

Grüner, Hans Peter

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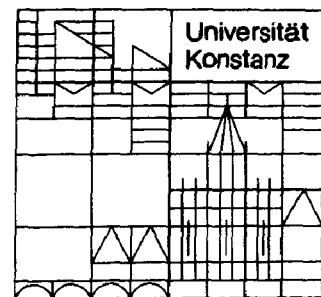
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Hans Peter Grüner

**Redistributive Policy,
Inequality and Growth**

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Redistributive Policy, Inequality and Growth

Hans Peter Grüner*

University of Konstanz

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Abstract: Does redistribution increase inequality? Is inequality harmful for growth? Both questions have recently been addressed in a number of single-tax models. In this paper, I examine the relationship between policy, growth and inequality when income and wealth can be taxed at different rates. In the model, parents accumulate human and physical capital in order to increase the quality of their children. Inequality arises because the learning ability of children is stochastic. Redistributive labor income taxation has a negative impact on short- and long-run growth and inequality while capital taxation increases growth without reducing inequality. I calculate a structure-induced equilibrium of the political process by means of a stochastic simulation of the model. In the short run initial income-inequality can stimulate growth, while initial inequality of the endowment with human capital is harmful for growth. In the long run the economies converge to the same politico-economic equilibrium.

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1 Introduction

Two aphorisms have become popular in the recent literature on inequality: "*redistribution can increase inequality*" and "*inequality is harmful for growth*". The first result was derived by Becker and Tomes (1979) from an OLG model where parents invest in low-ability children in order to increase their income. In the Becker-Tomes model, redistributive taxation reduces the net return on investment in children and, therefore, may reduce equality in the long run¹. The second statement became famous in the literature on tax policy and endogenous growth. Alesina and Rodrik (1991) and Persson and Tabellini (1991) state that inequality increases the median voter's preferred tax rate and thus reduces growth in an economy with a two-party system. Both strands of literature have in common that they consider one single policy instrument in their analysis. Becker and Tomes as well as Davies and Kuhn (1991) focus on the effects of a general income tax on the stationary-state coefficient of income variation and on the transition dynamics, respectively. Persson and Tabellini consider capital income taxation in an OLG model like Alesina and Rodrik do in their infinite horizon model. Perotti (1990) considers income taxation in his model of politics and endogenous growth. It is needless to say that in the context of tax policy, a one-dimensional policy decision is a rather restrictive assumption. This assumption is, however, often made in order to obtain simple results from the analysis of the median voter's preferences. In the present paper the relationship of tax policy, growth and inequality is reexamined in a model where two policy instruments are available: redistributive taxation of labour income and redistributive taxation of inherited stocks of physical capital. The second major difference to the previous literature on growth and inequality lies in the choice of the engine of growth. In Persson and Tabellini growth is caused by an externality which is related to the total stock of capital. In Alesina and Rodrik (1991) the government can foster growth by providing a public good. I assume that growth is created through the individual accumulation of human capital.

¹Davies and Kuhn (1988) show that this result only holds in the stationary state and that, in the short run, redistribution will reduce inequality.

The paper consists of two parts. In the first part I determine the effects of redistributive policies on growth and the distribution of income, taking the policy decision as given. This part shall answer the question whether the two tax rates will increase or reduce inequality in the long run. The introduction of human capital accumulation into the model also makes it possible to analyze the effect of the two tax rates on the rate of growth². The model is an OLG-model where parents are altruistic and leave human and physical capital as bequests to their children. The impact of taxation on short-term growth and on the balanced growth rate can be derived analytically. The effect of the two tax rates on the steady-state income distribution is examined in a dynamic stochastic simulation of the model. Inheritance taxation is found to have a positive impact on growth and no robust effect on inequality, while income taxes negatively affect short- and long-run growth and increase equality.

In the second part of the paper the tax rates on human and physical capital are endogenized. Two policy instruments are available to the government and a simple analysis of median-voter preferences becomes impossible. I use a numerical procedure in a simulation program in order to examine the evolution of politics. Given current policy, I assume that policy moves into the direction where a single competing party would maximize the number of votes. Policy remains unchanged if there is no new proposal that receives 50 percent of the votes. Thus, an equilibrium is a state which is at least locally politically stable. Another interpretation of this numerical procedure is that it reflects the actions of a government, maximizing political support. Recent work on the field with a one-dimensional policy decision by Persson and Tabellini (1991), Alesina and Rodrik (1991) and Perotti (1990), concludes that initial inequality negatively affects growth in the short run. In the present model, initial inequality of the endowment with human capital also reduces the rate of growth in the short run. Initial inequality of inherited stocks, however, initially increases growth if it leads to higher property or inheritance-tax rates. In the long run the model predicts that different economies converge

²The influence of income and inheritance taxation on the growth rate in a model with human capital accumulation has been previously examined in Grüner and Heer (1994). The present paper uses the same human capital accumulation function but examines redistributive taxation and considers heterogeneous agents.

to the same politico-economic equilibrium with identical values for taxes, the growth rate and income distribution.

The paper has the following structure: in section 2 the model is introduced and the decisions of the individuals are derived. The steady state rate of growth is calculated and the influence of taxes on this rate and on short-term growth is examined. The effect of the tax policy on the income distribution is examined with the help of a dynamic stochastic simulation procedure in section 3. In section 4, the political decision process is endogenized and the effect of initial conditions on steady state values of taxes, growth and distribution is determined. Section 5 concludes.

2. A model of inheritance, ability, distribution and growth

Time is divided into periods. In each period old individuals of mass 1 are alive and there is one storable good available. Individuals have one child and live for two periods. Each individual acquires human capital H_t in the first period of life, $t-1$. In the second period, t , she inelastically supplies one unit of labor and receives the real wage $(1-\theta)H_t\bar{w}$ and consumes. Like in Becker and Tomes(1979), Persson and Tabellini (1991) and Alesina and Rodrick (1991), factor prices are assumed to be given exogenously³. \bar{w} is the given real wage per efficiency unit of labor. At the beginning of the second period the individual receives the bequest B_{t-1} which is taxed at rate $(1-\tau)$. The rental rate of capital, $(1-\tau)B_{t-1}$ is given by \bar{r} . Tax revenues on bequests of the last generation and on current labor income are redistributed equally among society. The budget constraint of an old individual in t is

$$I_t := (1-\theta)H_t\bar{w} + (1-\tau)(1+\bar{r})B_{t-1} + T_t = c_t + B_t, \quad (1)$$

³ For a model with endogenous factor prices see Grüner and Heer (1994).

where I is the income of the old in period t and T are taxes on inherited wealth and current labor income. Following Becker and Tomes (1979), each parent wishes to increase the quality of her child and quality can be measured by the child's lifetime income. Besides worktime, each parent possesses an amount \bar{I} of time. She can devote a part of this time h_t to the education of her child. The utility function is Cobb-Douglas in consumption, quality of the child and leisure,

$$u(c_t, I_{t+1}, f_t) = c_t^{\alpha_1} I_{t+1}^{\alpha_2} (\bar{I} - h_t)^{\alpha_3} \quad (2)$$

