*Contributions to Macroeconomics*

*Volume* 4, *Issue* 1 2004 *Article* 6

# Endogenous Distribution, Politics, and the Growth-Equity Tradeoff

Satya P. Das* Chetan Ghate†

*Indian Statistical Institute, Delhi, das@isid.ac.in
†Indian Statistical Institute, Delhi, cghate@isid.ac.in

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Satya P. Das and Chetan Ghate

**Abstract**

In comparison to the standard literature on inequality and growth which assumes the former to be exogenous, we formulate a model in which inequality and growth are both endogenous. Long-run distribution, at least locally, is shown to be independent of the initial distribution of factor ownership. It is shown that exogenous policy changes that are primarily targeted towards growth and foster less inequality do enhance growth. But policies that are primarily redistributive and imply a more equal distribution reduce growth. This is consistent with recent empirical work which shows that inequality and growth may be positively related.

**KEYWORDS:** Median Voter, Endogenous Growth, Wealth Distribution, Distributive Conflict, Redistributive Policy

# 1 Introduction

A burgeoning literature has analyzed the impact of wealth and income distribution on economic growth.[1] Its general finding is that greater equality leads to higher long-run growth (Alesina and Rodrik, 1994; Persson and Tabellini, 1994). In the Alesina-Rodrik model for example, more inequality increases the political demand for transfers by the median household. Since redistribution occurs through a tax on capital, this leads to a lower after-tax return to capital, lesser investment, and a lower equilibrium growth rate.

An alternative set of models links wealth distribution to economic growth when capital markets are imperfect (Loury, 1981; Galor and Zeira, 1993; Banerjee and Newman, 1993; Benabou, 1995; Aghion and Bolton, 1997; Aghion and Howitt, 1998). In these models, redistributive policies that reduce investment inequality foster aggregate production by relaxing the credit constraints imposed by imperfect capital markets. This raises the equilibrium growth rate in the long run.

Initial empirical evidence–by Alesina and Rodrik (1994) (henceforth A-R) and Persson and Tabellini (1994) (henceforth P-T)–generated support for the finding that inequality harms growth. However, Easterly and Rebelo (1993), and more recent empirical work by Li and Zou (1998), Barro (2000), Forbes (2000), Banerjee and Duflo (2003), and Lundberg and Squire (2003), have found evidence to the contrary: namely, that more inequality may promote economic growth. For instance, in a structural regression accounting for the simultaneous endogeneity between growth and equality, Lundberg and Squire (2003, p. 336, Table 2) find that the point estimate of the coefficient of the Gini ratio is positive (where growth is the dependent variable). Using evidence from a broad panel of countries, Barro (2000) shows that the effect of the Gini coefficient on economic growth depends on a threshold level of economic development (as measured by real per capita GDP). Higher inequality hinders growth in poor countries, but has a positive impact on growth in richer countries. This suggests that the positive impact of inequality on growth is limited to richer countries.[2] Similarly, Banerjee and Duflo (2003) find that changes in

[1] See Aghion et al. (1999) for an exhaustive survey of this literature.

[2] Barro (2000) attributes this to the role that credit market constraints play at different stages of development. In poor countries, the net effect of inequality on growth may be negative because of the severity of credit market constraints. In rich countries, the growth promoting aspects of inequality may dominate since credit market constraints are less serious.

inequality in any direction are associated with lower future growth rates.

While these findings appear to resurrect the traditional trade-off between growth and equity, to the best of our knowledge, there doesn't exist to date any model of endogenous growth with redistributive politics that predicts, in a strong way, *a negative* causal relationship from an equity-enhancing policy to growth.[3] The purpose of this paper is to develop a model which implies such a negative link. Interestingly, to show this, one need not look for a framework that is drastically different in character from existing models of distribution and growth. We use the well-known A-R model and generalize it in two important aspects. The end product is capable of establishing a negative trade-off between equity and growth.

In A-R, households live indefinitely. There is an initial distribution of labor and capital holdings across households. The production function is of the "AK" variety and a variant of Barro (1990). These assumptions imply no transitional dynamics. Hence the initial distribution (even though capital grows for each household) of the *ratio* of capital to labor holding remains unchanged over time, i.e., the "distribution of factor ownership is time-invariant" (A-R, page 473). In addition, the politically determined (median-voter) tax on capital fixes the net return to capital and the long-run growth rate.

Using this framework, our model first endogeneizes wealth and income distributions. This is done by postulating that households have finite lifetimes and a bequest motive, i.e., via a warm-glow model with one-sided altruism. More specifically, we assume that households live for a single period. Further, their utility function has as arguments their own consumption and the amount that they bequeath, with positive and diminishing marginal utility from each argument (Aghion and Bolton, 1997). Interestingly, such a framework endogenizes wealth and income distributions. This is because the assumption of households having a limited lifetime, together with diminishing marginal utility from bequests (which equal to savings), implies that a household would not want to 'jump' to its steady-state capital holdings instantly. Hence, our model features transitional dynamics even though the production function is of the 'AK' variety.[4] This makes the evolution of wealth distribution endoge-

[3] In an earlier kind of exogenous growth model, Bourguignon (1981) has shown that, if the savings function is convex, an increase in inequality will have a positive level-effect on aggregate output.

[4] Indeed, our approach contrasts with Jones and Manuelli (1990) who append to a standard AK technology a production process that exhibits diminishing returns to capital. Such diminishing returns give rise to transitional dynamics. Put differently, 'convexity' in Jones and Manuelli (1990)

nous and independent of the initial distribution as in Stiglitz (1969).[5] This is our first generalization.

Our second generalization allows for both a non-political (exogenous) as well as a political (endogenous) redistributive policy. To wit, in the A-R as well as P-T frameworks, only one policy–the tax rate–is politically determined. Further, the policy implication that emerges from these models–that a more equal distribution of wealth affects economic growth positively–requires the existence of an *exogenous* redistributive policy to achieve this. However, there is no explicit exogenous redistributive policy in either model. To make this logic complete, we introduce a transfer scheme *in addition to* a tax on capital or total income. We then consider two cases: one in which the former is political (hence endogenous) while the latter is not, and vice versa.

Given this construct, our main finding makes appealing economic sense: *a non-political tax policy which promotes equity and the building of productive inputs increases long-run growth, whereas a non-political and equity-enhancing transfer policy reduces economic growth.* Accordingly, the choice of economic policy plays a key role in impacting the equilibrium growth rate, with higher redistributive spending enacted to curb inequality affecting growth adversely. In fact, we show that the position of the political equilibrium plays a key role in determining how and which redistributive policies affect growth.

The paper proceeds as follows. Section 2 develops our basic model. It assumes a single policy, a tax on capital, which is determined politically via majority voting. While this construct is similar to A-R, an important difference is that our model features transitional dynamics. This leads to the wealth distribution being determined endogenously in the long run. Section 3 introduces an explicit transfer scheme along with a tax on capital. However, none of our results are sensitive to the assumption that only capital or capital income is taxed. Section 4 analyzes a

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arises from the production side. In our model, it arises from the preferences of finitely lived households with one-sided altruism.

[5]While there is some similarity between the notion of endogenous distribution here and in Matsuyama (2000), there is one major difference. In Matsuyama (2000), there is no source of heterogeneity across households other than initial wealth (which is similar to A-R). Hence, in the presence of transitional dynamics, complete equality as well as initial-period dependent inequality are both non-trivial possibilities in the steady state. In contrast, in our model, heterogeneity in the distribution of innate skill implies that perfect equality cannot occur in the long run. Moreover, at least locally, the steady-state distribution is independent the initial distribution of wealth.

general income tax *a la* Barro (1990). As in Section 3, we find that whereas a more redistributive tax policy improves long-run growth, a more redistributive transfer scheme reduces growth. Section 5 concludes.

# 2 The Basic Model

The population or the number of households in the economy is given. Each household has one unit of labor, inelastically supplied to the market. Households are differentiated on the basis of a basic skill level, $L_h$, whose distribution is continuous on a finite support in $\Re_+$. This distribution is primitive and constitutes the basic source of heterogeneity.[6] No further assumption, such as on skewness, is necessary for the analysis of this section. For simplicity however, we assume that the distribution of $L_h$ is skewed to the right, i.e., $L_m$, the median skill, is less than $\bar{L}$, the mean skill level. It permits us, as will be seen later, to use the capital holding of the median household relative to that of the mean household (i.e. the relative wealth distance of the median voter) as a simple index of wealth inequality. Let $\int_{h\in H} L_h dh \equiv L$, where $H$ is the total number of households and $L$ is the total endowment of skill. For notational convenience, we normalize $H = 1$. Thus $L = \bar{L}$.

