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**Equity and Efficiency under Imperfect Credit Markets**

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# EQUITY AND EFFICIENCY UNDER IMPERFECT CREDIT MARKETS

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## Abstract

Recent macroeconomic research discusses credit market imperfections as a key channel through which inequality retards growth. Limited borrowing prevents the less affluent individuals from investing the efficient amount, and the inefficiencies are considered to become stronger as inequality rises. This paper, though, argues that higher inequality may actually boost aggregate output even with convex technologies and limited borrowing. Less equality in the middle or at the top end of the distribution is associated with a lower borrowing rate and hence better access to credit for the poor. We find, however, that rising relative poverty is unambiguously bad for economic performance. Hence, we suggest that future empirical work on the inequality-growth nexus should use more specific measures of inequality rather than measures of "overall" inequality such as the Gini index.

**JEL classification:** O11, F13, O16

**Keywords:** capital market imperfections, inequality, growth, efficiency

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# 1 Introduction

Recent macroeconomic research has brought up credit market imperfections as a key channel through which inequality may affect aggregate output and growth. If borrowing is limited, marginal returns are not necessarily equalized across investment opportunities - which is costly to aggregate output if technologies are convex. Based on this reasoning it has been prominently argued in the literature that *more inequality*, i.e., shifting resources away from poorer individuals to richer ones, lowers output and the growth rate further since the differences in marginal returns become even larger.<sup>1</sup>

In this paper, however, we show that the above intuition does in general not hold true once the credit market is not completely "turned off" but only imperfect. Specifically, we show that even with a *globally convex technology* and limited borrowing an increase in inequality may actually boost aggregate output. At the heart of this result is the interest rate's endogenous response to more inequality. With convex technologies, a regressive transfer from individuals belonging to the "middle class" to the rich reduces the interest rate. A lower capital cost softens the borrowing constraints of all entrepreneurs but particularly those of the poorest agents. As a result, the poor may increase their investments substantially, and - since they face high returns - it may well be that this interest rate effect dominates the negative direct effect of more inequality in the middle or at the top end of the distribution.<sup>2</sup>

We are, of course, not the only to point out that more inequality in presence of credit market imperfections may be good for output and growth. If the production function is not globally concave, the relationship between inequality

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<sup>1</sup>Relying on a constant interest rate and on an ad-hoc borrowing constraint, Banerjee and Duflo (2003, p. 277), for instance, argue in this context that "an exogenous mean-preserving spread in the wealth distribution ( $\dots$ ) will reduce future wealth and by implication the growth rate." Similar arguments can be found in the contributions by Barro (2000, p. 6) and Bénabou (1996, p. 17), among others.

<sup>2</sup>Note that the seminal theoretical contributions by, e.g., Aghion and Bolton (1997) and Piketty (1997) rely also on an endogenous borrowing rate. However, these papers do not explicitly address the impact of changes in inequality on contemporaneous output.

and aggregate output is ambiguous as well (see, e.g., Banerjee and Duflo, 2003, for a simple illustration). However, we emphasize and illustrate by means of an example that the relationship may be non-monotonic even if non-convexities are entirely absent. Moreover, the example shows that a positive association between inequality (as measured, for instance, by the Gini index) and efficiency is not only a local phenomenon but may extend over a wide inequality-range. Hence, also with decreasing returns and significant borrowing constraints, the theory offers no clear prediction whether the Gini index should enter a growth regression with a positive or negative sign.

While the relationship between overall inequality and efficiency under imperfect credit is ambiguous in general, we find, however, that a *specific type* of inequality is clearly bad for efficiency. More inequality at the expense of the poorest part of the population (i.e., higher inequality at the bottom end of the distribution) unambiguously reduces aggregate output. Intuitively, the argument that the poor gain much better access to credit in response to regressive transfers does no longer go through in this case. The negative direct effect of a lower wealth endowment on the poor's borrowing capacity dominates the interest rate effect. These results suggest that future empirical work on the transmission channels linking inequality to economic performance should use more specific measures of inequality. In particular, we conclude that the heterogeneous-returns argument should be evaluated by relating measures of *relative poverty* to subsequent economic growth.<sup>3</sup>

The set-up of the present model follows Bénabou (1996) in assuming a decreasing-return-to-scale technology and by introducing heterogeneity with respect to initial capital endowments. However, unlike in Bénabou's contribution, we assume an imperfect (rather than a completely closed) credit market. Bor-

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<sup>3</sup>To the best of our knowledge, there are two empirical contributions assessing the impact of inequality at the bottom end of the distribution on growth. Using a cross-section of U.S. Metropolitan Statistical Areas, Bhatta (2001) finds that the fraction of the population below the poverty line is negatively associated to future growth. Similarly, Voitchofsky (2005) shows in a panel of industrialized countries that 50/10 income percentile ratio inversely relates to growth.

rowing is limited because credit contracts are not well enforced. Specifically, the sanctions against default by borrowers are imperfect.