I assume that h_t increases the human capital of the child, H_{t+1} , but not the parent's human capital H_t ⁴. The stock of human capital of an individual that works in t , H_t is a function of the human capital of her parent, H_{t-1} , her own stochastic ability and the time, her parent invested into her human capital formation, h_{t-1} .

$$H_t = H_{t-1} (1 + Ah_{t-1}) \varepsilon_t \quad (3)$$

with $E(\varepsilon_t) = 1$

Parents know ε_{t+1} , when they choose consumption, c , invested time, h , and bequests, B . Figure 1 explains the time structure of the model. Optimality of this decision requires:

$$\frac{\alpha_1}{\alpha_2} \frac{I_{t+1}}{c_t} = (1 - \tau)(1 + \bar{r}) \quad (4)$$

and

$$\frac{\alpha_3}{\alpha_1} \frac{c_t}{\bar{I} - h_t} = \frac{(1 - \theta) H_t \bar{w} A \cdot \varepsilon_{t+1}}{(1 - \tau)(1 + \bar{r})}. \quad (5)$$

Substitution of (4) into (5) and solving for h_t yields:

$$h_t = \bar{I} - \frac{\alpha_3}{\alpha_2} \cdot \frac{I_{t+1}}{H_t (1 - \theta) \bar{w} A \varepsilon_{t+1}}. \quad (6)$$

Considering $B_{t-1} = I_{t-1} - c_{t-1}$ (4) becomes:

⁴I could have made H_t dependent upon h_t . This, however, would have given the household's decision problem a recursive structure. The present specification of human capital accumulation (3) has been chosen in order to capture the effect that the investment of parents into human capital spills over to the human capital stock of children.

$$B_{t-1} = I_{t-1} - \frac{\alpha_1}{\alpha_2} \frac{I_t}{(1-\tau)(1+\bar{r})}. \quad (7)$$

This formula simply means that parents leave their children less if the children will have a high lifetime income. I substitute (6) and (7) into (1) in order to obtain an equation for income at t:

$$I_t = (1-\theta)\bar{w}H_{t-1} \left[1 + A \left(\bar{l} - \frac{\alpha_3}{\alpha_2} \frac{I_t}{H_{t-1}\varepsilon_t(1-\theta)\bar{w}A} \right) \right] \cdot \varepsilon_t + (1-\tau)(1+r)I_{t-1} - \frac{\alpha_1}{\alpha_2} I_t + T_t \quad (8)$$

$$\Leftrightarrow \frac{\alpha_1 + \alpha_2}{\alpha_2} I_t = \varepsilon_t \cdot (1-\theta)\bar{w}H_{t-1} (1 + A\bar{l}) - \frac{\alpha_3}{\alpha_2} I_t + (1-\tau)(1+\bar{r})I_{t-1} + T_t \quad (9)$$

$$\Leftrightarrow I_t = \frac{\alpha_2}{\alpha_1 + \alpha_2 + \alpha_3} (\varepsilon_t (1-\theta)\bar{w}H_{t-1} (1 + A\bar{l}) + (1-\tau)(1+\bar{r})I_{t-1} + T_t) \quad (10)$$

The income in t is completely determined by the shock and the parent's decisions. (10) states that the old individual in t-1 decides to leave his child an income share α_2 of potential income in t+1. We are now in the position to derive the balanced growth paths of the economy.

The balanced growth rate

I now derive difference equations for average income and the average stock of human capital in order to calculate the balanced growth path for the economy. Taxes are paid on current labor income and the inherited capital stock. The average tax revenues are:

$$T_t = \tau \bar{B}_{t-1} + \theta \bar{H}_t \bar{w} = \tau \bar{I}_{t-1} - \frac{\alpha_1}{\alpha_2} \frac{\bar{I}_t \cdot \tau}{(1-\tau)(1+\bar{r})} + \theta \bar{H}_t \bar{w} \quad (11)$$

where an upper bar indicates an economy-wide average. Human capital in t can be calculated from (3) and (6):

$$H_t = \varepsilon_t H_{t-1} (1 + A\bar{l}) - \frac{\alpha_3}{\alpha_2} \frac{1}{(1-\theta)\bar{w}} I_t \quad (12)$$

Now suppose that \bar{H}_{t-1} and \bar{I}_{t-1} are given. We obtain from (10), (11) and (12):

$$\bar{H}_t = (1 + A\bar{l})\bar{H}_{t-1} - \frac{\alpha_3}{\alpha_2} \frac{1}{(1-\theta)\bar{w}} \bar{I}_t \quad (13)$$

and

$$\bar{I}_t = \Psi(\tau, \theta) \cdot [E(\varepsilon_t)\bar{w}(1 + A\bar{l})\bar{H}_{t-1} + (1 + (1 - \tau)\bar{r})\bar{I}_{t-1}], \quad (14)$$

$$\text{with } \Psi(\tau, \theta) := \left[\frac{\alpha_1 \left[1 + \frac{\tau}{(1-\tau)(1+\bar{r})} \right] + \alpha_2 + \alpha_3}{\alpha_2} + \frac{\alpha_3}{\alpha_2} \frac{\theta}{1-\theta} \right]^{-1}.$$

I also define: $g_t := \bar{H}_t / \bar{H}_{t-1}$, $z_t := \bar{I}_t / \bar{H}_t$. Division of (13) and (14) by \bar{H}_{t-1} yields:

$$g_t z_t = \Psi(\tau, \theta) [\bar{w}(1 + A\bar{l}) + (1 + (1 - \tau)\bar{r})z_{t-1}] \quad (15)$$

and

$$g_t = (1 + A\bar{l}) - \frac{\alpha_3}{\alpha_2} \frac{1}{(1-\theta)\bar{w}} g_t z_t \quad (16)$$

or:

$$z_t = \frac{\alpha_2}{\alpha_3} (1-\theta)\bar{w} \left[\frac{1 + A\bar{l}}{g_t} - 1 \right] \Leftrightarrow g_t = \frac{(1-\theta)\bar{w}(1 + A\bar{l})}{\frac{\alpha_3}{\alpha_2} z_t + (1-\theta)\bar{w}} \quad (17)$$

(15) and (17) describe the dynamics of the growth rate and the ratio of income and human capital. One can derive the dynamics of z by substitution of g from (17) into (15)

$$z_t = \Gamma(z_{t-1}) = \frac{\bar{w} + \frac{(1 + (1-\tau)r)}{(1 + A\bar{l})} z_{t-1}}{\frac{1}{\Psi} - \frac{\alpha_3}{\alpha_2} \frac{1}{(1-\theta)} - \frac{\alpha_3}{\alpha_2} \frac{1 + (1-\tau)r}{(1-\theta)\bar{w}(1 + A\bar{l})} z_{t-1}} \quad (18)$$