Besides basic skill, there are two other inputs, capital and a public infrastructure input.

## 2.1 A Household's Problem

Following Aghion and Bolton (1997) and Das (2000), agents live for a single period. At the end of the period, a replica is born to each agent, to which agents pass on a bequest. Households derive utility from consumption, $C_{ht}$, and the amount bequested (at time $t$) to time $t+1$, $K_{ht+1}$. Production occurs in the beginning of each period. Once production occurs, agents make consumption and bequest decisions. The bequest can be interpreted as inherited capital.

The utility function, $U$: $\Re_+^2 \rightarrow \Re_+$, satisfies the standard properties. For the sake of tractability, we assume that the utility function is given by a Cobb-Douglas specification: $U_{ht} = C_{ht}^{1-\beta} K_{ht+1}^{\beta}$, $\quad 0 < \beta < 1$. The budget constraint facing an agent

[6] Alternatively, we can interpret $L_h$ as labor time supplied by household $h$, with its distribution being based on how 'lazy' households are vis-a-vis one another.

$h$ is given by

$$C_{ht} + K_{ht+1} \leq w_t L_h + (1 + r_t - \tau_t) K_{ht}, \tag{1}$$

where $w_t$ and $r_t$ are the rewards to a unit of basic skill and a unit of capital, respectively. Implicit in the above equation is that capital depreciation is zero.

We assume that the skill level of a household does not change over time or across generations.[7] Each household is identified by a given $L_h$. There is no dynamic stochastic process governing the evolution of $L_h$.[8]

The household optimization exercise implies the Euler equation: $C_{ht} = \frac{1-\beta}{\beta} K_{ht+1}$. Substituting the Euler equation back into the budget constraint as well as into the utility function leads to the following individual capital accumulation equation and indirect utility function, respectively:

$$K_{ht+1} = \beta \left[ w_t L_h + (1 + r_t - \tau_t) K_{ht} \right], \tag{2}$$

$$V_{ht} = \text{Constant} \cdot \left[ w_t L_h + (1 + r_t - \tau_t) K_{ht} \right]. \tag{3}$$

## 2.2 Production

A single good is produced in the economy. The production function follows Barro (1990) and A-R:

$$Q_t = A \bar{K}_t^{\alpha} G_t^{1-\alpha} \bar{L}^{1-\alpha}. \tag{4}$$

Here, $Q_t$ denotes output at time $t$, $\bar{K}_t$ denotes mean or aggregate capital, $G_t$ denotes a public-infrastructure input, while $A > 0$ represents an index of technology.[9] Following the endogenous growth literature, we interpret $K$ as physical as well as human capital. Hence, $\alpha$ is the private return to physical and human capital. We

[7] In a very different context this is assumed, for instance, by Das (2000) and Ranjan (2001).

[8] The benefi t of this assumption is that it offers considerable analytical tractability. The cost is that it does not permit to say anything about social mobility. However, social mobility, although an important problem in its own right, is not our focus.

[9] By assuming a Cobb-Douglas specifi cation, we maintain consistency with the literature. But, more generally, our results hold as long as the production function is linearly homogeneous in capital and labor, and the infrastructure input plays the role of labor augmentation.

require a regularity condition: $\alpha > 1/2$. As will be seen later, this ensures that the net return to capital in equilibrium is positive.[10]

The input $G_t$ is financed by a (specific) tax on capital which is equivalent to a wealth tax.[11] The government budget constraint is satisfied in all time periods, i.e., $G_t = \tau_t \bar{K}_t$. The competitive factor rewards are:

$$\begin{gathered} r_t = \psi(\tau_t) \equiv \alpha A \tau_t^{1-\alpha} \bar{L}^{1-\alpha}; \quad w_t = \phi(\tau_t)\bar{K}_t, \\ \text{where } \phi(\cdot) \equiv (1-\alpha) A \tau_t^{1-\alpha} \bar{L}^{-\alpha}. \end{gathered} \tag{5}$$

Note that an increase in $\tau$ enhances the marginal product of both factors. This constitutes the source of gain to household income and the economy's growth rate.

Substituting (5) into (2) and (3), we obtain the following expressions denoting the household accumulation relation and household indirect utility, respectively:

$$K_{ht+1} = \beta \{\phi(\tau_t) L_h \bar{K}_t + [1 + \psi(\tau_t) - \tau_t] K_{ht}\}, \tag{6}$$

$$V_{ht} = \text{Constant} \cdot \{\phi(\tau_t) L_h \bar{K}_t + [1 + \psi(\tau_t) - \tau_t] K_{ht}\}. \tag{7}$$

## 2.3 A Household's Most Preferred Tax Rate

From (7), we can deduce the most preferred tax rate by any particular household. This will enable us to characterize the (decisive) tax preference of the median household. Define $n_{ht} \equiv K_{ht}/\bar{K}_t$, to be the relative capital holding by household $h$. Maximizing (7) with respect to $\tau_t$, we obtain the following first-order condition:

$$\frac{\phi'(\tau_t) L_h}{n_{ht}} + \psi'(\tau_t) - 1 = 0. \tag{8}$$

It is easy to verify that the second-order condition is met, i.e., indirect utility is single-peaked with respect to the tax rate. From (8), we can regard the marginal cost (MC) of a tax increase on disposable income as equal to 1, while the marginal

[10]With a narrower interpretation of $K$ as physical capital, it would be empirically implausible to assume $\alpha > 1/2$, but it is not so when capital is interpreted more broadly as we do here. Further, according to Barro and Sala-i-Martin (1995, page 38), even a value of $\alpha$ equal to 0.75 is quite reasonable.

[11]We later show that our results are robust to $G$ being funded by a proportional tax on capital earnings or on total income of a household.

benefit (MB) of a tax increase on disposable income (actually the MB/MC ratio) equal to $\phi'(\tau_t)L_h/n_{ht} + \psi'(\tau_t)$. These are illustrated in Figure 1. Consider two households: household 1 who is labor-rich and capital-poor and household 2 who is labor-poor and capital-rich, i.e., the ratio $L_h/n_{ht}$ is higher for the former. Notice that the MB of a tax increase on disposable income is greater for the former. As a result, the optimal tax for the former household is higher as shown ($\tau_1 > \tau_2$). Intuitively, a labor-rich-capital-poor household cares less about net capital income compared to a labor-poor-capital-rich household. Hence, the optimal tax rate is higher for the former.

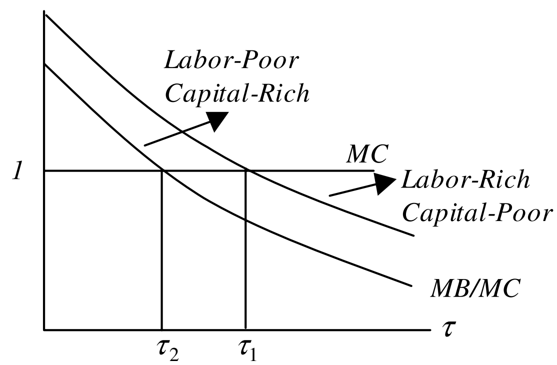


Figure 1: Optimal Tax for Households with Different Factor Holding Compositions

Using the definitions of $\phi(\cdot)$ and $\psi(\cdot)$ functions, equation (8) yields the following closed-form expression for the optimal tax rate of household $h$ at time $t$:

$$\tau_{ht} = \left\{ A(1-\alpha)\bar{L}^{1-\alpha} \left[ \frac{(1-\alpha)L_h}{n_{ht}\bar{L}} + \alpha \right] \right\}^{\frac{1}{\alpha}}. \tag{9}$$

From (9), the most preferred tax rate for a particular household depends on the ratio of two ratios, namely, $n_{ht}/(L_h/\bar{L})$. From now on, unless specified otherwise, we let "relative" mean relative to the mean household. Thus, quite intuitively, $\tau_{ht}$ is negatively related to the ratio of its relative capital holding to its relative skill. Also, note that the optimal tax rate for any household is bounded from below by the tax rate which will be chosen if a household's labor income were zero.[12]

[12] This is equal to the tax rate which maximizes the after-tax return to capital, $r_t - \tau_t$.

