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DISTRIBUTIVE POLITICS AND ECONOMIC GROWTH

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ABSTRACT

This paper studies the relationship between political conflict and economic growth in a simple model of endogenous growth with distributive conflicts. We study both the case of two "classes" (workers and capitalists) and the case of a continuum distribution of agents, characterized by different capital/labor shares. We establish several results concerning the relationship between the political influence of the two groups and the level of taxation, public investment, redistribution of income and growth. For example, it is shown that policies which maximize growth are optimal only for a government that cares only about the "capitalists." Also, we show that in a democracy (where the "median voter theorem" applies) the rate of taxation is higher and the rate of growth lower, the more unequal is the distribution of wealth. We present empirical results consistent with these implications of the model.

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I. Introduction

This paper analyzes a simple model of endogenous growth with distributive conflicts between labor and capital. The rate of economic growth is determined by policy decisions which are shaped by the struggle for distributive shares: we endogenize government policy in a model of endogenous growth.

We focus on the political conflict between individuals who derive their income from capital and those who derive their income from labor. The government has two decisions to make: (i) the rate at which capital is to be taxed; and (ii) the distribution of government expenditures between productive public investments and lump-sum transfers to workers. Holding the composition of public expenditure constant, the economy's growth rate is increasing in taxes on capital for "small" tax rates, and decreasing in taxes for "large" rates. Thus, a strictly positive tax rate on capital maximizes the economy's growth rate. On the other hand, holding the tax rate constant, growth is reduced by an increase in redistribution through transfers to workers, who supply labor inelastically.

We show how these public finance decisions (and therefore growth rates) are determined in two types of political models. In the first we consider a government which attributes certain weights to the welfare of two groups in the population, workers and capitalists. We can think of these weights as being determined by the lobbying or other political activities of the two groups. In addition to providing a simple, tractable model in which the growth consequences of distributional conflicts can be analyzed, this framework also leads to several results. First, we find that maximizing the economy's growth rate is the optimal policy only for a government that cares only about capitalists. A government that attributes some positive weight (no matter how small) to workers' welfare would always choose a growth rate that falls short of the maximum attainable. Workers always prefer a lower growth rate than capitalists, even though they fully internalize the future benefits of capital accumulation. Second, our model makes clear that, in general, the growth rate has no normative significance in and of itself: economic growth and welfare do not go hand in hand.

Third, a time inconsistency emerges whenever capitalists and workers have different discount rates. In this case a social planner would find it optimal to arbitrage across time: if workers are more impatient than capitalists, optimal government policy involves a time-varying pattern of capital taxation, with taxes starting high and decreasing over time, so that the economy's growth rate would increase over time. However, this policy is dynamically inconsistent. The time consistent solution instead implies a constant tax rate and constant transfers over time, thus a constant growth rate. Relative to the optimal policy, in the time consistent solution the workers "lose" at the beginning and gain later on; on the contrary the capitalists "gain" early and then "lose."

In order to analyze more precisely the relationship between wealth distribution and growth, we then consider a more general model in which rather than two groups, we have a distribution of types of individuals identified by their relative shares of labor and capital. We analyze the choice of the tax on capital made by majority rule and we establish a precise formal relationship between this version of the model with a continuous distribution of types and the previous model with only two types. We also show that there exists a monotonic relationship between wealth inequality and growth; our model implies that democracies with a more unequal distribution of capital ownership grow less rapidly than more egalitarian democracies. This is because the median voter has a relatively small endowment of capital when wealth is unequally distributed, and thus favors high taxes on capital which keep growth low. We present some empirical evidence consistent with this result at the end of the paper. Once again, the "positive" nature of these results should be stressed: growth and welfare are not the same in our framework.

Thus, our model extends the new literature on "endogenous growth" (see Barro and Sala y Martin (1990) and the references cited therein for a survey) by showing how distributional considerations affect the choice of growth in a political equilibrium. In particular, this paper builds a bridge between the endogenous growth literature and the literature on majority voting on tax rates (Romer (1975), Roberts (1977) and Meltzer-Richards (1981)).

Other attempts to introduce distributive issues in models of endogenous growth have focused on investment in human capital as the engine of development. Galor and Zeira (1989) focus on credit market imperfections: the "poor" are credit constrained and cannot borrow to invest in education. A fat tail in the income distribution implies that relatively few people can become educated, and growth is relatively low. Perotti (1990) studies a model in which the extent of the investment in education depends upon the initial distribution of income *and* the amount of redistribution achieved by income taxes and transfer. In turn the political equilibrium leading to the choice of the tax rate is influenced by the pre-tax distribution of income. Persson and Tabellini (1991) also discuss a model of investment in human capital and redistributive taxation. Our approach and these papers on accumulation of human capital should be viewed as complementary; an important difference between our paper and this work on human capital is that our paper leads to results having to do with wealth distribution rather than the personal income distribution.

The plan of our paper is as follows. In section 2 we present the basic model with "workers" and "capitalists." In section 3 we discuss the policies of a government which maximizes a weighted average of the welfare of the two groups. In section 4 we analyze a more general case in which rather than two groups, each individual in the economy has a different labor/capital share. We discuss some empirical evidence in Section 5. The last section highlights some possible extensions and concludes.

2. A Model with Two "Classes"

Consider a one sector closed economy with two groups of individuals, workers and capitalists. The workers supply labor inelastically and do not save or borrow; in each period they consume their total income. The capitalists own the capital stock, do not work, consume and save: these assumptions, then, resemble a "Kaldorian" model of distribution (Kaldor (1956)). In Section 4 below, we study a model with many types of agents in which everybody owns some capital and is allowed to save. The production function, adopted from Barro (1990), is given by:

$$y = AK^{\alpha}G^{1-\alpha}L^{1-\alpha} \qquad 0 < \alpha < 1 \tag{1}$$

In (1), y represents output; A is a parameter representing the "technology" available in this economy; K is the capital stock and L is labor input. G represents the flow of government spending on productive investment or social infrastructure; for concreteness, we can think of G as the provision of "law and order" services. Throughout the paper we do not explicitly indicate the time dependence of each variable; for instance y should be interpreted as y(t), etc. Also, we will henceforth normalize the economy's labor (L) endowment to one unit. The initial capital stock, K(0), is exogenously given.

The government always balances the budget by assumption and has a single tax instrument: a tax (τ) on capital. In addition to the expenditure on public investment, G, the government may choose to transfer resources to the workers, who, by assumption, are not taxed. (See Section 6 for a brief discussion of taxes on labor income.) We indicate with $\lambda \in [0,1]$ the share of government revenues which are transferred to workers. Thus, the budget constraint of the government implies:

$$G = (1-\lambda)\tau K \tag{2}$$

The transfers to the workers are given by $\lambda\tau K$. The government chooses λ and τ.

The representative capitalist faces the following problem:

$$\text{Max } U^K = \int_0^\infty (\log C^K) e^{-\rho t} dt \tag{3}$$

$$\text{s.t.} \qquad \dot{K} = (r-\tau)K - C^K \tag{4}$$

where C^K indicates the capitalist's consumption level and r stands for the marginal product of capital. The logarithmic specification of utility greatly simplifies the analysis, particularly in section 4 where a voting model is examined, but the results of this and the next section easily generalize to any isoelastic utility function. In solving problem (3) and (4), the capitalists take τ as given.

The workers' utility function is given by:

$$U^L = \int_0^\infty (\log\ C^L) e^{-\delta t} dt \tag{5}$$

where $\delta \geq \rho$ and C^L represents the workers' consumption. In the next section we will discuss both the case in which capitalists and workers have the same discount rate ($\delta = \rho$), and the case in which they don't — specifically the case in which the workers are more impatient than the capitalists ($\delta > \rho$). Given our assumptions, workers' consumption is given by:

$$C^L = w + \lambda \tau K \tag{6}$$

where w is the wage, equal to the marginal productivity of labor.

