Discussion Papers in Economics

ENDOGENOUS DISTRIBUTION, POLITICS AND THE GROWTH-EQUITY TRADEOFF

Satya P. Das
and
Chetan Ghate

Discussion Paper 03-06

September 2003

Indian Statistical Institute, Delhi
Planning Unit
7 S.J.S. Sansanwal Marg, New Delhi 110 016, India

ENDOGENOUS DISTRIBUTION, POLITICS, AND THE GROWTH-EQUITY TRADEOFF*

SATYA P. DAS and CHETAN GHATE
Indian Statistical Institute, Delhi Centre

LATEST VERSION: SEPTEMBER 24, 2003

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. Furthermore, long-run distribution, at least locally, is shown to be independent of 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 those that are primarily redistributive and imply 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.
JEL CLASSIFICATION: **D31** Personal Income and Wealth Distribution; **E62:** Fiscal Policy; **O40** Economic Growth; **P16:** Political Economy of Capitalism.

Correspondence to:
Chetan Ghate
Indian Statistical Institute – Delhi Centre
7 S.J.S. Sansanwal Marg
New Delhi 110016, India.
Tel: +91-11-651-4591. Fax: +91-11-685-6779.
Email: cghate@isid.ac.in

*The paper has benefitted from seminar presentations at the Catholic University of Louvain, Hong Kong University of Science and Technology, Indian Statistical Institute – Delhi, Tilburg University, DIW Berlin, ZEI Bonn, the Econometrica Society Meetings in Atlanta (January 2002), the Conference for Business Cycle and Growth Research (June 2002), University of Wisconsin-Milwaukee, and the University of Konstanz. 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 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.

1 Introduction

A burgeoning literature now analyzes the impact of wealth and income distribution on economic growth.[1] Its general finding is that greater equality implies higher long-run growth. In one class of models, the exogenous initial distribution of wealth engenders a balance of power in which distributive conflict influences optimal policy choices in equilibrium (Bertola, 1993; Perotti, 1993; Alesina & Rodrik, 1994; Persson & Tabellini, 1994; Aghion & Howitt, 1998). In these models, a greater level of inequality leads to voted policies which reflect a higher demand for redistribution. In Alesina-Rodrik model for example, less inequality reduces the political demand for transfer by the median household, and, the transfer being funded by a tax on capital, it implies a lower tax on capital, higher after-tax return to capital, higher investment, resulting in a lower equilibrium growth rate.

An alternative class of models links wealth distribution to economic growth when capital markets are imperfect (Loury, 1981; Galor & Zeira, 1993; Banerjee & Newman, 1993; Benabou, 1995; Aghion & Bolton, 1997; Aghion & 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 growth in the long run.

Initial empirical evidence – by Alesina-Rodrik and Persson-Tabellini – was supportive of the finding that inequality harms growth. But more recent empirical works – notably by Li and Zou (1998), Forbes (2000), Banerjee and Duflo (2003), and Lundberg and Squire (2003) – have found some evidence of the contrary: namely, more inequality may promote economic growth. For instance, in a structural regression accounting for the simultaneous endogeneity

[1] See Benabou (1995) and Aghion et. al. (1999) for an exhaustive survey of this literature.

between growth and equality, Lundberg and Squire (2003, p. 336, Table 2) find that the point estimate on the Gini coefficient is positive (where growth is the dependent variable). Similarly, Banerjee and Duflo (2003) find that changes in inequality *in any direction* are associated with lower future growth rates. Indeed, these findings appear to resurrect the traditional tradeoff between growth and equity. However, to the best of our knowledge, there doesn't exist to date any model of endogenous growth with re-distributive politics that predicts, in a strong way, *a negative* causal relationship from an equity-enhancing policy to growth.

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 the existing models of distribution and growth. We use the well-known Alesina-Rodrik (A-R) model and generalize it in two important aspects. The end-product is capable of establishing a negative tradeoff 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 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 distribution. This is done by postulating that households have finite lifetimes and there is a bequest motive, i.e., it is a warm-glow model with one-sided altruism. For simplicity, households are assumed to live for a single period and their utility function has, as arguments, their own consumption and the amount they bequest, with positive and diminishing marginal utility from each argument (Picketty, 1997; Aghion and Bolton, 1997). Interestingly, such a framework endogenizes wealth and income distribution. It is because limited lifetimes together with diminishing marginal utility from bequests (equal to savings) imply that households would not want to 'jump' to their steady-state capital holdings immediately. Thus, there are transitional dynamics, even though the production function is of the 'AK' variety.[2] This makes the evolution of wealth distribution endogenous – independent of the initial distribution.[3] This is our first generalization.

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

Given this construct, our main finding makes appealing economic sense: *a non-political tax policy, which is more redistributive but contributes toward growth-enhancing productive inputs*

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

[3]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 (similar to A-R actually). 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, as we shall see, 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.

does promote long-run growth, whereas a non-political and equity-enhancing transfer policy reduces economic growth. It is also shown that the position of the political equilibrium plays a role in the mechanism in which redistributive policies affect growth.

The paper proceeds as follows. Section 2 develops our basic finite-lifetime model. It assumes a single policy, tax on capital, which is political. This is same as the A-R model but the important difference is that there is transitional dynamics and the long-run wealth distribution is endogenous. Section 3 introduces a transfer scheme, along with tax on capital. One of these policies is non-political. None of our results are sensitive to the assumption that only capital or capital income is taxed. Section 4 analyzes a general income tax *a la* Barro (1990). In this model also, a more redistributive tax policy improves long-run growth, but a more redistributive transfer scheme reduces it. 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.[4] No further assumption such as 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 as a simple index of wealth

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

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 $L = \bar{L}$.