## 2.4 Uniqueness of the Median Household

Households vary with respect to their basic skill and capital holding. However, we show below that the across-household ranking with respect to these two characteristics is the same. This implies that the median-skill household is also the median household with respect to capital holdings. Further, the median households's preferred tax rate is the equilibrium tax rate in the economy.

First, taking the average of the individual accumulation equation (6) over households implies

$$\bar{K}_{t+1} = \beta \{\phi(\tau_t)\bar{L} + [1 + \psi(\tau_t) - \tau_t]\} \bar{K}_t. \tag{10}$$

Second, dividing equation (6) by (10) gives

$$n_{ht+1} = n_{ht} \left[ 1 + \frac{\phi(\cdot)(L_h/n_{ht} - \bar{L})}{\phi(\cdot)\bar{L} + 1 + \psi(\cdot) - \tau_t)} \right]. \tag{11}$$

Next, we track the economy from an initial period in which the tax rate is exogenous, or not politically determined. The dynamic process, equation (11), implies a steady state where

$$n_h^* = \frac{L_h}{\bar{L}} \Rightarrow \frac{K_h^*}{L_h} = \frac{\bar{K}}{\bar{L}}. \tag{12}$$

The asterisks mark the steady-state values. Relation (12) implies that $K_h^*/L_h$ is same for all $h$, i.e., the rankings of households in terms of capital held and basic skill are the same. The median household is thus identified by the ranking of $L_h$ only, i.e. by $L_h = L_m$.

Now suppose that the tax rate 'becomes' political. The economy goes off the steady state. However, *irrespective of* the tax rate, (6) implies that the next period's capital stock holding of household $h$ also has the same ranking as $L_h$. Further, this remains true for all successive time periods, on or off the steady state, as long as households do not face an asymmetric skill or preference shock so as to change the initial ranking of households on the $L_h$ scale. We assume away such shocks, so that the median household's identity is unchanged even though $\tau$ may change over time.

The implication is that the household with skill $L_m$ is the unique median household for all $t$ and the equilibrium tax rate is this household's most preferred tax rate.

Further, it is given by substituting $h = m$ in (9):

$$\tau_{mt} = \left\{ A(1-\alpha)\bar{L}^{1-\alpha} \left[ \frac{(1-\alpha)L_m}{n_{mt}\bar{L}} + \alpha \right] \right\}^{\frac{1}{\alpha}}, \tag{13}$$

where $n_{mt}$ is the relative capital holding of the median household.

## 2.5 Economy in the Aggregate

The linearity of equation (6) in $K_{ht}$ and $L_h$ implies that this equation can be perfectly aggregated. Since the number of households is normalized to one, aggregating it gives the same equation as (10), which is the economy-wide accumulation equation.

Define the economy's growth rate by $g_t \equiv K_t/K_{t-1}$. From equation (10),

$$g_{t+1} = \beta[\phi(\tau_t)\bar{L} + 1 + \psi(\tau_t) - \tau_t] = \beta(1 + A\bar{L}^{1-\alpha}\tau_t^{1-\alpha} - \tau_t). \tag{14}$$

As in Barro (1990), this shows a non-monotonic relationship between the growth rate and the tax rate. On one hand, an increase in $\tau$ increases the marginal products of labor and capital and thus tends to increase disposable income. On the other hand, an increase in the tax rate lowers after-tax income. Hence, there is a trade-off. Moreover, there exists a unique growth-maximizing tax rate equal to

$$t_g = \left[A(1-\alpha)\bar{L}^{1-\alpha}\right]^{\frac{1}{\alpha}}. \tag{15}$$

## 2.6 Steady State

Equation (11) with $h = m$, and equation (13) describe the dynamics of the economy. Both of these equations have two variables: $n_{mt}$ and $\tau_{mt}$. Substituting the condition, $n_{mt+1} = n_{mt} = n_m^*$, in (11), it follows that along the steady state

$$n_m^* = \frac{L_m}{\bar{L}} \Leftrightarrow \frac{K_m^*}{L_m} = \frac{\bar{K}^*}{\bar{L}}. \tag{16}$$

That is, the median household's composition of factor holdings is equal to that of the mean household. Indeed, from (11),

$$n_h^* = \frac{L_h}{\bar{L}} \Leftrightarrow \frac{K_h^*}{L_h} = \frac{\bar{K}^*}{\bar{L}} \quad \forall h. \tag{17}$$

In other words, compared to any given household, a more skilled household accumulates more capital in the long run and there is complete convergence of capital-labor ratio holdings across households in the steady state. A moment's reflection suggests that this is also natural: in the long run every one accumulates capital in proportion to his/her basic skill.

This does *not* mean that there is (perfect) equality: although $K_h^*/L_h$ is the same for all households, for any two households say $i$ and $j$ such that $L_i \neq L_j$, we have $K_i^* \neq K_j^*$. Interestingly, equation (17) implies that every household's preferred tax rate is the same, i.e., there is unanimity in the long run. Indeed, this is a general result, independent of the assumption of a Cobb-Douglas technology or the assumption that only capital is taxed.

Graphically, note that, in terms of the MB/MC and MC curves depicted in Figure 1, all households' MB/MC curves collapse to that of the mean household and its intersection with the MC=1 line gives a common $\tau_h$. This does not happen in the A-R model because factor ownership compositions are time-invariant. In our model the unanimously agreed equilibrium tax rate is equal to[13]

$$\tau = \left[A(1-\alpha)\bar{L}^{1-\alpha}\right]^{\frac{1}{\alpha}}. \tag{18}$$

Note that this is the *same* expression as the expression for the growth-maximizing tax rate given in equation (15), which follows from the convergence of the capital/labor ratios across households. In other words, *long-run growth is maximized at the political equilibrium*. This, we believe, is a very interesting departure from the exogenous-distribution framework, and a useful benchmark. The benefit of identifying this is that the inefficiency resulting from politics in a more realistic economy can be seen insightfully in terms of a deviation from such an environment. In the next section, we will indeed analyze such deviations.

In terms of comparative statics, we note from (18) that $d\tau/dA > 0$. This is because a positive technology shock enhances the marginal product of both labor and capital and thus raises the marginal gain from a tax increase. Hence, everyone's preferred tax rate is higher. Next, differentiating (14) and using the expression of $d\tau/dA > 0$, we find $dg/dA > 0$. Thus, a permanent positive technology shock increases both the equilibrium tax rate and the equilibrium growth rate. An important

[13]Using the following equation, the net return to capital, $\kappa \equiv r - \tau$, is equal to $(2\alpha-1)\tau/(1-\alpha)$, which may not positive for all $\alpha < 1$. This is where our regularity condition (R1), i.e. $\alpha > 1/2$, comes in; it assures that $\kappa > 0$.

corollary is that the cross-country correlation between the tax rate and the growth rate may be positive when countries are ranked in terms of their levels of technology. This contrasts with an *intra-country* relationship between the tax and growth rates, which may be negative or positive depending on what the tax rate is.[14]

We have not talked about inequality yet. Our assumption that $L_m < \bar{L}$ implies that in the steady state, $n_m = K_m/\bar{K} < 1$. Hence, we can take $n_m$, the median-mean wealth ratio, as the indicator of inequality. More specifically, a higher $n_m$ implies a more *equal* distribution of wealth. Note also that, along the steady state, a household's disposable income and indirect utility are both proportional to a household's holding of capital. Hence, the magnitude of $n_m$ also indicates inequality both in terms of income and utility. In other words, inequality in terms of wealth, income, and utility, are synonymous in our model.

Since the distribution of long-run wealth is the same as that of innate skill, unlike the tax rate or the growth rate, the level of inequality is not affected, for example, by a technology shock.[15,16] More generally, we can define inequality in terms of the coefficient of variation. From (17), note that the standard deviation of $K_h$ equals $c_L\bar{K}_t$, where $c_L$ is the coefficient of variation of $L_h$. Hence, the coefficient of variation of wealth is equal to $c_L$, which is also invariant with respect to a technology or preference shock.

Figure 2 illustrates the comparison and reconciliation with the A-R model. The non-monotonic relationship between the growth rate and the tax rate – given by equation (14) – is depicted in the top panel. We call it the 'growth-tax curve.' The tax rate that maximizes the average welfare is also the one that maximizes the growth rate. (This holds in the A-R model as well as in Barro (1990).)