A straightforward exercise in dynamic optimization shows that the solution of problem (3)/(4) implies the growth rate of capitalists' consumption is given by:

$$\gamma \equiv \frac{\dot{C}^K}{C} = (r - \tau - \rho) \tag{7}$$

By using the transversality condition and the resource constraint, it can be shown that the rate of growth of capital, and of workers' consumption, has to be equal to γ.

$$\frac{\dot{C}^L}{C} = \frac{\dot{C}^K}{C} = \frac{\dot{K}}{K} = \gamma \tag{8}$$

Using (2), one can show that:

$$r = \frac{\partial y}{\partial K} = \alpha A[(1-\lambda)\tau]^{(1-\alpha)} \equiv r(\lambda,\tau) \tag{9}$$

$$w = \frac{\partial y}{\partial L} = (1-\alpha)A[(1-\lambda)\tau]^{(1-\alpha)}K \equiv \omega(\lambda,\tau)K \tag{10}$$

Thus, combining (7) and (9) one obtains:

$$\frac{\dot{C}^K}{C} = (\alpha A[(1-\lambda)\tau]^{(1-\alpha)} - \tau - \rho) \equiv \gamma(\tau,\lambda). \tag{11}$$

Equation (11) implies that:

$$\frac{\partial\gamma}{\partial\lambda} < 0 \quad \text{for every } \lambda \tag{12}$$

$$\frac{\partial\gamma}{\partial\tau} \gtrless 0 \quad \Rightarrow \quad \tau \lesseqgtr [\alpha(1-\alpha)A]^{\frac{1}{\alpha}} \equiv \tau^* \tag{13}$$

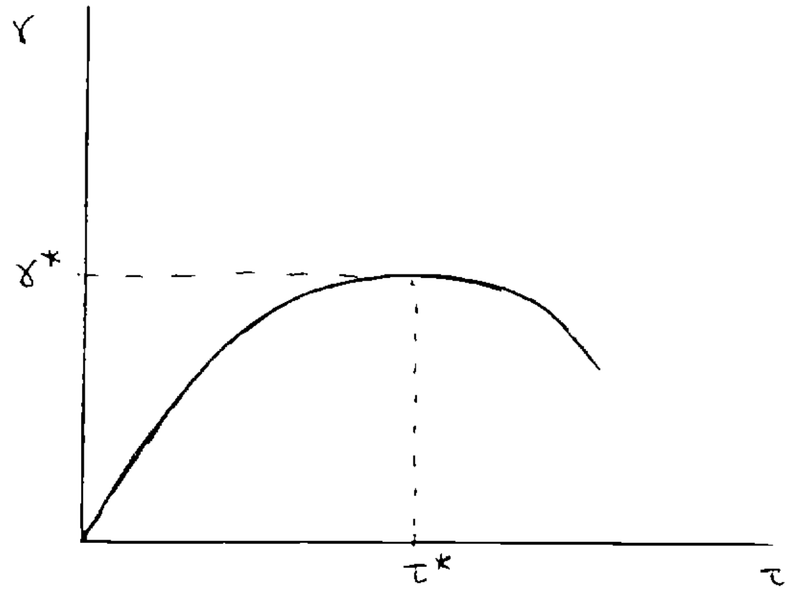
Equations (12) and (13) underscore that growth is maximized if $\lambda = 0$ and $\tau = \tau^* = [\alpha(1-\alpha)A]^{1/\alpha}$. The relationship between growth and τ is displayed in Figure 1. We can now examine the government's choice of τ and λ.

3. The Government's Problem

The government chooses τ and λ at every instant in time, in order to maximize a weighted average of the welfare of the two groups. A basic time inconsistency problem emerges here: since capital taxation is distortionary, the government could improve welfare by expropriating the capital stock and then publicly operating it and distributing the profits.

Figure 1

$(\lambda = 0)$



Alternatively, the government could expropriate the capital stock and then rent it to the former capitalists. These policies would achieve the "command" optimum and maximize welfare *even* from the point of view of a government that cares only about the capitalists.[1]

Such a solution would be both uninteresting and unrealistic. Since our focus is not on this particular time-consistency issue, we will rule out expropriation. In effect, we assume that the only way public services (G) can be financed is through a distortionary tax on income deriving from privately owned capital.

Under this assumption which rules out expropriation of capital, we can proceed to analyze the government's problem. It is useful to examine first the problem of a hypothetical government which completely disregards workers' interests:

$$\max_{\tau,\lambda} U^K = \int_0^\infty (\log C^K) e^{-\rho t} \tag{14}$$

$$\text{s.t.} \qquad C^K = (r(\tau,\lambda) - \tau)K - \gamma(\tau,\lambda)K \tag{15}$$

where (15) is obtained by using (4), (7) and (8). The problem can then be rewritten as follows:

$$\max_{\tau,\lambda} U^K = \int_0^\infty \log (\rho K) e^{-\rho t} dt \tag{16}$$

$$s.t. \qquad \frac{\dot{K}}{K} = \gamma(\tau,\lambda) \tag{17}$$

Thus, a "capitalist government" will choose the time path of the pair (λ,τ) which maximizes the rate of growth $\gamma(\tau,\lambda)$, namely, as shown above:

$$\lambda^{*} = 0; \qquad \tau^{*} = [\alpha(1-\alpha)A]^{\frac{1}{\alpha}} \tag{18}$$

Let us now consider the problem of a government that attributes a weight β to the workers and (1-β) to the capitalists, $\beta \in [0,1]$. For the moment, we consider β as exogenously given. In Section 4 we will examine a model in which the relative weight attributed to "labor" and "capital" is determined endogenously, as a function of the distribution of ownership of capital and by means of majority voting.

The problem faced by the government is given by:

$$\text{Max } (1-\beta) \int_0^\infty (\log C^K) e^{-\rho t} dt + \beta \int_0^\infty (\log C^L) e^{-\delta t} dt \tag{19}$$

$$\text{s.t.} \qquad C^K = \rho K \tag{20}$$

$$C^L = [\omega(\tau,\lambda) + \lambda\tau]K \tag{21}$$

$$\dot{K} = \gamma(\tau,\lambda)K \tag{22}$$

$$\lambda \geq 0 \tag{23}$$

The Hamiltonian of this problem can be written as follows:

$$H = (1-\beta) \log [(\rho K)] e^{-\rho t} + \beta \log \{[\omega(\lambda,\tau) + \lambda\tau]K\} e^{-\delta t} + \mu\gamma(\tau,\lambda)K \tag{24}$$

where μ is the (positive) co-state variable. The necessary conditions for an optimum are given by:

$$\beta(\frac{\partial\omega(\tau,\lambda)}{\partial\tau} + \lambda)\frac{1}{C^L}Ke^{-\delta t} + \mu\frac{\partial\gamma(\tau,\lambda)}{\partial\tau}K = 0 \tag{25}$$

$$\lambda\{\beta(\frac{\partial\omega(\tau,\lambda)}{\partial\lambda} + \tau)\frac{1}{C^L}Ke^{-\delta t} + \mu\frac{\partial\gamma(\tau,\lambda)}{\partial\lambda}K\} = 0 \quad \text{(w/ compl. slackness)} \tag{26}$$

$$-(1-\beta)e^{-\rho t}K^{-1} - \beta e^{-\delta t}K^{-1} - \mu\gamma(\tau,\lambda) = \dot{\mu} \tag{27}$$

An important result can be immediately derived by simply examining (25). Since (from (10)) $\partial\omega/\partial\tau > 0$, as long as $\beta > 0$ the first term in (25) is strictly positive. Since $\mu > 0$, a necessary condition for an optimum is that $\partial\gamma/\partial\tau < 0$, which implies $\tau > \tau^*$ (see Figure 1). Thus, as long as the workers' welfare is taken into consideration by the government, i.e. $\beta >$ 0, taxes on capital are set above the growth maximizing level; growth is *not* maximized. This result underscores that in an economy with distributive conflict, maximizing growth does not imply maximizing welfare.

The intuition behind this result is as follows. Consider an initial situation with τ set at the growth-maximizing τ^*. Now, at τ^* both growth *and* capitalist welfare is maximized. A slight increase in τ (starting from τ^*) will have a first-order effect on the *level* of consumption of workers (see (10)), and only a second-order effect on the growth rate and on capitalist welfare. Therefore, workers would necessarily be made better off (even though they care about growth), while capitalists would remain unhurt. Consequently, a government that attaches some positive weight to the welfare of workers will always choose $\tau > \tau^*$, and a lower-than-maximum growth rate.