2.1 Production

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

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

where Q_t is output at time t, $\bar{K}_t$ denotes the mean/aggregate capital, G_t is a public-infrastructure input and $A > 0$ is an index of technology.[5] Following the endogenous growth literature, we interpret K as physical as well as human capital. Hence, α is the private return to physical and human capital. We require a regularity condition: $\alpha > 1/2$, which, as will be seen later, ensures that the net return to capital in equilibrium is positive.[6]

As in A-R, the input G_t is financed by a (specific) tax on capital income, which is equivalent to a wealth tax.[7] The government budget constraint is satisfied in all time periods, i.e., $G_t = \tau_t \bar{K}_t$. The competitive factor rewards are:

$$r_t = \psi(\tau_t) \equiv \alpha A \tau_t^{1-\alpha} \bar{L}^{1-\alpha}, \quad w_t = \phi(\tau_t)\bar{K}_t, \text{ where } \phi(\cdot) \equiv (1-\alpha)A\tau_t^{1-\alpha}\bar{L}^{-\alpha}, \tag{2}$$

where r_t is the rent earned by capital and w_t denotes the wage rate. Note that an increase

[5] By assuming a Cobb-Douglas specification, we maintain consistency with the literature. But, more generally, the 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.

[6] 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 α equal to 0.75 is quite reasonable.

[7] 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.

in τ enhances the marginal product of both factors. This constitutes the source of gain to household income and the economy's growth rate. As in A-R, without loss of generality, we let the rate of capital depreciation be zero.

2.2 The Household's Problem

Following Aghion and Bolton (1997), Picketty (1997), and Das (2000, 2001), every one lives for a single period. At the end of the period, a replica is born to each agent, and agents pass on a bequest to their children. Households derive utility from consumption, C_{ht}, and the amount of the good 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. Hence, 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, it is Cobb-Douglas: $U_{ht} = C_{ht}^{1-\beta} K_{ht+1}^{\beta}, \quad 0 < \beta < 1$. The budget constraint facing an agent h is given by

$$C_{ht} + K_{ht+1} \leq \phi(\tau_t)\bar{K}_t L_h + [1 + \psi(\tau_t) - \tau_t] K_{ht}. \tag{3}$$

We assume that the skill level of a household does not change over time or generations.[8] Each household is identified by a given L_h. There is no dynamic stochastic process governing the evolution of L_h.[9]

The tax rate is already known when households make their consumption and bequest de-

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

[9] The benefit 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.

cisions. Their optimization exercise implies the following Euler equation for consumption: $C_{ht} = \frac{1-\beta}{\beta} K_{ht+1}$. It also leads to the following individual and aggregate accumulation equations:

$$K_{ht+1} = \beta \left\{ \phi(\tau_t) L_h \bar{K}_t + [1 + \psi(\tau_t) - \tau_t] K_{ht} \right\}, \tag{4}$$

$$\bar{K}_{t+1} = \beta \left\{ \phi(\tau_t) \bar{L} + [1 + \psi(\tau_t) - \tau_t] \right\} \bar{K}_t. \tag{5}$$

Substituting the Euler equation for consumption into the utility function yields

$$U_{ht} = \text{Constant} \cdot K_{ht+1}. \tag{6}$$

Finally, substituting eq. (4) into eq. (6) yields the household's indirect utility function:

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

It is sufficient to note that for any value of $\bar{K}_t$ and K_{ht}, the indirect utility is single peaked with respect to τ_t. This implies that the median household's optimal tax rate defines equilibrium under majority voting. However, before characterizing the prefered tax rate of the median voter, we first prove that the median household is unique – which is an implication of our assumption that for any given h, L_h does not vary over time. The invariance of the median voter's identity over time ensures analytical tractability of our model.

2.3 Uniqueness of the Median Household

Define $n_{ht} \equiv K_{ht}/\bar{K}_t$. Dividing (4) by (5),

$$n_{ht+1} = n_{ht}\left[1 + \frac{\phi(\cdot)(L_h/n_{ht} - \bar{L})}{\phi(\cdot)\bar{L} + 1 + \psi(\cdot) - \tau_t)}\right]. \tag{8}$$

Let us start to track the economy from an initial period in which the tax rate is exogenous, not politically determined. Note then that the dynamic process (8) leads to a steady state where

$$n_h^* = \frac{L_h}{\bar{L}} \Rightarrow \phi(\tau)\bar{K}^* + [1 + \psi(\tau^*) - \tau^*]\frac{K_h^*}{L_h} = \bar{K}^*\left[\phi(\tau^*) + \frac{1 + \psi(\tau^*) - \tau^*}{\bar{L}}\right]. \tag{9}$$

The asterisks mark the steady-state values. The relation (9) implies that K_h^*/L_h is same for all h, i.e. the ranking of households in terms of capital held and disposable income is the same in terms of L_h. This 'alignment' of K_h^* with L_h in terms of ranking implies that the median household is 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* what the tax rate is, (4) 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, off or on the steady state, as long as the households do not face asymmetric skill or preference shocks so as to change the initial ranking of households on the L_h scale. We assume away such shocks, which implies that the median household's identity is unchanged even though τ may change over time.

2.4 Analysis of Optimal Tax

How does the optimal tax rate compare across the households? Given (7), since the indirect utility of any particular household h is single-peaked with respect to τ_t, its optimal tax is given by the first order condition:[10]

$$\frac{\phi'(\tau_t)L_h}{n_{ht}} + \psi'(\tau_t) - 1 = 0. \tag{10}$$

From this equation, we can regard the marginal cost (MC) of a tax increase on disposable income as equal to 1, while the marginal 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: one is labor-rich and capital-poor and the other is labor-poor and capital-rich, i.e., the ratio L_h/n_{ht} is more 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 than a labor-poor-capital-rich household. Hence, the optimal tax rate is higher for the former.

Using the definitions of $\phi(\cdot)$ and $\psi(\cdot)$ functions, the eq. (10) yields the following closed-form expression for the optimal tax rate of the h^{th} household at time t, τ_{ht}:

$$\tau_{ht} = \left\{ A(1-\alpha)\bar{L}^{1-\alpha} \left[\frac{(1-\alpha)L_h}{n_{ht}\bar{L}} + \alpha \right] \right\}^{\frac{1}{\alpha}}. \tag{11}$$

Eq. (11) implies that the most preferred tax rate for a particular household depends on the

[10] The second-order condition can be easily verified.

