\cdot)$ and $m(\cdot)$ are positive, a sufficient condition for the first expression to hold is that $k_{\beta} \geq 0$ and $m_{\beta} \leq 0$. Differentiating $k(\cdot)$ and $m(\cdot)$ with respect to β , we have

$$(A.7) \quad \begin{aligned} k_{\beta} &= 6[1 - a(\tau)]\beta(1 - 2\beta) > 0 \quad \text{for } \beta < 1/2 \\ m_{\beta} &= -12\beta[1 - a(\tau) + (\tau/1 - \tau)] < 0 \end{aligned}$$

It follows that $G_{\beta} > 0$ for $\beta \leq 1/2$, as reported in the text.

Differentiating $k(\cdot)$ and $m(\cdot)$ with respect to τ , we have

$$(A.8) \quad \begin{aligned} k_{\tau} &= -n^2(3 - 4\beta)a'(\tau) < 0 \quad \text{for } \beta < 3/4 \\ m_{\tau} &= \frac{1 - \beta^2}{(1 - \tau)^2} + a'(\tau)\beta > 0 \end{aligned}$$

Noting that $a'(\tau) > 0$, inequality is decreasing in the tax rate for $\beta < 3/4$.

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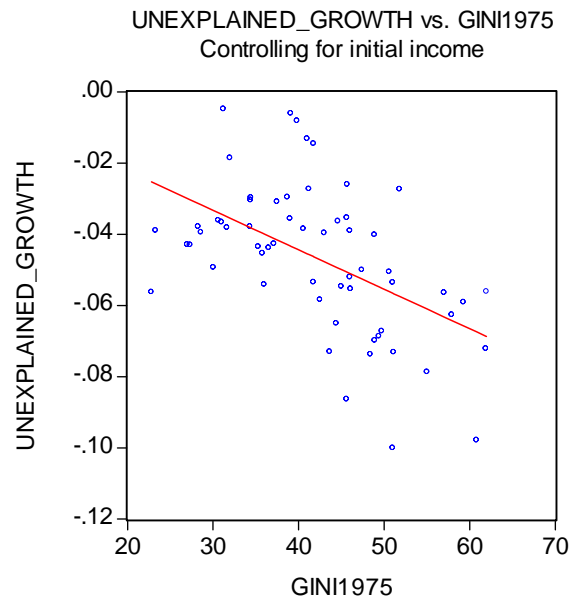
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Figure 1: Inequality and growth vary inversely across countries

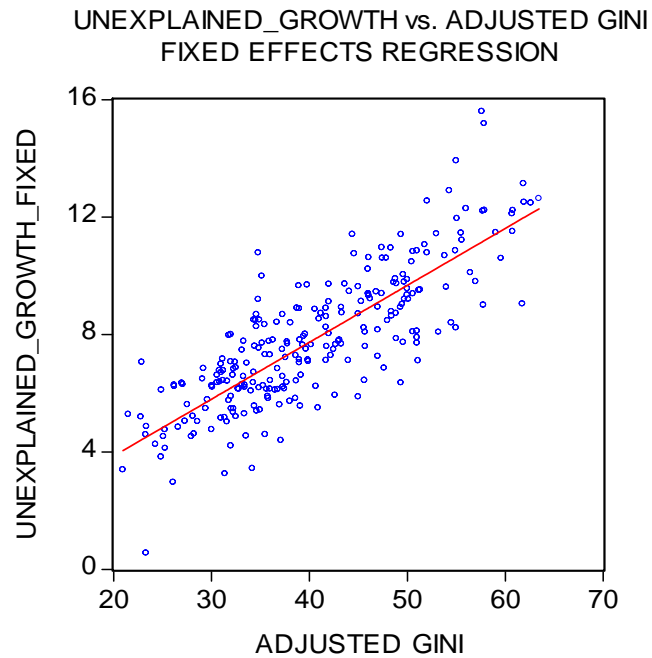


Notes to Figure 1:

Average growth rates computed from Summers and Heston, 6.1. Gini coefficients are from Deiniger and Squire (1996) high quality data set with adjustments for differences in methodology. Data cover 60 countries.

The estimated equation is $grow7595 = 0.76 - 1.33E-06 * income75 - 0.0011 * Gini1975$.
The figure shows the best fit OLS regression of growth 1975-1995 on initial inequality controlling for initial income.

Figure 2: Growth and inequality vary directly within countries over time



Notes to Figure 2:

Data sources as listed in notes to Figure 1. Graph shows results from 5-year panel regression controlling for initial income and country and period fixed effects.

The estimated equation is: $GROW = -2.69 - 3.24E-4 * Income + 0.183 * GINI$.

