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Status, Inequality and Growth*

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Abstract

In this paper, we investigate whether, because of differing social organisation, the effect of greater equality may have opposing effects on economic growth in different societies. We investigate a simple endogenous growth model where agents care about their status. This is determined by their ordinal rank in the distribution of consumption. In such a situation, each individual's problem becomes strategic as her utility will depend on the consumption choices of others, so that the equilibrium consumption and investment choices depend on the distribution of income. In this model, if individuals are concerned with their status when young, greater equality leads to more intense competition for status and thus higher levels of conspicuous consumption for a large mass of individuals, with a possibility of lower investment, and thus lower growth. If individuals are concerned with their status when old, the results are reversed.

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Keywords: Status, relative standing, income inequality, growth, consumption externalities.

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1 Introduction

For a long time, there has been an active debate over the relationship between inequality and growth. Traditionally, it was argued that inequality should stimulate capital accumulation. More recent cross-country empirical studies (including Alesina and Rodrik (1994), Persson and Tabellini (1994)) have shown that there is a negative relationship between inequality and growth. This view has been challenged by Forbes (2000), who looked into how a change in inequality within a given country is related to the growth within that country, and found a positive relationship between inequality and growth. To add more confusion, Banerjee and Duflo (2003) show that a change in inequality (either increase or decrease) is associated with lower growth in the short run.

On the theory side, there is no consensus either. Aghion, Caroli and García-Peñalosa (1999) provide an excellent survey of both "old" and "new" theories. They list three arguments, advanced by the "old" theories, for the positive relationship between inequality and growth: the marginal propensity to save of the rich is higher than that of the poor; in the absence of well-functioning credit markets, investment indivisibilities may require high wealth concentration; and inequality provides incentives for accumulation. They also list three arguments advanced by the "new" theories, that inequality may hamper growth: by reducing investment opportunities, by worsening borrowers' incentives, and by generating macro-economic volatility, and thus redistributive policies may lead to faster growth. On the other hand, Galor and Moav (2004) present a model where the relationship between economic growth and inequality may have positive or negative relationship depending on the "stage" of economic development.

This paper offers a different answer to the question about the relationship between inequality and growth: it depends on social concerns. That is, take two economies with the same production technology, the same tastes for absolute levels of consumption and even the same income distributions. Impose an redistributive tax scheme that reduces inequality. The effect on the growth rate will depend on the precise nature of the social concerns, and the effect of greater equality may have opposing effects on economic growth in different societies.

We look into specific form of social concerns - namely, concern with status. This is defined as ordinal rank in the distribution of consumption.[1] We take a simple stylized endogenous growth model with both production and consumption externalities, the latter present because agents are concerned with status. In such a situation, each individual's problem becomes strategic as her utility will depend on the consumption choices of others. We show that in such a context, the relationship between growth and inequality is not clear, with a possibility of greater equality leading to lower growth. Here, rather than comparing growth in the presence and absence of status concerns, we compare the comparative static effects of changes in the distribution of wealth. When there is competition for status, greater equality raises the marginal return of attempts

[1] Our model would be consistent with any other form of visible expenditure - which may include education, professional attainment, etc.

to differentiate oneself. We show that inequality-reducing redistributive tax scheme may result in more resources being diverted into conspicuous consumption, less saving, and less growth.

We take the simple overlapping-generations model with endogenous growth and market imperfections found in Aghion, Caroli and García-Peñalosa (1999),[2] and modify agent's preferences to allow them to compete for status as defined by their relative position in consumption. The preferences specification is based on that of Hopkins and Kornienko (2004a) and it nests the stylized model found in Aghion, Caroli and García-Peñalosa (1993). As an agent's status depends not only on own consumption decision in one of the periods of life, but also on that period's consumption decisions of those in the same age cohort, each individual's problem becomes strategic. We consider symmetric Nash equilibria of this "game of status".

Following Aghion, Caroli and García-Peñalosa (1999), we analyze the effects of increased income equality (which is generated by means of redistributive linear tax schedule) on economic growth. In contrast, we find that the effect of greater equality on economic growth is ambiguous. The ambiguity of our results arises because of the trade-off between equilibrium investment of different social "classes". We show that the effects of change in income inequality on agents' equilibrium investment decisions vary with agents' relative incomes as well as with the intensity of social competition. Our specification allows us to compare each individual's pre-tax and after-tax equilibrium investment decisions without specifying the form of income distribution.

There is already an ambiguity in the existing literature concerning the desire for status and its effect on growth. This arises from the lack of consensus about whether status arises from conspicuous consumption or from wealth. On one hand, Frank (1985, 1999) argues that, as status flows from visible consumption, status seeking induces a bias towards present consumption and hence leads to low saving and low growth. On the other hand, Cole, Mailath and Postlewaite (1992, 1998) and Corneo and Jeanne (1997, 2001) have focussed on the case where status is determined by relative wealth. There, the consequent rivalry may lead to the opposite result: capital accumulation and hence growth that is sub-optimally high.[3] Furthermore, Corneo and Jeanne (2001) show that in a status-in-wealth models, more inequality leads to slower growth.

As Corneo and Jeanne (1998) point out, both possibilities can be captured in effect by a life cycle model: if agents care more about status when young this leads to greater consumption, if they care more about status in their old age, they will save more. We take a similar approach here, allowing for status concerns to be active in the young or in the old. We find that which assumption is made alters fundamentally the response

[2] The model found in Aghion, Caroli and García-Peñalosa (1999) is based on Bénabou (1996). The literature exploring the effect of redistribution on investment opportunities was originated by Galor and Zeira (1993).

[3] Cole, Mailath and Postlewaite (1992, 1998) also consider the idea of an "aristocratic equilibrium" where status is inherited, leading to lower capital accumulation and growth than the if status is determined by wealth.

of growth to changes in equality.

We start by considering a situation where agents care about their status when young. This is defined as their ordinal rank in the distribution of the first-period consumption. The evidence for such form of social competition is abundant, and may be particularly pronounced in the early part of life because of the possibility for improved marriage prospects (for arguments for such an instrumental concern with status, see Postlewaite (1998)). While there seems to be plenty of informal evidence in modern societies that those of old age may care about their relative position in the consumption hierarchy, the reasons for that are less clear.[4] Nevertheless we later turn to the case when individuals care about their status when old, and show that the effects of greater equality on economic growth are reversed. Since the results of for the case when individuals are concerned with status when old is the mirror image of what happens if they are concerned with status when young, we spell out our results for the case of the concern with status when young.

In this paper, we also identify a new reason why status seeking may offer ambiguous predictions for growth: the intensity of social competition. As Postlewaite (1998) argues, status seeking can be rational if certain resources are allocated in a non-market fashion - according to one's status. Suppose that in a particular society the lowest ranking individuals are completely socially excluded from consumption of such socially "allocated" resources, such that, for example, they have no prospects for marriage. We call this situation "harsh" social competition. In such a situation, redistributive taxation does not generate an increase in investment. Instead, all of the income of the poorest is spent on the (futile) attempt to escape the misery of being at the bottom.[5] In harshly competitive societies with the concern for status by the young, such behavior by the poor obviates the rationale for redistributive taxation put forward by Aghion, Caroli and García-Peñalosa (1999), namely that in an economy with diminishing marginal returns to investment, shifting the income from the rich to the poor might generate higher growth.

