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CREDIT MARKETS AND STAGNATION IN AN ENDOGENOUS GROWTH MODEL

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Abstract:

This paper studies the effects that the inability of individuals to borrow against future income has on economic growth. The model assumes that human capital, which is accumulated through education, is the only factor of production. It is shown that liquidity constraints reduce growth. Further, in the presence of externalities that may induce two equilibria, it is shown that liquidity constraints not only reduce the rate of growth in the high-growth equilibrium, but can also make the low-growth equilibrium more likely to occur.

1. Introduction

Recent work on economic growth, some of which is reviewed below, seeks to explain why some economies may be trapped in a stage of underdevelopment or may go through long periods of stagnation. Part of this literature emphasizes the existence of multiple equilibria arising from some form of externality or coordination failure. Another branch of this literature focuses on fundamentals (preferences, production or market structure) that determine why poor economies stay poor, while rich economies may be able to sustain permanent growth.

This paper focuses on the role credit market imperfections play in explaining stagnation. In particular, the paper studies the effects of the inability of individuals to borrow against future income to finance current consumption on growth and the possibilities for an economy to become trapped in an equilibrium with low growth.

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The model of this paper assumes that the engine of growth is human capital accumulation (as in Lucas (1988) and Romer (1990)). The relevance of the accumulation of human capital in fostering growth has been recently documented by Romer (1990), Barro (1991), Barro and Lee (1993), and Benhabib and Spiegel (1993). The view taken in this paper is that investment in human capital consists of formal education, which transfers income from the present to the future.

Since individuals need to consume while receiving education, they need to find an alternative source of funds to labor income in order to finance their consumption needs. If credit markets were to function without frictions, individuals could borrow to finance current consumption and repay the borrowed amount (plus interest) in the future, when their productivity had been enhanced by education. However, if individuals face liquidity constraints, they will have the incentive to reduce time devoted to education in order to work to finance consumption. In turn, if human capital accumulation is the engine of growth, liquidity constraints may end up reducing the rate of growth. As shown later in the paper, if the economy is subject to multiple equilibria –one with high and the other with low growth– liquidity constraints could make it more likely for the economy to end up in the low growth equilibrium. Moreover, liquidity constrains could make the high growth equilibrium unattainable. These are the main ideas that this paper formalizes in a very simple framework, which, at the cost of realism, highlights clearly the channel through which credit market imperfections, in the form of restrictions to borrowing from future income, may reduce growth.

The main simplification of this model is that it ignores the role of physical capital and other forms of capital different from human capital, in promoting sustained growth. As is well known in the literature on the life cycle hypothesis (*e.g.*, Modigliani (1986)), and recently discussed in the context of economic growth in Jappelli and Pagano (1992) and De Gregorio (1992), liquidity constraints are likely to increase the savings rate, exerting a positive effect on growth. Therefore, while liquidity constraints are likely to reduce human capital accumulation, they are also likely to increase savings. The net effect on growth would be ambiguous[1].

One of the most important cases that can result in multiple steady state rates of growth is the existence of externalities associated with human capital accumulation. Azariadis and Drazen (1990), for instance, show that multiple equilibria can be the result of social returns on education being an increasing function of the stock of human capital. Thus, an economy with a low stock of human capital will also have low returns on education, and consequently can be trapped in a stage of underdevelopment. Conversely, growth perpetuates itself when an economy starts with a high level of human capital.

In a related work, Becker, Murphy and Tamura (1991) show that multiple equilibria can be the result of the interactions between the rates of fertility and human capital accumulation. In this model, the rate of return on human capital accumulation, as in Azariadis and Drazen (1990), depends positively on the stock of human capital. An economy rich in human capital will have a high return on human capital accumulation *vis-à-vis* the return on children. Thus, economies with a high stock of human capital will have high rates of growth and low rates of population growth, while poor economies will have low rates of growth and high fertility rates.

In a neoclassical model of growth à la Diamond (1965), Asilis and Ghosh (1992) show that the existence of a fixed cost of undertaking investment, which is increasing in the aggregate level of investment, may result in multiple equilibria. This is so because the returns on investment will be a positive function of aggregate investment (equal to savings in this model). Consequently, an economy can be trapped in a low savings equilibrium because of the spillover from low savings-investment to low private returns on investment[2].

Murphy, Shleifer and Vishny (1989) develop a model which captures the notion that a coordination failure may be responsible for stagnation and a "big push" (in the terminology of Rosenstein-Rodan (1943)) may be required to move the economy to a high income equilibrium. In their model, firms have access to two technologies –one with increasing returns to scale, that requires a minimum size to be profitable, and the other with constant returns to scale. If everybody chooses the technology with increasing returns to scale, the high income achieved because of the exploitation of scale economies may sustain this equilibrium. However, if no one chooses the more productive technology, the size of operation of each firm will not justify the use of the increasing returns to scale technology and the economy will be in a low income equilibrium. In this case, therefore, there is a coordination failure due to the lack of demand (see Cooper and John (1988)) that may prevent the economy from growing.