The bottom panel graphs equation (9): the optimal tax as a negative function of the ratio of relative capital holding to relative skill. In the A-R model, the median voter's relative capital holding is *assumed* to be less than its relative skill. Hence, $\rho_m \equiv n_m/(L_m/\bar{L}) < 1$. Accordingly, the economy operates effectively in the right-

[14] It is easy to see that an increase in the preference parameter $\beta$ does not affect the tax rate but leads to an increase in the growth rate.

[15] If skill can be enhanced by education and there are capital market imperfections, then the distribution of long-run wealth or income inequality will not be equal to that of the distribution of innate skill.

[16] However, a uniform additive skill shock to all households would increase $n_m$ and lower inequality.

hand side of the growth-tax curve. Suppose that initially $\rho_m = \rho_m^0$. The tax rate is read off the horizontal axis and the economy's growth rate is $g^0$. Now, if $\rho_m$ increases to $\rho_m^1$, i.e., the distribution becomes more equitable, we see that the tax rate falls and the economy's growth rate jumps up to $g^1$. In contrast, in our model, the distribution of income is endogenous. Every household's relative capital holding adjusts and converges in the steady state to its relative skill. That is, $\rho_h = 1$, for all $h$, including the median household. Thus, the political equilibrium implies the growth-maximizing tax rate, $\tau_g$. In other words, there is no conflict between politics and efficiency in the long run.

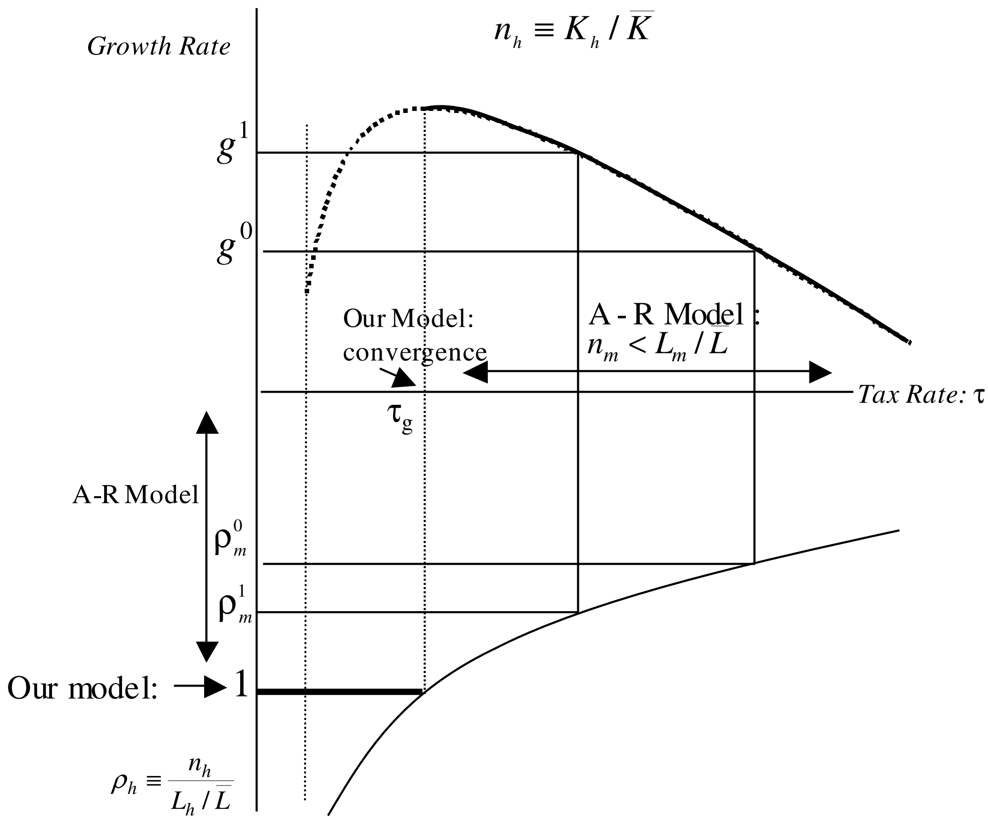


Figure 2: Comparison with the Alesina-Rodrik Model

## 2.7 Transitional Dynamics

Suppose there are skill shocks to households (without changing their ranking in terms of $L_h$) such that initially the median voter's relative capital holding is not equal to its steady state value. How does the economy adjust over time?

Totally differentiating equation (11), and evaluating the derivative by using the steady state condition, $L_m/n_{mt} = \bar{L}$, we get

$$0 < \left.\frac{dn_{mt+1}}{dn_{mt}}\right|_{n_{mt}\to L_m/\bar{L}} = \frac{1+\psi(\tau)-\tau}{\phi(\tau)\bar{L}+1+\psi(\tau)-\tau} < 1. \tag{19}$$

This implies that, locally, the transition path of inequality is monotonic and stable. Starting from $n_{m0} \neq L_m/\bar{L}$, the economy converges monotonically to the long run level of inequality defined by the basic source of heterogeneity, $L_h$. Given the dynamics of $n_{mt}$, the dynamics of the tax rate is evident from (13). The optimal tax along the transition path decreases or increases over time as $n_{m0} \lesseqgtr L_m/\bar{L} \Leftrightarrow \rho_m \lesseqgtr 1$.

How does the growth rate change during the transition? Interestingly, from Figure 2, we can readily infer that it increases over time – and tends to converge to the maximized growth rate – irrespective of whether $n_{m0} \lesseqgtr L_m/\bar{L}$. Further, since an increase in $n_{mt}$ means more equality, the contemporaneous correlation between growth and equality is negative and positive as $n_{m0} \lesseqgtr L_m/\bar{L}$.

This completes the analysis of our basic model.

## 2.8 Proportional Tax on Capital Earnings

Our benchmark result that everyone's holding of capital relative to basic skill is the same in the steady state does not hinge on our assumption of specific tax on capital earnings, or on wealth. To see this, let $\tau_t$ now denote a *proportional* tax on capital earnings. Then, $G_t = \tau_t r_t K_t$.

Working through the model, the optimal tax for any household $h$ is governed by the first-order condition analogous to (8). This is:

$$\frac{\breve{\phi}'(\tau_t)L_h}{n_{ht}} - \breve{\psi}(\tau_t) + (1-\tau_t)\breve{\psi}'(\tau_t) = 0, \quad \text{where}$$

$$\breve{\psi}(\tau_t) = \tilde{\psi}(\tau_t)^{\frac{1}{\alpha}}, \;\; \breve{\phi}(\tau_t) = A^{\frac{1}{\alpha}}(1-\alpha)\alpha^{\frac{1-\alpha}{\alpha}}\tau_t^{\frac{1-\alpha+\alpha^2}{\alpha}}\bar{L}^{\frac{1-2\alpha}{\alpha}}.$$

Likewise, similar to equations (6) and (10), the individual and aggregate accumulation equations are, respectively:

$$\begin{aligned} K_{ht+1} &= \beta\left\{\breve{\phi}(\tau_t)L_h\bar{K}_t + (1-\tau_t)\breve{\psi}(\tau_t)K_{ht}\right\}, \\ \bar{K}_{t+1} &= \beta\left\{\phi(\breve{\tau}_t)\bar{L} + (1-\tau_t)\breve{\psi}(\tau_t)\right\}\bar{K}_t. \end{aligned} \tag{20}$$

Given (20), wealth distribution evolves according to

$$n_{ht+1} = n_{ht}\left[1 + \frac{\breve{\phi}(\cdot)(L_h/n_{ht} - \bar{L})}{\breve{\phi}(\cdot)\bar{L} + (1-\tau_t)\breve{\psi}(\cdot)}\right]. \tag{21}$$

Hence, along the steady state,

$$n_h^* = \frac{L_h}{\bar{L}} \Leftrightarrow \frac{K_h^*}{L_h} = \frac{\bar{K}^*}{\bar{L}}, \tag{22}$$

i.e., every household's composition of factor holdings is the same. This implies unanimity. Further, following the reasoning before, it is easy to see that convergence to the steady state is monotonic.

In sum, irrespective of whether we consider a tax on wealth or capital earnings, the endogeneity of wealth distribution implies a configuration of the long-run growth rate, the tax rate, and the degree of inequality, which is quite different from the case where the distribution of wealth is exogenous.

However, this is only our benchmark model. As our second generalization, we now introduce an additional redistributive policy. Unanimity, as we shall see, breaks. Richer possibilities arise.

