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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 proposes that rather than being an "obvious fact," the disagreement apparent in the empirical work on inequality and growth is illusory. It does so by developing a simple model that provides a consistent account of the stylized facts regarding growth and inequality.

The primary theoretical barrier to understanding the nature of this relationship has been a strict division of theoretical labor in which theorists have tended to treat either growth or inequality as given. 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, in the tradition of Kaldor (1956), investigates the possible channels through which the initial distribution of income might influence subsequent accumulation and growth.[2] In some of these models inequality may evolve as the initial distribution converges to a stable or ergodic distribution, but it is treated as independent of policy variables. As Lundberg and Squire (2003, p. 326) note in a recent

[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

empirical paper, “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 proposes a new theoretical framework in which both inequality and growth are treated as endogenous functions of underlying policy variables. This approach adds a degree of conceptual freedom to the frameworks described above, and as a result makes it a relatively straightforward exercise 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 that does so. I also develop one such model in detail as an illustration.

At the broadest level, the paper suggests that there may not be a fixed relationship between inequality and growth. If this is true, then there is not a meaningful answer to the question that has occupied so much of the recent work in this area, Persson and Tabillini’s (1994) query, “Is inequality harmful for growth?” It may be more useful to ask instead, “Are the particular conditions that give rise to inequality in a given country good or bad for growth?”

This difference of approach may help to put at ease those economists who find themselves uncomfortable with the implications of either a positive or a negative relationship between inequality and growth. If one accepts the evidence of a negative relationship, for example, does this mean that Germany could grow faster if only it expanded its welfare system? Alternately, should we interpret evidence of a positive relationship to mean that growth in less developed countries benefits from the economic

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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.

marginalization of large segments of the population? As these examples are intended to suggest, the direct impact of inequality on growth may matter less than the impact of the variables that determine a country's level of inequality.

To the best of my knowledge, Lundberg and Squire (2003) is the only other paper to consider both growth and inequality as endogenous. Unlike this paper, they critique the existing empirical literature, rather than explaining how it arrived at apparently contradictory results, and do not attempt to develop a theoretical model.

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

Section II. The Conceptual Framework

Stylized Facts of Growth and Inequality

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

The first stylized fact is supported by cross-country growth regressions in which initial inequality is negatively and significantly related to subsequent growth.[3] That is, more equal economies grow faster. Despite the large number of studies that find support for this stylized fact, it should not be interpreted as a causal relationship. Several

[3] 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.

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 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.

***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).

The third stylized fact has a number of implications for how we view the first two. First, as Li et al. note, their finding suggests that inequality is primarily determined by factors that differ across countries rather than time. This supports the idea that time-invariant omitted variables may be driving the negative relationship between income inequality and economic growth found in cross-country growth regressions. Second, it reduces the importance we should place on the second fact. The positive relationship between inequality and growth within countries found using panel methods, while arguably based on better econometric techniques, is in fact only a small part of the overall story.

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.[4]

[4] 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 1: There is a set of exogenous variables, *X*, such that for x $\in$ X, $g_x / G_x < 0$, where g is a country's growth rate and G is its Gini coefficient. That is, a change in x moves growth and inequality in opposite directions.

Assumption 2: There is a set of exogenous variables, *Y*, such that for y $\in$ Y, $g_y / G_y > 0$. That is, a change in y moves growth and inequality in the same direction.

Assumption 3: X rather than Y is the "primary determinant" of inequality, in the sense that variations in X are responsible for most of the observed variation in inequality.

Assumption 4: X varies substantially across countries and is relatively constant within countries over time, while Y varies either primarily over time or relatively equally in both dimensions.

Assumptions 1 and 4 support the first stylized fact. If the variables constituting X are omitted, cross-country growth regressions will report an inverse relationship between growth and inequality. Assumptions 2 and 4 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 will vary 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.[5]

Section 3: Variable Selection – 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 a recent empirical study by Lundberg and Squire (2003) that, like this paper, adopts the assumption that both growth and inequality are endogenous. Their research finds that changes in education, inflation and land inequality are associated with desirable changes in both growth and inequality, and thus meet two of the requirements for *X* in Assumption 1, while changes in the Sachs-Warner index of openness and the Gastil index of civil liberties involve a growth-inequality trade-off, as suggested for *Y* in the second assumption (p. 338-9). Their paper, however, does not 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, with the degree of progressivity

[5] 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

increasing in the tax rate. Income taxes also reduce the return to capital, blunting the incentive for accumulation and reducing the growth rate. In a simple 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.[6] 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

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(2000) and Smith (2001).