As mentioned above, however, poverty traps and stagnation are not an exclusive feature of models with multiple equilibria. They can, however, be the only equilibrium an economy may reach. This is the case studied by Easterly (1991). In his model, different sets of policies are the cause for different growth outcomes. In particular, there are *policy thresholds* below which an economy stagnates, and once those thresholds are surpassed growth takes off. The main feature of this model is that preferences are assumed to be of the Stone-Geary type (see also Atkeson and Ogaki (1991) and Rebelo (1992)), which makes the savings rate depend on the path of consumption. More specifically, the elasticity of intertemporal substitution depends on how close consumption is to subsistence. Therefore, an economy can stagnate because close to the subsistence level of consumption people have no incentive to save. To motivate the relevance of stagnation, Easterly (1991) also provides evidence showing that more than a half of a sample of 87 developing countries had no growth during the period 1950-85, while all of OECD countries experienced positive growth in those years.

The model of this paper can generate both, unique equilibrium with low growth (Section 3) and multiple equilibria, where one of them entails stagnation (Section 4). The important message is that, in both cases, liquidity constraints can make low growth a more likely outcome.

The paper is organized in 5 sections. The next section presents a basic model without liquidity constraints. The model, a variant of Lucas (1988), uses a framework of overlapping generations where human capital is the only factor of production. Section 3 extends the basic model to analyze the effects of the inability of individuals to borrow against future income in a model with only one equilibrium. Section 4 incorporates threshold externalities to consider the case of multiple equilibria. Section 5 presents some concluding remarks.

2. The Basic Model

This section considers a small open economy, where individuals can freely lend and borrow at an interest rate equal to r. At period t each individual (indexed by $j \in J$) has a level of skills denoted by H_t^j and works ℓ_t^j units of time. The economy produces only one, non-storable, consumption good according to the following linear technology:

$$Y_t = \sum_{j \in J} H_t^j \ell_t^j . \tag{1}$$

The economy is populated by two overlapping generations[3]. According to equation (1), and using the price of the consumption good as the numeraire, competitive firms will set wages for worker j (w_t^j) equal to H_t^j. This corresponds to the familiar equality between the real wage and the marginal productivity of labor.

The generation born in period t inherits the average level of skills available in the economy, denoted by H_t. In order to increase these skills, individuals need to acquire education. The more time young people spend in formal education, the higher the level of skills when they reach middle age. To capture this idea I assume that individuals are endowed with one unit of non-leisure time in each period of their lives. When young, individuals have to allocate their endowment between education (h) and work ($1-h$). When old, they supply, inelastically, one unit of raw labor. The level of skills at $t+1$ of an individual born at time t who spends h^j units of time in education is given by:

$$H^j_{t+1} = (1 + \varepsilon + \delta h^j)H_t. \tag{2}$$

This equation implies that when individuals do not invest in education, their level of skills grows at a minimum rate equal to ε. In the case where $\varepsilon = 0$, equation (2) says that in the absence of education the level of skills remains constant. The parameter _ represents the minimum rate of growth of human capital and can be interpreted as exogenous technological progress[4]. The value of ε could depend, for instance, on the economy's ability to absorb knowledge from other countries, in which case ε would be related to the degree of openness. It could also be related to the existence of learning by doing or could be affected by economic policy. The parameter δ, in turn, corresponds to the marginal efficiency of education per unit of skills and could also depend on the economic environment[5]. In this and the next section ε and δ are assumed to be constant. In Section 4 the constancy assumption on δ is relaxed.

Young individuals can earn a wage (w_t^j equal to H_t^j.). On the other hand, allocating h^j units of time to education at time t allows them to earn a wage equal to $(1+\varepsilon+\delta h^j)w_t^j$ in period t+1. In consequence, lifetime income is given by $w_t^j(1-h^j)+w_t^j(1+\varepsilon+\delta h^j)/(1+r)$. As a normalization, no population growth is assumed and the size of each generation is set equal to one.

Individuals' behavior is the result of a dynamic optimization problem, where each individual of the young generation maximizes an increasing and concave utility function of the consumption path subject to the intertemporal budget constraint (superscript j is omitted):

$$\max u\,(c_{t,t},\, c_{t,\,t+1}) \tag{3}$$

subject to[6]:

$$c_{t,t} + \frac{c_{t,\,t+1}}{1+r} = w_t\,(1-h) + \frac{w_t\,(1+\varepsilon+\delta h)}{1+r}. \tag{4}$$

The solution to this problem gives the optimal values for $\{c_{t,t},\, c_{t,\,t+1},\, h\}$. In this model there is no direct cost associated with education, since it is provided free of charge. This is consistent with the assumption that education does not need to rent factors in order to increase the level of skills. The only cost involved in education is the opportunity cost, which consists of foregone labor income.