The hyperbola Γ has one, two or no positive fixed point. If there are two solutions, then only the smaller one is locally stable, because at this point the slope of Γ must be smaller than one (see Figure 1). Thus, from (17), two balanced growth solutions for g also exist and only the larger one is locally stable. This solution can be obtained from substitution of z from (17) into (15) assuming that we are in a steady state with growth g :

$$\frac{\alpha_2}{\alpha_3}(1-\theta)\bar{w}((1+A\bar{l})-g) = \Psi(\tau, \theta) \cdot \left[\bar{w}(1+A\bar{l}) + (1+(1-\tau)\bar{r})\frac{\alpha_2}{\alpha_3}(1-\theta)\bar{w}\left[\frac{1+A\bar{l}}{g}-1\right] \right] \quad (19)$$

Multiplication with g gives:

$$0 = \frac{\alpha_2}{\alpha_3}(1-\theta)\bar{w}g^2 - \frac{\alpha_2}{\alpha_3}(1-\theta)\bar{w}(1+A\bar{l})g + \Psi(\tau, \theta) \cdot \left[\bar{w}(1+A\bar{l})g + (1+(1-\tau)\bar{r})\frac{\alpha_2}{\alpha_3}(1-\theta)\bar{w}(1+A\bar{l}-g) \right] \quad (20)$$

Division by the after-tax wage gives:

$$0 = g^2 - (1+A\bar{l})g + \Psi(\tau, \theta) \cdot \left[\frac{\alpha_3}{\alpha_2} \frac{(1+A\bar{l})g}{(1-\theta)} + (1+(1-\tau)\bar{r})(1+A\bar{l}-g) \right] \quad (21)$$

This is

$$0 = g^2 + \left[\Psi \left(\frac{\alpha_3}{\alpha_2} \frac{(1+A\bar{l})}{(1-\theta)} - (1+(1-\tau)\bar{r}) \right) - (1+A\bar{l}) \right] g + \Psi(1+(1-\tau)\bar{r})(1+A\bar{l}) \quad (22)$$

The quadratic equation (22) has two positive solutions for the steady-state growth rate g , if the constant term is not too large. We are now in the position to examine the short- and long-run effects of the tax rates on steady-state growth.

Proposition 1 An increase in the inheritance tax rate τ

- (i) increases the stock of human capital H and average labour income in the short run, and
- (ii) increases steady state growth g .

Proof 1 Consider equation (18). Nominator and denominator can be viewed as two linear functions of z_{t-1} , one with positive, one with negative slope. Both curves become flatter as τ increases. The constant in the denominator rises because $\frac{\partial \Psi}{\partial \tau}, \frac{\partial \Psi}{\partial \theta} < 0$. This implies that the hyperbola $z_t = \Gamma(z_{t-1})$ is shifted downwards. (i) follows from the fact that for any given ratio z_{t-1} with $\Gamma(z_{t-1}) > 0$, the associated ratio z_t for the next period becomes smaller if τ is increased. Thus, from (17) short-term human-capital growth g_t is increased. (ii) follows from the fact that the smaller fixed point of (18) moves to the left if inheritance taxes are increased. From (17), long-term growth must increase.

Q.E.D.

A higher tax rate on inherited capital increases the balanced growth rate because it increases the incentive to invest in human capital. This also implies higher short-term growth of the human capital stock. Income taxation by contrast is harmful for growth as the following proposition shows.

Proposition 2 An increase of the income tax rate

- (i) reduces the growth rate of human capital in the short-run, and
- (ii) reduces the growth of lifetime income and human capital in the long run.

Proof 2 The constant in the denominator of (18),

$$\frac{1}{\Psi} - \frac{\alpha_3}{\alpha_2} \frac{1}{(1-\theta)} = \frac{\alpha_1 \left[1 + \frac{\tau}{(1-\tau)(1+\bar{r})} \right] + \alpha_2 + \alpha_3}{\alpha_2} + \frac{\alpha_3}{\alpha_2} \frac{\theta-1}{1-\theta},$$

does not change with θ . The slope of the denominator is increasing with the income tax rate. Thus, the falling line in figure 2 will be sloped downwards more strongly and the hyperbola $z_t = \Gamma(z_{t-1})$ is shifted upwards. (i) follows immediately: for any given ratio z_{t-1} with $\Gamma(z_{t-1}) > 0$, the associated ratio z_t for the next period becomes larger if income taxes are

increased. Thus, from (17) short-term human-capital growth g_t is decreased. (ii) follows from the fact that the smaller fixed point of (18) moves to the right if income taxes are increased. From (17), long-term growth must fall.

Q.E.D.

Inheritance taxation and income taxation have opposite effects on human capital accumulation and long-run growth. Inheritance taxes raise investment in human capital and therefore increase labor income growth in the short run. Income taxation has the opposite effect. Inheritance taxation increases, while income taxation reduce growth in the long-run. Both propositions confirm the result of a simulation by Grüner and Heer (1994) that inheritance taxation is beneficial for growth if altruistic parents can invest in human capital for their children. The following section analyses the impact of taxation on income inequality.

3. Taxation and inequality

I simulated the model of section 2 in order to find out how the two tax rates affect the steady-state rate of income distribution⁵. In period one of the simulation, each individual has an income and a stock of human capital of 1. Individuals get to know the learning ability of their child, ε_{t+1} , which is distributed uniformly on the interval $[0.75, 1.25]$. Each individual then chooses her optimal value of c , B and h . Simulations were run with 20 generations with 100 and 200 individuals. Tax rates were chosen from a two-dimensional grid between 0 and 95 percent with a 2.5 percent step-size, thus, 400 tax systems were considered. Six alternative calibrations were used. They are given in table 1⁶.

⁵ All simulations were executed with Maple V1. The programs are available upon request. The simulation in this section is based on the equations (3), (6) and (10); the simulations in section 4 use equations (2), (4), (5), (10), (11) and (13).

⁶Lifetime \bar{l} is normalized to 1. In simulation II, A has been chosen such that it can account for a 30-year labour productivity increase of 113 percent (this value has been calculated from the Institut der Deutschen Wirtschaft (1994, table 39)) if an individual invests 17 percent of it's lifetime in the accumulation of human capital.

Inequality is measured as the ratio of the standard deviation and mean of lifetime income. Life-cycle considerations are therefore ignored in this paper. The results can be summarized as follows (also see table 2):

1. When A , α_2 , and α_3 are positive, inheritance taxation has a positive impact on the long-run growth of the economy. In simulations I and II growth increases with the tax rate. In simulation III the weight of the child's quality was chosen low (.1) and the impact of the tax rate on growth became zero. The same is true for simulation IV, where A was chosen close to zero. In simulation V α_3 is chosen close to zero so that the investment in human capital is inelastic with respect to the tax rate. Figure 3 displays the growth rate as a function of the two policy variables for simulation II.