We first consider the solution of (25)/(27) for the case of equal discount rates, $\delta=\rho$. In this case the solutions (τ^{**} and λ^{**}) are given by:

(i) *If* $\beta \geq \frac{[(1-\alpha)A]^{\frac{1}{\alpha}}}{\delta}$ then:

$$\tau^{**} = \beta\delta \tag{28}$$

$$\lambda^{**} = 1 - \frac{[(1-\alpha)A]^{\frac{1}{\alpha}}}{\beta\delta} \tag{29}$$

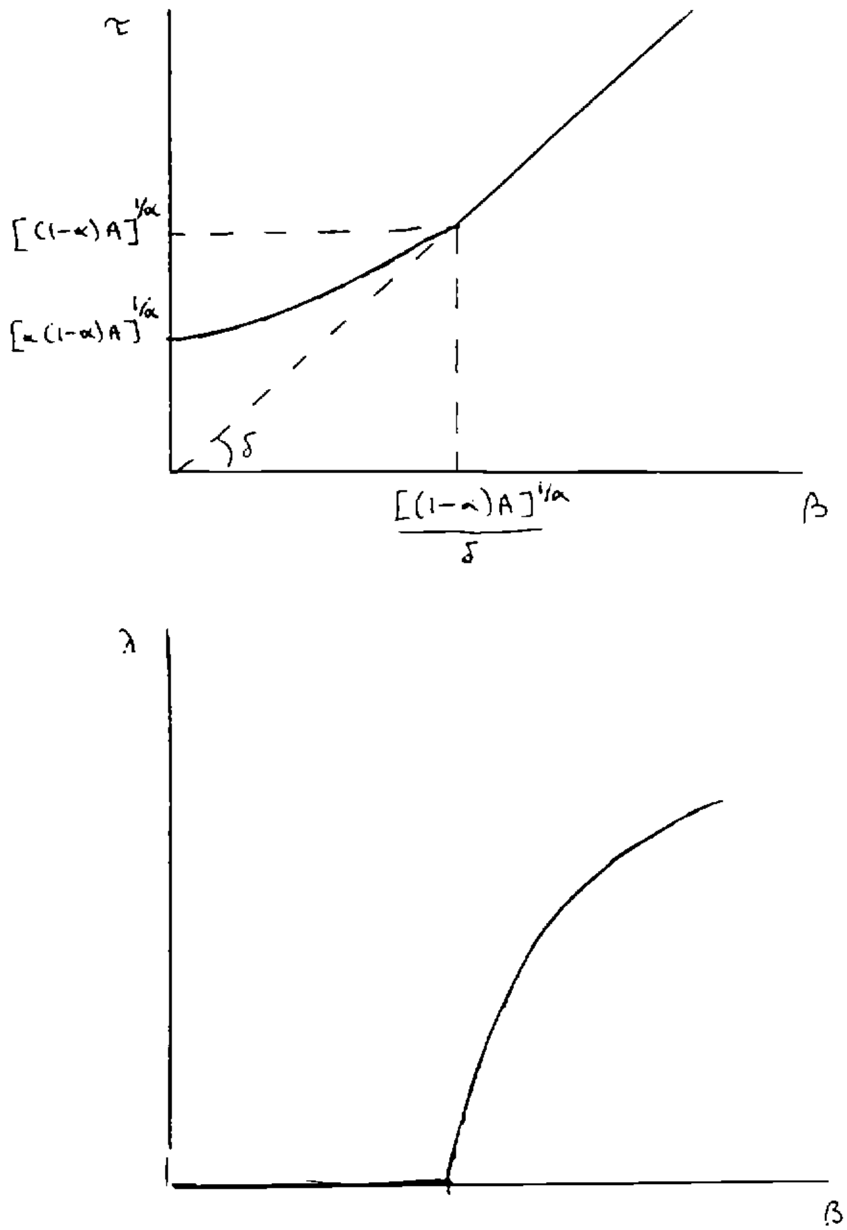
(ii) *If* $\beta < \frac{[(1-\alpha)A]^{\frac{1}{\alpha}}}{\delta}$ then:

$$\lambda^{**} = 0 \tag{30}$$

$$\tau^{**}\{1 - \alpha(1-\alpha)A\tau^{**-}\} = \beta\delta(1-\alpha) \tag{31}$$

Note that these solutions are time invariant, and are clearly time consistent; at no point in time does the government have an incentive to "reoptimize" and choose policies other than (28)/(31). The solutions of this problem highlight the existence of two "regions." In the first (high β) the government taxes capital *and* redistributes some of its revenues to the workers. In the second (low β) no redistribution takes place through transfers and all the government revenues are used to finance G. Note that (28) and (31) imply that τ^{**} is increasing in β in both regions. In the first region λ^{**} is increasing in β (see (29)). Figure 2 displays these solutions. Not surprisingly, the more the government cares about workers the more it taxes capital and redistributes to workers. Note, however, that there is a wide range of parameter values for which $\lambda^{**} = 0$; that

Figure 2



τ
$[(1-\alpha)A]^{1/\alpha}$
$[\alpha(1-\alpha)A]^{1/\alpha}$
δ
$\frac{[(1-\alpha)A]^{1/\alpha}}{\delta}$
β
λ
β

is no redistribution occurs through direct transfers. In fact, it is possible for λ^{**} to be zero for all $\beta \leq 1$ if δ is small enough. Growth is inversely related to β.

How are government policies and growth affected by the technological parameter, A? The more productive is the economy (i.e., the higher is A) the smaller is the redistribution in the first region, and the wider is the range of parameter values for which $\lambda^{**} = 0$. However, by applying the implicit function theorem to (31) we can also see that τ^{**} is increasing in A in the second (low β) region. Thus, A affects the rate of growth in the two ways. The usual channel is via the effect on the productivity of capital, holding λ and τ constant. The second one is via the effect of A on the choice of λ and τ by a redistributive government. A country where A falls (i.e. where the economy becomes technologically more backward) would grow more slowly thanks to the first effect. The second effect could aggravate or alleviate this effect, depending on β. When the government is pro-labor (high β), slower growth would be aggravated by increased redistribution due to the second channel. When, on the other hand, the government is pro-capital (low β) slower growth would be alleviated thanks to a lower τ.

Consider now the case in which $\delta > \rho$. In this situation, unlike in the case of $\delta = \rho$, a new time consistency problem arises. Therefore, we need to distinguish between the "optimal policy" with commitment and the "time consistent" policy. We characterize first the optimal policy with commitment, i.e. the policy which would be chosen by a government which at time zero can commit to a path for τ and λ. In the Appendix we show that the solutions of this problem ($\hat{\tau}$ and $\hat{\lambda}$) are non-increasing functions of time, given by:

(i) for $\hat{\tau} \geq [(1-\alpha)A]^{1/\alpha}$:

$$\hat{\tau} = \beta\delta\{\beta + (1-\beta)e^{(\delta-\rho)t}\}^{-1} \tag{32}$$

$$\hat{\lambda} = 1 - \frac{[(1-\alpha)A]^{\frac{1}{\alpha}}}{\hat{\tau}} \tag{33}$$

(ii) for $\hat{\tau} < [(1-\alpha)A]^{1/\alpha}$, $\hat{\tau}$ solves:

$$\hat{\tau}\{1 - \alpha(1-\alpha)A\hat{\tau}^{-\alpha}\}\{\beta + (1-\beta)e^{(\delta-\rho)t}\} = \beta\delta(1-\alpha) \tag{34}$$

$$\hat{\lambda} = 0 \tag{35}$$

Several comments are in order. Suppose first that $1 > \beta > [(1-\alpha)A]^{1/\alpha}/\delta$, i.e. we are in the "high β" region identified in the solution for the case of $\delta=\rho$. In this case at $t=0$, (32) implies that $\hat{\tau} = \tau^{**}$ and $\hat{\lambda} = \lambda^{**}$. But as time elapses, both $\hat{\tau}$ and $\hat{\lambda}$ fall monotonically. When $\hat{\tau}$ reaches the value of $[(1-\alpha)A]^{1/\alpha}$, $\hat{\lambda} = 0$ and we switch to the second region, identified by (34) and (35). (It is easy enough to verify that there is no discontinuity at the juncture of the two regions.) In this region $\hat{\tau}$ continues to decline over time, as implied by (34). In fact the second term in curly brackets on the left-hand side of (34) is increasing over time. The remaining term on the left hand side of (34) is increasing in $\hat{\tau}$. Thus in order for the left hand side of (34) to be constant over time, $\hat{\tau}$ has to be falling over time. In the limit, since for $\beta \in [0,1]$ $\lim_{t\to\infty} \{\beta + (1-\beta)e^{(\delta-\rho)t}\} = \infty$ the following must hold:

$$\lim_{t\to\infty} \quad \hat{\tau}\{1 - \alpha(1-\alpha)A\tau^{-\alpha}\} = 0 \tag{36}$$

which implies:[2]

$$\lim_{t\to\infty} \quad \hat{\tau} = \tau^{*} = [\alpha(1-\alpha)A]^{\frac{1}{\alpha}} \tag{37}$$

Thus, $\hat{\tau}$ converges in the limit to the growth maximizing level of τ, which is also the level which maximizes the capitalists' welfare. Note that this occurs regardless of the value of $\beta \in [0,1]$. To summarize, the time path of optimal policies for $\beta \in [0,1]$ can be described as follows:

$$\frac{d\hat{\tau}(t)}{dt} < 0, \qquad \hat{\tau}(0) = \tau^{**}, \qquad \lim_{t\to\infty} \hat{\tau}(t) = \tau^{*}$$

$$\frac{d\lambda(t)}{dt} \leq 0, \qquad \lambda(0) = \lambda^{**}, \qquad \lim_{t\to\infty} \lambda(t) = 0$$