Because individuals can lend and borrow freely, the optimal choice of h will be such that it maximizes the present value of income (human wealth) regardless of the consumption choice[7]. Therefore, the optimal choice of h will be such that the expression $1 - h + (1 + \varepsilon + \delta h)/(1 + r)$ is maximized. In addition, because returns on education are linear in h, the solution will be at a corner, either $h = 1$, or $h = 0$.

Each unit of time devoted to education when young will involve an opportunity cost of w_t. The benefit, in turn, will be additional earnings equal to (in present value) $w_t\delta/(1 + r)$. Hence, whenever w_t is greater than $w_t\delta/(1 + r)$, the individual will prefer to work rather than receive education. Conversely, when the present value of future wages, augmented by δ, is greater than the current wage, the individual will prefer not to work in favor of acquiring education. Therefore, the optimal choice of h, denoted by h^*, will be[8]:

$$h^* = \begin{cases} 1 & \text{if } \delta > 1+r \\ 0 & \text{if } \delta \le 1+r. \end{cases} \tag{5}$$

Now, we can turn to the analysis of the equilibrium of this model. To go from individual behavior to the aggregate economy, it is sufficient to note that the optimal individual decision of how much time to devote to human capital accumulation is independent of the decision of the rest of the population. Therefore, equation (5) also corresponds to the average time devoted to education, and hence H_t will grow at a rate equal to $\varepsilon + \delta h^*$, where h^* will be given by (5). Consequently, the equilibrium rate of growth of the economy, denoted by γ, will be given by the following equation:

$$\gamma = \begin{cases} \varepsilon+\delta & \text{if } \delta > 1+r \\ \varepsilon & \text{if } \delta \le 1+r. \end{cases} \tag{6}$$

The rate of growth is unique and depends exclusively on the relationship between δ and $1+r$. By equilibrium in the goods market, consumption will grow at the same rate as output, human capital and wages. In addition, this economy will not exhibit transitional dynamics, and will always grow at the same rate, given by equation (6).

3. The Effects of Liquidity Constraints

The economy described in the previous section is one in which individuals can lend and borrow without constraints (other than the standard solvency constraint). This enables them to use investment in education to maximize human wealth, regardless of the chosen consumption path. However, the presence of borrowing constraints may induce individuals to choose h taking into account the desire for consumption smoothing. Intuitively, if an individual cannot borrow against future income she will not be willing to devote all of her youth to education, since she will need to work when young to have positive consumption. Thus, even when the choice of $h=1$ is the one that maximizes the value of total wealth, it will not be optimal for individuals to do so.

To formally analyze the effects of liquidity constraints, consider an economy where individuals can borrow only a proportion $\sigma - 1$ of their current income to finance current consumption ($\sigma > 1$). This constraint is similar to credit constraints observed in the real world, where credit limits are imposed based on current and past income, and perhaps only partially on expected future income. Since the structure of credit markets is assumed rather than derived from frictions in the process of borrowing and lending, the liquidity constraint can also be thought of as coming from government regulation.

Although individuals cannot borrow as much as they might like (in the absence of liquidity constraints), they can still lend at the interest rate r. The representative agent will no longer face a single intertemporal budget constraint as in equation (4), but will also face the following liquidity constraints:

$$c_{t,t} \leq \sigma w_t (1-h) \tag{7}$$

and

$$c_{t,t+1} \leq \sigma w_{t+1}. \tag{8}$$

Because middle-aged individuals are at the last stage of their life (8) is not binding and can be ignored[9]. However, the optimal choice to the individual's problem when $\sigma > 1 + r$ will not be to set h equal to one, because she would have no income, and hence, no consumption in the first period of her life.

To obtain further insight into the effects of liquidity constraints, the utility function will be assumed to be of the following logarithmic form:

$$u = \log (c_{t,t}) + \beta \log (c_{t,t+1}). \tag{9}$$

Individuals maximize equation (9) subject to (4), (7) and the non-negativity constraints on c and h. The first order conditions of this problem are:

$$\frac{1}{c_{t,t}} = \lambda + \mu, \tag{10}$$

$$\frac{\beta}{c_{t,t+1}} = \frac{\lambda}{1+r}, \tag{11}$$

and

$$\mu = \frac{\lambda}{\sigma} \left(\frac{\delta}{1+r} - 1 \right), \tag{12}$$

where λ and μ are the Lagrange multipliers associated with constraints (4) and (7), respectively. Since λ is always positive, μ is also positive for all finite values of σ (under the maintained assumption that $\delta > 1 + r$)[10]. Only when σ goes to infinity, that is, liquidity constraints are not binding, μ is equal to zero. Using the first order conditions to find a relationship between $c_{t,t}$ and $c_{t,t+1}$ and then using (7) into the intertemporal budget constraint, the following is the expression for the optimal value of h (as long as it is strictly positive, see below):

$$h^* = \frac{(\sigma - 1)(1+\beta)(1+r) + \delta\beta - (1+\varepsilon)}{(\sigma - 1)(1+\beta)(1+r) + \delta\beta + \delta} < 1. \tag{13}$$

In order to focus on the interesting case where the economy can *potentially* grow at $\varepsilon + \delta$, but liquidity constraints will prevent it from doing so, the following inequality is assumed to hold:

$$\delta > 1 + r. \tag{A1}$$

By examining equation (13), the following result can be shown to hold:

Proposition 1

Under (A1), and if the parameters are such that h^* is strictly positive, liquidity constraints reduce human capital accumulation, that is: $\partial h^* / \partial \sigma$ is positive. Consequently, the rate of growth, $\varepsilon + \delta h^*$, increases with the relaxation of liquidity constraints.