2. Labor income taxation is harmful for growth.

3. The effect of labor and capital taxation on inequality is sensitive with respect to the calibration of the model. Inheritance taxation does influence the degree of inequality negatively in some of the simulations. Figure 4 shows how taxation affects the steady state distribution in simulation I. In most of the simulations, income taxation reduces inequality in the steady state.

The extension of the Becker-Tomes model for human capital accumulation and two distinct tax rates leads to modified results. The simulation does not lead to a robust monotone relationship between income taxation and inequality. The long-run effect of inheritance taxation on equality can equally be zero, positive or negative. The simulation shows that, in accordance with my analytical results above, there are opposite effects of the two tax rates on growth. As a consequence of this analysis, policymakers who are concerned about growth and inequality should consider wealth taxation as an alternative to the taxation of income flows if intra-family human capital spillovers of the kind considered above exist. It is, however, very unlikely that actual economic policy, whether in representative or direct democracies, will take into account such long-run effects of taxation. Just consider that the length of one period in this model

corresponds to about 35 years. The following section presents some stylized facts about the importance of property taxation.

3.1 Some stylized facts

Table 3 displays some 1989 GNP shares of income-, capital-income- and property taxes in different countries. Property- and inheritance taxes do not contribute significantly to tax revenues in most countries. In almost all of the countries selected, property taxes account for less than 3 percent of GDP. The GNP shares of income-, property- and inheritance taxation in the OECD countries are very similar to each other. Income taxes are 14.1 percent of GDP on average (37 percent of total tax revenues), while property taxes account for only 3 percent of GDP (5.4 percent of total tax revenues) (source OECD tax revenue statistics (1991)). Taxes on corporate income are of similar (un)importance with GDP shares of less than three percent in most countries. Exceptions are the UK (4.5%) and Japan with a 7.7 percent share of corporate taxes. The following section analyzes how individuals vote for the two tax rates in a democracy in order to determine how policy, growth and distribution will evolve in the short run and in the long run and subsequently the results are compared to these stylized facts.

4.The political equilibrium

This section examines the evolution of economic policy, growth and income distribution in a democracy. Earlier papers which model the interactions of inequality, policy and growth are Persson and Tabellini (1991), Alesina and Rodrick (1991) and Perotti (1990). All three papers find that initial inequality reduces growth in the short run. In Persson and Tabellini's OLG model individuals save for the second period. An initial inequality of endowment with skills will lead to higher taxes on capital income and thus decreases investment. A lower capital stock, however, reduces growth and thus, initial inequality reduces growth. In Alesina and Rodrik (1991) the (single) capital tax is used to finance a public good that enters in the economy's production function. In this model, initial inequality of the relative factor endowment increases

the tax rate and thus, reduces incentives to invest. In Alesina and Rodrik, individuals are infinitely lived. The median voter would prefer a time-invariant tax rate. An unequal distribution of capital reduces growth. Alesina and Rodrick do not consider whether individuals would change the policy later due to an induced change of the income distribution. Perrotti also finds a positive relationship between equality and growth. In his model, a credit market imperfection hinders very poor people to invest in education at all.

I extended the stochastic simulation from section 3 with a voting routine in order to determine a politico-economic equilibrium for the model of section 2. The program was modified as follows: in the beginning of each period, the old individuals compare four proposals with the actual tax rate: an increase (reduction) in τ of 5 percent, and an increase (reduction) in θ of 5%. The tax rates remain unchanged if all four different proposals receive less than 50 percent of the votes. If there are proposals which received more than 50 percent, the one with the largest number of votes is implemented for the rest of the period. In a steady state, growth, income distribution and the tax rates remain unchanged. One interpretation of this process is that an incumbent policymaker offers the old policy, while a second party tries to achieve a majority in a given environment. Policy moves into the direction where the second party would obtain the largest majority of the votes. Policy does not change if no such solution exists in a certain environment. A second interpretation of this process is that it reflects the moves of a government which searches to increase political support in an environment of its current policy. If one determines the political equilibrium when two policy variables are available cycles in collective decisions may arise. Such cycles did not emerge in any of the simulations.

The prior values for the first period are $\tau=0.3$ and $\theta=0.1$. A stationary population of 200 individuals was considered. This time, however, different initial income and human capital distributions were used. I assumed that in period 0 there were two homogenous groups. In the first simulation, both groups received 50 percent of total period 0 income and owned 50 percent of total human capital. ϕ is the size of the larger group and thus a measure of initial inequality. Table 4 shows how growth, the income distribution and the two tax rates are

affected by ϕ in the short run. Initial inequality increases taxes and, therefore, decreases growth in the short run (table 3). Thus, a negative relationship between total inequality and growth was established. The result is also valid if only the initial endowment with human capital and not initial income is unequal. But results can change if only income and not human capital is distributed unequally. Initial income inequality can increase the tax rate on capital stocks and therefore increase growth in the short run (see figure 6 for an example). The model therefore predicts that redistribution of wealth and public schooling programs should have opposite effects on short-run growth. Redistribution of wealth should reduce the rate of growth while a redistribution of human capital could reduce income taxes and thus increase short term growth.

In the simulation, there was no long-run relationship between inequality and growth. Figure 4 shows that in the present two-tax model, redistributive policy changes the income distribution so that tax rates and growth rates converge in the long run. Table 5 displays numerical values for tax rates, growth and the income distribution from simulation II after 8 iterations. The initial distribution does not affect the long-run outcome in this model and there are no multiple equilibria. Strikingly in all the simulations, both steady-state tax rates are rather large (above 35 percent). While this is compatible with the actual income tax rates in most countries, it is obviously not compatible with the actual importance of property- and corporate income taxes.

5. Conclusion

The objective of this paper was to investigate the interrelationship between inequality, taxation and growth in a setting where growth is mainly created through the accumulation of human capital and where there is intergenerational altruism. The consideration of the tax rate on bequests as a second political variable besides income taxation modifies a number of results obtained in earlier work on growth and inequality. We have seen that if human capital accumulation is the motor of growth then redistributive taxation of inherited stocks and

redistributive taxation of income flows affect growth in opposite ways. The taxation of stocks increases the rate of growth of human capital in the short run and consequently raises the steady-state growth rate. The relationship between taxes and equality is sensitive to the calibration of the model. Inheritance taxation can but need not increase inequality (the Becker-Tomes effect). Redistributive income taxation has ambiguous effects on the long-run distribution of income, as well.

The politico-economic analysis modifies the result of Persson and Tabellini (1991), Alesina and Rodrik (1991) and Perotti (1990) that, in the short run, inequality increases taxes and thus reduces the rate of growth. The type of inequality becomes crucial in the analysis: a negative growth effect can be observed when human capital is distributed unequally because income taxes will rise. Inequality in the distribution of stocks, by contrast, raises taxes on wealth and promotes growth. Redistributive policies that aim to move the economy to another growth path could therefore fail if redistribution concerns only wealth and not human capital.