# 3 Political and Non-Political Policies

As discussed in the introduction, any policy inference from redistribution to growth must presume that the policy is exogenous or non-political. Accordingly, suppose there is also a transfer policy, where a fraction, $\theta$, of tax revenues is disbursed back uniformly across households. This leads to two policies: $\tau$ and $\theta$. While both are redistributive as well as have implications towards growth, the parameter $\theta$ is primarily (and directly) redistributive, while $\tau$ is not as it finances the public input $G$. Assume now that one of the two policies is political and the other is not.

We then ask how an exogenous change in the policy that is non-political affects the politically determined policy through the political process, thereby affecting distribution and growth. By voting over a single issue, the median voter theorem continues to hold.

Hence, there are two possibilities: (a) $\tau$ is political as before, while $\theta$ is not and (b) $\tau$ is non-political and $\theta$ is political. For simplicity, we revert back to the assumption that $\tau$ represents a specific tax on capital.

## 3.1 $\tau$ Political and $\theta$ Non-Political

Of the two instruments, we let the policy which is political have a time subscript only. Given our construct, we have $G_t = (\tau_t - \theta)\bar{K}_t$, while, $S_t \equiv \theta K_t$, is transferred back uniformly to all households. We denote, $T_t \equiv \tau_t - \theta$, to be the net tax on capital. Normalizing $A = 1$ for the sake of notational simplicity, the competitive rewards are

$$\begin{gathered} w_t = \tilde{\phi}(T_t)\bar{K}_t;\; r_t = \tilde{\psi}(T_t) \\ \text{where } \tilde{\phi}(\cdot) = (1-\alpha)T_t^{1-\alpha}\bar{L}^{-\alpha};\; \tilde{\psi}(\cdot) = \alpha(T_t\bar{L})^{1-\alpha}. \end{gathered} \tag{23}$$

Solving out the household problem exactly as before, we obtain the following expressions for $K_{ht+1}$, $K_{t+1}$, and indirect utility:

$$K_{ht+1} = \beta\left\{\tilde{\phi}(T_t)L_h\bar{K}_t + [1+\tilde{\psi}(T_t) - \tau_t]K_{ht} + \theta\bar{K}_t,\right\} \tag{24}$$

$$\bar{K}_{t+1} = \beta\left\{\tilde{\phi}(T_t)\bar{L} + 1 + \tilde{\psi}(T_t) - T_t\right\}\bar{K}_t, \tag{25}$$

$$V_{ht} = \text{Constant}\cdot\left\{\tilde{\phi}(T_t)L_h\bar{K}_t + [1+\tilde{\psi}(T_t) - \tau_t]K_{ht} + \theta K_t\right\}. \tag{26}$$

Maximizing indirect utility with respect to $\tau_t$ for a given $\bar{K}_t$ and $K_{ht}$ gives the most preferred tax rate of household $h$. The first-order condition is $\tilde{\phi}'(T_t)L_h\bar{K}_t + [\tilde{\psi}'(T_t) - 1]K_{ht} = 0$, which effectively gives the optimal *net* tax on capital. This leads to an analog of equation (9):

$$T_{ht} = \left\{(1-\alpha)\bar{L}^{1-\alpha}\left[\frac{(1-\alpha)L_h}{n_{ht}\bar{L}} + \alpha\right]\right\}^{\frac{1}{\alpha}}. \tag{27}$$

Next, dividing equation (24) by equation (25) provides the dynamics for the household accumulation of relative capital holdings:[17]

$$n_{ht+1} = n_{ht}\left[1 + \frac{\tilde{\phi}(T_t)(L_h/n_{ht} - \bar{L}) + \theta(1/n_{ht} - 1)}{\tilde{\phi}(T_t)\bar{L} + 1 + \tilde{\psi}(T_t) - T_t}\right]. \tag{28}$$

The steady-state conditions are obtained by substituting $h = m$ into equations (27) and (28):

$$T_m^* = \left\{(1-\alpha)\bar{L}^{1-\alpha}\left[\frac{(1-\alpha)L_m}{n_m^*\bar{L}} + \alpha\right]\right\}^{\frac{1}{\alpha}} \tag{29}$$

$$(1-\alpha)(\bar{L}T_m^*)^{1-\alpha}\left(n_m^* - \frac{L_m}{\bar{L}}\right) = \theta(1-n_m^*). \tag{30}$$

In view of our assumption that $L_m < \bar{L}$, equation (30) implies $L_m/\bar{L} < n_m^* < 1$.[18] Hence, factor compositions are not equalized and there is no unanimity. Furthermore, the median household holds a higher capital/skill ratio than the mean household. This is because the proportion of transfers received relative to pre-transfer income is higher for the median than the mean household. This does *not* however imply that the median household is richer than the average. More specifically, although $K_m^*/L_m > \bar{K}^*/\bar{L}$, we have (as in the basic model) $K_m^* < \bar{K}^*$ and $L_m < \bar{L}$.[19]

From (27), the optimal $\tau$ for a household rises with its relative skill but falls with its relative capital holding. Hence, the optimal tax for a household is negatively related to the ratio of relative capital holding to relative skill. Since this ratio is higher for the median household than for the mean, $\tau_m$ is lower than the mean household's $\tau$. This implies that, at a given $\theta$, the optimal net tax rate of the median household, which is equal to the equilibrium net tax rate, is less than that of the mean household. But the mean household's net tax rate coincides with the growth maximizing net tax rate. Let us denote the mean household's net tax rate by, $T_g$.[20] Hence, $T_m^* < T_g$, i.e., the political equilibrium lies in the left-hand region of the growth-tax curve.

[17] It is straightforward to verify that the transitional dynamics are monotonic and stable.

[18] Suppose $n_m^* \geq 1$. Then from (30), $n_m^* \leq L_m/\bar{L}$. Thus $L_m < \bar{L}$ implies $n_m^* < 1$, which is a contradiction.

[19] In Appendix 1 we prove that despite the median household holding a higher capital/labor ratio than the average household, its relative capital-holding is equal to its relative after-tax income.

[20] By equating $n_h$ to $L_h/\bar{L}$ in (27), $T_g = [(1-\alpha)\bar{L}^{1-\alpha}]^1/\alpha$.

It is worth noting here that the implication that the median household, poorer than the average, demands a lower tax on capital is sensitive to our assumption thus far that only capital is taxed. As shown in the next section, when the politically chosen tax instrument is a general income tax on capital and labor income – which is closer to what is empirically relevant – the median household prefers a higher tax rate than does the mean household. (Yet more redistributive transfers causes lower growth.)

Returning to the model, in terms of comparative statics, the two steady-state conditions yield $dn_m^*/d\theta > 0$.[21] Intuitively, more transfers lead to less inequality. This, in view of (29), implies, $dT_m^*/d\theta < 0$: i.e., less inequality lessens the political demand for the net tax on capital. This is illustrated in Figure 3.

The effect of an increase in θ on long-run growth is now straightforward. Since $T_m^* < T_g$ and $dT_m^*/d\theta < 0$, the growth rate falls. In other words, a transfer policy that reduces inequality *hurts* growth.

## 3.2 τ Non-Political and θ Political

We now consider the case where the tax rate is exogenous and the transfer policy is political. Using the expression for indirect utility, the most preferred "transfer rate"

[21] Substituting (29) into (30), eliminating $T_m^*$, and log-differentiating the resulting equation implies $dn_m^*/d\theta = 1/(a\theta)$, where,

$$a \equiv \frac{1}{1-n_m^*} + \frac{1}{n_m^* - L_m} - \frac{1-\alpha}{\alpha}\frac{(1-\alpha)L_m}{n^*[(1-\alpha)L_m + \alpha n_m^*}.$$

Given our regularity condition, $\alpha > 1/2$,

$$\begin{aligned} a &> \frac{1}{1-n_m^*} + \frac{1}{n_m^* - L_m} - \frac{(1-\alpha)L_m}{n^*[(1-\alpha)L_m + \alpha n_m^*} > \frac{1}{1-n_m^*} + \frac{1}{n_m^* - L_m} - \frac{1}{n^*} \\ &= \frac{1}{1-n_m^*} + \frac{L_m}{n_m^*(n_m^* - L_m)} > 0. \end{aligned}$$

This implies, $dn_m^*/d\theta > 0$.