It can also be verified that an increase in the exogenous rate of growth, ε, reduces h^*. The intuition for this result is that an increase in ε implies that the rate of growth of income will be higher, regardless of the value of h, reducing the incentives to transfer income from the first period to the second period through education. Hence, in response to an increase in ε individuals will prefer to work more during their youth in order to increase current consumption. During middle age, they can rely on a high rate of exogenous growth. In contrast, the effect of δ on h^* is ambiguous. On the one hand there is an income effect analogous to that of an increase in ε, which would tend to reduce h^*, but, on the other hand, there is also a substitution effect, since the increase in δ will induce individuals to increase time spent on education.

As in the specification without liquidity constraints, the equilibrium is unique and depends on the relationship between δ and $1 + r$. If (A1) does not hold, that is $\delta < 1 + r$, the liquidity constraint will not be binding. In this case the optimal choice is $h^* = 0$ and growth will be at its minimum level, regardless of the existence of liquidity constraints, because there is no demand for credit.

Another implication of equation (13) is that the parameters could be such that h^* could be negative. If this is the case, the optimal value of h would be zero and the rate of growth would be equal to ε. To discuss this case, consider σ to be equal to 1, *i.e.*, borrowing is not allowed. Equation (13) becomes:

$$h^* \big|_{\sigma=1} = \frac{\delta\beta - (1+\varepsilon)}{\delta\beta + \delta}, \tag{14}$$

as long as the expression $\delta\beta$ is greater than $1 + \varepsilon$. Otherwise, when the following inequality holds:

$$\delta\beta < 1 + \varepsilon, \tag{15}$$

h^* is equal to zero. Assuming that (15) holds, it immediately follows from Proposition 1 (h^* is increasing in σ) that there will be a value of σ, represented by $\tilde{\sigma}$, such that h^* will be equal to zero for all $\sigma < \tilde{\sigma}$. Note that (15) may hold even when (A1) holds. This implies that, even when in the absence of liquidity constraints h would be set at its maximum, tight liquidity constraints could result in h being at its minimum. In terms of relevance, condition (15) could be easily satisfied. Suppose, for example, that the discount rate is equal to the foreign interest rate, *i.e.*, $\beta = 1/(1 + r)$. If, in addition, (A1) holds by a small margin, a relatively small value of ε may be enough for (15) to hold.

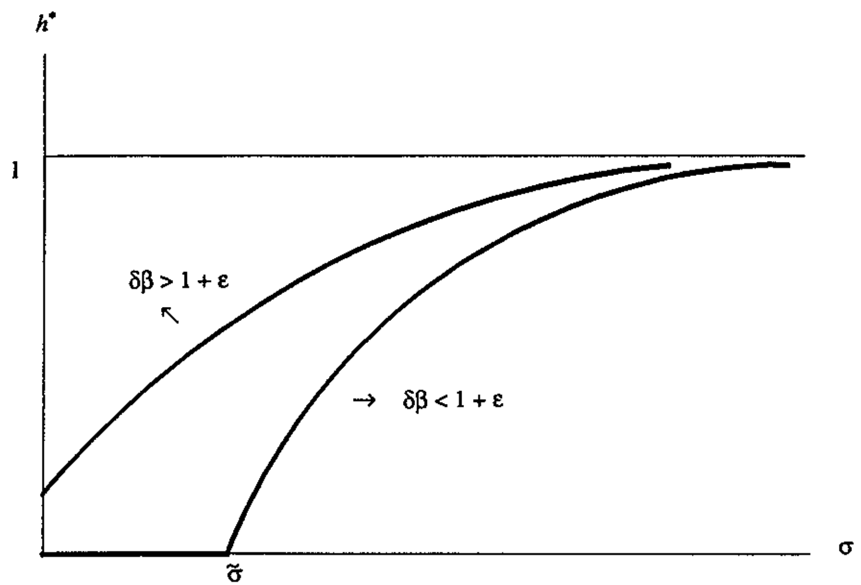
Figure 1 summarizes the discussion of this section and shows the negative relationship between liquidity constraints and human capital accumulation. As σ goes to infinity, liquidity constraints disappear and h^* goes to its unconstrained maximum. However, when liquidity constraints tighten, human capital accumulation declines. If $\delta\beta < 1 + \varepsilon$, h^* will decline up to a point, $\tilde{\sigma}$, where no time is devoted to education. The implications for growth are analogous, since the rate of growth of the economy is equal to $\varepsilon + \delta h$, and consequently the shape of the relationship between liquidity constraints and growth is the same as those of Figure 1.