The model also predicts the long-run convergence of tax policies among different countries. This last prediction is not completely incompatible with the stylized facts about some selected tax systems which are reported in table 2. But the numerical values for the property tax rates which were derived in the simulations and the actual importance of those taxes are strikingly different. In most countries, wealth taxation only insignificantly contributes to the total tax revenues. This difference between predicted and actual importance of property taxation can have at least two reasons. One prominent explanation is that capital mobility and the numerous possibilities of tax-evasion make high wealth taxes unattractive for the median voter. A second possible reason, however, is that the median-voter approach adopted in this paper need not be the appropriate way to model the determination of the two tax rates. If rich owners of capital form a small and well-organized group with high potential gains or losses from taxation, the outcome of the political process should be affected by their lobbying activity for low tax rates on wealth (for the same critique see Ursprung (1990)). Thus, a comparison of the explanatory

power of a model with lobbying and a median voter-model of the above type is on the agenda for further research.

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Table 1: The calibration of the model

Simulation No.	α_1	α_2	α_3	l	\bar{w}	\bar{r}	A
I	1/3	1/3	1/3	1	1	0.8	1
II	1/3	1/3	1/3	1	1	0	6.64
III	0.8	0.1	0.1	1	1	.8	6.64
IV	1/3	1/3	1/3	1	1	0.3	.05
V	2/3	1/3	0.01	1	1	0.3	6.64
VI	1/3	1/3	1/3	1	1	0.8	6.64

Table 2: The effect of fiscal policy on growth and income distribution

Simulation No.	The effect of τ on growth	The effect of τ on equality	The effect of θ on growth	The effect of θ on equality
I	+	-	-	+
II	+	0	-	-
III	0	0	-	+(growth is zero)
IV	0	0	-	+
V	0	0	-	+
VI	+	+	-	-

Table 3: Tax revenue as percentage of GDP in 11 countries, 1989.

(source IMF, Government Finance Statistics Yearbook)

Country	Taxes on income of individuals in % of GDP 1989	Taxes on corporate income in % of GDP 1989	Property taxes (includes inheritance tax and property tax) in % of GDP 1989
Germany ¹	9.8	1.2	1.0
France ²	4.6	2.4	0.9
UK ³	9.8	4.5	4.7
Switzerland ⁴	10.6	0.6 (1.5)	2.7
Italy ²	10.9	2.7	0.6
US ⁴	10.5	2.0 (2.5)	3.0
Japan ³	7.2	7.7	2.7
Israel ³	11.1	2.2	2.5
Kuwait	0.0	0.3	0.03
Brazil	0.2	0.0	0.0
Argentina ⁴	0.2	0.0	1.2

¹ The decentralized system requires all administrative levels to be taken into account: central, provincial/state and local governments.

² The figures do not include the tax revenues of the local governments (which amount to 3.9% of GDP in France, 0.01% in Italy).

³ The data represents tax revenues of central and local governments.

⁴ Tax revenues occur on all three levels (central, provincial/state, local), but due to the aggregation of the data on the provincial and local level it was impossible to allocate the correct share of the taxes to the respective sources. The figures in brackets, therefore, give an approximation of the actual percentage of the taxes on corporate income including all the relevant administrative levels (tax on corporate income = tax on income, profits, capital gains -taxes on income of individuals). In the case of Argentina provincial and local governments receive some additional taxes on income of individuals and corporations that amount to 1.3% of GDP and which are not taken into account in the above table.

Table 4: Initial inequality and political equilibrium after 2 periods, simulation II

ϕ	100 (equality)	120	140	160	180
Income tax rate	.15	.10	.10	.15	.20
Inheritance tax rate	.15	.40	.40	.35	.30
coefficient of variation	.175	.209	.189	.171	.168
Growth-rate	5.09	4.56	4.48	3.95	3.60

**Table 5: Initial inequality and political equilibrium after 8 periods,
simulation II, 200 Individuals**

ϕ	100 (equality)	120	140	160	180
Income tax rate	.40	.45	.45	.45	.45
Inheritance tax rate	.35	.35	.35	.30	.35
coefficient of variation	.662	.686	.699	.665	.621
Growth-rate	3.82	3.45	3.65	3.50	3.64

eval (thetax);

		time											
φ	θ	1	2	3	4	5	6	7	8	9	10	11	12
	1	.1	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65
	2	.1	.1	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60
	3	.1	.1	.15	.15	.15	.20	.25	.30	.30	.35	.40	.45
	4	.1	.1	.1	.1	.1	.15	.20	.25	.30	.35	.40	.45
	5	.15	.15	.15	.15	.15	.15	.15	.20	.20	.25	.30	.35
	6	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70
	7	.15	.15	.15	.15	.15	.15	.15	.20	.25	.30	.35	.40
	8	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70
	9	.15	.15	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60
	10	.15	.20	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65

eval (taux);

		time											
φ	τ	1	2	3	4	5	6	7	8	9	10	11	12
	1	.35	.35	.35	.35	.35	.35	.35	.35	.35	.35	.35	.35
	2	.35	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40
	3	.35	.40	.40	.45	.50	.50	.50	.50	.55	.55	.55	.55
	4	.35	.35	.40	.45	.50	.50	.50	.50	.50	.50	.50	.50
	5	.3	.35	.40	.40	.45	.50	.55	.55	.60	.60	.60	.60
	6	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3
	7	.3	.35	.40	.40	.45	.50	.55	.55	.55	.55	.55	.55
	8	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3
	9	.3	.35	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40
	10	.3	.3	.35	.35	.35	.35	.35	.35	.35	.35	.35	.35

Table 6 The political process. φ is a measure of initial inequality.