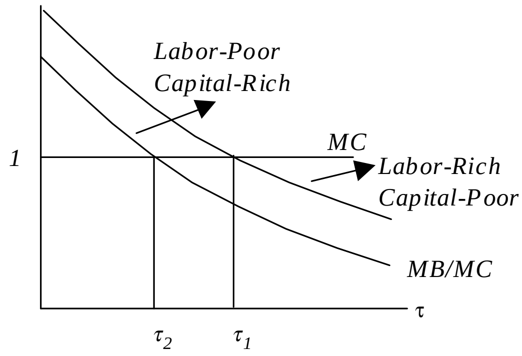

Figure 1: Optimal Tax for Households with Different Factor Holding Compositions

ratio of two ratios, namely, $n_{ht}/(L_h/\bar{L})$. From now on, unless specified otherwise, let "relative" mean relative to the mean household. Thus, quite intuitively, τ_{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 always positive. Moreover, this is bounded from below by the tax rate which will be chosen if a household's labor income were zero.[11]

In particular, the equilibrium tax rate is equal to the optimal tax of the median household. This is given by substituting $h = m$ in (11):

$$\tau_{mt} = \left\{ A(1-\alpha)\bar{L}^{1-\alpha} \left[\frac{(1-\alpha)L_m}{n_{mt}\bar{L}} + \alpha \right] \right\}^{\frac{1}{\alpha}}, \tag{12}$$

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

2.5 Steady State

The dynamics of the economy is fundamentally described by (8) with $h = m$ and eq. (12). They contain two variables, n_{mt} and τ_{mt}.

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

Substituting $n_{mt+1} = n_{mt} = n_m^*$ in (8), it follows that, along the steady state,

$$n_m^* = \frac{L_m}{\bar{L}} \Leftrightarrow \frac{K_m^*}{L_m} = \frac{\bar{K}^*}{\bar{L}}. \tag{13}$$

That is, the median household's composition of factor holdings is equal to that of the mean household. Indeed, (8) holds for all households, i.e.,

$$n_h^* = \frac{L_h}{\bar{L}} \Leftrightarrow \frac{K_h^*}{L_h} = \frac{\bar{K}^*}{\bar{L}} \quad \forall h. \tag{14}$$

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. This does *not* mean that there is (perfect) equality: although K_h^*/L_h is 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, (14) 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 Cobb-Douglas technology or that only capital is being taxed. 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.

Graphically, note that in terms of the MB/MC and MC curves depicted in Figure 1, each household's MB/MC curve collapses to that of the mean household and its intersection with the MC=1 line gives τ in equation (15). 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[12]

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

We note a technical point here. Using (15), 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 $\kappa > 0$.

Turning to the economy's growth rate, let us define it by $g_t \equiv K_t/K_{t-1}$. From (5),

$$g_{t+1} = \beta[\phi(\tau_t)\bar{L} + 1 + \psi(\tau_t) - \tau_t] = \beta(1 + A\bar{L}^{1-\alpha}\tau_t^{1-\alpha} - \tau_t). \tag{16}$$

This shows a non-monotonic relationship between growth and the tax rate. On one hand, an increase in τ increases the marginal products of labor and capital and thus tends to increase disposable income. On the other hand, it lowers after-tax income. Hence, there is a trade-off. Moreover, similar to the A-R model, there is a unique growth-maximizing tax rate equal to

$$t_g = \left[A(1-\alpha)\bar{L}^{1-\alpha}\right]^{\frac{1}{\alpha}}. \tag{17}$$

However, unlike in A-R, this is *same* as the equilibrium tax rate in the steady state given by equation (15), i.e. *long-run growth is maximized at the political equilibrium.* It follows from the convergence of capital-labor ratio holdings across households. This, we believe, is

[12] In Galor and Moav (2002), there is also unanimity. However, our model contrasts from theirs in two respects. In their model unanimity occurs in a very different context: i.e., once the descendants of workers are sufficiently rich to invest in their human capital. Further, there is unanimity in both the short run and the long run. In our model, it holds in the long run only.

a very interesting departure from the exogenous-distribution framework, and, a useful benchmark case where political equilibrium coincides with maximization of growth. The benefit of identifying this economic environment 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 (15) 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 (16) 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 corollary of this 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.[13]

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, and, 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 would also indicate inequality in terms of income and utility. In other words, inequality in terms of wealth, income and utility are synonymous in our model.

[13]It is easy to see that an increase in the preference parameter β does not affect the tax rate but leads to an increase in the growth rate.

Further, we observe directly from (13) that the long run wealth inequality is the same as the inequality in skill, i.e., more generally, the distribution of long-run wealth is the same as that of the skill. Within the purview of the model this is only natural.[14] Since the innate skill distribution is exogenous, unlike the tax rate or the growth rate, the level of inequality is not affected, for example, by a technology shock.[15]

More generally, we can define inequality in terms of coefficient of variation.[16] From (14) 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.

2.6 Comparing With the A-R Model

Figure 2 illustrates the comparison and reconciliation with the A-R model in a simple manner. The non-monotonic relationship between the growth rate and the tax rate – given by eq. (16) – is depicted in the top panel. We call it the 'growth-tax curve.' The tax rate that maximizes the aggregate/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 eq. (11): 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-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

[14] 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 innate skill distribution.

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

[16] See Caselli and Ventura (1999) and Das (2000, 2001).

is g^0. Now, if ρ_m increases to ρ_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 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 political equilibrium implies the growth-maximizing tax rate, τ_g. There is no conflict between politics and efficiency.