On the contrary, if the social competition is "milder" - that is, even the lowest ranking individual is guaranteed to get some absolute level of consumption of socially "allocated" resources, [6] the poor respond to increased equality by investing more. However, such benefits of equality may be eroded by the investment behavior of those with

[4] One of the possible explanations is that, as we show, in the equilibrium, the relative position in consumption hierarchy coincides with the rank in the distribution of (unobservable) saving, investment and production, and thus may serve as a signal of unobservable merit.

[5] Note that this is social rather than economic misery. The whole point is that the poorest can be socially excluded even if they are materially well-off in comparison with the poor in other societies.

[6] One possible interpretation of the guaranteed level of consumption of socially "allocated" goods is the following. Consider a modification of a marriage matching model found in Cole, Mailath and Postlewaite (1992, 1998) under monogamy with a significant imbalance between the two sides - for example, when there is a serious shortage of men. In this "mild" case, even the lowest ranked man is guaranteed to be matched with a woman of a specific "quality". If, instead, men are in surplus, the lowest ranking man has no prospect for marriage, so that the social competition is "harsh". We explore this more in details in Hopkins and Kornienko (2004b).

incomes close to the mean income, as they invest a lower proportion of their incomes. This is because when there is competition for status, greater equality raises the marginal return of attempts to differentiate oneself. As a consequence of linear redistributive taxes, the density of the population is particularly high around the mean income. As the result those with the mean income (whose income is not affected by the redistributive tax) invest less. The same surprisingly may also apply to some people with incomes below the mean income even those their income increases. What is also important is that in many societies, a great mass of the individuals have incomes close to the mean income, and thus their decreased investment has an important effect on economic growth.

The above findings can be summarized shortly as follows. A redistributive taxation will likely to slow down economic growth in the societies where only the young are concerned with status and the conditions of social competition are "harsh" leading to an utmost misery of those at the bottom. But the same redistributive taxation will likely to speed up economic growth in the societies where only the old are concerned with status than the young and the conditions of social competition are "mild". These findings are important as they show that existing arguments in support of greater income equality fostering faster economic growth may not be robust.

The effects of status concerns on savings and growth have been considered in a number of other works. The literature on concern for status dates back to Veblen (1899), and Duesenberry (1949) was the first to build a formal link between consumption and savings decisions and relative concerns. Cole, Mailath and Postlewaite (1992, 1998) and Corneo and Jeanne (1997, 2001) look at status as an additional motivation for the accumulation of wealth. Cooper, García-Peñalosa and Funk (2001) analyze a growth model where there is concern for status, but agents only interact with other agents of the same wealth. Direr (2001) examines numerically a simple two period overlapping generations model where agents care about their status (as determined by their rank in consumption hierarchy) in both periods. Corneo and Jeanne (2001) is closest to the current work. They explore the effect of changes in the income distribution on growth where agents care about status as determined by the contemporaneous rank in the wealth hierarchy. However, they restrict their analysis to the steady state where agents have constant propensity to consume and to a particular family of income distributions.

Here, rather than comparing the relative effect on economic growth in the presence and absence of status concerns, we offer the first general analysis of the comparative static effects of changes in the distribution of income on economic growth when people care about status. We show that different forms of social competition lead to different relationships between inequality and saving and, hence, growth. We see this as a reflection of the complexities of the relationships between social organisation, inequality and growth.

The paper is organized as follows. Section 2 presents a general model. Sections 3 and 4 are devoted to the comparative statics analysis when individuals are concerned with status when young and old, respectively. The last Section concludes.

2 An Endogenous Growth Model in the Presence of Concern for Status

We employ a modified version of a simple endogenous growth model found in Aghion, Caroli and García-Peñalosa (1999), which is, in turn, based on Bénabou (1996),[7] in which individual production functions generate learning-by-doing and knowledge spillovers. Note first that this strain of literature treats each individual as a producer (whose individual output is a function of own capital stock, and which then is aggregated into total output) instead of treating each individual as a rentier (so that the aggregate output is produced by the aggregate stock of capital).

Consider an economy with only one good that serves both as capital and consumption good. There is a continuum of overlapping-generation families, indexed by $i \in [0, 1]$. Each individual lives for two periods. Individuals differ in their initial endowments, which are randomly determined at birth (that is, there are no intergenerational transfers and thus no bequest decisions). Let the endowment (wealth) of individual i upon birth at date t be given by $z_{i,t}$, independently and identically distributed random variable with a distribution $G(\cdot)$ with a continuously differentiable density g, that is strictly positive on the support $[\underline{z}, \bar{z}]$.

We modify Aghion, Caroli and García-Peñalosa (1999)'s model to allow for utility to depend on social status. We assume that in one of the periods of life, the consumption is observable. In this period, rather than being concerned with the absolute level of their consumption, individuals care about their social status as determined by their relative rank in consumption.[8] Following Frank (1985) and Robson (1992), an agent's status will be determined by her position in the distribution of visible (conspicuous) consumption, with higher consumption meaning higher status. Here, we define status as follows:

$$S(x, F(\cdot)) = \delta F(x) + (1 - \delta) F^{-}(x) + S_0 \tag{1}$$

where x is individual's consumption, $\delta \in [0, 1)$, $F(x)$ is the mass of individuals with consumption less or equal to x, and $F^{-}(x) = \lim_{x' \to x^{-}} F(x')$ is the mass of individuals with consumption strictly less than x. The current formulation is a way of dealing with ties. For example, if all agents chose the same level of consumption in one sense they would all be "equal first", but here they would have status $\delta < 1$. In contrast, if the distribution of consumption $F(x)$ is continuous, the above measure of status is identical to rank in consumption, or $S(x, F(\cdot)) = F(x)$. The parameter $S_0 \geq 0$ is a constant representing a guaranteed minimum level of status, and it represents the intensity of

[7] This model is described more in details in Aghion and Howitt (1998, section 9.1.1).

[8] The assumption that, in one period, agents care only about status, might seem extreme. However, the current setup would be consistent with the assumption that all individuals have a base level of consumption (not modelled here) that is identical (and affordable) for all. Once those basic needs have been satisfied, any further consumption is aimed at building status. See also Van Kempen (2003) for a survey of evidence that conspicuous consumption is important even amongst the poor in developing countries.

social pressures.[9]

The reasons why individuals may care about status are determined by a social norm. As Veblen (1899) suggested, individuals may care about status as it brings them an intrinsic satisfaction. Alternatively, as Postlewaite (1998) pointed out, individuals may care about status for more traditional reasons as this provides them with better marriage opportunities. We thus will consider two societies which differ in *when* an individual's consumption is used to determine an individual's status.