A clear implication is that the economy's growth rate is increasing over time, $d\gamma(t)/dt > 0$.[3]

The intuition behind these results is that the social planner optimally distributes over time the welfare of the two groups. Since the workers are more impatient, they obtain at the beginning of the planning horizon more benefits, high taxes, and, for some parameter values, positive transfers. The capitalists who, by assumption, are more patient, can "wait" until later for their benefits. In other words, the social planner arbitrages between the two groups' different time preferences, with the consequence that the growth rate starts out low but picks up over time.[4]

The optimal policies described above are, however, dynamically inconsistent. If the social planner is allowed to reoptimize in every period, he would not follow over time the path for τ and λ described in (32)/(35). The time consistent solutions can be easily characterized. Problem (19) can be rewritten as follows, using the constraints:

$$\underset{\tau,\lambda}{\text{Max}}\ (1-\beta)\int_0^\infty (\log\ \rho K(0))e^{-\rho t} + (1-\beta)\int_0^\infty \{\log\ e^{\int_0^t \gamma(\tau(s),\lambda(s))ds}\}e^{-\rho t}dt\ +$$

$$\beta\int_0^\infty [\log\ K(0)]e^{-\delta t}dt + \beta\int_0^\infty \{\log\ [\omega(\tau(s),\lambda(s)) + \lambda(s)\tau(s)]e^{\int_0^t \gamma(\tau(s),\lambda(s))ds}\}e^{-\delta t}dt$$

$$\text{s.t.}\quad \lambda \geq 0 \tag{38}$$

Since the initial capital stock, K(0) is given, from (38) it follows immediately that the solutions $\{\tau(t),\lambda(t)\}$ are independent of K. But since $\{\tau,\lambda\}$ do not depend on the state variable, they have to be constant over time.[5] In the Appendix, it is shown that the time consistent solutions, denoted $\hat{\tau}'$ and $\hat{\lambda}'$ are given by:

(*i*)
$$\text{if } \beta \geq \frac{\frac{\theta}{\rho^2}[(1-\alpha)A]^{\frac{1}{\alpha}}}{\delta + [(1-\alpha)A]^{\frac{1}{\alpha}}(\frac{\theta}{\rho^2} - 1)} \tag{39}$$

then:

$$\hat{\tau}' = \frac{\beta\delta}{[\beta + \frac{\theta}{\rho^2}(1-\beta)]} \tag{40}$$

$$\hat{\lambda}' = 1 - \frac{[(1-\alpha)A]^{\frac{1}{\alpha}}[\beta + \frac{\theta}{\rho^2}(1-\beta)]}{\beta\delta} \tag{41}$$

$$(ii) \qquad \text{if } \beta < \frac{\frac{\delta}{\rho}[(1-\alpha)A]^{\frac{1}{\alpha}}}{\delta + [(1-\alpha)A]^{\frac{1}{\alpha}}(\frac{\delta}{\rho} - 1)} \tag{42}$$

then:

$$\hat{\lambda}' = 0 \tag{43}$$

$$\hat{\tau}'^{-\alpha}\{1 - \alpha(1-\alpha)A\hat{\tau}'^{-\alpha}\} = \frac{\beta\delta(1-\alpha)}{[\beta + \frac{\delta}{\rho}(1-\beta)]} \tag{44}$$

First of all, notice that if $\delta=\rho$, the solutions (39)/(44) simplify to (28)/(31) i.e. the optimal policies for the case of equal discount rates. In fact, since the time inconsistency problem arises only for $\delta\neq\rho$, the optimal and the time consistent solutions are indentical for $\delta=\rho$. Second, it is useful to compare the time consistent solutions $(\hat{\tau}', \hat{\lambda}')$ with the optimal ones $(\hat{\tau}, \hat{\lambda})$. Suppose that we are in the "high β" region defined by (39). Then, simple algebra establishes the following inequalities:

$$\lim_{t\to\infty} \hat{\tau}(t) < \hat{\tau}' < \hat{\tau}(0) \tag{45}$$

$$\lim_{t\to\infty} \hat{\lambda}(t) < \hat{\lambda}' < \hat{\lambda}(0) \tag{46}$$

In the "low β" regime as defined by (42), condition (45) holds as well, while (46) becomes:

$$\lim_{t \to \infty} \hat{\lambda}(t) = \hat{\lambda}' = 0 \leq \hat{\lambda}(0) \tag{47}$$

Note that, by continuity, (45) implies that there exists a $\bar{t}$ such that $\hat{\tau}(\bar{t}) = \hat{\tau}'$. Analogous arguments apply to (46) and to the "low β" region. The intuition of these results is straightforward. The time consistency requirement prevents the implementation of the intertemporal trade offs which would be optimal. The time consistent solution thus makes the workers worse off at the beginning and better off later, relative to the optimal solution. The opposite occurs for the capitalists.[6] Finally, while the optimal plan implies an increasing rate of growth for the economy, the time consistent solution requires a constant growth rate.

It is useful to examine the solutions of our problem for certain parameter values. Table 1 displays the optimal policies (τ^{**} and λ^{**}) for the case of equal discount factors.

Table 1: Solutions for $\delta = \rho = 0.05$

β	0.00	0.25	0.50	0.75	1.00
τ	0.141	0.153	0.163	0.176	0.186
λ	0.00	0.00	0.00	0.00	0.00
growth (%)	9.06	9.04	8.99	8.86	8.75

These calculations assume A = 1.5; $\alpha = 0.5$.

Table 2 displays the solutions for the case of $\delta > \rho$; in particular we have chosen $\delta = 0.30$ and $\rho = 0.05$. The first five columns of this table report the time consistent solutions for τ and λ; the second set of five columns shows the optimal solutions at time zero; the last column shows the optimal solution for $\tau \to \infty$, which, as shown above is independent of β.

Several comments are in order. First of all these parameter values imply that $\lambda=0$ for any value of β. In fact, when public spending (G) is relatively productive in enhancing productivity, it is in the interest of even a pro-labor government to channel all the fiscal resources into G and avoid any explicit redistribution. With a higher value of α, which implies lower productivity of G, we obtain positive values of λ for high values of β. (Results are available.) Table 1 highlights the non-monotonic decrease of the growth rate with the increase in β. The derivative of the growth rate with respect to β is increasing (in absolute value) with α.

Table 2 shows that the time consistent solution for τ is quite different from the optimal solution at time zero if β is high. A pro-labor government would highly "reward" impatient workers at the beginning of the planning horizon, if committments were available.

4. Distribution of Capital Ownership and Growth

Consider an economy in which the population rather than belonging to one of two groups has a certain distribution of capital ownership. Individual i has labor supply ℓ^i, constant over time and in period zero owns a capital stock equal to $K^i(0)$. Since we have normalized total

Table 2: Solutions for $\delta > \rho$: $\delta=0.30$; $\rho=0.05$

	Time Consistent Solutions					Optimal Solutions at Time Zero					Optimal Solutions at Time = ∞	
β	0.00	0.25	0.50	0.75	1.00	0.00	0.25	0.50	0.75	1.00	$0 \leq \beta < 1$	$\beta = 1$
τ	0.141	0.143	0.149	0.162	0.381	0.141	0.210	0.270	0.330	0.381	0.141	0.381
λ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
growth (%)	9.06	9.06	9.05	8.98	3.19	9.06	8.39	6.37	5.19	3.19	9.06	3.19

These calculations assume $A = 1.5$; $\alpha = 0.5$

labor at 1, we have that $\sum_{i=1}^{N} K^i(0) = K(0)$ and $\sum_{i=1}^{N} \ell^i = 1$. It will be convenient to identify the generic consumer i by $\sigma^i = \frac{\ell^i}{K^i(0)/K(0)}$; that is σ^i is the initial relative factor endowment of consumer i.[7] Consumers only differ in their σ's; they are identical in every other respect. Specifically they all have the same discount rate, ρ. Since we will explicitly model voting by majority rule, we reduce the choice set to a single dimension by setting $\lambda=0$. That is, the only issue which is voted upon is the level of the tax on capital.[8]

Individual i solves the following problem:

$$\max\ U^i = \int_0^\infty (\log\ C^i) e^{-\rho t} dt \tag{48}$$

$$\text{s.t.}\quad \omega(\tau)K^i\sigma^i + [r(\tau) - \tau]K^i = C^i + \dot{K}^i \tag{49}$$

In writing the budget constraint we made use of (9) and (10) which identify the wage rate ($\omega(\tau)$K) and the productivity of capital r(τ). Note that we have set $\lambda=0$.