[6] 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)

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 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 such 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 4, 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 empirics. 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

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critiques the political economy literature on inequality, redistribution and growth. Benabou (1996) provides a comprehensive overview of the issues involved and empirical findings.

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.

The idea that institutional quality affects economic growth is also well established, e.g. Knack and Keefer (1995), Mauro (1995), Rodrik (2000), Acemoglu, Johnson and Robinson (2001) and Easterly (2001). The restrictiveness of institutions, however, is likely to capture institutional variation along a somewhat different dimension than that implied by "institutional quality," which often treated as synonymous with the protection of property rights. To cite just one example, the abolition of slavery in the US both reduced institutional restrictiveness 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. The indices of institutional quality used in empirical work, e.g. Knack and Keefer (1995), are often broadly defined and appear to capture aspects of institutions closely linked to restrictiveness, such as corruption and bureaucratic quality. Thus, evidence that institutional quality matters for growth may be interpreted as tacit support that restrictive institutions do as well.

There are several arguments that restrictive institutions increase income inequality. 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 and governance of commercial and financial organizations, and restrictions on political participation. Empirically, Li et al. (1998) find that a large proportion of the variation in income inequality is accounted for by variables that may be viewed as reflecting the effects of restrictive economic and political institutions: 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 is at the heart of 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 Verdier (2000) and Acemoglu and Robinson (2000), gives a central role to unequal or restricted political participation.

This brief discussion suggests that restrictive institutions are a plausible candidate for the variable 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 incorporate in a single model. For this reason I focus on a particular form of restriction: 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 the World Bank (2004).

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 consider the link between institutions and informality.

The model is also related to the growing literature on informality.[7] A central issue in this literature is the role of taxation in informality. Johnson et al. (1997) and Dessy and Palange (2003) find that formal sector taxation has an ambiguous effect on sectoral participation when tax revenues fund productive public goods. Both models support multiple equilibria with high and low informal sector participation. Unlike the model developed here, these models are static and do not consider regulation, redistributive taxation or income inequality. Ahmed, et al. (2004) consider redistributional taxation and social capital in an informal model with two-way causal relationship between inequality and informality.

Closer to our model is Loayza (1996), which investigates the relationships between taxation, regulation and inequality in an endogenous growth model. As in the model developed here, Loayza finds that regulation increases inequality and lowers growth. A key difference is that, the formal sector is based on Barro (1990), so that taxation funds public goods rather than redistribution. As a result, his model is incapable of supporting both the positive and negative relationships between inequality and growth that are found in the empirical literature. In addition, we posit that it is something other than its ability to be taxed that makes the formal sector primary role the primary engine of growth.

Section III. Formal Model

In arguing for a link between informality and inequality, this paper follows in a development economics tradition established by Kuznets (1965) and Lewis (1954) of treating inequality as a manifestation of economic dualism. We depart from this literature, however, in a number of ways. First and most importantly, we treat growth as endogenous, rather than tracking the changes in income inequality that would result from modern sector expansion. More specifically, we formalize the proposition that the modern 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, most development models define dualism in terms of the type of good produced, e.g. agricultural vs. manufactured, and treat dualism as resulting from labor market rigidities, in the form of either an institutionally determined subsistence wage in the traditional sector (Lewis, 1954) or a downwardly immobile modern sector wage (Harris and Todaro, 1970). Here, dualism is captured in the formal-informal sector distinction, which operates along legal and technological dimensions. Furthermore, informal sector participation is treated as a business decision by entrepreneurs faced with regulatory barriers to formality, rather than a labor market outcome, "underemployment." This fits well with evidence that many informal sector participants are self-employed for work in family firms (XX). In particular, informality results from policy-induced distortions, specifically regulations restricting formal sector access (De Soto, 1990).

[7] See Schneider and Enste (2000) for a recent review.