If individuals care about their status *when young* (which may be because higher status leads to better marriage opportunities),[10] in such a society the utility of an individual i born at date t is given by:

$$U_{t,i}^{S-young} = \log S(c_{i,t}, F_t(c_{i,t})) + \rho \log c_{i,t+1} \tag{2}$$

where $c_{i,t}$ and $c_{i,t+1}$ denotes consumption when young and when old, respectively, and $S_{i,t} = S_{i,t}(c_{i,t}, F_t(c_{i,t}))$ is this individual's status when young, and is determined, as specified in equation (1), by her position in the first-period consumption hierarchy among individuals in her age cohort.

Alternatively, if individuals care about their status *when old* (which could arise if society values productivity and thrift),[11] in such a society the utility of an individual i born at date t is given by:

$$U_{t,i}^{S-old} = \log c_{i,t} + \rho \log S(c_{i,t+1}, F_{t+1}(c_{i,t+1})) \tag{3}$$

where $S_{i,t+1} = S_{i,t+1}(c_{i,t+1}, F_{t+1}(c_{i,t+1}))$ is this individual's status when young, and is determined by her position in the second-period consumption hierarchy among individuals in her age cohort.

Each individual can either consume her endowment, or invest it into the production of the future consumption good. In the extreme case of capital market imperfections, when borrowing is not possible, each individual faces the following constraints: $c_{i,t} + k_{i,t} \leq z_{i,t}$, $c_{i,t+1} \leq y_{i,t}$, $c_{i,t} \geq 0$ and $c_{i,t+1} \geq 0$. When individual i invests an amount of physical or human capital $k_{i,t}$ at date t, production of the future consumption good (i.e., of the good available at date $t+1$) takes place according to the technology

$$y_{i,t} = A_t k_{i,t}^{\alpha} \tag{4}$$

where $0 < \alpha < 1$. A_t is the level of human capital or technological knowledge available in period t, and it is common to all individuals. The output of each individual productive unit $y_{i,t}$ is aggregated into aggregate production y_t simply as

$$y_t = \int y_{i,t} di$$

[9] See Hopkins and Kornienko (2004a) for a rationale of this specification.

[10] As we will show later, in equilibrium, individual's consumption when young may signal an individual's endowment.

[11] In the case of imperfect capital markets, individual's consumption when old is simply the product of his investment.

Furthermore, learning-by-doing means that the more an agent produces one period, the more she learns, and hence the greater the level of knowledge available in the next period. The presence of such spillovers implies that the learning done by one individual affects the level of technology of all other agents in the economy. These two assumptions are captured by the following dynamics of productivity parameter:

$$A_t = \int y_{i,t-1} di = y_{t-1}$$

That is, accumulation of knowledge results from past aggregate production activities. As a result of learning-by-doing, growth depends on individual investments. The rate of growth between period $t-1$ and period t is given by

$$\gamma_t = \ln\left(\frac{y_t}{y_{t-1}}\right) = \ln \frac{\int A_t k_{i,t}^{\alpha} di}{A_t} = \ln \int k_{i,t}^{\alpha} di \tag{5}$$

The rate of growth therefore depends on the distribution of individual capital investments.

Aghion, Caroli and García-Peñalosa (1999) go on to show that greater equality leads to a higher level of growth. The argument is simply that if production is at the level of the individual and if each individual produces with decreasing returns to scale, then redistributing the endowments from the rich to the poor (and thus increasing equality in incomes) increases aggregate production. Then, because there is learning by doing, this feeds through to greater growth.

As we will show in the next two sections, when status concerns are present, redistribution may or may not lead to faster growth. Following Bénabou (1996) and Aghion, Caroli and García-Peñalosa (1999), we will consider a pure redistributive taxation scheme of the following form: individuals with above-average endowment pay a tax of $\tau(z_{i,t} - \mu)$, while those with below-average endowment receive a subsidy of $\tau(\mu - z_{i,t})$, where $\tau \in [0, 1)$ is the tax rate, μ is the average endowment in the society. The redistribution scheme is equivalent to the one in which everyone is taxed at a flat rate τ, and the tax revenue is redistributed back equally:

$$z_{i,t}^{\tau} = (1-\tau) z_{i,t} + \tau\mu \Rightarrow z_{i,t} = \frac{z_{i,t}^{\tau}}{1-\tau} - \frac{\tau\mu}{1-\tau} \tag{6}$$

As the result, the initial before-tax distribution $G(z)$ is a mean-reserving spread of the after-tax distribution $G^{\tau}(z^{\tau})$ (see Figure 1). In other words, the above pure redistributive taxation scheme is inequality-reducing.

Being a lump-sum tax, the policy does not change the returns to $k_{i,t}$, and hence it only affects the incentives to invest insofar as it changes the current endowment of the individual. However, it does change the return to consumption through the change in returns to status as it is determined by the income distribution. To see that, observe that the after-tax distribution of income $G^{\tau}(z_i^{\tau})$ is *the same type*[12] as the before-tax

[12] Distribution functions F and G with density functions f and g, respectively, are of the same *type* if there exist constants $a > 0$ and b, such that $G(x) = F(ax + b), g(x) = af(ax + b)$ for all x (see, for example, Feller (1968).