Figure 1: The Time Structure

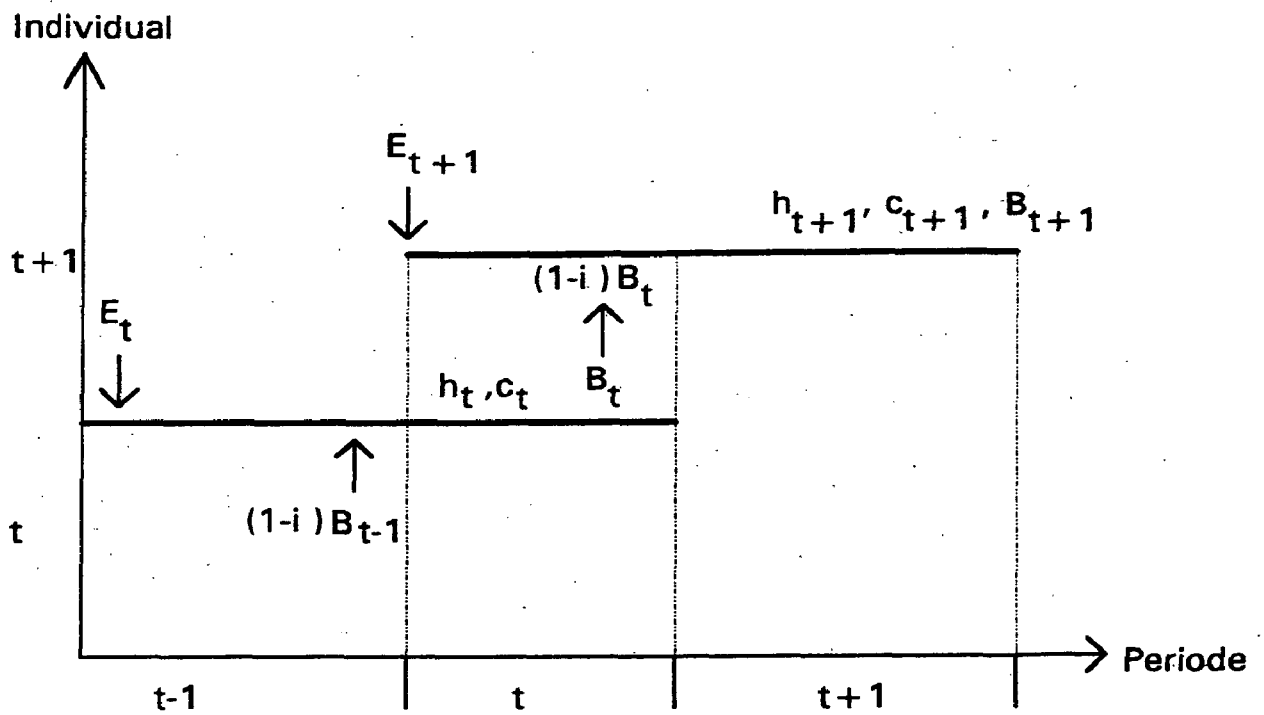
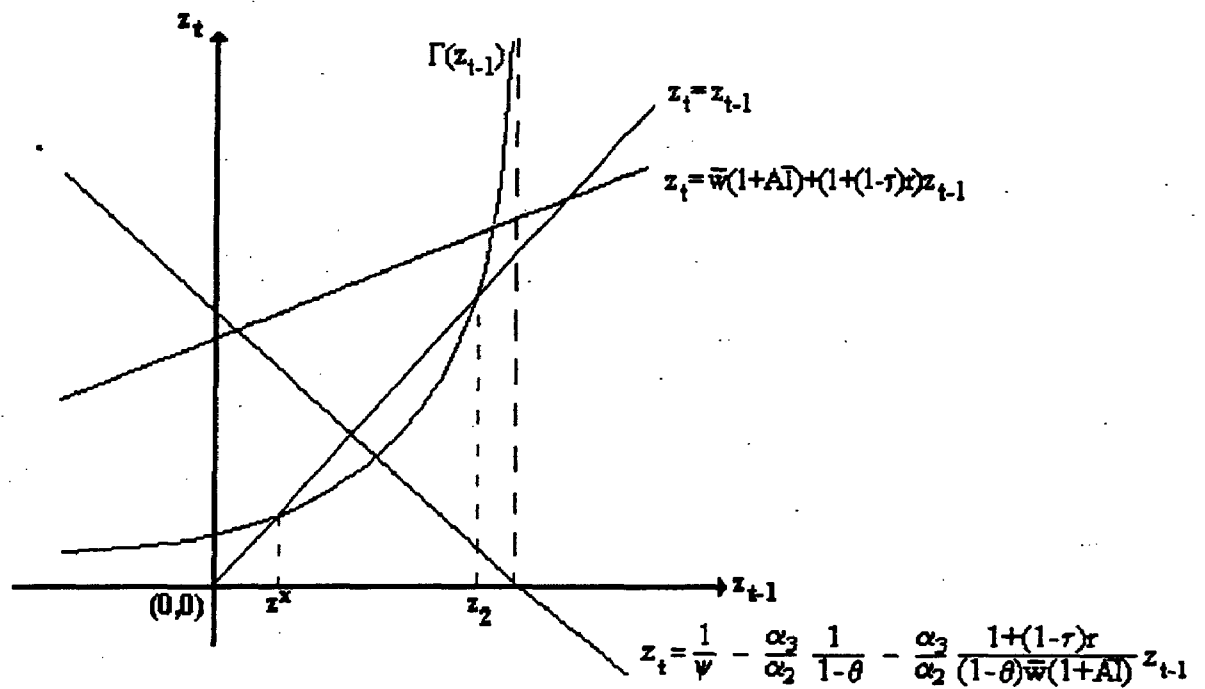


Figure 2



The dynamics of the ratio $z_t = \frac{\bar{I}_t}{\bar{H}_t}$. z^x is the smaller locally stable solution.