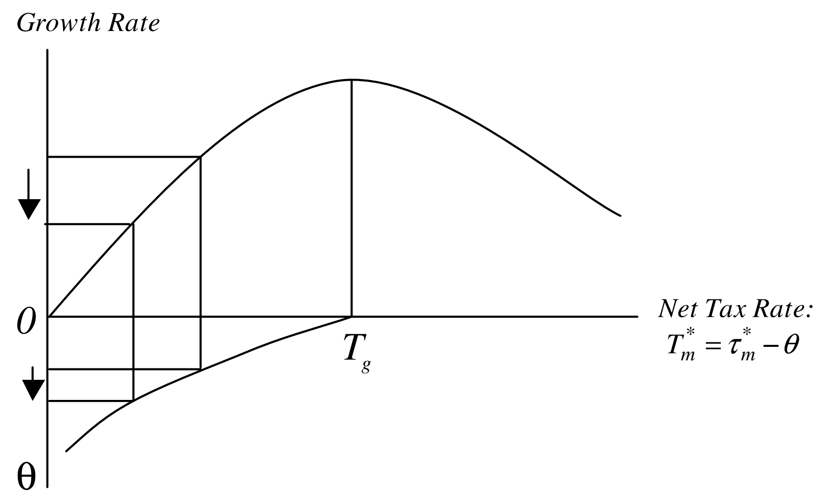


Figure 3: τ Political; θ Non-Political

of household $h$ is given by,

$$\theta_{ht} = \tau - \left\{(1-\alpha)\bar{L}^{1-\alpha}\left[\frac{(1-\alpha)L_h}{\bar{L}} + \alpha n_{ht}\right]\right\}^{\frac{1}{\alpha}}, \tag{31}$$

$$\Leftrightarrow T_{ht} \equiv \tau - \theta_{ht} = \left\{(1-\alpha)\bar{L}^{1-\alpha}\left[\frac{(1-\alpha)L_h}{\bar{L}} + \alpha n_{ht}\right]\right\}^{\frac{1}{\alpha}}. \tag{32}$$

It is obvious but important to note that the most-preferred transfer rate falls with a household's relative skill as well as its relative capital holding. This is because the richer the household – either in terms of skill or capital – the larger is the marginal benefit of an increase in the net tax rate and hence the *greater* is the marginal detrimental effect of a rise in θ – which tends to reduce the net tax rate – on its disposable income. This implies that a richer household will demand less θ and therefore a higher net tax. However, there is a qualitative difference with the previous case: here, the net tax rate increases with relative capital. In the previous case, the net tax rate decreased with relative capital.

The equation governing the dynamics of $n_{ht}$ is the same as in the previous case, except that τ is now exogenous and θ is a variable. In the steady state however, this equation reduces exactly to equation (30).[22] Thus, as before, $L_m/\bar{L} < n_m^* < 1$.

Further, since the median household is skill-poor and capital-poor relative to the mean, in view of equation (32), $T_m^*$ is less than the optimal net tax rate of the mean household. Accordingly, $T_m^* < T_g$, and like the previous case, the equilibrium lies on the left-hand arm of the growth-tax curve.

In the steady state we have

$$(1-\alpha)(\bar{L}T_m^*)^{1-\alpha}\left(n_m^* - \frac{L_m}{\bar{L}}\right) - T_m^*(1-n_m^*) = \tau(1-n_m^*), \tag{33}$$

$$T_m^* = \left\{(1-\alpha)\bar{L}^{1-\alpha}[\frac{(1-\alpha)L_m}{\bar{L}} + \alpha n_m^*]\right\}^{\frac{1}{\alpha}}, \tag{34}$$

where the former is a restatement of equation (30) and the latter follows from equation (32).

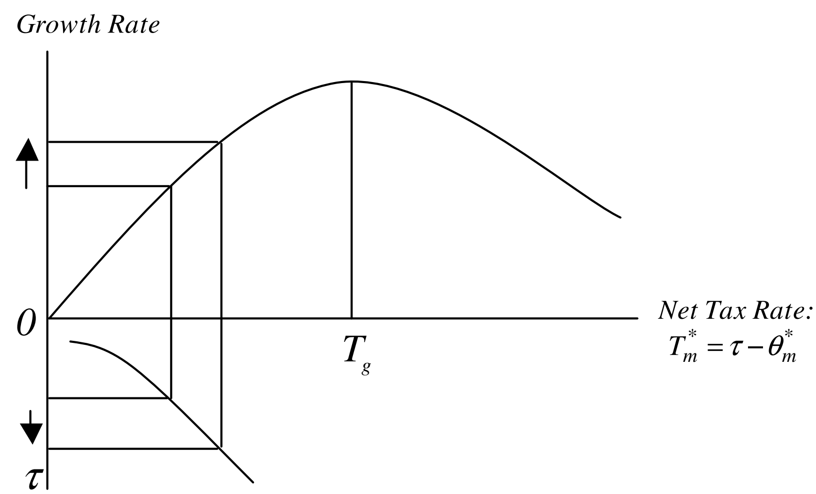


Figure 4: $\tau$ Non-Political; $\theta$ Political

It is easy to show that $dn_m^*/d\tau > 0$ and $dT_m^*/d\tau > 0$. Both implications are intuitive. As $\tau$ increases, the former implies less inequality and the latter implies higher growth. This is shown in Figure 4. Thus, a policy which is more redistributive but finances a productive input increases long-run growth.

[22] It is easy to derive that the local dynamics is locally stable and monotonic.

# 4 A General Income Tax

Similar policy conclusions hold when the input $G$ is funded by a general tax on income. However, the nature of the equilibrium may be quite different compared to when capital or capital income is taxed.

Let $\tau_{yt}$ denote a proportional tax on the sum of labor income and income from capital, and let $S_t = \theta_{yt} Q_t$ be the amount transferred back uniformly to the households. Thus $G_t = (\tau_{yt} - \theta_{yt})Q_t \equiv T_{yt} Q_t$.[23] The production function is the same, and, for notational simplicity, let $A = \bar{L} = 1$.

Given that the tax base is a household's total income, the factor rewards have the following expressions: $w_t = \hat{\phi}\bar{K}_t$, and $r_t = \hat{\psi}$. Note that $\hat{\phi} = (1-\alpha)T_{yt}^{1/\alpha}$, and $\hat{\psi} = \alpha T_{yt}^{1/\alpha}$. The household's budget constraint is given by $C_{ht} + K_{ht+1} \leq (1 - \tau_y)(w_t L_h + r_t K_{ht}) + K_{ht} + S_t$. However, the optimization exercise leads to the same Euler equation. The accumulation equation and the expression for indirect utility are, respectively,

$$K_{ht+1} = \beta \left\{ (1-\tau_{yt})[\hat{\phi}(T_{yt})L_h\bar{K}_t + \hat{\psi}(T_{yt})K_{ht}] + K_{ht} + \theta_{yt} T_{yt}^{1/\alpha} \bar{K}_t \right\}, \tag{35}$$

$$\begin{aligned} V_{ht} = \text{Constant} \cdot \big\{ & (1-\tau_{yt})[\hat{\phi}(T_{yt})L_h\bar{K}_t + \hat{\psi}(T_{yt})K_{ht}] \\ & + K_{ht} + \theta_{yt} T_{yt}^{1/\alpha} \bar{K}_t \big\}, \end{aligned} \tag{36}$$

where we have utilized the fact that $Q_t = w_t + r_t\bar{K}_t = (\hat{\phi} + \hat{\psi})\bar{K}_t = T_{yt}^{1/\alpha}\bar{K}_t$, such that $S_t = \theta_{yt} T_{yt}^{1/\alpha}\bar{K}_t$.

Aggregating equation (35), the economy's growth rate is equal to

$$g_{t+1} = \frac{K_{t+1}}{K_t} = (1-\tau_{yt})T_{yt}^{1/\alpha} + \theta_{yt} T_{yt}^{1/\alpha} = (1-T_{yt})T_{yt}^{1/\alpha}. \tag{37}$$

Thus the growth-maximizing net tax rate has the expression, $T_{yg} = 1/(1+\alpha)$. There are two cases again: $\tau_y$ is determined politically, whereas $\theta_y$ is not, and, vice versa.

## 4.1 $\tau_y$ Political and $\theta_y$ Non-Political

It will be shown that an increase in $\theta_y$, the rate of transfer, will reduce growth – which is similar to what was obtained in the case of a tax on capital only. However

[23] This can be viewed as a generalization of Barro (1990), wherein $\theta_{yt} = 0$.

interestingly, the mechanisms at work are quite different.