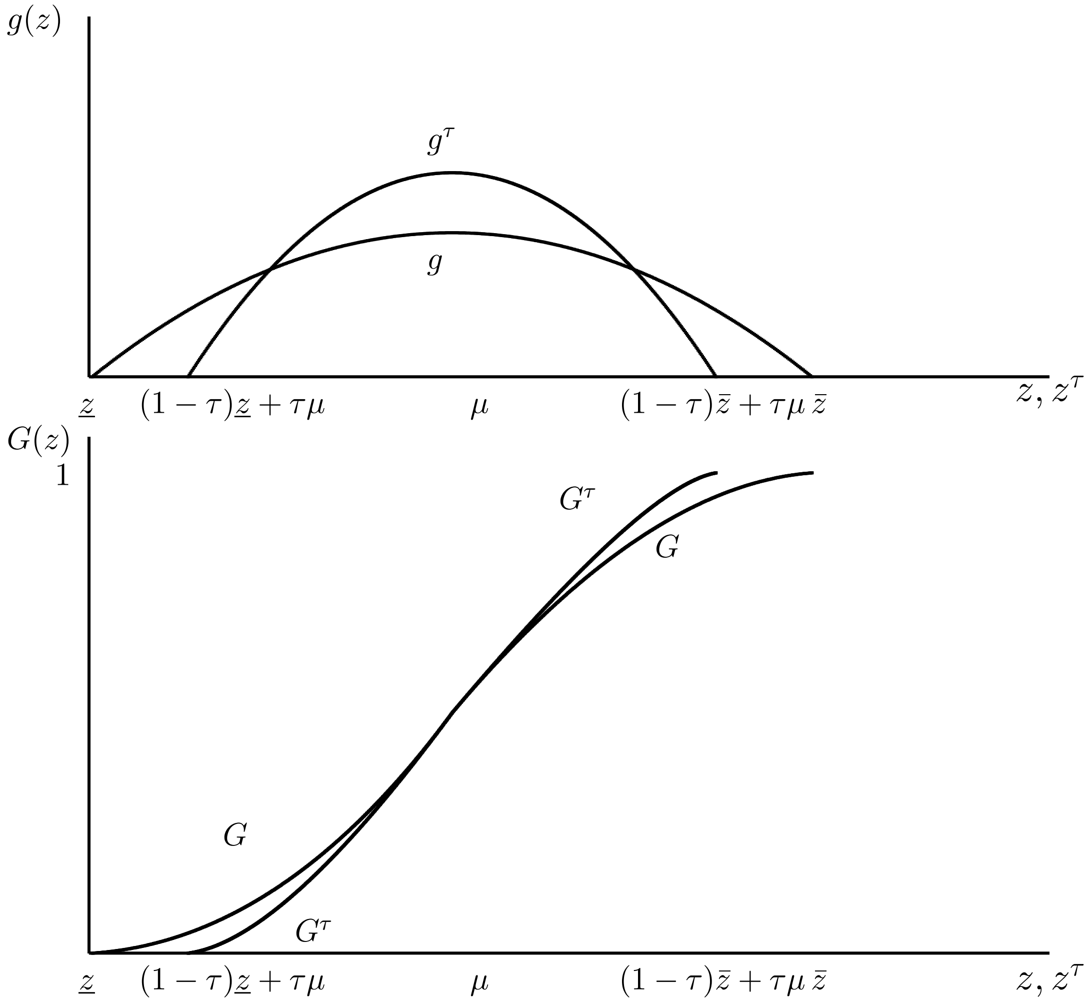


Figure 1: Before-tax endowment distribution G is a mean-preserving spread of after-tax endowment distribution G^τ, and the two distributions cross at the mean income μ.

distribution $G(z_i)$, so that

$$\begin{aligned} G^\tau(z_i^\tau) = G(z_i) &= G\left(\frac{z_i^\tau}{1-\tau} - \frac{\tau\mu}{1-\tau}\right) \\ g^\tau(z_i^\tau) = \frac{1}{1-\tau} g(z_i) &= \frac{1}{1-\tau} g\left(\frac{z_i^\tau}{1-\tau} - \frac{\tau\mu}{1-\tau}\right) \end{aligned}$$

That is, while the linear redistributive tax scheme is rank-preserving (that is, individual i has the same rank in the after-tax income hierarchy as in the before-tax income hierarchy), the density of individuals is, however, increased at every income level, which, in turn, will increase the returns to conspicuous consumption.

In what follows, we explore how redistributive taxes change incentives to consume and invest when status concerns are present. To do so, we fix an individual i with before-tax income z_i, and compare her optimal choices before and after tax. Let us employ the following notations:

$$c^\tau(z_{i,t}) = c(z_{i,t}^\tau) = c((1-\tau)z_{i,t} + \tau\mu)$$

$$k^{\tau}(z_{i,t}) \quad = \quad k(z_{i,t}^{\tau}) = k((1-\tau)z_{i,t} + \tau\mu)$$

where $c^{\tau}(z_{i,t})$ and $k^{\tau}(z_i)$ to denote after-tax consumption and investment decisions for individual i with before-tax income z_i.

It will be also interesting to see how different income groups contribute to economic growth. For that, the following measure can be of use:

$$\gamma_{i,t} = \ln\left(\frac{y_t}{y_{t-1}}\right) = \ln \int_{\underline{z}}^{z_{i,t}} k(z)^{\alpha} g(z) dz \tag{7}$$

which shows the cumulative growth rate for all individuals with incomes below or equal to income $z_{i,t}$. Obviously, when $z_{i,t} = \bar{z}$, we get the overall growth rate γ_t which is given in equation (5).

3 Concern for Status by the Young

As Corneo and Jeanne (1998) point out, the effect of competition in consumption on saving depends crucially on when during one's lifetime is status important. If agents care more about status when young this leads to greater consumption; if they care more about status in their old age, they will save more. We take a similar approach here, allowing for status concerns to be active in the young or in the old. We find that which assumption is made alters fundamentally the response of growth to changes in equality.

Some insight may come if we consider why status people care about status. Suppose individuals care about their status *instrumentally.* That is, in spirit of Cole, Mailath, and Postlewaite (1992, 1998), some goods are not supplied by the market but are allocated in a non-market fashion. In particularly, they are awarded according to one's social status. A prominent of example of this is where the set of whom it is socially acceptable to marry is determined by one's status.[13] It makes sense to assume that only the young participate in the marriage market. Here, therefore we make the assumption that when young, individuals attempt to build up their status and hence, implicitly, marriage opportunities. In their old age, they are only interested in consumption.

In this case, the utility of an individual i born at date t is given by the equation (2). The interpretation of the above utility function is that, when young, individuals are concerned exclusively with status as defined by their rank in the distribution of current consumption, whereas, when old, care only about consumption. That is, when young, individuals are not interested in their consumption *per se*, and care only about their marriage prospects, as determined by their relative, and not absolute, consumption. As the result, the individual's problem is:

$$\max U_{t,i}^{S-young} = \log S(c_{i,t}, F_t(c_{i,t})) + \rho \log c_{i,t+1} \tag{8}$$

[13] The instrumental approach to status allows us to assume that the utility of a standard consumption and the utility of consumption of this socially allocated good are separable (see Hopkins and Kornienko (2004b) for further argument for this approach).

subject to $c_{i,t} + k_{i,t} \leq z_{i,t}$, $c_{i,t+1} \leq A_t k_{i,t}^{\alpha}$, $c_{i,t} \geq 0$ and $c_{i,t+1} \geq 0$.

The fact that, in each time period, the young are in competition for status implies that their choice of consumption is strategic. It is possible to solve the resulting game but the solution will, however, depend on the distribution of income in society. This approach is developed in more detail in Hopkins and Kornienko (2004a), so here we will only briefly sketch the solution.

Suppose all agents adopt the same increasing, differentiable strategy $c_{i,t} = c(z_{i,t})$ and consider whether any individual agent has an incentive to deviate. Suppose that instead of following the strategy followed by the others, an agent with wealth $z_{i,t}$ chooses $c_{i,t} = c(\hat{z})$, that is, she consumes as though she had wealth $\hat{z}$. Note first that $F(c_{i,t}) = G(c^{-1}(c_{i,t})) = G(\hat{z})$, resulting in $S_{i,t} = S_0 + G(\hat{z})$, and second that her utility would be equal to

$$U_{i,t}^{S-young} = \log(S_0 + G(\hat{z})) + \alpha\rho \log(z_{i,t} - c(\hat{z})) + \alpha\rho \ln A_t$$

We differentiate with respect to $\hat{z}$. Then, given that in a symmetric equilibrium, the agent uses the equilibrium strategy and so $\hat{z} = z_{i,t}$, this gives the first order condition,

$$\frac{g(z_{i,t})}{S_0 + G(z_{i,t})} - \frac{\alpha\rho c'(z_{i,t})}{z_{i,t} - c(z_{i,t})} = 0. \tag{9}$$

This first order condition therefore defines a differential equation, which depends on the distribution of endowments:

$$c'(z_{i,t}) = \left(\frac{z_{i,t} - c(z_{i,t})}{\alpha\rho}\right)\left(\frac{g(z_{i,t})}{S_0 + G(z_{i,t})}\right) \tag{10}$$

We also need to specify the boundary conditions for the differential equation. As Hopkins and Kornienko (2004a) show, the boundary condition depends on the "intensity" of concern with status, S_0. In particular, if $S_0 = 0$, then $c(\underline{z}) \leq \underline{z}$ with $\lim_{z \to \underline{z}^+} c(z) = \underline{z}$ and if $S_0 > 0$, then the choices of the individual with the lowest income $\underline{z}$ are the opposite. That is,

$$c(\underline{z}) = \begin{cases} \underline{z} & \text{if } S_0 = 0 \\ 0 & \text{if } S_0 > 0 \end{cases} \tag{11}$$

$$k(\underline{z}) = \begin{cases} 0 & \text{if } S_0 = 0 \\ \underline{z} & \text{if } S_0 > 0 \end{cases} \tag{12}$$

As we show later, these boundary conditions play an important role in our analysis.