Production

There is a continuum of agents indexed by $i \in [0, 1]$. Agent *i* is endowed with *i* units of a non-accumulable resource called "ability" and h_i units of human capital. The distribution of ability defines a "natural" level of income inequality that would prevail in the absence of distortions. Initial endowments of human capital conform to $h_i = ih_1$, where h_1 is the human capital of the most able agent. Restricting the initial distribution of human capital in this manner prevents the model from providing insights into the role of initial asset allocations on equilibrium growth and inequality. As discussed below, however, the model quickly becomes intractable if this assumption is relaxed.

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

$$(1)\quad z_{Fi}(h_i) = A_{Fi} h_i^{\alpha}$$

$$(2)\quad z_{Ii}(h_i) = A_{Ii} h_i^{\alpha},$$

where the A's are productivity parameters, $\alpha \in (0, 1)$. Initial levels of human capital are distributed according to $h_i = ih_1$, where h is the human capital of the most able agent.

Productivity is heterogeneous across agents and sectors, with more able agents and formal sector producers enjoying a productivity premium. A formal sector productivity premium may arise for a number of reasons. Dessy and Pallage (2003) suggest that formal sector firms may be more successful in exploiting scale economies. This might be the case, for example, if large scale extralegal production invites predation

by officials. Alternately, formal sector firms may enjoy superior access to productive public goods, such as contract enforcement services (Loayza 1996, Johnson et al. 1997).

We assume the productivity parameters reflect the influence of modern sector human capital spillovers. This assumption serves to make the modern sector "the engine of growth." In practice, the modern sector of an economy uses intensively those types of capital typically associated with spillovers: human capital and knowledge. Furthermore, the modern sector enjoys greater ease of contracting, which may lead to a higher division of labor and greater interdependence among agents, both of which tend to promote spillovers. Formal sector participation and greater ability play a role in allowing a given worker to capture knowledge spillovers, making the technology parameters agent and sector specific. The productivity parameters are assumed to take the form

$$(3)\quad \begin{aligned} A_{Ii} &= \gamma A_{Fi} \equiv \gamma A_i, \quad \gamma < 1 \\ A_i &= \left[H_F i\right]^{1-\alpha} \end{aligned}$$

where H_F is total modern sector human capital.[8]

Taxation and Income

Formal sector income is subject to proportional taxation at rate τ. Tax revenues are distributed uniformly, with each agent receiving a transfer x. The manner in which we treat taxation and transfers abstracts from a number of important issues regarding

[8] 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.

their relationship to growth and inequality. Income taxation may be progressive, in which case average and marginal tax rates will differ. Tax rates may differ across factor incomes (XXXX). Tax revenues may be used to fund productive government services, rather than transfers, as in Dessy and Palange (2003). Finally, transfers may be means tested, increasing their equalizing effect on income, or in kind as in subsidized health care, in which case they will not show up in household income data.

Barriers to formal sector participation, described in detail below, partition agents according to their ability. In particular, an agent participates in the informal sector if her ability falls below a critical value, $i < n(\beta)$, where β is an index of the restrictiveness of regulatory barriers and $n'(\beta) > 0$. It follows that $n(\beta)$ is the informal sector's share of employment. Accounting for taxes, transfers and sectoral participation, agent i's income is given by

$$(4)\quad y_i = \begin{cases} y_{Ii} = \gamma A_i h_i^{\alpha} + x, & i < n(\beta) \\ y_{Fi} = (1-\tau) A_i h_i^{\alpha} + x, & i \geq n(\beta) \end{cases}.$$

If the tax rate is sufficiently high to completely offset the formal sector productivity premium, then all agents opt for informality. This level of taxation would be hard to support as a political equilibrium. In addition, in the absence of a formal sector, the productivity parameter A_i is zero. For this reason, we assume in what follows that the tax rate is upwardly bounded $\tau < 1-\gamma \equiv \tau_{max}$. Since the most able agent is always a formal sector participant, we will omit the subscript "F" in referring to her, e.g. $y_1 \equiv y_{F1}$.