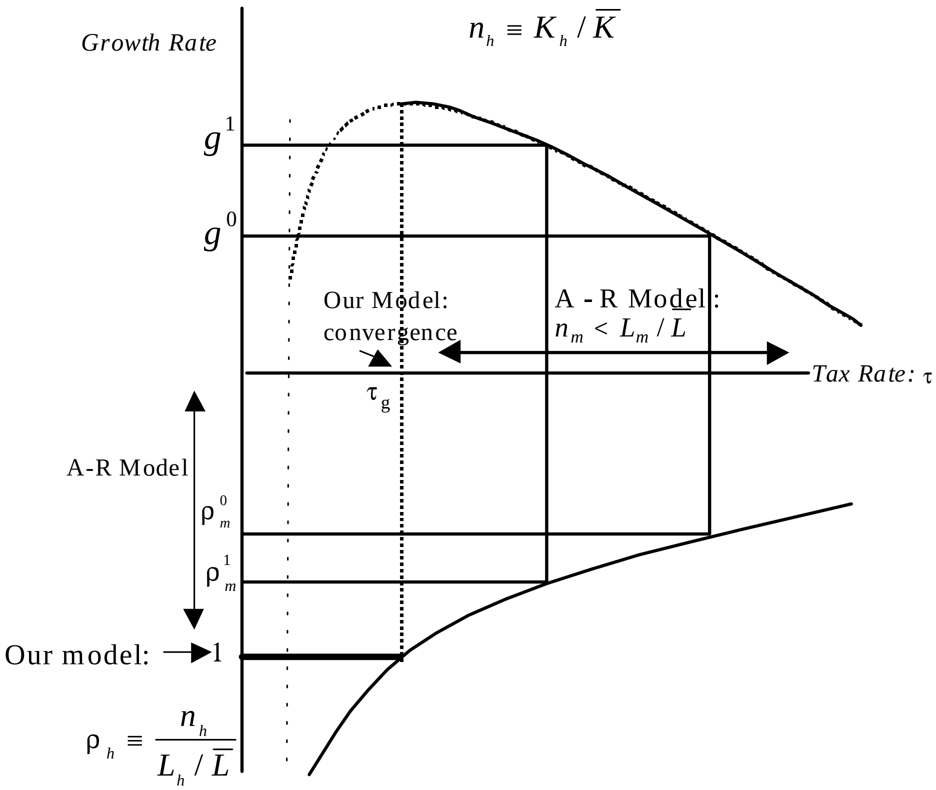

Figure 2: Comparison with the Alesina-Rodrik Model

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? The transitional dynamics are governed by equations (8) and (12).

Totally differentiating equation (8) and evaluating the derivative by using the steady state condition $L_m/n_{mt} = \bar{L}$, we get

$$0 < \left. \frac{dn_{mt+1}}{dn_{mt}} \right|_{n_{mt} \to L_m/\bar{L}} = \frac{1 + \psi(\tau) - \tau}{\phi(\tau)\bar{L} + 1 + \psi(\tau) - \tau} < 1. \tag{18}$$

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 in L_h. Given the dynamics of n_{mt}, the dynamics of the tax rate are evident from (12). 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 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 $\rho_{m0} \lesseqgtr L_m/\bar{L}$ initially. Furthermore, since increase in ρ_{mt} means more equality, the contemporaneous correlation between growth and equality is negative and positive as $\rho_{m0} \lesseqgtr L_m/\bar{L}$ initially.

This completes the analysis of our basic model.

2.8 Proportional Tax on Capital Earnings

We now demonstrate that our bench-mark result that everyone's relative holding of capital to basic skill is the same does not hinge on our assumption of specific tax on capital earnings, which is equivalent to a wealth tax.[17] Let τ_t now denote the *proportion* of capital earnings that is taxed. Then $G = \tau_t r_t K_t$.

Working through the model, the optimal tax for any household h is governed a the first-order condition analogous to (10). This is given by

$$\frac{\breve{\phi}'(\tau_t)L_h}{n_{ht}} - \breve{\psi}(\tau_t) + (1-\tau_t)\breve{\psi}'(\tau_t) = 0, \text{ where } \breve{\psi}(\tau_t) = \tilde{\psi}(\tau_t)^{\frac{1}{\alpha}}, \ \ \breve{\phi}(\tau_t) = A^{\frac{1}{\alpha}}(1-\alpha)\alpha^{\frac{1-\alpha}{\alpha}}\tau_t^{\frac{1-\alpha+\alpha^2}{\alpha}}\bar{L}^{\frac{1-2\alpha}{\alpha}}.$$

Likewise, similar to eqs. (4) and (5), the individual and aggregate accumulation equations are:

$$K_{ht+1} = \beta\left\{\breve{\phi}(\tau_t)L_h\bar{K}_t + (1-\tau_t)\breve{\psi}(\tau_t)K_{ht}\right\}; \quad \bar{K}_{t+1} = \beta\left\{\breve{\phi}(\tau_t)\bar{L} + (1-\tau_t)\breve{\psi}(\tau_t)\right\}\bar{K}_t. \tag{19}$$

Given (19), wealth distribution evolves according to

$$n_{ht+1} = n_{ht}\left[1 + \frac{\breve{\phi}(\cdot)(L_h/n_{ht} - \bar{L})}{\breve{\phi}(\cdot)\bar{L} + (1-\tau_t)\breve{\psi}(\cdot)}\right]. \tag{20}$$

Hence, along the steady state,

$$n_h^* = \frac{L_h}{\bar{L}} \Leftrightarrow \frac{K_h^*}{L_h} = \frac{\bar{K}^*}{\bar{L}}. \tag{21}$$

Every household's composition of factor holdings is the same. There is unanimity. Further, following the reasoning before, it is easy to see that convergence to the steady state is smooth and monotonic.

In sum, whether it is a tax on wealth or capital earning, the endogeneity of wealth distribu-

[17] Nor does it depend on the assumption of Cobb-Douglas technology.

tion implies a configuration of the long-run growth rate, 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 bench-mark model with endogenous long-run distribution. As our second generalization, we now introduce an additional distributive policy. Unanimity, we shall see, now 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 independent or non-political. Accordingly, suppose that there is also a transfer policy, where θ denotes the fraction of tax revenues disbursed back uniformly across households. Thus, there are two policies: τ and θ. Both are redistributive as well as have implications towards the growth. However, θ is relatively more redistributive, whereas τ is primarily more targeted towards growth (as it finances the public input G). Assuming that one of the two policies is political and the other is not, we ask how an exogenous change in the policy that is non-political affects the other policy through the political process and thereby affects distribution and growth.

There are two possibilities: (a) τ is political as before, while θ is not and (b) τ is non-political and θ is political. For simplicity, let us revert back to the assumption (as in A-R) that τ represents specific tax on capital earnings.