The solution to the above differential equation is well-known in the theory of first price auctions.[14]

[14] Increasing one's expenditure on first-period consumption leads to a trade-off between the increase in status and the lowering of direct utility from decreased consumption in the second period, just as a bidder in an auction must trade off increasing his probability of winning against lower realized profits in the event of winning.

Proposition 1 *In the symmetric equilibrium described by the first order condition (10) and boundary conditions (11)-(12), an individual with income z chooses her consumption and investment as follows:*

$$c(z_{i,t}) = z_{i,t} - \frac{\int_{\underline{z}}^{z_{i,t}} (S_0 + G(z))^\nu dz + \underline{z} S_0^\nu}{(S_0 + G(z_{i,t}))^\nu} \tag{13}$$

$$k(z_{i,t}) = \frac{\int_{\underline{z}}^{z_{i,t}} (S_0 + G(z))^\nu dz + \underline{z} S_0^\nu}{(S_0 + G(z_{i,t}))^\nu} \tag{14}$$

where $\nu = (\alpha\rho)^{-1}$.

All proofs are given in Appendix A. The above equilibrium choices lead to the following striking result.

Proposition 2 *When individuals care about status when young, the relationship between the before-tax and after-tax symmetric equilibrium investment decisions of a fixed individual i with before-tax income z_i is described by:*

$$k^\tau(z_{i,t}) = (1-\tau)k(z_{i,t}) + \tau\mu \frac{S_0^\nu}{(S_0 + G(z_{i,t}))^\nu} \tag{15}$$

In turn, this implies that:
(i) if $S_0 = 0$ then $k^\tau(z_{i,t}) < k(z_{i,t})$ for all $z_{i,t} > \underline{z}$, and
(ii) if $S_0 > 0$, then there exists $\hat{z} \in (\underline{z}, \mu)$ such that, for all $z_{i,t} < \hat{z}$, $k^\tau(z_{i,t}) > k(z_{i,t})$, and for all $z_{i,t} > \hat{z}$, $k^\tau(z_{i,t}) < k(z_{i,t})$, with the point of crossing $\hat{z}$ determined as follows:

$$\int_{\underline{z}}^{\hat{z}} \left(1 + \frac{G(z)}{S_0}\right)^\nu dz = \mu - \underline{z} \tag{16}$$

The above proposition says the following. Fix an individual i with income z_i. Then, if $S_0 = 0$, for all i's after-tax investment is necessary lower than before-tax investment for all $z_{i,t} > \underline{z}$. However, if $S_0 > 0$, then there exists $\hat{z} \in (\underline{z}, \mu)$ such that for all incomes $z_{i,t} < \hat{z}$ the after-tax investment is higher, but for all $z_{i,t} > \hat{z}$ the after-tax investment is lower. An example of this can be seen on Figure 2 (see the derivation for the equilibrium choices in Appendix B).

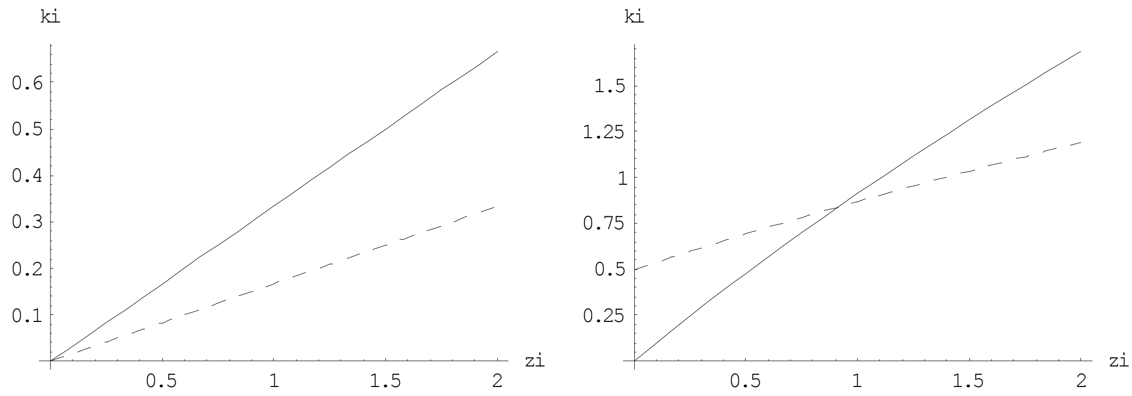
It immediately follows from the above Proposition that if $S_0 = 0$, then the after-tax economy grows slower than the before-tax economy by $\alpha \ln(1-\tau)$.

To see that, notice that the before-tax growth rate, given in equation (5) is:

$$\gamma_t = \ln \int_{\underline{z}}^{\bar{z}} k(z)^\alpha g(z) dz$$

and after-tax growth rate is:

$$\gamma_t^\tau = \ln \int_{\underline{z}}^{\bar{z}} k^\tau(z)^\alpha g(z) dz = \ln \int_{\underline{z}}^{\bar{z}} \left((1-\tau)k(z) + \tau\mu \frac{S_0^\nu}{(S_0 + G(z))^\nu}\right)^\alpha g(z) dz$$



a) Very "harsh" social competition ($S_0 = 0$); b) "Mild" social competition ($S_0 = 1$).

Figure 2: Investments $k_{i,t}$ before-tax (solid curves) and after-tax (dashed curves) (for a uniform distribution on $[0, 2]$, $\rho = 1$, $\alpha = 0.5$, $\tau = 0.5$).