The most preferred tax rate of household $h$ is the one that maximizes indirect utility with respect to $\tau_{yt}$. The first-order condition yields

$$T_{yht} \equiv \tau_{yht} - \theta_y = \frac{1}{1+\alpha} + \frac{\theta_y}{1+\alpha}\left[\frac{1}{(1-\alpha)L_h + \alpha n_{ht}} - 1\right]. \tag{38}$$

Note that in contrast to the very first case where the political demand for a tax on capital rises with the relative skill but falls with relative capital, in this case the tax on total income falls with respect to both. This is because both sources of income are subject to taxation.

Aggregating equation (35), the dynamics for the median household's accumulation of relative capital holdings is given by

$$n_{mt+1} = n_{mt}\left[1 + \frac{(1-\alpha)(1-\theta_y - T_{ymt})(\frac{L_m}{n_{mt}} - 1) + \theta_y(\frac{1}{n_{mt}} - 1)}{1 - T_{ymt} + T_{ymt}^{-1/\alpha}}\right]. \tag{39}$$

In the steady state, equation (38) gives the following expression for the most preferred net tax rate by the median household:

$$T_{ym}^{*} = \frac{1}{1+\alpha} + \frac{\theta_y}{1+\alpha}\left[\frac{1}{(1-\alpha)L_m + \alpha n_m^{*}} - 1\right]. \tag{40}$$

The other steady state condition follows from (39):

$$(1-\alpha)(1-\theta_y - T_{ym}^{*})(n_m^{*} - L_m) = \theta_y(1 - n_m^{*}). \tag{41}$$

Again $L_m < n_m^{*} < 1$.

However, from equation (40), it follows that, $T_{ym}^{*} > 1/(1+\alpha) = T_{yg}$. Importantly, and unlike the previous cases, the political equilibrium lies towards the *right*-hand side of the growth-tax curve. Intuitively, given that the median household is both skill and capital poor relative to the mean household, and, as derived earlier, the optimal income tax rate of a household falls with both relative skill and relative capital holding, the median household's preferred tax rate on income is *higher* than that of the mean household.

How does an increase in $\theta_y$ affect $n_m^{*}$ and $T_{ym}^{*}$? Totally differentiating equations (40) and (41), it follows easily that $dn_m^{*}/d\theta_y > 0$; as expected, a higher rate of

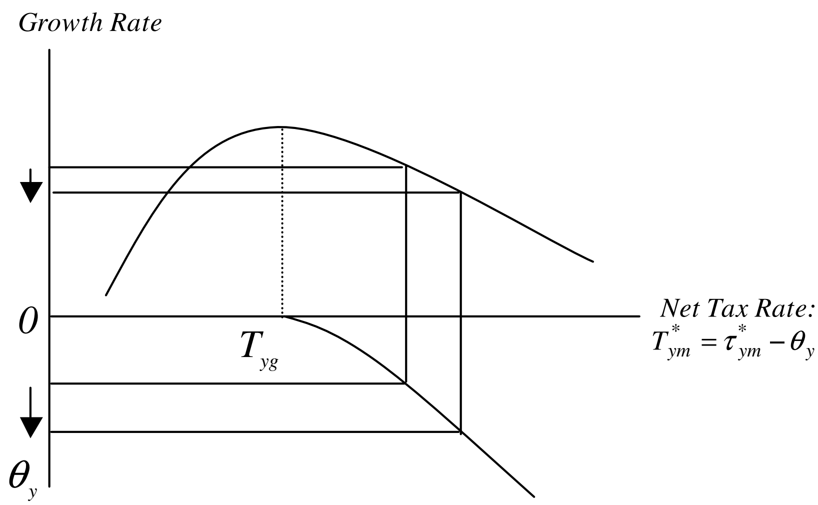


Figure 5: $\tau_y$ Political; $\theta_y$ Non-Political

transfer brings more equity. What is not apparent is that $dT^*_{ym}/d\theta_y > 0$.[24] That is, an increase in the transfer not only increases the politically determined tax rate, but it does so by more than the increase in the transfer – i.e. $d\tau^*_{ym}/d\theta_y > 1$.

Intuitively, a rise in the net tax rate increases total earnings (both from labor and capital) *as well as* the transfer income (because transfers are funded from total income). Therefore, an increase in $\theta_y$ raises the marginal gain of a rise in the net tax rate on disposable income. This leads to a demand for a higher net tax rate.

The implications towards growth is now immediate. Since the economy operates on the right-hand side of the growth-tax curve and the net tax rate increases with $\theta_y$, the growth rate falls with $\theta_y$ (Figure 5). In other words, quite interestingly, the position of the political equilibrium and the effect of an increase in the transfer rate on the net tax rate are both opposite of what they are in case of a tax on capital income only. But in tandem, the two opposites together lead to the same policy implication.

[24]See Appendix 2 for a proof.

## 4.2 $\tau_y$ Non-Political and $\theta_y$ Political

This is similar to the case of $\tau$ being non-political and $\theta$ political considered in Section 3.2. Maximizing the indirect utility expression in (36) with respect to $\theta_{yt}$ yields a household's preferred net tax as a function of $\tau_y$ and $n_{ht}$:

$$T_{yht} \equiv \tau_y - \theta_{yt} = \frac{\tau_y + (1-\tau_y)[(1-\alpha)L_h + \alpha n_{ht}]}{1+\alpha}. \tag{42}$$

The desired rate of transfer falls and the net tax rate rises with both relative skill and relative capital holding. Analogous to (39), the median household's relative capital evolves in accord with

$$n_{mt+1} = n_{mt}\left[1 + \frac{(1-\alpha)(1-\tau_y)(\frac{L_m}{n_{mt}} - 1) + (\tau_y - T_{ymt})(\frac{1}{n_{mt}} - 1)}{1 - T_{ymt} + T_{ymt}^{-1/\alpha}}\right]. \tag{43}$$

In the steady state,

$$T_{ym}^* = \frac{\tau_y + (1-\tau_y)[(1-\alpha)L_m + \alpha n_m^*]}{1+\alpha}, \tag{44}$$
$$(1-\alpha)(1-\tau_y)(n_m^* - L_m) = (\tau_y - T_{ym}^*)(1-n_m^*). \tag{45}$$

The last two equations are obtained from equations (42) and (43), respectively. Differentiating these, we obtain $dT_{ym}^*/d\tau_y$ and $dn_m^*/d\tau_y$ to be both positive.[25]

We see from equation (44) that $T_{ym}^* < T_{yg}$.[26] Thus, as shown in Figure 6, the political equilibrium lies towards the left-hand side of the growth-tax curve. Since $dT_{ym}^*/d\tau_y > 0$, an increase in $\tau_y$ increases long-run growth, i.e., both equity and growth improve.

[25]Substituting equation (44) into equation (45) and eliminating $T_{ym}^*$ yields

$$\frac{(1-\alpha^2)(n_m^* - L_m)}{1-n_m^*} + (1-\alpha)L_m + \alpha n_m^* = \frac{\alpha\tau_y}{1-\tau_y}.$$

This leads to $dn_m^*/d\tau_y > 0$. Using this, equation (44) implies $dT_{ym}^*/d\tau_y > 0$.

[26]In equation (44), the coefficient of $1-\tau_y$ is less than one. Hence the numerator, which is a weighted average of $\tau_y$ ($<1$) and $1-\tau_y$, is less than one. This implies $T_{ym}^* < 1/(1+\alpha) = T_{yg}$.

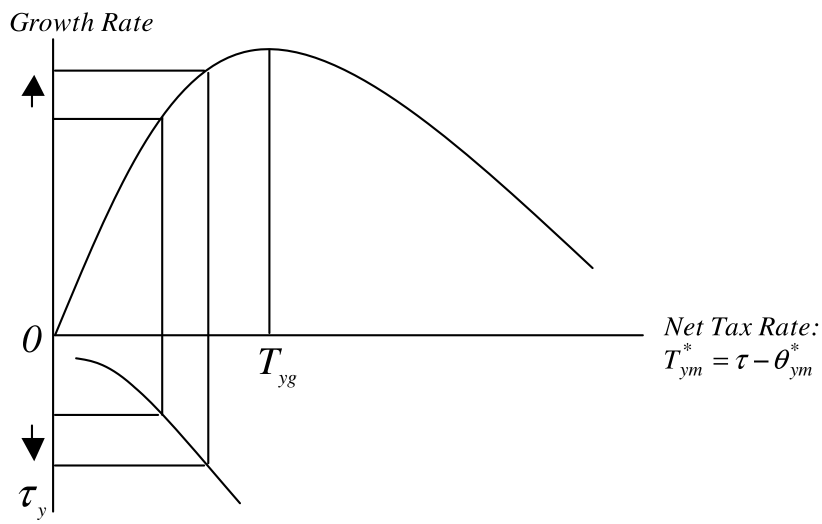


Figure 6: $\tau_y$ Non-Political; $\theta_y$ Political

# 5 Summary

This paper has formulated a model in which inequality and growth are jointly determined in a political equilibrium. There is a unique non-degenerate distribution of wealth and income in the steady state, independent of the initial distribution as in Stiglitz (1969). In terms of the political equilibrium, our model follows the median-voter approach of Alesina and Rodrik (1994) and Persson and Tabellini (1994), although our model is closer to the former. Our model also allows for a non-political (exogenous) policy instrument.