It can be shown that problem (48) implies:

$$\frac{\dot{C}^i}{C^i} = (r - \tau - \rho) \quad \text{for every } i \tag{50}$$

Thus, the rate of growth of consumption is the same for every consumer, regardless of his σ^i. The transversality condition and the resource constraint imply that

$$\frac{\dot{K}}{K} = \frac{\dot{K}^i}{K^i} = \frac{\dot{C}^i}{C^i} = (r - \tau - \rho) \quad \text{for every } i \tag{51}$$

It follows immediately that the relative shares of labor and capital, σ^i, are time invariant. This result is, of course, crucially dependent on the specific form of the utility function and the existence of an identical discount rate.

Let us now consider the policy which would be chosen by consumer i, if he were a dictator; this problem will identify voter i's ideal policy.

$$\max_{\tau} \; U^i = \int_0^\infty (\log C^i) e^{-\rho t} dt \tag{52}$$

$$\text{s.t.} \quad C^i = [\omega(\tau)\sigma^i + \rho] K^i \tag{53}$$

$$\dot{K}^i = \gamma(\tau) K^i \tag{54}$$

$$\dot{K} = \gamma(\tau) K \tag{55}$$

Note that (53) is obtained rearranging (49) and using (51). Constraint (55) is needed because K enters in the definition of σ^i.

In the Appendix it is shown that there is a time-invariant tax rate which solves this problem, indicated by τ^{i*}, given by the solution of the following:

$$\tau^{i*}\{1 - \alpha(1-\alpha)A\tau^{i*-}\} = \rho(1-\alpha)\{\frac{\omega(\tau^{i*})K\sigma^i}{C^i}\} = \rho(1-\alpha)\{\frac{\omega(\tau^{i*})\sigma^i}{\omega(\tau^{i*})\sigma^i + \rho}\} \tag{56}$$

The term in curly brackets on the right hand side of (56) represents the ratio of labor income to total consumption of consumer of type i. It is instructive to emphasize the relationship between (56) and the solution found for the government maximizing a weighted average of utilities, that is equation (34). Consumer i's welfare would be maximized by a government that places a weight on labor income (β, in the two-class model) equal to consumer i's ratio of labor income over total consumption.

Equation (56) implies a unique solution for τ, and consumer i's preferences are single peaked over τ. In fact, using (10), recalling that $\lambda=0$ in this problem, and rearranging (56) one obtains:

$$\{\rho + \sigma^i[(1-\alpha)A\tau^{1-\alpha}]\}\{\tau^{\alpha} - \alpha(1-\alpha)A\} = \rho(1-\alpha)\sigma^i A \tag{57}$$

Since the left hand side is strictly increasing in τ and the right hand side is a constant, (57) admits a unique solution for τ^{*i}. Finally, from equation (56) it is easy to verify that τ^{*i} is monotonically increasing in σ^i; that is the higher the relative labor endowment, the higher the desired tax rate on capital. Note that for a "pure" capitalist, for which $\sigma^i=0$, the optimal tax rate is the growth maximizing one τ^*, as shown in section 2: $\tau^* = [\alpha(1-\alpha)A]^{1/\alpha}$.

Suppose now that the decision over the tax rate if reached by pairwise comparisons with simple majority rule. The nature of the problem is such that we can apply the median voter theorem to it, and conclude that the tax rate chosen by majority rule is the one which solves the following problem

$$\tau^*\{1 - \alpha(1-\alpha)A\tau^{*-}\} = \rho(1-\alpha)\{\frac{\omega(\tau^*)\sigma^M}{\omega(\tau^*)\sigma^M + \rho}\} \tag{58}$$

where σ^M is the median value of σ. The median voter theorem can be applied because voting occurs on a single issue, preferences are single peaked and there exists a monotonic relationship between ideal policies and voters' relative shares of labor and capital endowment. Also, since the ideal policies of the consumers are constant over time and the distribution of shares is also time invariant, it does not matter whether voting takes place only once at time zero or is repeated every period.

Equation (58) establishes a precise relationship between the distribution of ownership of capital and growth. A perfectly egalitarian society is one in which everybody has the same labor/capital shares, $\sigma^M = \sigma^i = 1$ for every i. A measure of inequality is thus $(\sigma^M - 1)$: this measure captures how much below the average share is the median share. For example, a very high σ^M implies that 50 percent of the voters have a very low share of capital. Equation (48) establishes one of the most important result of this paper which we can summarize as follows: *In a democracy, the more unequal is the distribution of wealth, i.e. the higher is σ^M above 1, the lower is the rate of growth of the economy.*

The intuition behind this result is straightforward. With an unequal distribution of ownership, a majority of the population owns very little capital, thus favors a high tax on capital, which in turn, reduces the growth rate.[9] This result is related to the work by Romer (1975), Roberts (1977) and Meltzer and Richards (1981) on voting over linear tax rates on labor income. These authors analyze a static model in which an income tax has to be chosen, and show that the more unequal is the distribution of productivities (thus of pre-tax income) the higher is the tax rate (and the transfer level) desired by the median voter. We have obtained a similar result in a dynamic model in which consumers differ not in their productivity but in their factor endowments.

Table 3 displays some illustrative numerical examples.

Table 3: Wealth Distribution and Growth

σ^M	0.00	0.50	1.00	2.00	∞
β^*	0.00	0.63	0.77	0.87	1.00
τ	0.09	0.11	0.12	0.12	0.12
growth	8.90	8.78	8.72	8.69	8.63

These calculations assume $A = 1.0$, $\alpha = 0.6$, $\rho = 0.05$.
Note: *This is the β that would yield an identical solution in the two-class model.

This table highlights the monotonic relationship between σ^M and the value of β which would yield the identical solution in the two class model (i.e. β).

5. Empirical Evidence

The empirical implications of this paper can be summarized as follows. When voting plays an important role in generating policy choices, we expect to find countries where wealth is unevenly distributed to grow more slowly than those where the distribution is less skewed. In countries where policies are generated less democratically, it is the weights attributed by the policy maker to the welfare of different classes which determines growth: in particular, we expect governments that are "pro-capitalist" to be more conducive to growth than those that are "pro-labor". If the theory is correct, then, there ought to be a relationship between wealth distribution and growth, but this relationship should hold only for democracies. Given the subjective nature of classifying non-democratic regimes as "pro-capital" or "pro-labor" over long stretches of time, we have decided to test for this, more limited, version of the theoretical prediction. Our model predicts a relationship between *wealth distribution* and growth. Since indicators of wealth distribution and/or distribution of ownership of capital are unavailable for a sufficiently large sample of countries, we are forced to use income distribution as a proxy for wealth distribution.

We provide results of cross-country regressions where the average per capita GNP growth rate (measured in percent per year over 1960-85) is regressed on three explanatory variables: (i) GDP60, the initial level of per capita income in 1960 (in thousands of 1980 dollars); (ii) PRIM60, the primary-school enrollment ratio for 1960; and (iii) an income distribution variable. All the data, except for income distribution are obtained from Barro and Wolf (1989) and Heston and Summers (1988). Note that a measure of investment is not included as an explanatory variable, even though it is commonly used in such regressions. The reason is that investment is an endogenous variable in our model, and is determined simultaneously with growth.

Ideally, we would like to have a measure of income distribution dated 1960, since, according to our model, income distribution is a predetermined explanatory variable for growth. However, income distribution is measured infrequently and imperfectly. We assembled the largest sample of countries for which we could find income distribution measures dated reasonably close to 1960. Our sources were Lecallion et al. (1984) and Jain (1975). We managed to obtain data for 67 countries in which income distribution is measured in range of years from 1948 (Italy) to 1972 (Botswana). For 42 of these countries and, in particular, for 19 of the 24 democracies, income distribution is measured in a period between 1956 to 1964, thus reasonably close to 1960. For a list of countries see Table A-1 in Appendix. Table A-2, in Appendix, summarizes some basic statistics of our data set.

The results are reported for three groups of countries. Table 4 reports the results for the full sample; in Table 5, we consider a sub-sample which includes only countries with non-democratic regimes; Table 6 shows the results for the sub-sample of democracies.[10] In all these Tables, regressions (1) to (5) include as an indicator of income distribution the share of income held by different quintiles of the population, from the lowest to highest. The sixth regression includes the share of income held by the richest 5% of the population.