For $S_0 = 0$ the above expression becomes simply:

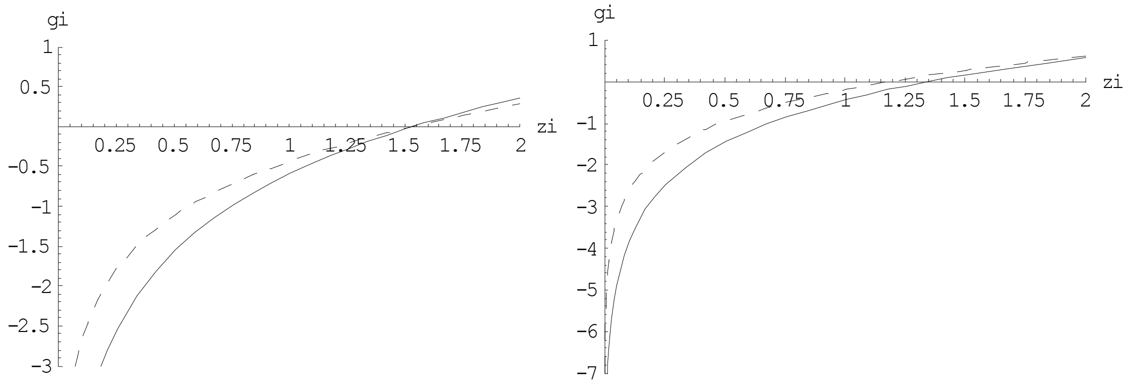
$$\gamma_t^{\tau} = \ln \int_{\underline{z}}^{\bar{z}} ((1-\tau)k(z))^{\alpha}\, g(z)dz = \alpha \ln(1-\tau) + \gamma_t < \gamma_t$$

so that the after-tax economy unambiguously grows slower than the before-tax economy.

However, if $S_0 > 0$, the investment by the relatively poor (i.e. those with incomes below $\hat{z}$) is higher in the after-tax economy, while the investment by the "middle" and "upper" class (i.e. those with incomes above $\hat{z}$) is lower in the after-tax economy. The diminishing marginal returns to investment imply that it is possible that the fruits of the increased investment by the relatively poor outweight the consequences of the decreased investment by those in the middle and at the top of the distribution. Whether this happens or not, depends on the intensity of social pressures, S_0. When the social competition is relatively "harsh" (Figure 3a), the increased investment by the "poor" is not enough to outweight the decreased investment by the "middle" and "upper" class, but once the plight of the poorest individual "softens", the increased investment by the "poor" outweights the decreased investment by the "middle" and "upper" class (Figure 3b).

Moreover, as the growth rate is a continuous function of S_0, there must exist a critical value $\hat{S}_0$ such that for all values $S_0 < \hat{S}_0$, $\gamma_t^{\tau} < \gamma_t$, and, conversely, for all $S_0 > \hat{S}_0$, $\gamma_t^{\tau} > \gamma_t$. In other words, if the intensity of social competition is relatively harsh, linear taxes are harmful for the growth, but if the society is not "cut throat" then linear taxes bolster the growth (see Figure 4a).

Moreover, the "milder" social competition (i.e. the higher S_0), the greater rate of economic growth (see Figure 4b). It is also important to mention that there exists an optimal tax rate, $\hat{\tau}$: for small values of S_0 it is zero, but for higher values of τ it is positive.



a) "Harsh" competition ($S_0 = 0.5$); b) "Mild" competition ($S_0 = 5$).

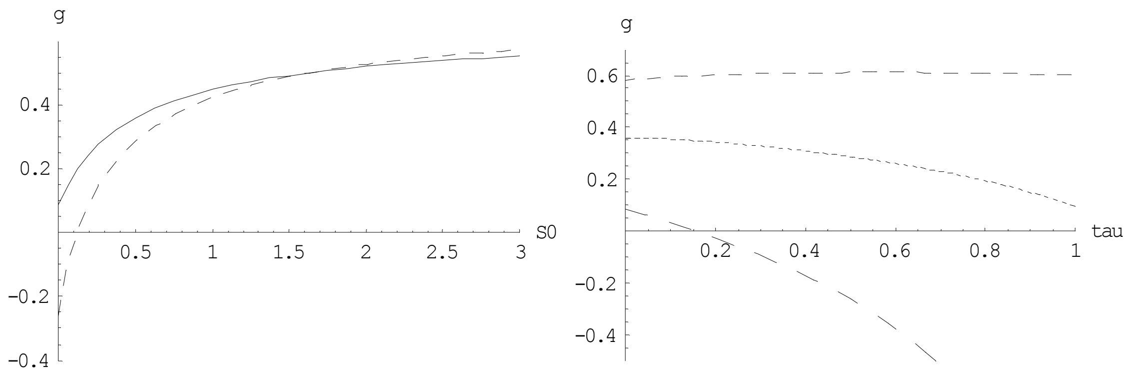
Figure 3: Cumulative growth rate $\gamma_{i,t}$ before-tax (solid curves) and after-tax (dashed curves) (for a uniform distribution on $[0, 2]$, $\rho = 1$, $\alpha = 0.5$, $\tau = 0.5$).

4 Concern for Status by the Old

Here we will briefly discuss a situation where individuals care about their status when old. This may be determined as their rank in the distribution second-period consumption of their age cohort. While there seems to be plenty of evidence in modern societies that those of old age may care about their relative position in the consumption hierarchy, this seems to be less pronounced than the concern with status by the young.

The reasons for concern for status by the old are not clear, and a marriage-based explanation for status concerns by the old seems to be a bit far-fetched. However, there might another reason for concern for conspicuous consumption by the old - namely, signalling of unobservable merit. Importantly, the reduced-form solution to the "game of status" problem where status is determined by the second-period relative consumption coincides with the one for the case where status is determined by the relative position in saving, investment, or production. While saving (and, possibly, investment or production) may not be observable, the second-period consumption is. Thus, in the equilibrium, the second-period consumption is simply a signal of (unobservable) saving, investment, production, and, of course, of endowment. This allows one to provide an interesting interpretation to this case. If the society sees accumulation (in the form of saving or investment), or production, as meritorious, then second-period consumption is a signal of unobservable merit.

In any case, the individual's problem is given by the equation (3). The procedure for constructing a symmetric equilibrium is the same as for the case of concern for status when young. That is, suppose all agents adopt the same increasing, differentiable strategy $k_{i,t} = k(z_{i,t})$ and consider whether any individual agent has an incentive to deviate. Suppose that instead of following the strategy followed by the others, an agent with wealth $z_{i,t}$ chooses $k_{i,t} = k(\hat{z})$, that is, she consumes as though she had wealth $\hat{z}$. In this case, $F(c_{i,t+1}) = F(y_{i,t}) = F(k_{i,t}^{\alpha}) = G(k^{-1}(k_{i,t})) = G(\hat{z})$, resulting in



a) Growth rate changes with S_0. b) Growth rate changes with τ.

Figure 4: Growth rate γ_t is affected by both the intensity of social competition, S_0, and the tax rate, τ (for a uniform distribution on $[0, 2]$, $\rho = 1$, $\alpha = 0.5$, $\tau = 0.5$). On the left panel (a), solid curve shows before-tax growth rate and dashed curve shows after-tax growth rate. On the right panel (b), the bottom dashed curve shows the growth rate for $S_0 = 0$, the middle one is for $S_0 = 0.5$, and the top one is for $S_0 = 5$.