Dynamic Optimization

Each agent maximizes lifetime utility $U = \int_0^{\infty} e^{-\theta t} \ln c_t dt$ where θ is the subjective discount rate subject to her initial endowment of human capital and accumulation equation $\dot{h} = y - c$, where θ is the subjective discount rate. Agents take policy parameters β and τ as given. As is well-known, the transition dynamics for this problem do not admit an analytical solution. For this reason, and because measures of inequality introduce significant complexity into the model, we concentrate the dynamic analysis on steady state outcomes. In the steady state the return to capital is constant, and an agent's income, consumption and human capital grow at a constant rate given by

$$(5) \quad g = r - \theta .$$

Sectoral Incomes in the Steady State

Differentiating formal sector income with respect to human capital, agent *i*'s return to human capital is given by

$$(6) \quad r_{iF} = \alpha(1-\tau) H_F^{1-\alpha} i^{1-\alpha} h_i^{\alpha-1}$$

With the return to capital constant, agent *i*'s human capital must grow at the same rate as the formal sector capital stock. This occurs when the return to capital is equal across agents in the formal sector. Equating (6) with r_1, we find that steady state formal sector human capital is linear in ability:

(7) $h_{Fi}^{ss} = ih_1^{ss}$.

It follows that the steady state formal sector capital stock, return to capital, and income are

(8) $H_F = \int_n^1 h_i^{ss} di = \int_n^1 ih_1^{ss} = \frac{1-n^2}{2} h_1^{ss}$

(9) $r_F = \alpha(1-\tau)\left[\frac{1-n^2}{2}\right]^{1-\alpha}$

(10) $y_{Fi}^{ss} = (1-\tau)\left[\frac{1-n^2}{2}\right]^{1-\alpha} h_1^{ss} i + x = iw_1^{ss} + x$,

where $w_1^{ss} = y_1^{ss} - x$ is the most able agent's earned income.

For an agent in the informal sector, the return to capital is given by

(11) $r_{Ii} = \alpha\gamma\left[H_F i\right]^{1-\alpha} h_i^{\alpha-1}$

The return to capital will be constant provided h_i and H_F grow at the same rate. This occurs when the return to capital is uniform across sectors. Imposing this restriction, $r_{Ii} = r_F$, gives the steady state level of informal sector human capital:

(12) $h_{Ii}^{ss} = a(\tau)h_1 i$

where $a(\tau) = \left[\frac{\gamma}{1-\tau}\right]^{\frac{1}{1-\alpha}} < 1$, with the inequality following from $\tau < \tau_{max}$.

Comparing equations (7) and (12), we see that formal sector participation increases an individual's steady state level of human capital, a result that follows directly from the formal sector productivity premium. This result captures the stylized fact that informal sector production is less capital and human capital intensive than formal sector production.

Substituting (15) into (4) and manipulating, we find that steady state informal sector income is given by

$$(16)\quad y_{Ii}^{ss} = a(\tau)w_1 i + x$$

Figure 1 shows steady state formal and informal sector incomes for all agents.

Transfer payments are found by integrating tax revenues over formal sector participants and may be expressed in terms of the ablest agent's earned income:

$$(17)\qquad x = \int_n^1 \tau \left[\frac{1-n^2}{2}\right]^{1-\alpha} h_1^{ss} i di = \int_n^1 \frac{\tau}{1-\tau} w_1^{ss} i di = \frac{\tau}{1-\tau}\left[\frac{1-n^2}{2}\right] w_1^{ss}.$$

Regulatory Barriers and Sectoral Participation

We model the regulatory barriers to formal sector participation in the simplest manner. It is assumed that an agent may not participate in the formal sector if her

earnings are below a predetermined level. This level of earnings is defined as a given fraction $\beta < 1$ of the earnings of the ablest individual, such that it evolves overtime at the equilibrium growth rate. Higher levels of β correspond to greater barriers to formality. The requirement for formal sector participation is thus

$$(18) \qquad w_{Fi} > \beta w_{F1}$$

This manner of formalizing regulation has several interpretations which correspond to existing regulatory structures. First, in both developing and industrialized economies, formal sector participation may be limited by minimum wage legislation. Agents whose market determined wage in the formal sector would fall below this level barred from formal sector employment. With a Cobb-Douglas production technology, payments for labor services are a constant share of earnings, so there is a direct relationship between minimum wages and minimum income restrictions.