3.1 τ Political and θ Non-Political

Let the policy which is political have time subscript, whereas the other doesn't. We have $G_t = (\tau_t - \theta)\bar{K}_t$, where $S_t \equiv \theta K_t$ is transferred back uniformly to all households. Denote

$T_t \equiv \tau_t - \theta$, the net tax on capital. Normalizing $A = 1$ for the sake of notational simplicity, the competitive rewards are then

$$w_t = \tilde{\phi}(T_t)\bar{K}_t; \quad r_t = \tilde{\psi}(T_t) \quad \text{where } \tilde{\phi}(\cdot) = (1-\alpha)T_t^{1-\alpha}\bar{L}^{-\alpha}; \quad \tilde{\psi}(\cdot) = \alpha(T_t\bar{L})^{1-\alpha}. \tag{22}$$

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

$$K_{ht+1} = \beta\left\{\tilde{\phi}(T_t)L_h\bar{K}_t + [1+\tilde{\psi}(T_t)-\tau_t]K_{ht} + \theta\bar{K}_t\right\} \tag{23}$$

$$\bar{K}_{t+1} = \beta\left\{\tilde{\phi}(T_t)\bar{L} + 1 + \tilde{\psi}(T_t) - T_t\right\}\bar{K}_t, \tag{24}$$

$$V_{ht} = \text{Constant}\cdot\left\{\tilde{\phi}(T_t)L_h\bar{K}_t + [1+\tilde{\psi}(T_t)-\tau_t]K_{ht} + \theta K_t\right\}. \tag{25}$$

Maximizing indirect utility with respect to τ_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 (11):

$$T_{ht} = \left\{(1-\alpha)\bar{L}^{1-\alpha}\left[\frac{(1-\alpha)L_h}{n_{ht}\bar{L}} + \alpha\right]\right\}^{\frac{1}{\alpha}}. \tag{26}$$

Next, dividing (23) by (24) gives the dynamics for the household accumulation of relative capital holdings:[18]

$$n_{ht+1} = n_{ht}\left[1 + \frac{\tilde{\phi}(T_t)(L_h/n_{ht}-\bar{L}) + \theta(1/n_{ht}-1)}{\tilde{\phi}(T_t)\bar{L} + 1 + \tilde{\psi}(T_t) - T_t}\right]. \tag{27}$$

[18] It is straight forward to verify that the transitional dynamics are monotonic and stable.

Steady-state conditions are obtained by substituting $h = m$ in (26) and (27):

$$T_m^* = \left\{(1-\alpha)\bar{L}^{1-\alpha}\left[\frac{(1-\alpha)L_m}{n_m^*\bar{L}} + \alpha\right]\right\}^{\frac{1}{\alpha}} \tag{28}$$

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

In view of our assumption that the median skill is less than the mean, i.e, $L_m < \bar{L}$, eq. (29) implies that $L_m/\bar{L} < n_m^* < 1$.[19] 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. It 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. Although $K_m^*/L_m > \bar{K}^*/\bar{L}$, we have, as in the basic model, $K_m^* < \bar{K}^*$ and $L_m < \bar{L}$.[20]

From (26), the optimal τ for a household rises with the relative skill and falls with the relative capital holding and thus 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, τ_m is lower than the mean household's τ. This implies that, at given θ, the optimal net tax rate of the median household, equal to the equilibrium net tax rate, is less than that of the mean household. But the mean household net tax rate coincides the growth maximizing net tax rate, say T_g.[21] Hence, $T_m^* < T_g$, i.e., the political equilibrium lies in the left-hand side of the growth-tax curve.

[19]Suppose $n_m^* \geq 1$. Then, from (29), $n_m^* \leq L_m/\bar{L}$. Thus $L_m < \bar{L}$ implies $n_m^* < 1$, which is a contradiction.

[20]Also, in Appendix 1, we prove that, despite the median household holding more capital/labor ratio than does the average household, the capital-holding and the after-tax income ratios are equal between the two households.

[21]By equating n_h to $L_h/\bar{L}$ in (26), $T_g = [(1-\alpha)\bar{L}^{1-\alpha}]^1/\alpha$.

In terms of comparative statics, the two steady-state conditions yield $dn_m^*/d\theta > 0$.[22] Intuitively, more transfers leads to less inequality. This, in turn, implies, in view of (28), $dT_m^*/d\theta < 0$: less inequality lessens the political demand for less net tax on capital.

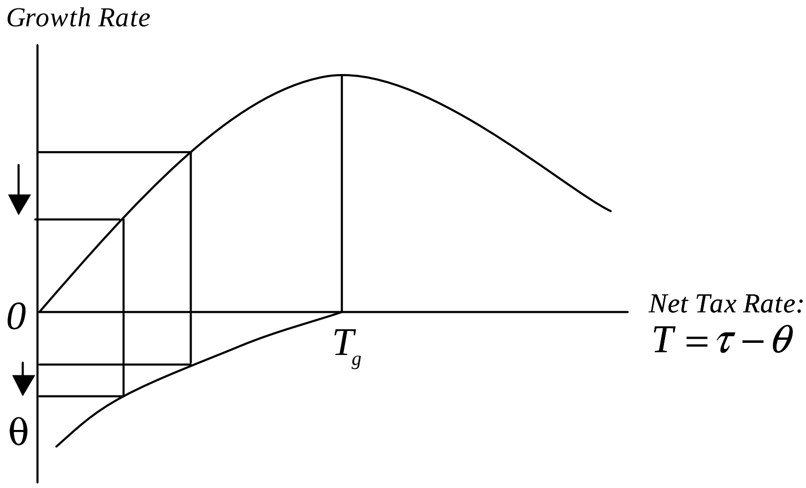

Figure 3: τ Political; θ Non-Political

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.

[22] Substituting (28) into (29), eliminating T_m^* and log-differentiating the resulting equation give $dn_m^*/d\theta = 1/(a\theta)$, 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 $dn_m^*/d\theta > 0$.

3.2 τ Non-Political and θ Political

This is the case where the tax rate is exogenous and the transfer policy is political. Using the expression of indirect utility, the most preferred "transfer rate" of household h is given by

$$\theta_{ht} = \tau - \left\{(1-\alpha)\bar{L}^{1-\alpha}\left[\frac{(1-\alpha)L_h}{\bar{L}} + \alpha n_{ht}\right]\right\}^{\frac{1}{\alpha}} \tag{30}$$

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

It is obvious but important to note that the optimal transfer rate falls with a household's relative skill as well as relative capital holding. It 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 *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.

There is a qualitative difference with the previous case: here the net tax rate increases with relative capital, whereas it decreased with relative capital in the previous case.

The equation governing the dynamics of n_{ht} is 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 (29).[23] Thus, as before, $L_m/\bar{L} < n_m^* < 1$.