$S_{i,t+1} = S_0 + G(\hat{z})$, and her utility would be equal to

$$U_{i,t} = \log(z_{i,t} - k(\hat{z})) + \rho \log(S_0 + G(\hat{z}))$$

We differentiate with respect to $\hat{z}$. Then, given that in a symmetric equilibrium, the agent uses the equilibrium strategy and so $\hat{z} = z_{i,t}$, this gives the first order condition,

$$\frac{k'(z_{i,t})}{z - k(z_{i,t})} - \frac{\rho g(z_{i,t})}{S_0 + G(z_{i,t})} = 0.$$

This first order condition defines a differential equation, which depends on the distribution of endowments:

$$k'(z_{i,t}) = \left(\frac{z_{i,t} - k(z_{i,t})}{\rho}\right)\left(\frac{g(z_{i,t})}{S_0 + G(z_{i,t})}\right) \tag{17}$$

The boundary conditions are opposite of those for concern when young (11)-(12):

$$c(\underline{z}) = \begin{cases} 0 & \text{if } S_0 = 0 \\ \underline{z} & \text{if } S_0 > 0 \end{cases} \tag{18}$$

$$k(\underline{z}) = \begin{cases} \underline{z} & \text{if } S_0 = 0 \\ 0 = k^*(\underline{z}) & \text{if } S_0 > 0 \end{cases} \tag{19}$$

Notice that, the equilibrium in case of status when old is a mirror image of the equilibrium in case of status when young. That is, one can go from one to another by simply exchanging $k_{i,t}$ to/from $c_{i,t}$ and ρ to/from $(\alpha\rho)$. Thus, one can write the analog of Proposition 1 for the case of status when old.

Proposition 3 *In the symmetric equilibrium described by the first order condition (17) and boundary conditions (18)-(19), an individual with income z chooses her consumption and investment as follows:*

$$c(z_{i,t}) = \frac{\int_{\underline{z}}^{z_{i,t}} (S_0 + G(z))^{\phi} dz + \underline{z} S_0^{\phi}}{(S_0 + G(z_{i,t}))^{\phi}} \tag{20}$$

$$k(z_{i,t}) = z_{i,t} - \frac{\int_{\underline{z}}^{z_{i,t}} (S_0 + G(z))^{\phi} dz + \underline{z} S_0^{\phi}}{(S_0 + G(z_{i,t}))^{\phi}} \tag{21}$$

where $\phi = \rho^{-1}$.

When the old are concerned with status, the plight of the poorest individual has an opposite effect on growth - that is, the "harsher" the social competition (i.e. the lower S_0), the higher is equilibrium investment for all individuals, resulting in the higher rate of economic growth. Interestingly, the equilibrium investment (and thus the rate of economic growth) does not depend on the technology parameter α. This is because individuals do not care about absolute levels of consumption when old.

The analog of Proposition 2 is less straightforward and the proof is given in Appendix A.

Proposition 4 *When individuals care about status when old, the relationship between the before-tax and after-tax symmetric equilibrium investment decisions of a fixed individual i with before-tax income z_i is described by:*

$$k^{\tau}(z_{i,t}) = (1-\tau)k(z_{i,t}) + \tau\mu\left(1 - \frac{S_0^{\phi}}{(S_0 + G(z_{i,t}))^{\phi}}\right) \tag{22}$$

In turn, this implies that for any $S_0 \geq 0$, there exists $\breve{z} \in (\mu, \bar{z})$ such that, for all $z_{i,t} < \breve{z}$, $k^{\tau}(z_{i,t}) > k(z_{i,t})$, and for all $z_{i,t} > \breve{z}$, $k^{\tau}(z_{i,t}) < k(z_{i,t})$, with the point of crossing $\breve{z}$ determined as follows:

$$\int_{\underline{z}}^{\breve{z}} z d(S_0 + G(z))^{\phi} = \mu((S_0 + G(\breve{z}))^{\phi} - S_0^{\phi})) \tag{23}$$

When the old are concerned with status, after-tax investment of those with lower incomes exceeds their before-tax investment, which, in turn, imply greater after-tax growth. Moreover, here "harsher" social conditions as a stimulus for investment works even better when redistributive taxation are imposed. As the intensity of social competition S_0 increases, it provides relatively greater incentive to invest after redistributive taxes than before.

5 Conclusions

The present paper joins the growing body of literature that emphasizes the importance of social arrangements. We show here that the same redistributive taxation scheme may have opposing effects on economic growth in different societies. In this paper, we analyzed a simple model of endogenous growth with concern for status. We show that the effects of greater equality on economic growth is ambiguous and is determined by two key considerations: that is, how does the society treats its "lowest" members, and in which period of individual's life social status is more important.

Here we considered two types of societies - one where individuals care about their status when young and the other where they care about status when old. Yet we conjecture that the model where concern with status when young seems to be a more realistic model than the one where individuals are concern with status when old. As in majority of existing societies, higher social status leads to better marriage opportunities. Moreover, as Galor and Moav (2002) point out, reproductive success is evolutionary important and, moreover, family considerations may have significant influence on economic growth. In other words, in reality, social arrangements may vary less than the present paper maintains. Nevertheless, this does not diminish the importance of social conditions, as social conditions may create additional incentives to consume and to save, and may have dramatic effects on the resulting economic growth.

Evidently, there may be other social considerations that may affect the rate of economic growth. Knack and Keefer (1998) argue that since trust is essential to investment activity, but inequality is detrimental to trust, there may be a negative relationship between growth and inequality, this arguments being further advanced by Zak and Knack (2001). Interestingly, Chan, Mestelman, Moir, and Muller (1996, 1999) find a small but positive effect of inequality on voluntary contributions to public goods, particularly by the "poor", while Haile, Sadrieh and Verbon (2003) show an experimental evidence that the nature of income inequality is important for subjects' cooperative efforts, with slower growth resulting as a consequence of income distribution imposed by a dictator rather than by nature.

Appendix A: Proofs

Proof of Proposition 1: One can rewrite (10) as

$$\nu g(z_{i,t})z_{i,t}(S_0 + G(z_{i,t}))^{\nu-1} = c'(z_{i,t})(S_0 + G(z_{i,t}))^{\nu} + \nu c(z_{i,t})g(z_{i,t})(S_0 + G(z_{i,t}))^{\nu-1}.$$

Integrating both sides, and taking into account the boundary condition (11), get

$$c(z_{i,t})(S_0 + G(z_{i,t}))^{\nu} = \int_{\underline{z}}^{z_{i,t}} z \; d \; (S_0 + G(z))^{\nu}$$

The expression for k follows directly from the budget constraint. ∎

Proof of Proposition 2: Since before-tax and after-tax distributions are of the same type, one rewrite the expression for equilibrium investment (14) as follows:

$$\begin{aligned}
k^\tau(z_{i,t}) = k(z^\tau_{i,t}) &= \frac{\int_{\underline{z}^\tau}^{z^\tau_{i,t}} (S_0 + G^\tau(z))^\nu dz + \underline{z}^\tau S_0^\nu}{(S_0 + G^\tau(z^\tau_{i,t}))^\nu} = \\
&= \frac{\int_{(1-\tau)\underline{z}+\tau\mu}^{(1-\tau)z_{i,t}+\tau\mu} \left(S_0 + G\left(\frac{u}{1-\tau} - \frac{\tau\mu}{1-\tau}\right)\right)^\nu dz + ((1-\tau)\underline{z} + \tau\mu)S_0^\nu}{(S_0 + G(z_{i,t}))^\nu} = \\
&= (1-\tau)\frac{\int_{\underline{z}}^{z_{i,t}} (S_0 + G(z'))^\nu dz' + \underline{z}S_0^\nu}{(S_0 + G(z_{i,t}))^\nu} + \tau\mu\frac{S_0^\nu}{(S_0 + G(z_{i,t}))^\nu} = \\
&= (1-\tau)k(z_{i,t}) + \tau\mu\frac{S_0^\nu}{(S_0 + G(z_{i,t}))^\nu}
\end{aligned}$$

To find $\hat{z}$, where the investment schedules cross, set $k^\tau(\hat{z}) = k(\hat{z})$. In this case,

$$k(\hat{z}) = \mu\frac{S_0^\nu}{(S_0 + G(\hat{z}))^\nu}$$

Substituting the formula for equilibrium investment (14), get the desired condition (16).