The results are consistent with the prediction of the model. For all countries taken together (Table 4), the coefficients on the income distribution variables have the sign predicted by the theory, in some cases statistically significant at the conventional levels. However, Table 5 and 6 confirm that there is a clear difference between democracies and non-democracies, as predicted by the theory. In non-democracies (Table 5) the coefficients on the income distribution variable are insignificant, even though generally they have the correct sign. For the sub-sample of democracies, on the other hand (Table 6), income distribution does appear to influence growth in the way predicted by the model: democracies with a more equal distribution of income grow faster. In particular the pattern of the coefficients in Table 6 suggest that an increase in the income share of the middle class, at the expense of the richest quintile of the population is growth enchancing. On the other hand, an increase in the income share of the poorest quintile at the expense of the middle class may not have positive effects on growth. The other independent variables are also significant in all the regressions: GDP60 has a statistically

Table 4

Growth Regressions: All Countries
Income distribution measured in the 50s/60s
Sample - 67
(t-statistics in parentheses)

Eqn	CONST.	GDP60	PRIM60	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%	Highest 5%	R^2
(1)	-0.522	-0.432	0.042	0.063						0.26
	(-0.63)	(-2.94)	(4.67)	(0.62)						
(2)	-1.426	-0.500	0.042		0.147					0.29
	(-1.52)	(-3.35)	(4.82)		(1.70)					
(3)	-2.007	-0.582	0.043			0.156				0.30
	(-1.87)	(-3.62)	(4.90)			(2.03)				
(4)	-1.513	-0.513	0.042				0.074			0.27
	(-1.07)	(-3.11)	(4.73)				(1.05)			
(5)	2.070	-0.533	0.043					-0.040		0.28
	(1.40)	(-3.39)	(4.85)					(-2.03)		
(6)	1.273	-0.533	0.042						-0.047	0.30
	(1.42)	(-3.53)	(4.82)						(-2.03)	

Sources: See text.

Table 5

Growth Regressions: Non-Democracies
Income distribution measured in the 50s/60s
Sample = 43
(t-statistics in parentheses)

Eqn	CONST.	GDP60	PRIM60	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%	Highest 5%	R^2
(1)	0.283	-0.844	0.043	-0.024						0.26
	(0.25)	(-2.52)	(3.59)	(-0.17)						
(2)	-0.539	-0.814	0.044		0.072					0.27
	(-0.41)	(-2.50)	(3.69)		(0.60)					
(3)	-1.121	-0.848	0.044			0.099				0.28
	(-0.75)	(-2.62)	(3.75)			(0.94)				
(4)	-0.762	-0.891	0.044				0.048			0.27
	(-0.43)	(-2.60)	(3.69)				(0.55)			
(5)	1.252	-0.844	0.044					-0.021		0.27
	(0.66)	(-2.59)	(3.70)					(-0.63)		
(6)	1.129	-0.863	0.044						-0.035	0.28
	(1.00)	(-2.67)	(3.78)						(-1.12)	

Sources: See text.

Table 6

Growth Regressions: Democracies
Income distribution measured in the 50s/60s
Sample = 24
(t-statistics in parentheses)

Eqn	CONST.	GDP60	PRIM60	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%	Highest 5%	R^2
(1)	-1.806 (-0.91)	-0.384 (-2.29)	0.051 (2.56)	0.123 (0.86)						0.29
(2)	-3.169 (-1.53)	-0.487 (-2.88)	0.051 (2.74)		0.228 (1.78)					0.36
(3)	-4.931 (-1.97)	-0.620 (-3.20)	0.057 (3.04)			0.262 (2.06)				0.39
(4)	-5.611 (-1.78)	-0.576 (-2.95)	0.057 (2.95)				0.210 (1.72)			0.36
(5)	2.525 (1.01)	-0.552 (-3.06)	0.055 (2.95)					-0.075 (-1.91)		0.38
(6)	0.517 (0.29)	-0.504 (-3.02)	0.054 (2.94)						-0.075 (-2.04)	0.39

Sources: See text.

significant negative coefficient in every regression indicating a certain amount of "convergence"; the primary school enrollment ratio has a statistically significant positive effect on growth.

The size of the coefficients on the income distribution variables implies that the effects of income inequality on growth is quite substantial. Consider, for instance, regression (5) in Table 6. The average value for the percentage of income held by the richest quintile is about 43. A reduction of ten percent in this percentage would lead to an increase of about 1/3 of a percentage point in the rate of growth.

The accuracy of our income distribution measure (obtained from multiple sources) may be questionable, particularly for non-OECD economies. Therefore we rerun our regressions on the data set recently compiled in the World Bank's *World Development Report* (1990). The sample of countries is overall much smaller (we have 38 countries), however we gain two democracies (see Table A-1). Income distribution in this data set is measured in the late seventies/early eighties; summary statistics for this sample of 38 countries are provided in Table A-3 in Appendix. Results of these regressions for the entire sample and the sub-sample of democracies are presented in Tables 7 and 8 respectively. The pattern of coefficients on the income distribution variable is qualitatively very similar to the pattern in Tables 4 and 6. In fact, the effect of income equality on growth appears even stronger with this data set.

Persson and Tabellini (1991) have independently obtained results consistent with our Tables 7 and 8. They use a different source for their income distribution data, which in their paper is measured in the mid to late seventies.

In both Persson and Tabellini (1991) and in our Tables 7 and 8, there is a simultaneity problem, since the income distribution variables which we use are not measured at the beginning

Table 7

Growth Regression: All Countries
Income distribtuion measured in the 80s
Sample = 38
(t-statistics in parentheses)

Eqn	CONST.	GDP60	PRIM60	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%	Highest* 10%	R^2
(1)	-0.373 (-0.23)	-0.417 (-2.17)	0.039 (2.52)	0.117 (0.70)						0.17
(2)	-1.310 (-0.71)	-0.475 (-2.41)	0.037 (2.47)		0.179 (1.16)					0.19
(3)	-2.587 (-1.03)	-0.541 (-2.55)	0.037 (2.45)			0.219 (1.34)				0.20
(4)	-4.657 (-1.05)	-0.568 (-2.45)	0.037 (2.45)				0.250 (1.18)			0.19
(5)	3.134 (1.25)	-0.500 (-2.45)	0.038 (2.50)					-0.055 (-1.19)		0.19
(6)	2.455 (1.25)	-0.514 (-2.48)	0.038 (2.50)						-0.059 (-1.23)	0.19

Sources: see text.

*For this sample of countries we do not have the income share of the richest 5% of the population

Table 8

Growth Regressions: Democracies Only
Income distribution measured in the 80s
Sample = 26
(t-statistics)

Eqn	CONST.	GDP60	PRIM60	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%	Highest 10%	R^2
(1)	-2.824	-0.330	0.043	0.381						0.37
	(-1.55)	(-2.15)	(2.36)	(2.18)						
(2)	-5.053	-0.459	0.038		0.481					0.49
	(-2.62)	(-3.25)	(2.29)		(3.23)					
(3)	-7.858	-0.622	0.041			0.517				0.57
	(-3.66)	(-4.41)	(2.45)			(4.10)				
(4)	-13.011	-0.719	0.049				0.574			0.54
	(-3.89)	(-4.58)	(3.24)				(3.95)			
(5)	6.708	-0.584	0.044					-0.147		0.54
	(2.78)	(-4.18)	(2.88)					(-3.81)		
(6)	4.411	-0.584	0.044						-0.150	0.56
	(2.33)	(-4.18)	(2.88)						(-3.96)	

Sources: See text.

of the time period considered but towards the end. In order to correct for that we (as well as Persson and Tabellini) performed two stage least square regressions. We have chosen a compact measure of income distribution (RTL) defined as the ratio of the income share of the richest 20 percent of the population, over the income share of the poorest 40 percent. We followed Persson and Tabellini in our choice of instruments for the RTL variable: GDP60; PRIM60; SEC60 (the ratio of the population enrolled in secondary schools in 1960); AG60 (the ratio of the population enrolled in the agricultural sector in 1960); ML60 (the male life expectancy in 1960).

The OLS and 2SLS regressions for both sample of countries (democracies and non-democracies) are presented in Table 9. The OLS regressions, not surprisingly, confirm the results of Tables 7 and 8. The 2SLS regressions are also consistent with the theory: in both regressions the coefficient on RTL has the correct sign but it has a higher t-statistic (in absolute value) for the sub-sample of democracies, where this coefficient is significant at the 5 percent confidence level. Also the coefficient on RTL is much higher in absolute value for the democracies than for the entire sample.[11]

These results suggest that income inequality reduces growth in democratic countries, while this effect disappears or it is weaker in dictatorships. In particular, it would appear that redistributing income from the very rich to the middle class improves the growth performance of the economy. Overall, this picture is consistent with the predictions of our model. More generally, the result that income inequality is associated with poor economic outcomes is also consistent with findings by Berg and Sachs (1988). They point out a statistical relationship

Table 9

Growth Regressions on RTL
(t-statistics in parentheses)

	OLS		2SLS	
	(1)	(2)	(1)	(2)
SAMPLE	ALL (n=38)	DEMOCRACIES (n=26)	ALL (n=37)*	DEMOCRACIES (n=26)
CONSTANT	0.784 (0.58)	2.417 (1.33)	3.237 (1.33)	5.04 (1.73)
GDP60	-0.434 (-2.17)	-0.480 (-3.30)	-0.775 (-2.64)	-0.576 (-3.18)
PRIM60	0.038 (2.45)	0.041 (2.48)	0.059 (3.03)	0.037 (1.91)
RTL	-0.101 (-0.43)	-0.863 (-3.08)	-1.344 (-1.74)	-1.540 (-2.49)
R^2	0.16	0.47	0.19	0.44