4. Stagnation and Threshold Externalities

In this section, I discuss a case where there are two equilibria. It is shown that liquidity constraints not only reduce human capital accumulation and the rate of growth in the high growth equilibrium, but can also make the low growth equilibrium more likely to occur.

FIGURE 1

LIQUIDITY CONSTRAINTS AND HUMAN CAPITAL ACCUMULATION



One of the most important features of models of growth and human capital accumulation is the usual assumption that there is an externality in the process of acquisition of education. The standard specification assumes that the private marginal return on education (δ) is increasing in the *aggregate stock* of human capital. The notion is that in societies with high levels of education, the technology for human capital accumulation is more efficient.

For simplicity of exposition, I assume that the returns to education are a function of the *flow* of investment in human capital. In other words, this assumption implies that education is more efficient the more people go to school[11]. This is the simplest case that yields multiple equilibria. For example, if few people go to school, the return on education will be low and as a consequence few people will want to go to school, or else they will be willing to spend only a few years in school. In the other equilibrium, where many people go to school, the return on education will be high and there will be many people interested in acquiring education[12].

The above discussion can be captured by assuming that the marginal efficiency of education is increasing in the amount of hours people devote to education. That is:

$$\delta = \delta\left(\sum_{j \in J} h^j\right), \tag{16}$$

with $\delta' > 0$.

Because of the normalization of the size of each generation to 1 and concentrating attention on symmetric equilibria, equation (16) can be written as:

$$\delta = \delta(h). \tag{17}$$

Similar to (A1), I assume that:

$$\delta(0) < 1 + r \text{ and } \delta(1) > 1 + r, \tag{A2}$$

that is, when no one devotes time to education the marginal efficiency of human capital accumulation is low enough to prevent individuals from acquiring education. In contrast, when the young generation devotes all of its non-leisure endowment to education the marginal efficiency of education is such that it is optimal to choose $h = 1$. The important implication of the externality in human capital accumulation is that δ is taken as given when individuals choose the optimal consumption path and the amount of time devoted to education.

First, consider the case of no liquidity constraints and denote the equilibrium value of h as $\hat{h}$. Thus, the solution for optimal h, denoted by h^{**}, will be given by:

$$h^{**} = \begin{cases} 1 & \text{if } \delta(\hat{h}) > 1 + r \\ 0 & \text{if } \delta(\hat{h}) \leq 1 + r. \end{cases} \tag{18}$$

An equilibrium is a value of h^{**} such that $h^{**} = \hat{h}$, and therefore, under the maintained assumption (A2), this economy will have two equilibria. In the high growth equilibrium, $\hat{h} = 1$ and $\gamma = \varepsilon + \delta$. In the equilibrium with stagnation, $\hat{h} = 0$ and $\gamma = \varepsilon$. Note that both equilibria are stable. For example, starting from the equilibrium with $\hat{h} = 0$, a small deviation of h from 0 will still induce individuals to optimally choose $h = 0$, and hence, $\hat{h} = 0$ will still be the equilibrium. The same analysis is valid for $\hat{h} = 1$.

In what follows I show that in the presence of liquidity constraints not only does the rate of growth in the high growth equilibrium fall –in similar fashion to the exercise of the previous section– but also the low growth equilibrium *may be the only equilibrium.*

In the presence of liquidity constraints, the solution for the individually optimal value of h is given by h^* in equation (13) whenever $\delta(\hat{h}) > 1 + r$. When $\delta(\hat{h}) < 1 + r$ the optimal solution is $h = 0$. Then, the optimal choice of time devoted to human capital accumulation in the presence of liquidity constraints and threshold externalities can be summarized as:

$$h^{**} = \begin{cases} h^* \text{ if } \delta(\hat{h}) > 1 + r \\ 0 \text{ if } \delta(\hat{h}) \leq 1 + r. \end{cases} \tag{19}$$

Again, the equilibrium will be such that $h^{**} = \hat{h}$. The possible equilibria are illustrated in Figure 2. The hh schedule corresponds to the optimal value of *h when the solution is interior*, that is, h^* in equation (13). Panel (a) is drawn under the assumption that $(\sigma - 1)(1 + r) > 1 + \varepsilon$. This assumption guarantees that h^* is decreasing and convex in δ, because the income effect discussed above would dominate the substitution effect when δ changes. Panel (b) draws the case of $(\sigma - 1)(1 + r) < 1 + \varepsilon$, where hh is increasing in δ and concave. On the other hand, the schedule $\delta\delta$ corresponds to the function $\delta(h)$, and, as assumed in (A2), is increasing and starts at a value less than $1 + r$[13].