Endogeneity of distribution together with a non-political distributive policy offers novel insights. Table 1 summarizes the results. Given that a directly redistributive transfer policy is politically determined, an exogenous increase in the tax rate on capital or on total income that finances a productive input enhances both equity and growth. But when such a tax rate is politically determined, an increase in the (non-political) transfer rate raises equality but reduces long-run growth. In this sense there may be a *negative* trade-off between growth and equity. This result is consistent with recent empirical work showing that equality and growth may be negatively related. It also means that countries which primarily use redistributive transfers and maintain heavy welfare states are not likely to enjoy high long-run growth. Indeed, politics determines the mechanism behind how redistributive policies affect growth.

Table 1: Summary of Results

| TAX ON CAPITAL | Equilibrium Net Tax Rate | Growth/Equity |
|---|---|---|
| $\tau_t$ political, $\theta$ non-political; $\theta \uparrow$ | $T^* < T_g$ | growth $\downarrow$; equity $\uparrow$ |
| $\tau$ non-political, $\theta_t$ political; $\tau \uparrow$ | $T^* < T_g$ | growth $\uparrow$; equity $\uparrow$ |
| GENERAL INCOME TAX | Equilibrium Net Tax Rate | Growth/Equity |
| $\tau_{yt}$ political, $\theta_y$ non-political; $\theta_y \uparrow$ | $T_y^* > T_{yg}$ | growth $\downarrow$; equity $\uparrow$ |
| $\tau_y$ non-political, $\theta_t$ political; $\tau_y \uparrow$ | $T_y^* < T_{yg}$ | growth $\uparrow$; equity $\uparrow$ |

The difficulty of simultaneously characterizing the economic and political equilibrium in the context of growth and distribution has been recognized in the literature, e.g., Drazen (2000, p. 473). Our analysis hopes to prove a general point that the joint analytical determination of inequality, growth, and a political equilibrium is not an intractable proposition. The specific model achieves tractability by assuming limited life time and an economy in which the identity of the median household does not change over time. Hopefully, for future research, this approach would suggest other ways to ensure tractability in similar models and at the same time offer more generality. For example, what happens when individuals vote on a tax schedule rather than a tax rate? Also, there are several sources of individual heterogeneity, of which we have considered only the innate-skill heterogeneity, so as to illustrate the contrast with the existing literature. Other sources of heterogeneity such as preference shocks should be considered and their implications toward long-run distribution and growth be systematically studied.

# 6 Colophon

Satya P. Das, Planning Unit, Indian Statistical Institute, 7 S.J.S. Sansanwal Marg, New Delhi, 110016, India. Tel: (91-11)2656 4741 ext. 212. Fax: (91-11)-2685 6779. E-mail: das@isid.ac.in

Chetan Ghate, Planning Unit, Indian Statistical Institute, 7 S.J.S. Sansanwal Marg, New Delhi, 110016, India. Tel: (91-11) 2656 4741 ext. 214. Fax: (91-11)-2685 6779. E-mail: cghate@isid.ac.in, cghate@diw.de. Corresponding author.

We thank two anonymous referees and the editor, Charles I. Jones, for valuable comments. Earlier versions of this paper have benefitted from seminar presentations at the Catholic University of Louvain, Hong Kong University of Science and Technology, Indian Statistical Institute – Delhi and Kolkata, Tilburg University, DIW Berlin, ZEI Bonn, the Econometrica Society Meetings in Atlanta (January 2002), the Conference for Business Cycle and Growth Research, Manchester–UK (July 2002), University of Wisconsin-Milwaukee, the University of Konstanz, the 40th Annual Indian Econometric Society Meetings at ISEC, Bangalore–India (Jan 2004), and the “75 Years of Development Research” Conference at Cornell University, USA (May 2004). Chetan Ghate thanks the Chapman Fund at Colorado College for financial support. He also thanks the Department of Macro and Forecasting at DIW Berlin for financial support where part of this paper was written. Satya P. Das acknowledges financial support from the Belgian French Community’s program, “Action de Recherches Concertee’ 99/04-235”. See DIW Berlin Discussion Paper 310 for an earlier working paper version of this paper.

## Appendix 1

We prove that in the model of Section 3, $y_m^*/\bar{y}^* = K_m^*/\bar{K}^*$, where $y_{ht}$ denotes after-tax-transfer income, and equals $(1-\alpha)T_t^{1-\alpha}\bar{L}^{-\alpha}\bar{K}_t L_h + [1+\alpha(T_t\bar{L})^{1-\alpha} - \tau_t]K_{ht} + \theta_t\bar{K}_t$. Note that in section 3.1, where $\tau$ is political and $\theta$ is not, in the steady state

$$\begin{aligned}\frac{y_m}{\bar{y}} &= \frac{(1-\alpha)(T_m^*\bar{L})^{1-\alpha}\bar{K}L_m^*/\bar{L} + [1+\alpha(T_m^*\bar{L})^{1-\alpha} - \tau_m^*]K_m^* + \theta\bar{K}}{[(1-\alpha)(T_m^*\bar{L})^{1-\alpha} + 1 + \alpha(T_m^*\bar{L})^{1-\alpha} - \tau_m^* + \theta]\bar{K}}\\ &= \frac{(1-\alpha)(T_m^*\bar{L})^{1-\alpha}L_m^*/\bar{L} + [1+\alpha(T_m^*\bar{L})^{1-\alpha} - \tau_m^*]n_m^* + \theta}{(1-\alpha)(T_m^*\bar{L})^{1-\alpha} + 1 + \alpha(T_m^*\bar{L})^{1-\alpha} - \tau_m^* + \theta}.\end{aligned}$$

Thus,

$$\frac{y_m}{\bar{y}} - n_m = \frac{(1-\alpha)(T_m^*\bar{L})^{1-\alpha}(L_m^*/\bar{L} - n_m^*) + \theta(1-n_m^*)}{(1-\alpha)(T_m^*\bar{L})^{1-\alpha} + 1 + \alpha(T_m^*\bar{L})^{1-\alpha} - \tau_m^* + \theta}$$

Substituting the steady state condition (30), it is readily seen that the numerator of the above term is zero. This proves that $y_m/\bar{y} = n_m$.

Equation (30) also holds in section 3.2, wherein $\tau$ is not political and $\theta$ is political. Hence, in this case also, $y_m^*/\bar{y}^* = K_m^*/\bar{K}^*$.

## Appendix 2

We prove here that in the model where $\tau_y$ is political and $\theta_y$ is non-political, the net tax rate ($T_{ym}^*$)increases with $\theta_y$. Rewrite (41) as

$$\begin{aligned}\frac{1-n_m^*}{n_m^* - L_m} + 1 - \alpha &= \frac{(1-\alpha)(1-T_{ym}^*)}{\theta_y}\\ \Leftrightarrow \frac{\theta_y[1-(1-\alpha)L_m - \alpha n_m^*]}{n_m^* - L_m} &= (1-\alpha)(1-T_{ym}^*).\end{aligned}$$

Substituting equation (40) and eliminating $\theta_y$, the above equation is stated as

$$\begin{aligned}\frac{[(1+\alpha)T_{ym}^* - 1][(1-\alpha)L_m + \alpha n_m^*]}{n_m^* - L_m} &= (1-\alpha)(1-T_{ym}^*)\\ \Leftrightarrow \frac{L_m}{n_m^* - L_m} + \alpha &= \frac{(1-\alpha)(1-T_{ym}^*)}{(1+\alpha)T_{ym}^* - 1}.\end{aligned}$$

Hence, $n_m^*$ and $T_{ym}^*$ have a positive 1-1 relation independent of $\theta_y$. Therefore, $dn_m^*/d\theta_y > 0$ implies $dT_{ym}^*/d\theta_y > 0$.

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