*Botswana, which is included in the OLS regressions, is not included in the 2SLS regressions for lack of data on the variables needed as instruments.

between the frequency of debt rescheduling and measures of economic inequality. In a footnote of their paper, they also highlight a negative correlation between growth and inequality.[12]

6. Extensions and Conclusions

Rather than summarizing systematically all the results of this paper, we again highlight its empirical implications. Our model establishes connections between regime type, distribution of wealth and growth. According to our model, democracies with an uneven distribution of wealth should exhibit lower growth than democracies with more equally distributed resources. This is because a large working class with little capital would vote for high taxes on capital: the positive effect on the level of workers' real incomes would be traded off against the adverse growth consequences. "Technocratic" dictatorship, i.e., dictatorships in which the wealth-owners control policy, should experience high growth, regardless of the distribution of resources. On the other hand, "populist" non-democratic governments should experience low growth and implement redistributive programs from "capitalists" to "workers." Our empirical results are consistent with the implication that democracies with less inequality grow faster. More specifically, we find that a redistribution of income from the wealthiest quintile of the population in favor of the middle class would be growth enhancing.

One can envision several extensions to our model. First of all, one may introduce other forms of taxation in addition to capital taxation. For instance labor income could be taxed as well. In our model this could be easily taken into account by allowing λ to be negative. For instance, in the specification studied in Section 3, for sufficiently low values of β, i.e., if the government cares sufficiently about the capitalists' welfare, a negative λ implying taxes on labor rather than transfers might be chosen. Such an extension would be, however, much more insightful if labor were not supply inelastically and a tax on labor income could influence the leisure-labor choice of workers.

A second extension for the model with "workers" and "capitalists" would be to make β endogenous by explicitly modelling costly lobbying activities, as in the endogenous tariffs literature. "High" and "low" β would then be the results of high and low relative costs of workers' and capitalists' lobbying activities (and the relative productivities of these activities in influencing government decisions). This extension is relatively easy if we assume an exogenous function relating the level of lobbying efforts of the two groups to the value of β. Lobbying efforts in turn could be modelled as losses of income and/or utility. Income can be used to directly "bribe" politicians; losses of utility capture the amount of time and effort invested in political action.[13]

A third much more difficult extension would be to allow for time varying shares of labor and capital, that is building a model in which different consumers save at different rates. It is interesting to note that this would introduce not only complicated economic dynamics but also complicated voting decisions. In fact, if capital/labor shares change over time the identity of the median voter also changes over time.[14] Thus different policy paths would be achieved depending on whether voting takes place only once at the beginning of the planning horizon or repeatedly.

Notes

1. This time inconsistency problem in capital taxation is closely related to that pointed out by Fischer (1980). See also the discussion in Rodrik (1990).

2. It is easy to see that $\hat{\tau}$ cannot converge to zero. Remember that if $\hat{\tau} = 0$, $G = 0$, $y = 0$ and $C^L = 0$ implying an infinite disutility.

3. If $\beta = 0$ ($\beta = 1$), at time zero the government adopts the policy most desired by the capitalist (workers) and such policy is never changed. For the two extreme values of β, growth is time invariant.

4. In an overlapping generation model this kind of intertemporal redistributions would imply redistribution across generations which may be difficult to achieve since the interests of future generations may not be represented in today's political system.

5. In fact, suppose not. Then τ and λ would change over time independently of $K(t)$. It is easy to verify that such a solution cannot be time consistent.

6. It is instructive to highlight a connection between our results and those recently obtained by Boylen, Ledyard and McKelvey (1990). They study a Solow-type growth model in which voters with different discount factors choose by majority rule a growth path for the economy. If commitments are available (i.e. voting occurs only in period zero and the entire growth path can be chosen forever) than very high discount factor voters may form a coalition with low discount factor voters by means of intertemporal trade offs. The possibility of forming these coalitions between voters with opposite preferences destroys any "median voter" equilibrium. However, if the time consistency requirement is imposed on this problem (by voting every period) these

coalitions of voters are "non credible" and the growth path most preferred by the voter with the median discount rate emerges as the unique equilibrium. The analogy is in this lack of credibility of intertemporal trade-offs between voters, or "classes," with different discount factors.

7. A static version of a similar model is considered in the trade-policy context by Mayer (1984).

8. Note that it may be the case that for a range of parameter values, $\lambda=0$ would actually be preferred by a majority of voters, but we do not investigate explicitly this case.

9. It is perfectly admissible in our model for the median voter to hold no capital, in which case $\sigma^M \to \infty$. The right hand side of (48) converges to 1 as $\sigma^M \to \infty$. It is easy to see that the tax rate which is chosen in this case is identical to the one which would be chosen by a pro-labor government completely disregarding the capitalists' interests, i.e. when $\beta=1$ in the model examined in section 3.

10. The classification of countries as democracies or not is generally unambiguous. We defined as a "democracy" a country in which general elections are regularly held and voters can choose between at least two parties. In any event, we classified the countries before running any regression and we never readjusted the classification. For the few "ambiguous" countries, i.e. countries which had a regime change in the sample period, such as Spain, Greece and Chile, we checked whether dropping these countries or changing their classification, affected significantly our results. This analysis confirmed that our results are robust to these sensitivity tests.

11. We also performed these regressions using the log of RTL. The results (available upon request) are very similar to those presented in Table 9.

12. Berg and Sachs (1988) however do not distinguish between democracies and non-democracies and do not control for other factors influencing growth.

13. Models of endogenous growth with lobbying activities have been recently proposed by Terrones (1989) and Mohtadi and Roe (1990). These models however, are based upon the assumption of a "representative" consumer-lobbyist. They do not consider a labor/capital redistributive conflict.

14. Perotti (1990) discusses a model of repeated voting in a growth model. Tabellini and Alesina (1990) study a two period model with stochastic changes in the identity of the median voter.

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APPENDIX

1.) Solution of problem (25)/(27).

Let us define y_x as the partial derivative of y with respect to x. Suppose $\lambda > 0$. Then from (25) and (26) one obtains:

$$\frac{\omega_\tau(\tau,\lambda)+\lambda}{\omega_\lambda(\tau,\lambda)+\tau} = \frac{\gamma_\tau(\tau,\lambda)}{\gamma_\lambda(\tau,\lambda)} \tag{A.1}$$

Using the definitions of γ and τ, (A.1) implies

$$(1-\lambda)\tau = [(1-\alpha)A]^{\frac{1}{\alpha}} \tag{A.2}$$

Equation (27) can be rewritten as follows:

$$\frac{\dot{\mu}}{\mu} = -\gamma(\tau,\lambda) - (1-\beta)\frac{e^{-\rho t}}{\mu K} - \frac{\beta e^{-\delta t}}{\mu K} \tag{A.3}$$

If $\lambda > 0$ then the following condition holds:

$$\frac{\gamma_\tau}{\omega_\tau+\lambda} = -1 \tag{A.4}$$

By taking time derivatives of (25), using (A.4) and rearranging, one obtains:

$$\frac{\dot{\mu}}{\mu} = -\frac{\dot{c}}{c} - \delta \tag{A.5}$$

Using (A.3) and (A.5) one obtains:

$$\delta = (1-\beta)\frac{e^{-\rho t}}{\mu K} + \beta\frac{e^{-\delta t}}{\mu K} \tag{A.6}$$

Using (A.6) and (25), some algebra establishes the following:

$$\omega(\tau,\lambda) + \lambda\tau = \delta\{1+\frac{1-\beta}{\beta}\rho^{(\delta-\rho)t}\}^{-1} \tag{A.7}$$

Let us consider first the case of $\delta = \rho$, in which case the right-hand side of (A.7) simplifies to $\delta\beta$. By using the definition of $\omega(\tau,\lambda)$ given by (10), solving (A.7) and (A.2) for λ and τ one obtains:

$$\tau^{**} = \beta\delta \tag{A.8}$$

$$\lambda^{**} = 1-\frac{[(1-\alpha)]A]^{\frac{1}{\alpha}}}{\beta\delta} \tag{A.9}$$

Note that (A.8) and (A.9) which reproduce (28) and (29) in the text, hold only for $\lambda > 0$, thus for $\beta > \frac{[1-\alpha)A]^{\frac{1}{\alpha}}}{\delta}$.