Second, many less developed countries employ minimum capital requirements for registering a new firm. For example, the World Bank (2004, 118-20) lists minimum capital requirements for over ninety developing countries. As shown above, in the steady state formal sector capital and income are linear in agent ability. Thus the restriction on earnings is equivalent to requiring that an agent possess a certain fraction of the ablest agent's capital, $h_i \geq \beta h_1$. In the same vein, there is a long tradition of treating formal sector employment as being rationed by educational attainment, a restriction that may also be interpreted in terms of a minimum capital requirement.

Note that we have defined sectoral participation in such a manner that it is not sensitive to the tax rate. Dessy and Pallage (2003) show that if taxation funds productive public services, an increase in 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. The model does, however, suggest a link between taxation and sectoral earnings differentials. An increase in taxes serves to offset some of the formal sector productivity premium, resulting in more similar levels of steady state human capital and earnings: $a'(\tau) > 0$.

Treating barriers to formal sector participation as a minimum income restriction, we find that in the steady state agent i participates in the formal sector provided $i \geq \beta$, implying that informal sector participation is given by

$$n(\beta) = \beta. \tag{19}$$

This outcome depends sensitively on several assumptions. First, initial human capital is distributed according to $h_i = ih_1$, implying that formal sector participants are endowed with their steady state levels of human capital. This assumption avoids complicated dynamic which arise due to presence of multiple equilibria, one in each sector, and the dependence of the return to capital on sectoral participation. Transitions between sectors would occur, for example, if an agent had sufficiently high initial capital to start model time in the formal sector but insufficient ability to maintain this position. Alternately, a high ability agent with low initial human capital might be drawn toward the informal

sector steady state if her discount rate were sufficiently high. While interesting in their own right, such outcomes preclude an analytic solution.

Second, we assume that agents who may participate in the formal do so. An agent with $i \geq \beta$ could decide to consume a portion of her capital and transition to the informal sector steady state, enjoying higher initial consumption at a cost of lower future consumption. The differential equations describing the time path of consumption along this trajectory do not permit an analytical solution. However, this option is less attractive the higher an agent's valuation of future relative to current consumption, and we assume that θ is sufficiently low to preclude this option.

Growth and Policy

Combining equations (5) and (9), the steady state rate of growth is

$$g(\beta,\tau) = \alpha(1-\tau)\left[\frac{1-\beta^2}{2}\right]^{1-\alpha} - \theta \tag{20}$$

Both higher tax rates and higher barriers to formality slow growth

$$\begin{aligned} g_\tau &= -\alpha\left[\frac{1-\beta^2}{2}\right]^{1-\alpha} < 0 \\ g_\beta &= -\alpha(1-\alpha)(1-\tau)\beta\left[\frac{1-\beta^2}{2}\right]^{-\alpha} < 0 \end{aligned} \tag{21}$$

An increase in taxes slows growth by reducing the after-tax return to capital. A higher value of β reduces the number of formal sector participants, which lowers the knowledge spillovers generated in the formal sector.

The lines in Figure 2 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, $g_{\max} = g(0,0) = \alpha / 2^{1-\alpha} - \theta$. Growth is decreasing as one moves to lines further from the origin. The slope of the iso-growth lines is given by

$$(21) \qquad \left.\frac{d\beta}{d\tau}\right|_{dg=0} = -\frac{1-\beta^2}{2(1-\alpha)(1-\tau)\beta}.$$

Examination shows that the iso-growth lines become flatter in b and steeper in t, which accounts for their portrayal as "bowed-out."

Income Inequality and Policy

Income inequality is measured with a Gini coefficient. The Gini coefficient varies from zero to one, with a higher value indicating greater income 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:

$$(22) \qquad G(\beta,\tau) = \frac{1+3[1-a(\tau)]\beta^2 - 4[1-a(\tau)]\beta^3}{6\left[1-[1-a(\tau)]\beta^2 + \frac{\tau}{1-\tau}(1-\beta^2)\right]}.$$

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 not effect on average income.

Differentiating the inequality index with respect to β, we find that $G_\beta > 0$ for $\beta \leq$ ½. 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: the income differential between individuals *i* and *j* belonging to the same sector, is $w_1|i\text{-}j|$ if they are in the formal sector and $a(\tau)w_1|i\text{-}j|$ if they are in the informal sector. Third, due to the income gap between sectors, inequality is increasing in the probability that two randomly chosen individuals come from different sectors. This probability is maximized when sector employment shares are equal, or $\beta =$ ½, and falls thereafter as the informal sector expands.