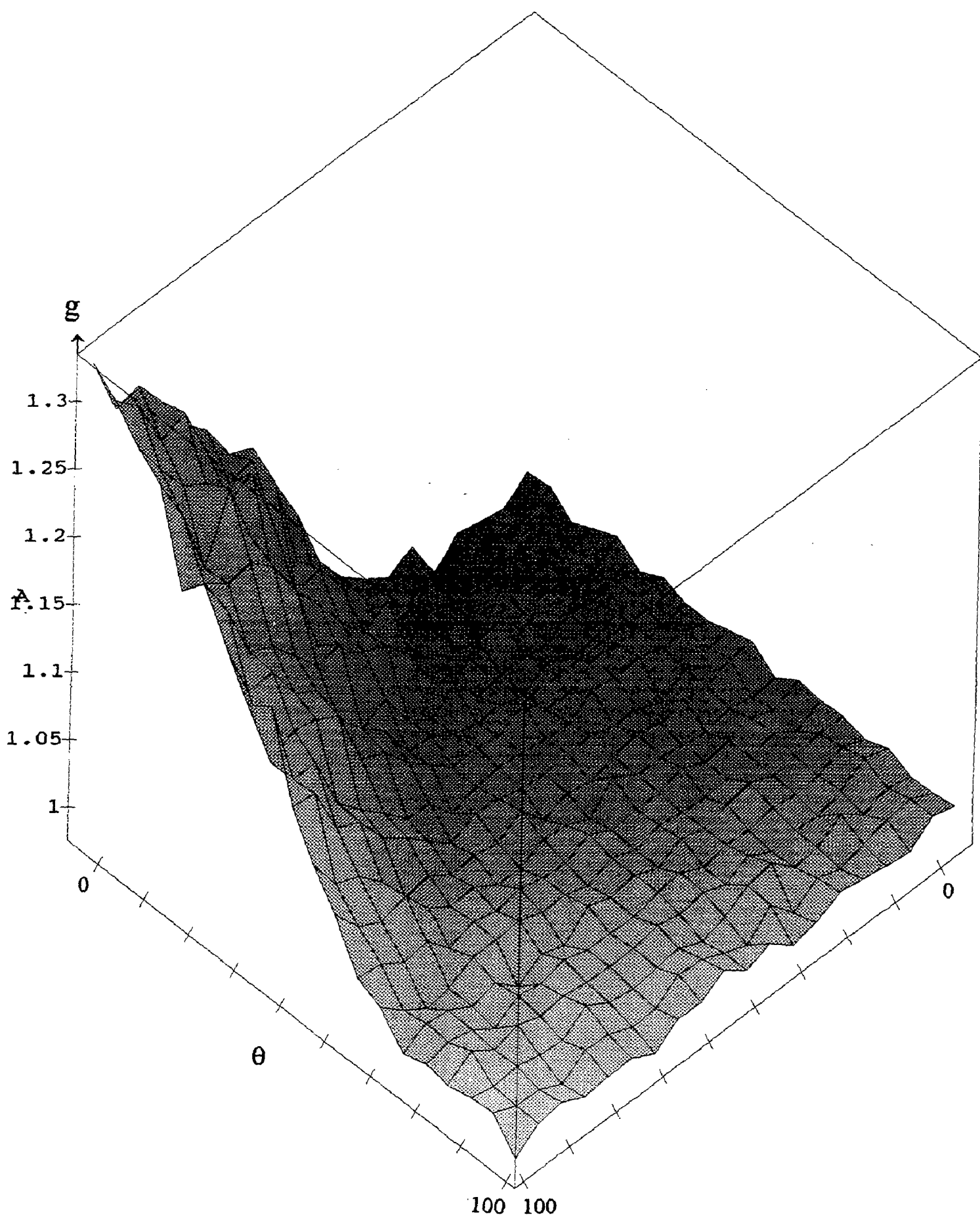


Figure 3 Taxation and steady-state growth. The parameters are taken from simulation I, Table 1. The simulation was run with 200 individuals and 20 periods. The growth rate is the average of the last three period over-period growth rates.

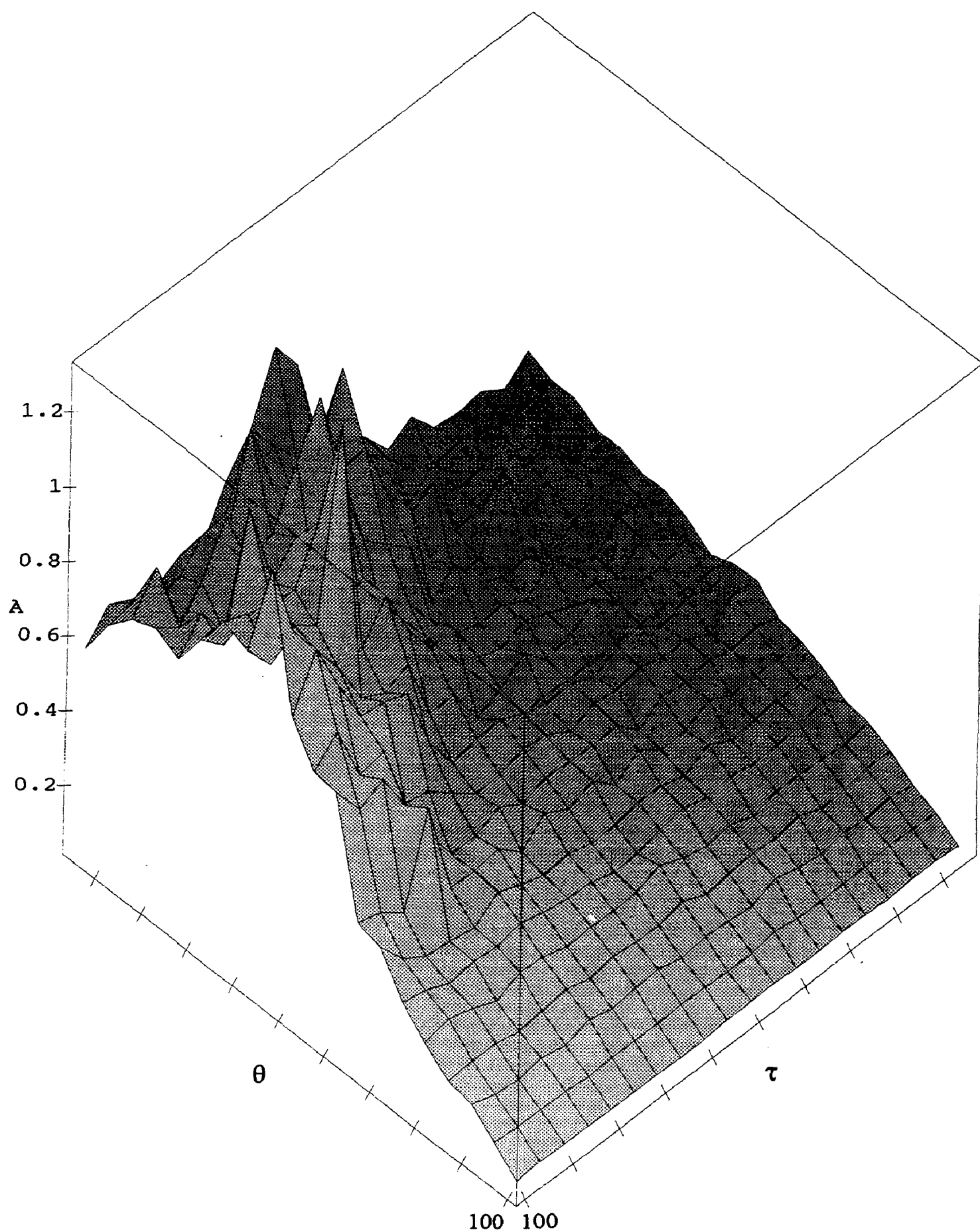


Figure 4 The coefficient of income variation ϕ as a function of the tax-rates τ and θ . The parameters are taken from simulation I, Table 1. The simulation was run with 200 individuals and 20 periods.