Finally, define $Q(G(z)/S_0, \nu) = (1 + G(z)/S_0)^\nu - 1 > 0$, so that the condition (16) can be written as:

$$\begin{aligned}
\int_{\underline{z}}^{\hat{z}} \left(1 + Q\left(\frac{G(z)}{S_0}, \nu\right)\right) dz = \mu - \underline{z} \Rightarrow \hat{z} - \underline{z} + \int_{\underline{z}}^{\hat{z}} Q\left(\frac{G(z)}{S_0}, \nu\right) dz = \mu - \underline{z} \Rightarrow \\
0 < \int_{\underline{z}}^{\hat{z}} Q\left(\frac{G(z)}{S_0}, \nu\right) dz = \mu - \hat{z}
\end{aligned}$$

which implies that $\hat{z} \in (\underline{z}, \mu)$. ∎

Proof of Proposition 4: The first expression is obvious. To find $\breve{z}$, where the investment schedules cross, set $k^\tau(\breve{z}) = k(\breve{z})$. In this case,

$$k(\breve{z}) = \mu\left(1 - \frac{S_0^\phi}{(S_0 + G(\breve{z}))^\phi}\right)$$

Substituting the formula for equilibrium investment (21), get the desired condition (23). For $S_0 = 0$ the condition reduces to $k(\breve{z}) = \mu$. To see that $\breve{z} > \mu$, write the condition for $\breve{z}$ as:

$$(\mu - \underline{z}) - (\mu - \breve{z})\left(1 + \frac{G(\breve{z})}{S_0}\right)^\phi = \int_{\underline{z}}^{\breve{z}} \left(1 + \frac{G(t)}{S_0}\right)^\phi dt$$

Again, define $W(G(z)/S_0, \phi) = (1 + G(z)/S_0)^\phi - 1 > 0$, and so that the above equation can be rewritten as:

$$(\mu - \underline{z}) - (\mu - \breve{z})\left(1 + \frac{G(\breve{z})}{S_0}\right)^\phi - (\breve{z} - \underline{z}) = \int_{\underline{z}}^{\breve{z}} W\left(\frac{G(z)}{S_0}, \phi\right) dz$$

so that the left-hand side is positive if and only if $\breve{z} > \mu$. ∎

Appendix B: an Example with the Uniform Distribution

As it was shown in Section 3, one can derive explicit solution to the differential equation 10 characterizing the equilibrium choices, so that the solutions are given by equations (13)-(14). An example using uniform distributions can be particularly instructive.

For simplicity, let us assume that $z_{i,t}$ is distributed uniformly on $[a,b]$. Then the after-tax income $z^{\tau}_{i,t}$ is distributed uniformly on $[a+(b-a)\tau/2, b-(b-a)\tau/2]$ with $0 \leq \tau < 1$. This has the interpretation that the initial distribution of endowments in uniform on $[a,b]$ but may become more equal in response to redistributive taxation of the form (6). (Obviously, the before-tax situation can be easily derived by setting $\tau = 0$.) In this case, the after-tax equilibrium investment for each individual i with pre-tax income $z_{i,t}$ is given by:

$$
\begin{aligned}
k^{\tau}(z_{i,t}) &= \frac{\int_{a+(b-a)\tau/2}^{z^{\tau}_{i,t}} \left(S_0 + \frac{1}{1-\tau}\left(\frac{u-a}{b-a} - \frac{\tau}{2}\right)\right)^{\nu} dz + \left(a + (b-a)\frac{\tau}{2}\right) S_0^{\nu}}{\left(S_0 + \frac{1}{1-\tau}\left(\frac{z^{\tau}_{i,t}-a}{b-a} - \frac{\tau}{2}\right)\right)^{\nu}} \\
&= \frac{(1-\tau)\int_a^{z_{i,t}} \left(S_0 + \frac{t-a}{b-a}\right)^{\nu} dt + \left(a + (b-a)\frac{\tau}{2}\right) S_0^{\nu}}{\left(S_0 + \frac{z_{i,t}-a}{b-a}\right)^{\nu}} \\
&= \frac{1}{\left(S_0 + \frac{z_{i,t}-a}{b-a}\right)^{\nu}} \left(\frac{1-\tau}{\nu+1}(b-a)\left(\left(S_0 + \frac{z_{i,t}-a}{b-a}\right)^{\nu+1} - S_0^{\nu+1}\right) + \left(a + (b-a)\frac{\tau}{2}\right) S_0^{\nu}\right) \\
&= \frac{1-\tau}{\nu+1}\left((b-a)S_0 + (z_{i,t}-a)\right) + \left(a + (b-a)\left(\frac{\tau}{2} - \frac{1-\tau}{\nu+1}S_0\right)\right)\left(\frac{S_0}{S_0 + \frac{z_{i,t}-a}{b-a}}\right)^{\nu}
\end{aligned}
$$

Obviously, when $S_0 = 0$, the after-tax equilibrium investment is linear in individual's endowment and is $1-\tau$ smaller than the before-tax equilibrium investment (see Figure 2b):

$$
k^{\tau}(z_{i,t}) = (1-\tau)k(z_{i,t}) = \frac{1-\tau}{1+\nu}(z_{i,t}-a) \tag{24}
$$

Substituting it into equation (5), the after-tax growth rate is given by

$$
\begin{aligned}
\gamma_t^{\tau} &= \ln \int (k^{\tau}(z_{i,t}))^{\alpha} di = \ln \int_a^b \left(\frac{1-\tau}{\nu+1}(t-a)\right)^{\alpha} \frac{1}{b-a} dt = \\
&= \underbrace{-\ln(1+\alpha) - \alpha\ln(1+\nu) + \alpha\ln(b-a)}_{\gamma_t} + \underbrace{\alpha\ln(1-\tau)}_{<0}
\end{aligned}
$$

i.e. the after-tax growth rate is less than the before-tax growth rate by $\alpha\ln(1-\tau)$. Also, this expression is clearly decreasing in τ. In other words, redistributive taxation leading to greater equality will decrease growth.

If $S_0 > 0$, the investment functions cross at $\hat{z}$, which is given by the following expression:

$$\hat{z} = a + (b-a)S_0 \left[\left(\frac{\nu+1}{2S_0} + 1 \right)^{\frac{1}{\nu+1}} - 1 \right]$$

so that those with incomes below $\hat{z}$ invest more and those with incomes above $\hat{z}$ invest less after the tax imposed.

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