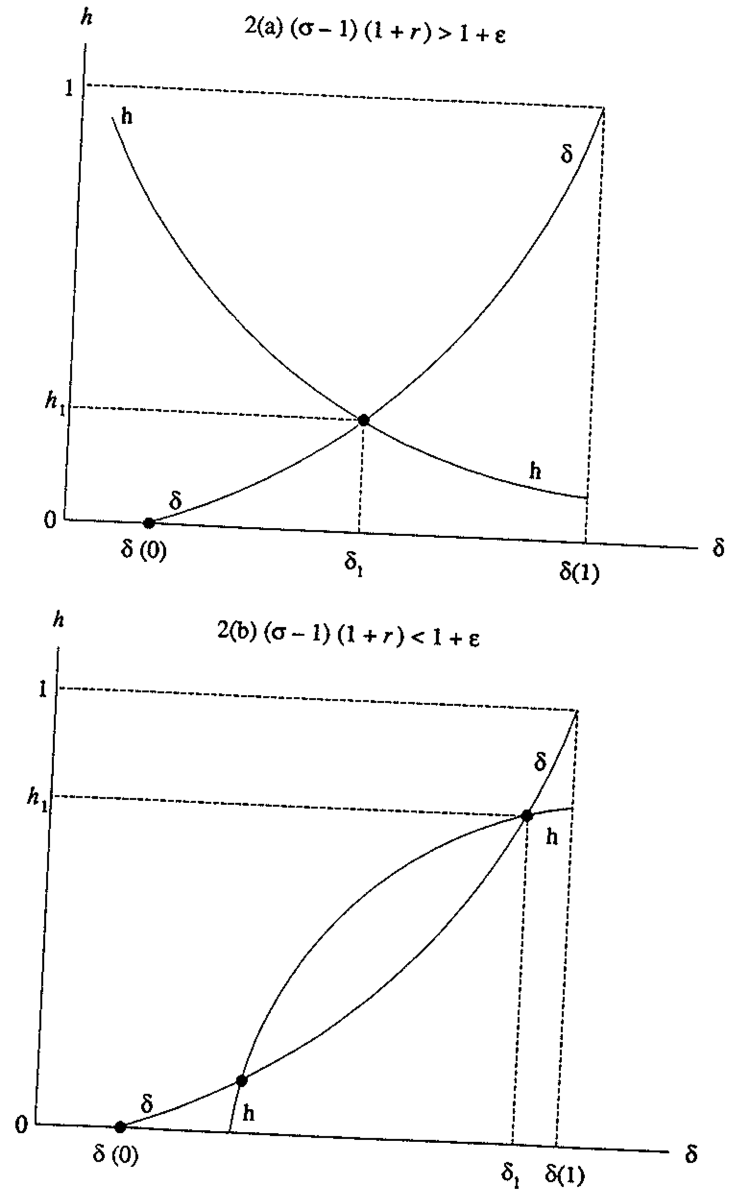
Because $\delta < 1 + r$ for $h = 0$, a state with no human capital accumulation is always an equilibrium. That is, the point $(\delta(0),0)$ in Figure 2 is always an equilibrium. In this equilibrium the marginal efficiency of education is so low that individuals will have the incentive to work all of their non-leisure time when they are young. The rate of growth of output in this equilibrium is equal to ε. Whether or not the interior solution (δ_1 and h_1) is an equilibrium will depend on the value of the parameters, in particular on the relationship between r and δ. In the case drawn in 2(b) there are three possible equilibria, one will correspond to stagnation and the other two will be interior solutions for h. It can be shown, however, that the high growth equilibrium is stable, and the intermediate growth equilibrium is unstable, so it will not be considered further[14]. There are two possible cases for the stable equilibria:

Case 1: $1+r < \delta_1$. This is a case of multiple equilibria, where (δ_1, h_1) and $(\delta(0),0)$ are the two stable equilibria. In the high growth equilibrium, the marginal efficiency of education is high compared to r, and hence, the young generation will decide to pursue education in order to transfer income from their youth to their middle age. A special subcase is when there is no liquidity constraint ($\sigma = \infty$). In the version of Section 3 the equilibrium is unique, because there are no externalities, and the choice of h is independent of other individuals' decisions. However, in the presence of externalities the optimal choice for a young individual will depend on what others do. If they do not choose education, this will be the optimal choice for the individual, but when the rest of the young generation chooses $h = h^* > 0$, that will also be the optimal decision at the individual level.

Case 2: $1+r > \delta_1$. In this case only $(\delta(0),0)$ is an equilibrium, since δ_1 is not enough to induce the young generation to pursue education and they will inevitably