The paper is organized as follows. Section 2 presents the model and characterizes the aggregate equilibrium. In Section 3, we derive the two main results and illustrate that the relationship between inequality and output may be non-monotonic even in a simple example. Finally, Section 4 discusses the generality of our results and concludes.

## 2 The Basic Model

### 2.1 Assumptions

**Preferences, endowments, and technology.** We consider a closed and static economy that is populated by a continuum of individuals of measure 1. The individuals derive utility from consumption of a single output good; marginal utility is strictly positive. The agents are heterogeneous with respect to their initial capital endowment,  $\omega_i$ ,  $i \in [0, 1]$ . Initial capital is distributed according to the distribution function  $G(\omega)$ .

Each individual runs a single firm which uses capital to produce the homogeneous output good. The amount of capital invested by agent  $i$  is denoted by  $k_i$ . The technology, which is identical across firms, is given by  $y = f(k)$ , where  $f(0) = 0$ ,  $f'(k) > 0$ ,  $f''(k) < 0$ , and satisfies the Inada conditions. The price of the output good is normalized to unity.

**The credit market.** Individuals may borrow and lend capital on a competitive but imperfect credit market. The credit market is *competitive* in the sense that the individuals take the equilibrium interest rate,  $\rho$ , as given. It is *imperfect*, however, since the agents face borrowing constraints due to the possibility of default at low cost. Following Matsuyama (2000), we assume that agent  $i$  loses only a fraction  $\lambda \in (0, 1]$  of the firm revenue,  $f(k_i)$ , in the event of default on the repayment obligation which is given by the amount of credit

times  $\rho$ .<sup>4</sup> The parameter  $\lambda$  can be interpreted as the degree of legal protection of creditors. A low  $\lambda$  means poor creditor protection since a borrower may default on the loan without incurring a substantial cost, and vice versa.

We further assume that each borrower  $i$  defaults whenever it is in his interest to do so. Taking these incentives into account, a lender will give credit only up to  $\lambda f(k_i)/\rho$  so that the borrower just pays back; awarding a larger amount of credit would induce the latter to break the contract and hence leave the lender without any income out of this credit relationship. Note that default does not occur in equilibrium. Borrowing is limited because it is *possible* to default.

## 2.2 Investment Decision

Agent  $i$  chooses  $k_i$  to maximize income,  $f(k_i) - \rho(k_i - \omega_i)$ . Thereby, he is limited by the borrowing constraint

$$\rho(k_i - \omega_i) \leq \lambda f(k_i), \quad (1)$$

stating that the repayment obligation cannot exceed the cost of default. Note that for each endowment level  $\omega_i$  there exists a unique level of maximal investment  $\bar{k}(\omega_i)$ , implicitly defined by equation (1) when holding with equality. Since initial wealth is the only source of heterogeneity across individuals, we will drop the index for individuals in what follows. That is, we write  $\bar{k}(\omega)$  in place of  $\bar{k}(\omega_i)$  if convenient.

**Lemma 1** *Let  $\rho > 0$ . Then, the maximum firm size  $\bar{k}(\omega)$  is strictly increasing and strictly concave in the initial capital endowment,  $\omega$ .*

**Proof.** *Since the Inada conditions hold,  $f'(k)$  declines from infinity to zero. Thus, the equation  $\rho(k - \omega) = \lambda f(k)$  defines a unique  $\bar{k}(\omega)$  with  $\rho > \lambda f'(\bar{k}(\omega))$ . Implicit differentiation gives  $d\bar{k}/d\omega = \rho / (\rho - \lambda f'(\bar{k})) > 0$ , and  $d^2\bar{k}/d\omega^2 < 0$  follows from  $f'' < 0$ . ■*

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<sup>4</sup>We could also think of  $\lambda$  as the probability of catching a renegeing agent who is, if caught, punished as severely as possible.