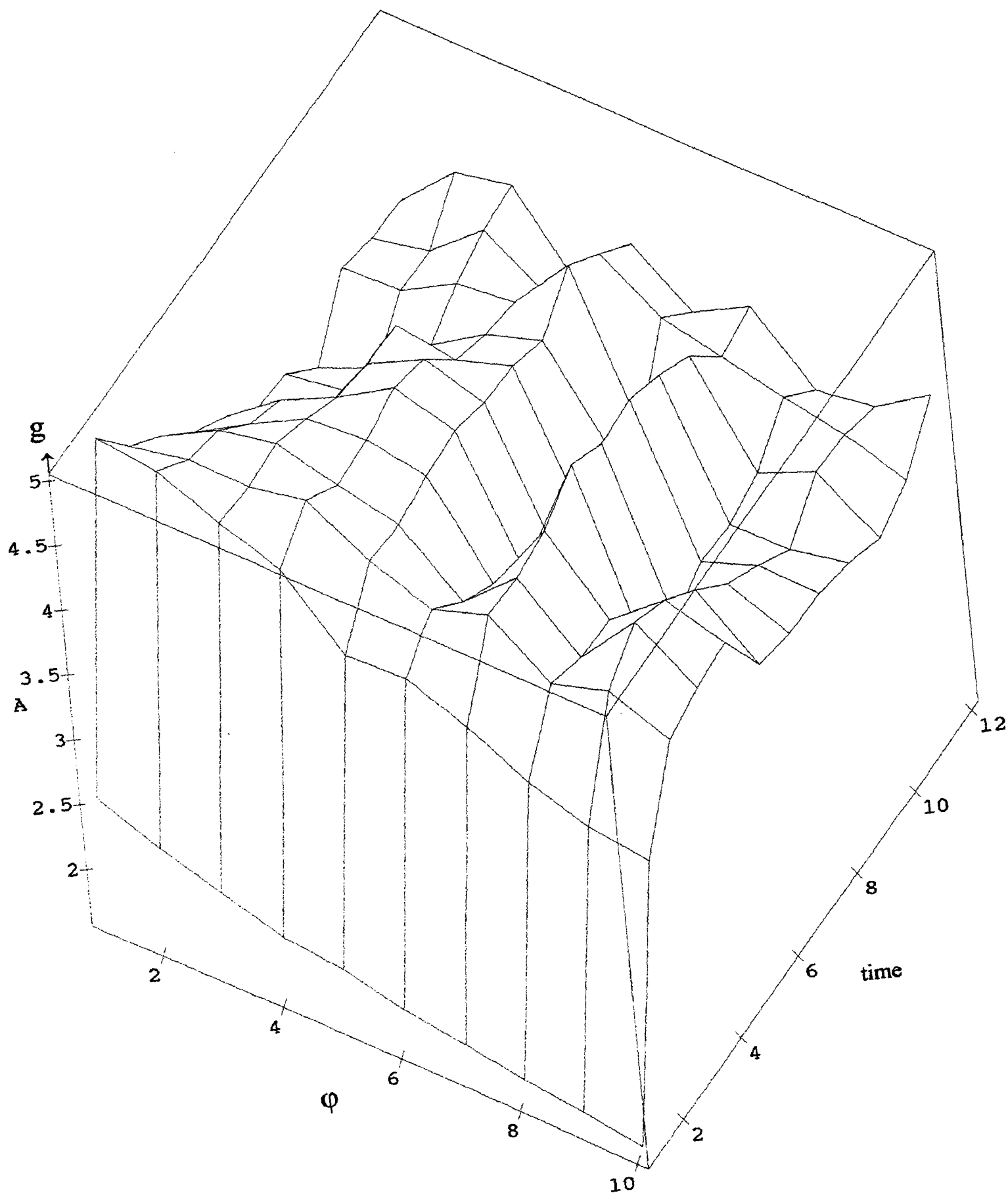


Figure 5 Growth as a function of time and initial inequality, ϕ . The political process converges in the long run.

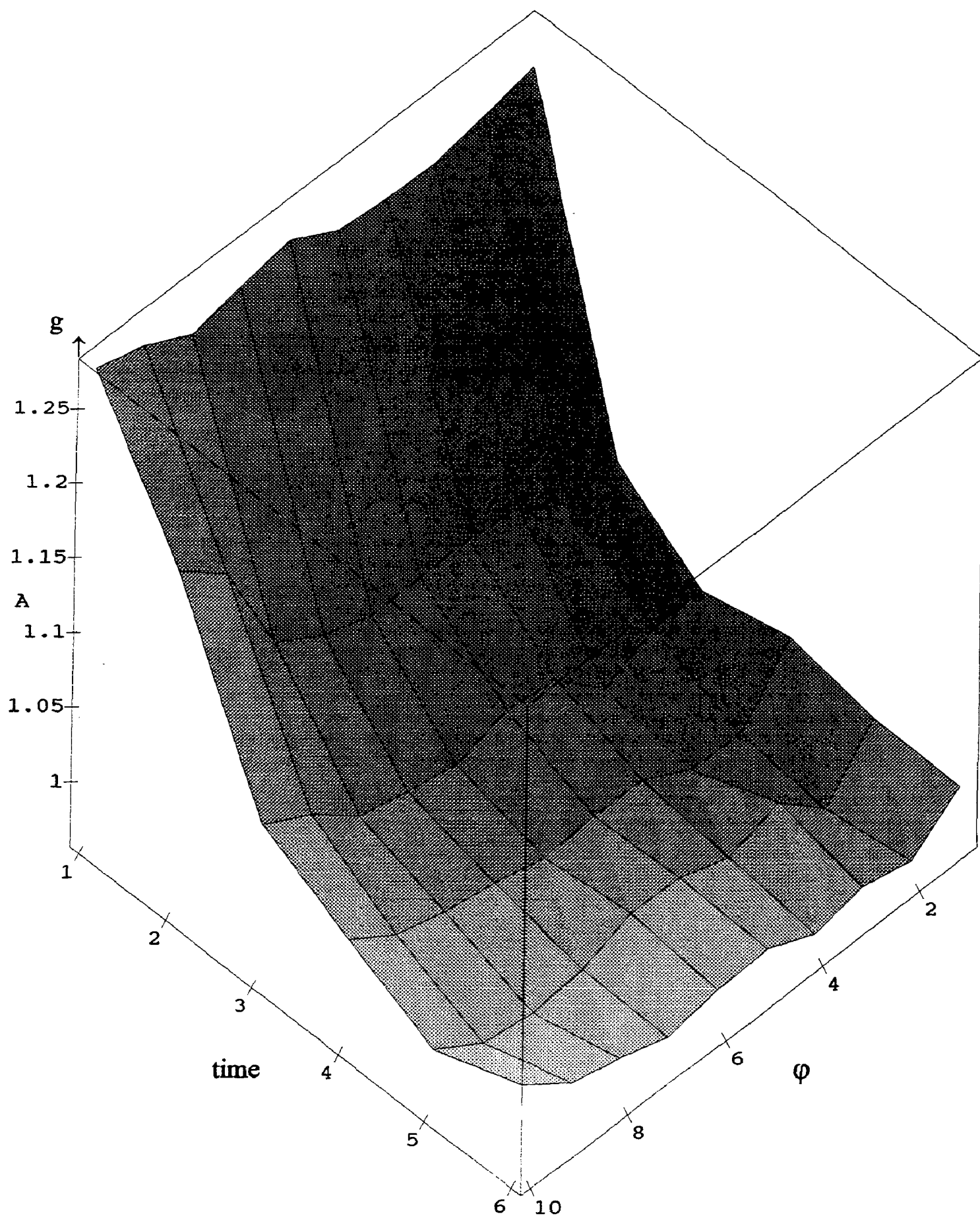


Figure 6 Initial income inequality ϕ and growth g in the short-run ($A=2$, $r=3$, $w=1$).