FIGURE 2

MULTIPLE EQUILIBRIA AND THE DETERMINATION OF h*



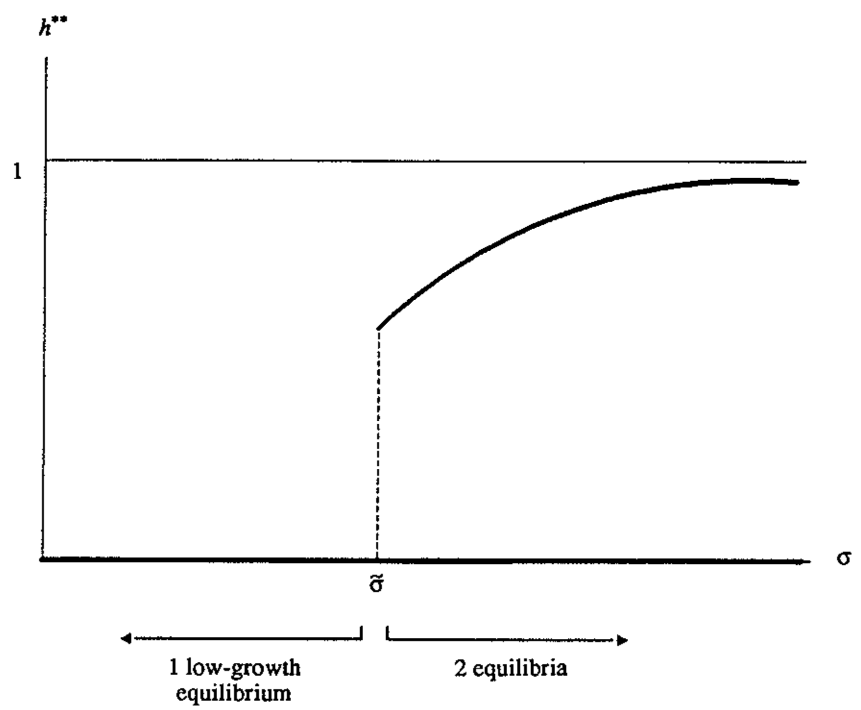
choose the corner solution of no education and working their entire endowment of non-leisure time.

The comparative statics results for changes in the liquidity constraints parameter, σ, can be seen in Figure 2. A decline in σ (increase in liquidity constraints) will lead to a reduction in h^* for all values of δ, causing a downward shift in hh. This will result in a reduction of h and δ in the high growth equilibrium. It is possible that σ may fall enough to make the high growth equilibrium no longer attainable, and thus, moving the economy from case 1 to 2.

The relationship between the rate of growth, h^{**} and liquidity constraints, can be summarized in the following proposition (see also Figure 3):

FIGURE 3

LIQUIDITY CONSTRAINTS AND HUMAN CAPITAL ACCUMULATION IN THE PRESENCE OF EXTERNALITIES



Proposition 2

Assume that (A2) holds and define as the value of $\bar{\sigma}$ that solves $\delta(h) = 1 + r$, where $\bar{h} = \bar{h}(\bar{\sigma})$ in equation (13). Then,

- For $\sigma \geq \bar{\sigma}$ there are two equilibria: in the high growth equilibrium the rate of growth is equal to $\varepsilon + \delta(h^*)h^*$, which is increasing in σ, and h^* is given by equation (13). In the low growth equilibrium, the rate of growth is constant and equal to ε.
- For $\sigma < \bar{\sigma}$ there is one equilibrium in which the rate of growth is equal to ε.

The last case is important because it highlights how the economy, which in the absence of liquidity constraints has two equilibria, may end up with a unique equilibrium with minimum growth as the result of liquidity constraints. In this equilibrium, (small) changes in the extent of liquidity constraints have no effect. Therefore, the liquidity constraints are not binding and although they are a main cause for stagnation, the economy would have an "excess of credit."

A standard critique of models with multiple Pareto rankable equilibria is that it may be possible for the government to announce a policy that moves the economy from stagnation to a high growth equilibrium, because stagnation results from a coordination problem. In contrast, when stagnation is the only equilibrium, policies that aim to coordinate private agents' decisions will not work, and unless the basic distortion is corrected, by increasing σ in this case, there is no constrained Pareto-superior policy.

5. Concluding Remarks

Most of the literature on credit markets and long-run growth centers on the interaction between the growth process and the production side of the economy. For example, existing models have analyzed the impact of well-functioning credit markets in allocating investment to its best use, or the incentive effects on innovation[15]. This paper, however, focuses on the effects credit market imperfections have on households' behavior, and the implications for growth. As shown in De Gregorio (1992), the most robust result of liquidity constraints is the negative effect on human capital accumulation. In addition, if we ignore other forms of capital, and assume that growth is driven exclusively by human capital accumulation, this paper shows that its effect on growth could be substantial. Specifically, in the case of multiple equilibria, where one equilibrium has high growth and the other corresponds to stagnation, this paper shows that liquidity constraints not only reduce growth in the high growth equilibrium, but can make such an equilibrium unattainable, leaving stagnation as the only outcome. The results of this paper could be considered extreme, but the analysis of household behavior in response to capital market imperfections may provide new insights to our understanding of underdevelopment.

Perhaps the most important reinterpretation of the model discussed in this paper is to view it as a description of a poor economy that has not yet developed a capital market. In many poor countries, especially in those that are predominantly agricultural, most production activities occur at the household level. In this context, it is natural to expect a close connection between households' and firms' behavior, since they correspond to the same unit. Now, consider the decision of adopting a technology (or perhaps a crop) and assume that there are two alternatives: one has high productivity but takes more time to yield benefits, while the other is less efficient, but its benefits are immediate. In this context, we can interpret h as the fraction of resources devoted to the most productive technology. If households have no access to credit to finance current consumption, it follows from the discussion in the previous sections that there is incentive for them to use the less productive technology[16].