The median household being skill-poor and capital-poor relative to the mean, in view of (31), T_m^* is less than the optimal net tax rate of the mean household. Accordingly $T_m^* < T_g$ and like in the previous case, the equilibrium lies on the left-hand arm of the growth-tax curve.

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

In the steady state we have

$$(1-\alpha)(\bar{L}T_m^*)^{1-\alpha}\left(n_m^* - \frac{L_m}{\bar{L}}\right) - T_m^*(1-n_m^*) = \tau(1-n_m^*) \tag{32}$$

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

where the former is a restatement of (29) and the latter follows from eq. (31).

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

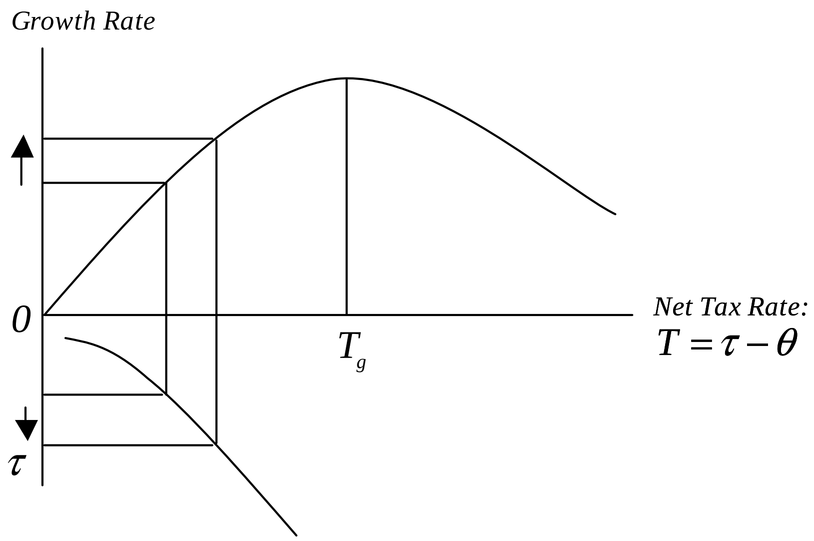

Figure 4: τ Non-Political; θ Political

4 A General Income Tax

The same policy conclusions hold when the input G is, instead, 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 τ_{yt} denote a proportional tax on the sum of labor and income from capital, and let $S_t = \theta_{yt} Q_t$ be the amount transferred back uniformly to the households. Thus $G_t = (\tau_{yt} - \theta_{yt})Q_t \equiv T_{yt} Q_t$.[24] The production function is the same, and, for notational simplicity, let $A = \bar{L} = 1$. There are again two cases: τ_y is not political, whereas θ_y is, and, the vice versa. We consider these in turn.

4.1 τ_y Non-Political and θ_y Political

This is quite similar to the previous case.

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 $r_t = \hat{\psi}$, where $\hat{\phi} = (1-\alpha)T_{yt}^{1/\alpha}$ and $\hat{\psi} = \alpha T_{yt}^{1/\alpha}$. A household's budget constraint is given by $C_{ht} + K_{ht+1} \leq (1-\tau_y)(w_t L_h + r_t K_{ht}) + S_t$. However, the household optimization leads to the same first-order condition. Together with the budget constraint, it gives rise to

$$K_{ht+1} = \beta\left\{(1-\tau_y)[\hat{\phi}(T_{yt})L_h\bar{K}_t + [1+\hat{\psi}(T_{yt})]K_{ht}] + \theta_{yt}T_{yt}^{1/\alpha}\bar{K}_t\right\}, \tag{34}$$

$$V_{ht} = \text{Constant}\cdot\left\{(1-\tau_y)[\hat{\phi}(T_{yt})L_h\bar{K}_t + [1+\hat{\psi}(T_{yt})]K_{ht}] + \theta_{yt}T_{yt}^{1/\alpha}\bar{K}_t\right\} \tag{35}$$

where we have utilized 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 $S_t = \theta_y T_{yt}^{1/\alpha}\bar{K}_t$.

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

Maximizing (35) with respect to θ_{yt} yields the net tax as a function of τ_y and n_{ht}:

$$T_{yht} \equiv \tau_y - \theta_{yt} = \frac{\tau_y + (1-\tau_y)[(1-\alpha)L_h + \alpha n_{ht}]}{1+\alpha}. \tag{36}$$

Analogous to the previous case, the rate of transfer falls and the net tax rate rises with both relative skill and relative capital holding.

Using (34) and aggregating it, the dynamics for the median household's accumulation of relative capital holdings is given by

$$n_{mt+1} = n_{mt}\left[1 - \frac{(1-\alpha)(1-\tau_y)(1-\frac{L_m}{n_{mt}}) + (\tau_y - T_{yt})(1-\frac{L_m}{n_{mt}})}{1-T_{yt}}\right]. \tag{37}$$

In the steady state then

$$T_y^* = \frac{\tau_y + (1-\tau_y)[(1-\alpha)L_m + \alpha n_m^*]}{1+\alpha} \tag{38}$$

$$(1-\alpha)(1-\tau_y)(n_m^* - L_m) = (\tau_y - T_y^*)(1-n_m^*). \tag{39}$$

The last two equations are respectively obtained from (36) and (37). Eq. (39) implies $L_m < n_m^* < 1$. Differentiating these equations, we obtain $\partial T_y^*/\partial\tau_y$ and $\partial n_m^*/\partial\tau_y$ both positive.[25] The intuition is similar to the previous case.

Aggregating (34) gives a slightly different expression of growth as a function of the net tax, namely, $g^* = \beta(1-T_y)T_y^{1/\alpha}$. But the trade-off is analogous. There is a growth-maximizing net

[25]Substituting (38) into (39) and eliminating T_y^* gives

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

This yields $\partial n_m^*/\partial\tau_y > 0$. Using this, eq. (38) implies $\partial T_y^*/\partial\tau_y > 0$.