Taken together, these comparative static imply that for $\beta \leq$ ½, 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 2*. 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.

An Interpretation of Implications for Growth and Inequality

Figure 2 summarizes the primary results of the model. To interpret this figure, recall that barriers to formality reflect deep institutional structures, which are assumed to vary dramatically across countries but relatively little within countries over time, while rates of taxation and redistribution differ across both time and space. Cross-country growth regressions therefore capture movements along the vertical axis. Suppose we compare two countries, A and B, with the same tax rate τ_1 and $\beta_A > \beta_B$, such that country A has more restrictive institutions. As illustrated on the graph, country A will have a higher level of inequality, $G_2 > G_1$, and a lower growth rate, $g_1 < g_0$. Thus, our observations will confirm that high growth is associated with low levels of inequality.

Alternately, suppose we look at the relationship between growth and inequality within countries over time. In this case, institutions are held constant and our observations capture movements along horizontal lines in *Figure 2*. Suppose both

country A and B raise their tax rates from τ_1 to τ_2. In each country, both the growth rate and the Gini coefficient fall. For example, in country A, the growth rate falls from g_1 to g_0 and inequality falls from G_2 to G_1. Given these observations, we would conclude that lower inequality is associated with lower growth, the correlation found in empirical studies that consider growth and inequality within countries over time.

The model also provides a potential explanation for Barro's (2000) finding in a cross-country growth regression that growth and inequality are positively related for developed countries, though still negatively related for developing countries. This would occur if, in looking across developed countries, most of the variation in the $\beta-\tau$ policy space were in the horizontal direction. That is, if developed countries have relatively similar institutional and legal structures and differ strongly with respect to the extent of redistribution.

So in investigating the impact of a higher value for beta, we are thinking of the implications of a change in beta at the start of model time. It should be noted, however, that looking within a country over time, the impact of a change in beta is asymmetric with respect to its sign.

A small rise in the in the barriers to formality will make steady state formality impossible for the marginal formal participant. (**More here**) However, a small fall in beta may be insufficient to attract the most able informal participant into the formal sector. Even though formality would be a possibility, she begins with a significantly lower steady state stock of human capital than she needs in order to generate the income to legally join the formal sector: $a(\tau)h_1 i$ rather than $h_1 i$. This asymmetry may generate a ratcheting effect in which formality may be easily lost but is difficult to regain. It also

suggests that radical rather than incremental institutional changes may be necessary to remove the enduring effects of previous marginalization.

I.V. Conclusion

Much theoretical work begins with an account of the primary 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 suggests 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 "Are the particular circumstances that give rise to inequality in a given country good or bad for growth?" This may be a more appealing approach for those who have found themselves uncomfortable with any claim of a fixed relationship between the two variables.

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. The ratcheting effects noted in the last section, however, suggests that marginal changes in institutional structure may be ineffective. Restrictive institutions may generate impacts that persist even if institutions are reformed.

Appendix

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

$$
\begin{aligned}
& y_F^{ss}(i) = (1-\tau)\left(\frac{1-\beta^2}{2}\right)^{1-\alpha} hi + x = wi + x \\
& y_I^{ss}(i) = (1-\tau)a(\tau)\left(\frac{1-\beta^2}{2}\right)^{1-\alpha} hi + x = awi + x \\
& x = \tau\left(\frac{1-\beta^2}{2}\right)^{2-\alpha} h = \left(\frac{\tau}{1-\tau}\right)(1-\beta^2)\frac{w}{2} \\
& \text{where} \qquad w = (1-\tau)\left(\frac{1-\beta^2}{2}\right)^{1-\alpha} h
\end{aligned}
\tag{A.1}
$$

Define g(i) as the cumulative income of the poorest i people, and y as average income. That is,

$$\text{(A.2)}\qquad g(i)=\int_0^i y(j)dj=\begin{cases}\dfrac{awi^2}{2}+xi, & i<n\\ \dfrac{\left[i^2-(1-a)\beta^2\right]w}{2}+xi, & i>n\end{cases}$$