Liquidity constraints are assumed to be exogenous, without providing a justification for such a distortion. One reason is that there are government regulations that impose limits on borrowing. However, establishing credit records, and efficient monitoring and enforcement technologies may require sizable investment. Thus, in general the creation of credit markets requires allocating resources that may be worth spending only after the economy has reached a certain level of development. Therefore, this model could be used to explain why some economies have an extended low growth period, after which capital markets develop and the rate of growth begins to accelerate.

Notes

1 De Gregorio (1992) presents a more general model where both human and physical capital are the engines of growth, which shows that liquidity constraints reduce human capital accumulation, although their effects on growth are ambiguous. However, this paper rules out the possibilities of multiple equilibria. In addition, De Gregorio (1992) presents empirical evidence showing that liquidity constraints have a negative effect on huan capital accumulation. For empirical evidence on liquidity constraints, savings and growth, see Jappelli and Pagano (1992).

2 See also Tsiddon (1992) for a model of growth with multiple equilibria stemming from imperfect information.

3 Normally, two-period overlapping generations models consider one young and one old generation. In this paper, however, it is more appropriate to think about young and middle-aged people, since both generations are able to work and there is no retirement.

4 Depreciation of individuals' human capital would imply a negative value of ε, but, without loss of generality, I assume that ε is non-negative.

5 Formally, $\delta = (1/H_t)(\partial H^i_{t+1}/\partial h^i)$. For short, δ will be called marginal efficiency of education. Finally, for reasons that will be clear later, δ is also the marginal private return on education.

6 Note from equation (4) that education is provided free of charge. Therefore, when specifying liquidity constraints later in the paper, these refer to the inability to borrow to finance consumption, not education.

7 If utility is assumed to include altruistic behavior the results would be basically the same, since the choice of h is independent of the choice of consumption, and hence of utility.

8 Note that h may take any value in [0,1] when $\delta = 1 + r$. I will not discuss further this case, and to sumplify the presentation I will assume that h reaches its minimum when $\delta = 1 + r$.

9 The model could be extended to a third period, which would correspond to retirement, without altering any of the results. In these circumstances, middle-aged individuals would save rather than borrow, and again (8) would not be binding. However, the extension to a third period is useful when physical capital accumulation ins included (De Gregorio (1992)).

10 A condition for optimization is that λ and μ must be greater than, or equal to, zero. When $\delta \leq 1 + r$, μ is equal to zero, that is, liquidity constraints are not binding.

11 It is plausible that there may be some economies of congestion, which are ignored in this analysis.

12 One could roughly think of education as being produced with an "o-ring" technology (see Kremer (1991)), by which a large number of similarly skilled students increases the efficiency of education.

13 As should be clear by now, a problem with specifying δ as a function of H rather than h is that in the presence of positive exogenous growth (equal to ε) it is not possible for an economy to be "stuck" in the low growth equilibrium. Sooner or later δ will be such that $h = h^*$ is the optimal solution.

14 In the case of 2(a) I assume that $\delta(h)$ is convex and that the slope conditions which ensure that the equilibrium (δ_1, h_1) is stable hold. In addition, in the case drawn in 2(b), if the value of δ that makes $h^* = 0$ is less than $\delta(0)$, there will be only two equilibria.

15 For reviews of the literature on financial markets and economic growth, see Roubini and Sala-i-Martin (1992), De Gregorio and Guidotti (1992), and King and Levine (1992).

16 For similar analysis, but focusing on the effects of financial markets on providing insurance and incentive to adopt efficient technologies, see Greenwood and Jovanovic (1990), Bencivenga and Smith (1991), Sain Paul (1992), and Greenwood and Smith (1993).

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DOES INCOME INEQUALITY REDUCE GROWTH?

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Abstract:

This paper examines the effects of inequality on the rate of growth of an economy. We assume that it is easier for an individual to achieve a given level of human capital the higher society's average level of human capital. Agents with above average human capital find it relatively more costly to acquire additional human capital, while agents with below average human capital find it relatively cheaper to acquire additional human capital. The existence of such an externality implies that even when there is no income inequality agents will behave inefficiently. In order to achieve the optimal growth rate, a lump sum tax must be combined with a subsidy to investment in education. When incomes are heterogenous, we show that income convergence is attained in the long run. We also show that the effect of inequality on the growth rate of an economy depends on the functional form of the externality. When the externality function is concave, income dispersion reduces the rate of growth. On the other hand, when the externality function is convex, the effect is ambiguous.

I. Introduction

The purpose of this paper is to analyze the effects of income inequality on the growth rate of an economy. Our interest in the subject is motivated by the striking differences in the growth rates of different developing countries.

In the classical development literature, succesful growth was associated with higher income inequality (Lewis (1954)). The classical argument runs as follows.

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