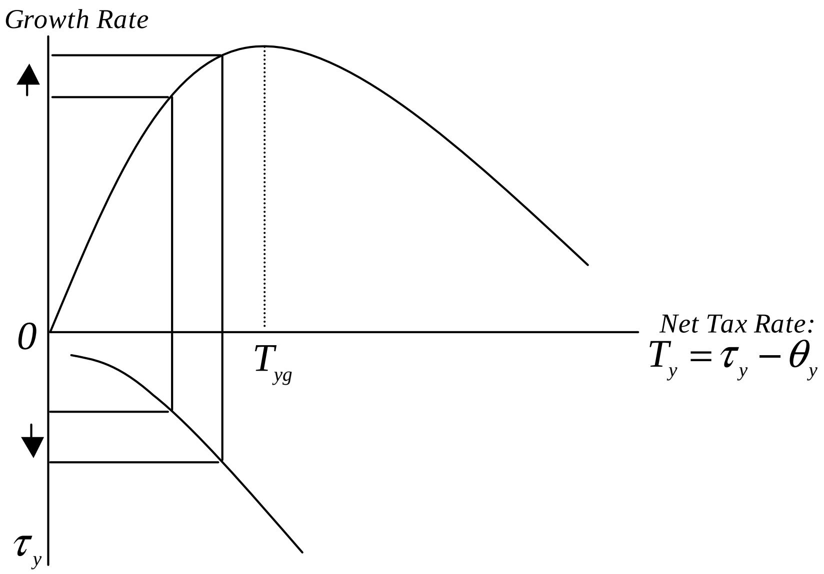

Figure 5: τ_y Non-Political; θ_y Political

tax rate, and, this is given by $T_{yg} = 1/(1+\alpha)$. We see from (38) that $T_y^* < T_{yg}$.[26] Thus the political equilibrium lies in the left-hand side of the growth-tax curve.

How does an increase in τ_y affect growth? Since $\partial T_y^*/\partial \tau_y > 0$, it follows that it increases long-run growth. This is shown in Figure 5. As in case of tax on capital, an increase in the tax rate on total income enhances both growth and equity.

4.2 τ_y Political and θ_y Non-Political

It will be shown that an increase in θ_y, the rate of transfer, will reduce growth – which is similar to what was obtained in case of tax on capital only. But, interestingly, the mechanisms at work are quite different.

[26] In (38) the coefficient of $1-\tau_y$ is less than one. Hence the numerator, which a weighted average of τ_y (< 1) and $1-\tau_y$, is less than one. This implies $T_y^* < 1/(1+\alpha) = T_{yg}$.

Proceeding as in earlier cases, the equilibrium tax rate is given by

$$\tau_{yht} = \theta_y + \frac{1}{1+\alpha} + \theta_y \left[\frac{1}{(1-\alpha)L_h + \alpha n_{ht}} - \frac{1}{1+\alpha} \right]. \tag{40}$$

Note that, in contrast to the very first case where the political demand for the tax rate rises with the relative skill but falls with relative capital, here it falls with respect to both – because it is a tax on total income, not just on capital.

In the steady state and for the median household, eq. (40) gives the following expression of the net tax rate:

$$T_y^* = \frac{1}{1+\alpha} + \theta_y \left[\frac{1}{(1-\alpha)L_m + \alpha n_m^*} - \frac{1}{1+\alpha} \right]. \tag{41}$$

The other steady state is condition is (39), which can restated as:

$$\frac{1-n_m^*}{n_m^* - L_m} = \frac{(1-\alpha)(1-\theta_y - T_y^*)}{\theta_y}. \tag{42}$$

Note that if $\theta_y = 0$, then $n_m^* = L_m$. Unanimity holds. But given $\theta_y > 0$ it does not, and the last equation gives $L_m < n_m^* < 1$.

Notice from (41) that $T_y^* > 1/(1+\alpha) = T_{yg}$, that is, unlike in the previous three cases, the political equilibrium lies in the *right*-hand side of the growth-tax curve. The median household is both skill- and capital-poor relative to the mean household, and, as derived earlier, the optimal income tax rate falls with relative skill and relative capital holding. Hence its preferred tax rate on income is *higher* than that of the mean household. At any given θ_y it translates to the equilibrium tax rate being higher than the growth-maximizing tax rate.

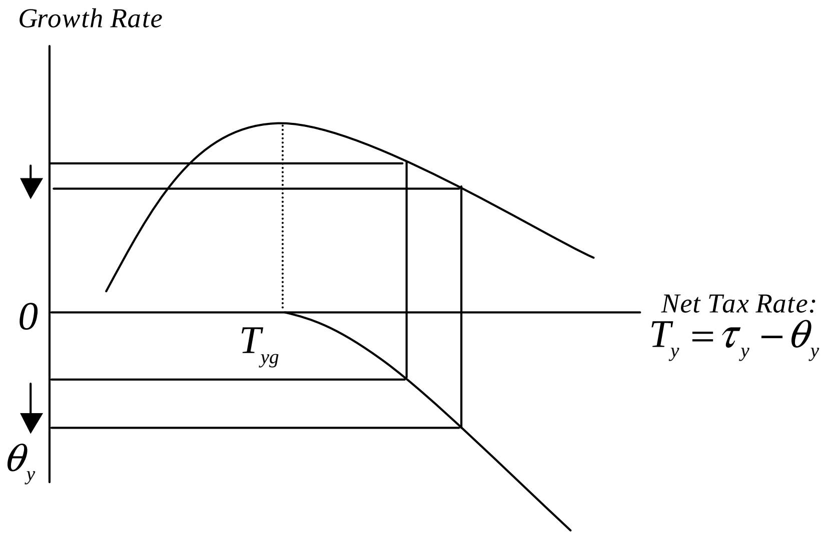

Figure 6: τ_y Political; θ_y Non-Political

For comparative statics, it is easier to substitute (41) into (42), obtain

$$\frac{(1+\alpha)T_y^* - 1}{1 - T_y^*} = \frac{1-\alpha}{\alpha + L_m/(n_m^* - L_m)} \tag{43}$$

and treat (41) and (43) as two equations having two variables, T_y^* and n_m^*. Totally differentiating these equations with respect to θ_y, $dn_m^*/d\theta_y > 0$; as expected, a higher rate of transfer brings more equity. What may not be so apparent is that $dT_y^*/d\theta_y > 0$. This means that an increase in transfer not only increases the politically determined tax rate, it does so by more than the increase in transfer – i.e. $\partial\tau_y^*/\partial\theta_y > 1$.