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

The Gini coefficient may be expressed as the integral over population of population share minus income share. Then the Gini coefficient is given by

$$\text{(A.3)}\qquad G=\int_0^1 i-\frac{g(i)}{y}di=\frac{1}{2}-\frac{1}{y}\int_0^1 g(i)di=\frac{y-2\int_0^1 g(i)di}{2y}.$$

Integrating over *g(i)*, we have

$$\begin{aligned}\int_0^1 g(i)di&=\int_0^\beta\left[\frac{awi^2}{2}+xi\right]di+\int_\beta^1\left[\frac{\left(i^2-(1-a)\beta^2\right)w}{2}+xi\right]di\\ &=\frac{aw\beta^3}{6}+\frac{x\beta^2}{2}+\frac{w}{6}(1-\beta^3)-\frac{(1-a)w}{2}(\beta^2-\beta^3)+\frac{x}{2}(1-\beta^2)\\ &=\frac{w}{6}\left[1-3(1-a)\beta^2+2(1-a)\beta^3\right]+\frac{x}{2}\end{aligned}\qquad\text{(A.4)}$$

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

$$\text{(A.5)}\qquad G(\beta,\tau)=\frac{k(\beta,\tau)}{m(\beta,\tau)}=\frac{1+3\left[1-a(\tau)\right]\beta^2-4\left[1-a(\tau)\right]\beta^3}{6\left[1-\left[1-a(\tau)\right]\beta^2+(\tau/1-\tau)(1-\beta^2)\right]},$$

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 dualistic 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:

$$\text{(A.6)} \qquad \begin{aligned} G_\beta &= \frac{k_\beta - m_\beta G}{m(\beta,\tau)} > 0 \\ G_\tau &= \frac{k_\tau - m_\tau G}{m(\beta,\tau)} < 0 \end{aligned} \quad .$$

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

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

It follows that $G_\beta > 0$ for $\beta \leq 1/2$, as reported in (21).

Differentiating k(..) and m(..) with respect to τ, we have

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

Noting that $a'(\tau) > 0$, inequality is decreasing in the tax rate for $\beta <$ ¾, as reported in (22).

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Figure 1: *Steady State Income Levels*