Consider now the case $\delta > \rho$. First of all, note that at t=0, (A.8) and (A.9) are the solutions of this case as well. More generally, the solution, using (10), (A.7) and (A.2) again is given by:

$$\hat{\tau} = \beta\delta\{\beta + (1-\beta)e^{(\delta-\rho)t}\}^{-1} \tag{A.10}$$

which reproduce (32) and (33) in the text. Once again, since these solutions are obtained for

$$\hat{\lambda} = 1 - \frac{[(1-\alpha)A]^{\frac{1}{\alpha}}}{\hat{\tau}} \tag{A.11}$$

$\lambda > 0$, they hold only for $\hat{\tau} > [(1-\alpha)A]^{\frac{1}{\alpha}}$.

Let us consider now the case of $\lambda = 0$. Consider first the case $\delta = \rho$; thus the relevant first-order conditions are (25) and a simplified version of (27):

$$-e^{-\delta t}K^{-1} - \mu\gamma(\tau,\lambda) = \dot{\mu} \tag{A.12}$$

By rearranging (25) one obtains:

$$\frac{e^{-\delta t}}{\mu K} = \frac{[\omega(\tau,\lambda) + \lambda\tau]\gamma_\tau(\tau,\lambda)}{\beta[\omega_\tau(\tau,\lambda) + \lambda]} \tag{A.13}$$

(A.5) and (A.12) imply (recalling that $\frac{\dot{c}^i}{c} = \gamma$):

$$\frac{\dot{\mu}}{\mu} = -\delta - \frac{\dot{c}^i}{c} = -\frac{\rho^{-\delta t}}{\mu K} - \gamma(\tau,\lambda) \tag{A.14}$$

(A.13) and (A.14) imply after substituting the expressions for $\omega(\tau,\lambda)$, $\gamma(\tau,\lambda)$, $\omega_\tau(\tau,\lambda)$ and $\gamma_\tau(\tau,\lambda)$ at $\lambda = 0$:

$$\tau\{1-\alpha(1-\alpha)A\tau^{-\alpha}\} = \beta\delta(1-\alpha) \tag{A.15}$$

which is equation (31) in the text.

An analogous procedure for the case $\delta > \rho$, using (27) in the text rather than (A-12) leads to (34) in the text.

2.) The time consistent solutions of problem (25)/(27)

As argued in the text the time consistent solutions for (τ and λ) have to be constant over time. For constant τ and λ, (38) is equivalent to:

$$\max_{\tau,\lambda}\ (1-\beta)\gamma(\tau,\lambda)\int_0^\infty te^{-\rho t}dt + \beta(\log[\omega(\tau,\lambda)+\lambda\tau])\int_0^\infty e^{-\delta t}dt + \beta\gamma(\tau,\lambda)\int_0^\infty te^{-\delta t}dt \quad \text{(A.16)}$$

$$\text{s.t. } \lambda \geq 0. \quad \text{(A.17)}$$

Problem (A.16) can be rewritten as:

$$\max_{\tau,\lambda}\ \frac{(1-\beta)}{\rho^2}\gamma(\tau,\lambda) + \frac{\beta}{\delta}[\log[\omega(\tau,\lambda)+\lambda\tau]] + \frac{\beta}{\delta^2}\gamma(\tau,\lambda) \quad \text{(A.18)}$$

$$\text{s.t } \lambda \geq 0.$$

The solutions (39)/(44) in the text can be obtained as a result of this optimization problem.

3.) Solution of problem (42)/(45).

The Hamiltonian of this problem can be written as follows:

$$H = \log\{[\omega(\tau)\frac{\ell^i}{K^i}K+\rho]K^i\}e^{-\rho t} + \mu_1\gamma(\tau)K^i + \mu_2\gamma(\tau)K \quad \text{(A.19)}$$

The first order conditions are as follows:

$$H_\tau = \omega_\tau(\tau)\frac{\ell^i K}{c^i}e^{-\rho t} + \mu_1\gamma_\tau(\tau)K^i + \mu_2\gamma_\tau(\tau)K = 0 \tag{A.20}$$

$$-H_{K^i} = -\frac{1}{c^i}\rho e^{-\rho t} - \mu_1\gamma(\tau) = \dot{\mu}_1 \tag{A.21}$$

$$-H_K = -\frac{1}{c^i}\omega(\tau)\ell^i e^{-\rho t} - \mu_2\gamma(\tau) = \dot{\mu}_2 \tag{A.22}$$

From (A.17) one obtains:

$$-\frac{\dot{c}^i}{c^i} - \rho = -\frac{\sigma_K^i\dot{\mu}_1 + \dot{\mu}_2}{\sigma_K^i\mu_1 + \mu_2} \tag{A.23}$$

In (A.23) $\sigma_K^i \equiv \frac{K^i}{K}$. From (A.20)/(A.23), recalling that $\gamma(\tau) = \frac{\dot{c}^i}{c}$: one obtains:

$$\frac{\sigma_K^i\dot{\mu}_1 + \dot{\mu}_2}{\sigma_K^i\mu_1 + \mu_2} = \gamma_\tau(\tau)\frac{\omega(\tau)\ell^i + \rho\sigma_K^i}{\omega_\tau(\tau)l^i} - \gamma(\tau) = -\frac{\dot{c}^i}{c^i} - \rho \tag{A.24}$$

Substituting the expressions for $\gamma_\tau(\tau)$, $\omega(\tau)$ and $\omega_\tau(\tau)$ in (A.24) and recalling that $c^i = \omega(\tau)\ell^i K^i + \rho K^i$ one obtains (56) in the text.

Table A-1

List of Countries

DEMOCRACIES	NON-DEMOCRACIES
Australia (66-67) *	Argentina (61)
Belgium # *	Bangladesh (63-64) $ *
Canada (61) $ *	Bolivia (68)
Colombia (64) *	Botswana (72) $ *
Costa Rica (69) *	Brazil (60) *
Denmark (63) *	Burma (58)
Finland (62) *	Chad (58)
France (62) *	Chile (68)
Germany (64) *	Dominican Republic (69) $
Greece (57)	Egypt (64-65) $
India (56-57) *	El Salvador (65)
Israel (57) *	Gabon (60)
Italy (48) *	Ghana # *
Jamaica (58) *	Guatemala (66) $ *
Japan (57-58) *	Honduras (67-68) $
Malaysia (63) *	Hong Kong (71) $ *
Netherlands (62) *	Indonesia (71) $ *
New Zealand (66) $ *	Iran (59) $
Norway (63) *	Iraq (56)
Spain (64-65) $ *	Ivory Coast (59) *
Sri Lanka (63) *	Kenya (69) $
Sweden (63) *	Korea (66)
Switzerland # *	Madagascar (60)
United States (69) *	Malawi (69) $
United Kingdom (64) *	Mexico (63)
Venezuela (62) *	Morocco (65) *
	Niger (60)
	Nigeria (59)
	Pakistan (63-64) *
	Panama (69)
	Peru (61) *
	Philippines (61) *
	Senegal (60)
	Sierra Leone (68)
	Singapore # *
	South Africa (65)
	Sudan (69)
	Taiwan (59-60) $
	Tanzania (64)
	Thailand (62) $
	Trinidad and Tobago (57-58)
	Tunisia (71)
	Uganda (70) $
	Uruguay (67) $
	Zambia (59)

The year following each country indicates the date in which income distribution is measured for the regressions in Tables 4, 5 and 6. * - countries included in the regressions of Tables 7, 8 and 9. # - countries <u>not</u> included in Tables 4, 5 and 6. $ - data obtained from Jain (1975); for all other countries data are from Lecallion et al. (1984).

Table A-2

Summary Statistics for the Sample of 67 Countries

	Mean	Standard Deviation	Minimum	Maximum
GR6085	2.18	1.86	-2.83	6.62
GDP60	2.04	1.86	0.21	7.38
PRIM60	77.61	30.58	5.00	144.00
Lowest 20%	5.18	2.02	1.60	10.00
Second 20%	9.15	2.41	4.20	14.00
Third 20%	13.27	3.03	7.00	18.80
Fourth 20%	19.82	3.39	12.40	26.40
Highest 20%	52.58	8.93	36.00	71.00
Highest 5%	26.47	9.17	11.20	48.30

Table A-3

Summary Statistics for the Sample of 38 Countries

	Mean	Standard Deviation	Minimum	Maximum
GR6085	2.66	1.83	-1.70	7.45
GDP60	2.89	2.15	0.44	7.38
PRIM60	90.42	26.83	30.00	144.00
Lowest 20%	5.95	1.74	2.40	9.80
Second 20%	10.89	2.00	5.70	19.70
Third 20%	15.81	2.18	10.70	18.90
Fourth 20%	22.47	1.94	18.40	25.60
Highest 20%	44.89	7.00	36.00	62.60
Highest 10%	29.36	6.96	20.80	46.20