Figure 3: Steady State Formal and Informal Sector Human Capital

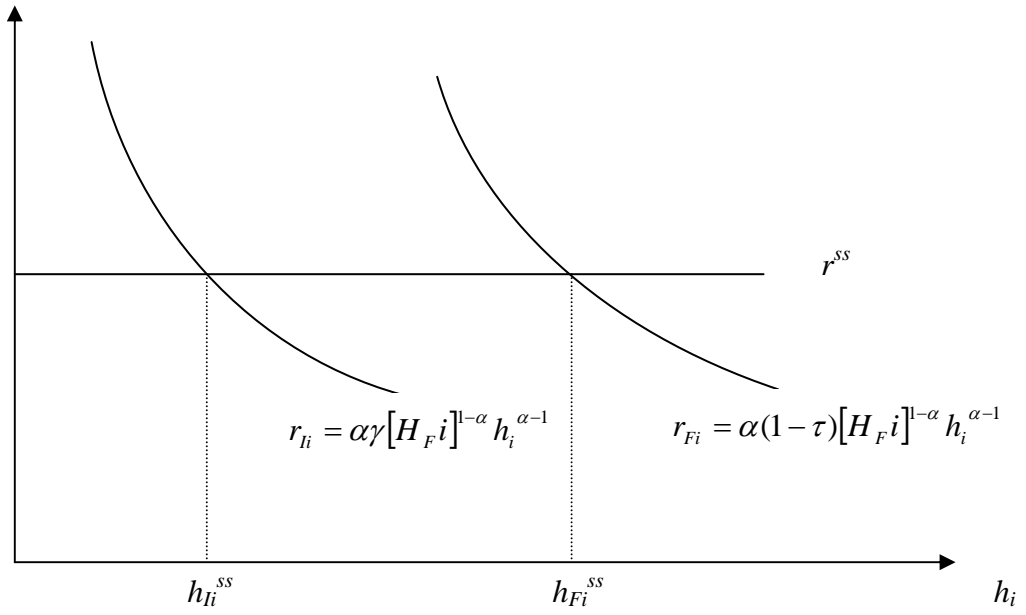
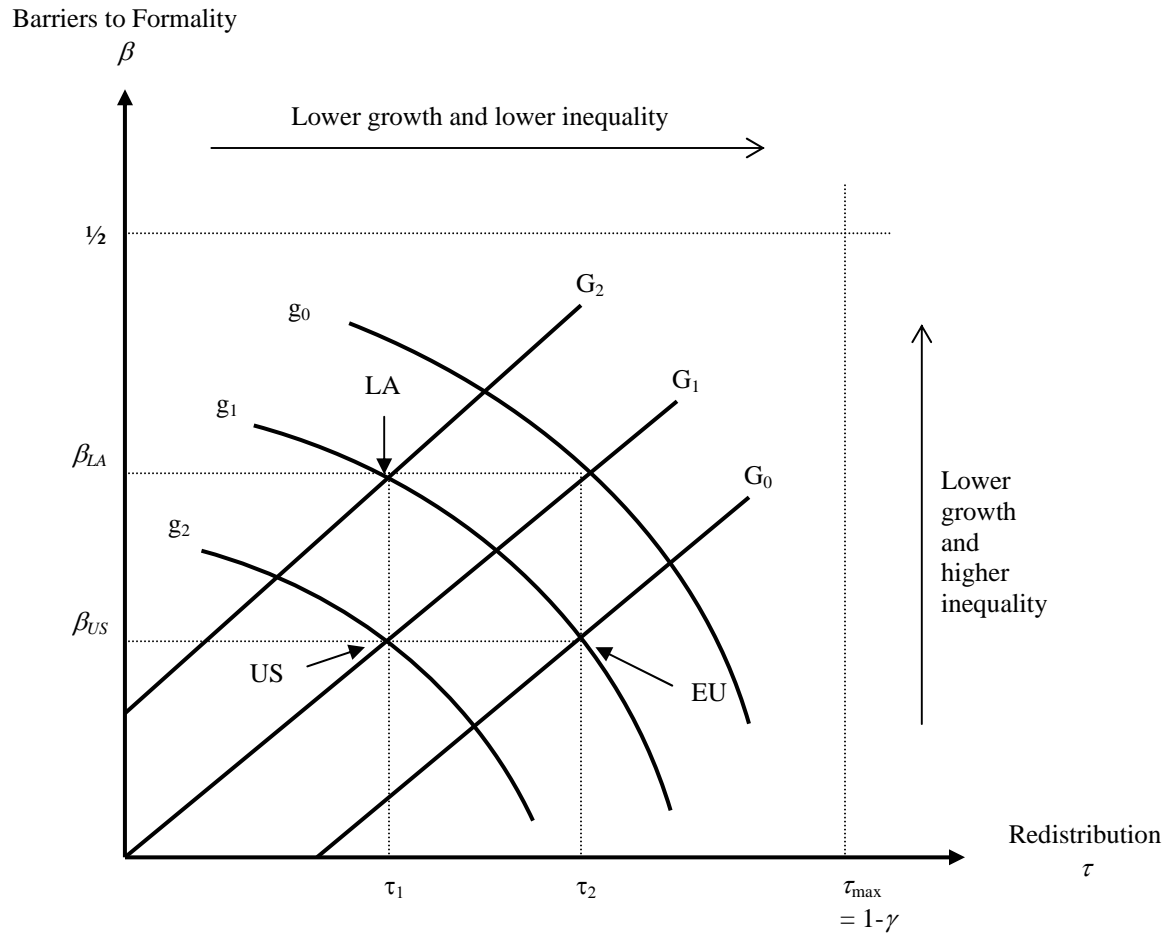


Figure 4: Iso-Inequality and Iso-Growth Lines



Iso-Inequality Lines: heavy upward sloping lines showing combinations of β and τ that generate the same Gini coefficient. Inequality is increasing as one moves to the left: $G_0 < G_1 < G_2$. $G_1 = 1/6$ corresponds to the level of inequality that occurs in the absence of distortions, $\beta = \tau = 0$.

Iso-Growth Lines: heavy downward sloping curves showing combinations of β and τ that generate the same growth rate. Growth is increasing as one moves toward the origin: $g_0 < g_1 < g_2$. The origin corresponds to the maximum growth rate, g_{max} .