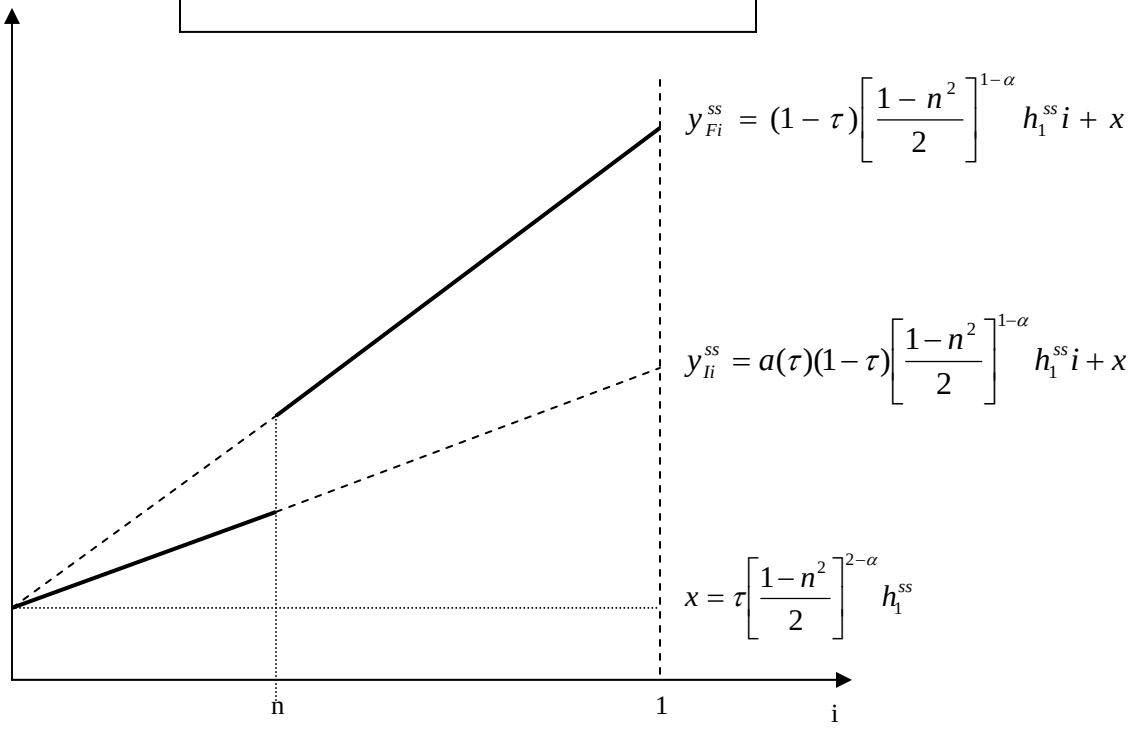
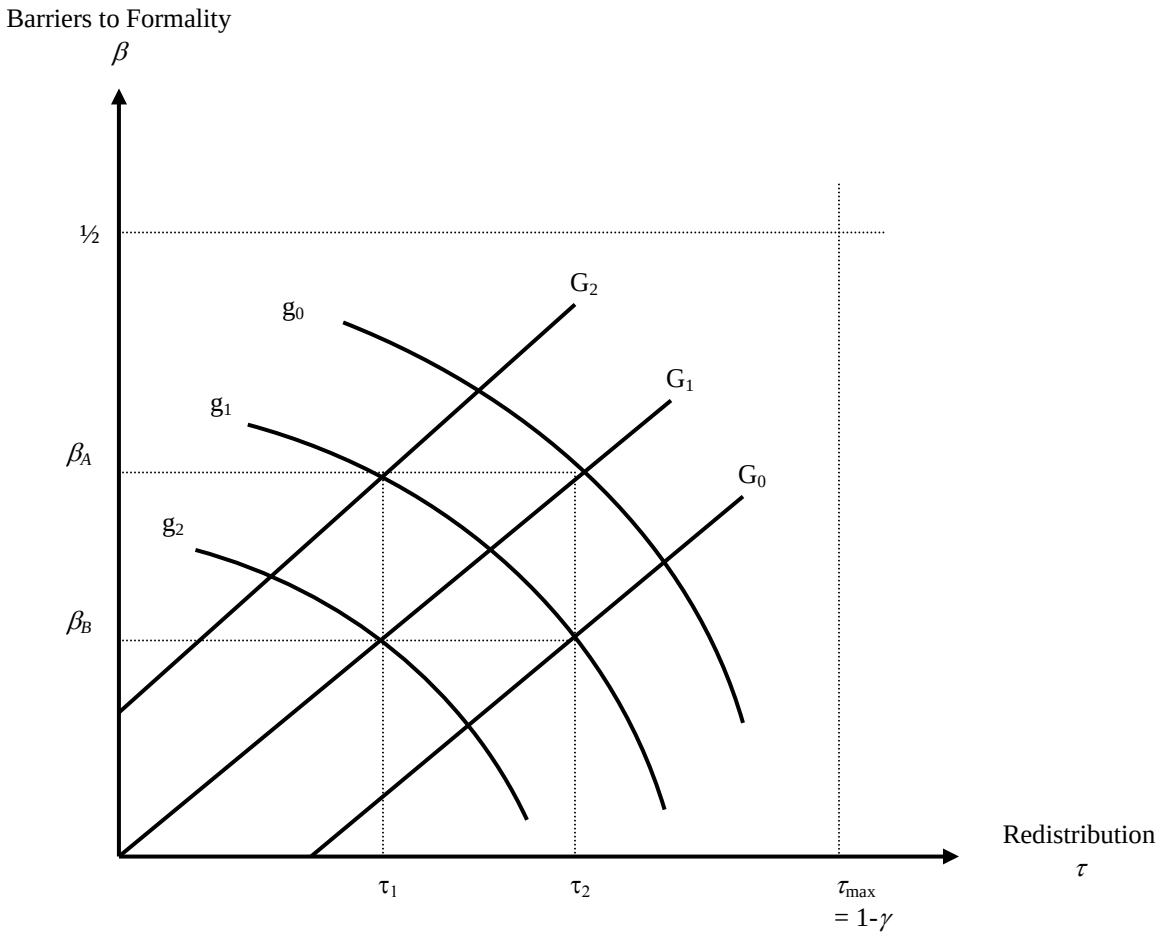


Figure 2: *Iso-Inequality and Iso-Growth Lines*



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}.