Intuitively, a rise in the net tax rate increases earning (both from labor and capital) *as well as* the transfer income (because transfers are funded from total income). Therefore, an increase in θ_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 θ_y, growth rate falls (Figure 6). 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 tax on capital income only. But in tandem, the two opposites together lead to the same policy implication.

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. In terms of the political equilibrium, our model follows the median-voter approach of Alesina-Rodrik and Persson-Tabellini. More specifically, the model is closer to the former. Our model also allows for a non-political policy instrument.

Endogeneity of distribution together with a non-political distributive policy offers novel insights. Table 1 summarizes the results. When the growth-oriented redistributive policy is politically determined, a rise in the (non-political) transfer rate raises equality but reduces long-run growth. In this sense there is a *negative* tradeoff between growth and equity. This sharply contrasts the existing, central, (theoretical) result that more equality is growth-enhancing. But our result is consistent with recent empirical work by several authors such as Li and Zou (1998), Forbes (2000), Banerjee and Duflo (2003), and Lundberg and Squire (2003) which argues that equality and growth may be negatively related. Politics determines the mechanism behind how redistributive policies affect growth.

Table 1: Summary of Results

Tax on Capital	Equilibrium Net Tax Rate	Effect on Growth/Equity
τ_t political, θ non-political; $\theta \uparrow$	$T^* < T_g$	Less growth/more equity
τ non-political, θ_t political; $\tau \uparrow$	$T^* < T_g$	More growth/ more Equity
General Income Tax	Equilibrium Net Tax Rate	Effect on Growth/Equity
τ_{yt} political, θ_y non-political; $\theta_y \uparrow$	$T_y^* > T_{yg}$	Less growth/more equity
τ_y non-political, θ_t political; $\tau_y \uparrow$	$T_y^* < T_{yg}$	More growth/more equity

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. We have considered innate-skill heterogeneity, so as to illustrate the contrast with the existing literature as sharply as possible. Other sources of heterogeneity such as various types individual preference shocks should be considered and their implications toward long-run distribution and growth be systematically studied.

Appendix 1

We prove that in the model of Section 3, $y_m^*/\bar{y}^* = K_m^*/\bar{K}^*$, where y_t is the after-tax-transfer income, equal to $(1-\alpha)T_t^{1-\alpha}\bar{L}^{-\alpha}\bar{K}_t L_h + [1+\alpha(T_t\bar{L})^{1-\alpha} - \tau_t]K_{ht} + \theta_t\bar{K}_t$. In section 3.1 where τ is political and θ 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 (29), it is readily seen that the numerator of the above term is zero. This proves that $y_m/\bar{y} = n_m$.

Eq. (29) also holds in section 3.2, wherein τ is not political and θ is political. Hence, in this case also, $y_m^*/\bar{y}^* = K_m^*/\bar{K}^*$

References

Aghion, P. and P. Bolton. (1997). A Theory of Trickle-Down Growth and Development, *Review of Economic Studies*, 64: 151-172.

Aghion, P. and P. Howitt. (1998). *Endogenous Growth Theory.* MIT Press, Cambridge.

Aghion, P., E. Caroli and C. Garcia-Penalosa. 1999. Inequality and Economic Growth: The Perspective of the New Growth Theories, *Journal of Economic Literature*, 37: 1615-60.

Alesina, A. and D. Rodrik (1994).Distributive Politics and Economic Growth. *Quarterly Journal of Economics*, 109 :465-490.

Banerjee, A. and A. Newmann .(1993). Occupational Choice and the Process of Development. *Journal of Political Economy*, 101: 274-98.

Barro, R. (1990). Government Spending in a Simple Model of Endogenous Growth. *Journal of Political Economy*, 98 Part 2: S103-26.

Barro, R. and X. Sala-i-Martin, *Economic Growth*, Mc-Graw Hill.

Bertola, G. (1993). Factor shares and savings in endogenous growth. *American Economic Review*, 83: 1184-1198

Benabou, R. (1995). *Unequal Societies.* New York: New York University, April, Mimeo. Revised May 1996, Cambridge, MA: NBER Research Working Paper 5583.

Caselli, F. and J. Ventura (1999). A Representative Consumer Theory of Distribution. *American Economic Review* 90: 909-926.

Das, S.P. (2000). Trade among Similar Countries and the Personal Distribution of Income and Wealth. *Economica*, 67, 265-281.

Das, S.P. (2001). Endogenous Distribution and the Political Economy of Trade Policy, *European Journal of Political Economy*, 17, 465-491.

Drazen, A. (2000). *Political Economy in Macroeconomics.* Princeton University Press, Princeton: New Jersey.

Forbes, K. (2000). A Reassessment of the Relationship between Inequality and Growth. *American Economic Review*, 90: 869-887.

Galor, O. and J. Zeira. (1993). Income Distribution and Macroeconomics. *Review of Economic Studies*, 60: 35-52.

Galor O., and O. Moav. (2002). Das Human Kapital, Brown University Working Paper.

Jones, L. and R. Manuelli. (1990). A Convex Model of Equilibrium Growth: Theory and Policy Implications. *Journal of Political Economy*, 98(5):1008-1038.

Li, H. and H. Zou (1998). Income Inequality is not Harmful for Growth: Theory and Evidence. *Review of Development Economics*, Vol 2(3), 318-334.

Lundberg, M. and L. Squire. (2003). The Simultaneous Evolution of Growth and Inequality. *Economic Journal*, 113, 326-344.

Loury, G. (1981). Intergenerational Transfers and the Distribution of Earnings. *Econometrica*, 49: 843-867.

Matsuyama, K. (2000). Endogenous Inequality. *Review of Economic Studies*, 67: 743-759.

Perotti, R. (1993). Political Equilibrium, Income Distribution, and Growth. *Review of Economic Studies*, 60: 755-776.

Persson, T. and G. Tabellini.(1994). Is Inequality harmful for growth? Theory and Evidence. *American Economic Review*, 48: 600-621.

Piketty, T. (1997). The Dynamics of the Wealth Distribution and the Interest Rate with Credit Rationing. *Review of Economic Studies*, 64: 173-189.

Ranjan, P. (2001). Credit Constraints and the Phenomenon of Child Labor. *Journal of Development Economics*, 64, 81-102.

Saint-Paul, G. and T. Verdier. (1993). Education, Democracy, and Growth. *Journal of Development Economics*, 42:399-407.