The maximum firm size rises in  $\omega$  for two reasons. To see this, we write the derivative of  $\bar{k}$  with respect to initial capital as

$$\frac{d\bar{k}}{d\omega} = 1 + \frac{\lambda f'(\bar{k})}{\rho - \lambda f'(\bar{k})}. \quad (2)$$

The first term on the right-hand side simply captures that - for a given amount of credit - the feasible level of investment increases one-to-one in the entrepreneur's wealth endowment. The second term mirrors the higher borrowing capacity of richer investors. Intuitively, since punishment is a fraction of total output (which is produced from borrowed funds *and* own capital), richer individuals can offer a higher "collateral." However, as the technology exhibits decreasing returns, the positive impact of an additional endowment unit on the entrepreneur's borrowing capacity falls in  $\omega$ .

Consider now the individuals' decision problem. We refer to  $\tilde{k}$  as the investment level that equates the marginal product of capital and the interest rate:

$$f'(\tilde{k}) = \rho. \quad (3)$$

Obviously, an agent with endowment  $\omega \geq \tilde{k}$  invests  $\tilde{k}$  capital units in his own firm and lends the rest,  $\omega - \tilde{k}$ , on the credit market. Otherwise, if  $\omega < \tilde{k}$ , the agent borrows as much as he can in order to close the gap between  $\tilde{k}$  and  $\omega$ . Denote by  $\tilde{\omega}$  the level of  $\omega$  allowing to invest exactly  $\tilde{k}$  capital units and thus separating *credit-constrained* entrepreneurs from entrepreneurs being able to implement the unconstrained optimum.<sup>5</sup> Inserting equation (3) into the borrowing constraint (1) and rearranging terms yields

$$\tilde{\omega} = \begin{cases} \tilde{k} - \lambda f(\tilde{k})/f'(\tilde{k}) & \text{if } \lambda < \alpha(\tilde{k}) \\ 0 & \text{if } \lambda \geq \alpha(\tilde{k}) \end{cases}, \quad (4)$$

where  $\alpha(\tilde{k}) \equiv \tilde{k}f'(\tilde{k})/f(\tilde{k}) < 1$ . Equation (4) states that, given  $\rho$  and  $G(\omega)$ , the mass of credit-ratoned individuals decreases in the degree of creditor protection,

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<sup>5</sup>Here, an entrepreneur is said to be credit-constrained if and only if the amount he would optimally like to rise exceeds his credit limit.

$\lambda$ , and goes to zero as  $\lambda$  approaches  $\alpha(\bar{k})$ , the output elasticity with respect to capital.

The discussion so far suggests that, for a given interest rate, the optimal *incentive-compatible* firm size,  $k(\omega)$ , is given by

$$k(\omega) = \begin{cases} \bar{k}(\omega) & \text{if } \omega < \tilde{\omega} \\ \tilde{k} & \text{if } \omega \geq \tilde{\omega} \end{cases}. \quad (5)$$

According to Lemma 1,  $k(\omega)$  increases in  $\omega$  if  $\omega < \tilde{\omega}$  and stays constant thereafter.

### 2.3 Aggregate Equilibrium

In equilibrium, the interest rate has to equate aggregate (gross) capital supply,  $K^S$ , and aggregate (gross) capital demand.  $K^S$  is exogenously given and equals  $K \equiv \int_0^\infty \omega dG(\omega)$ . Aggregate capital demand,  $K^D \equiv \int_0^\infty k(\omega) dG(\omega)$ , is obtained by adding up the individual investments,  $k(\omega)$ . Using equation (5),  $K^D$  reads

$$\begin{aligned} K^D(\rho) &= \int_0^{\tilde{\omega}} \bar{k}(\omega) dG(\omega) + \int_{\tilde{\omega}}^\infty \tilde{k} dG(\omega) \\ &= \int_0^{\tilde{\omega}} \bar{k}(\omega) dG(\omega) + (1 - G(\tilde{\omega})) \tilde{k}. \end{aligned} \quad (6)$$

The proposition below establishes that the equilibrium borrowing rate,  $\rho$ , is uniquely determined.

**Proposition 1** *There exists a unique credit market equilibrium.*

**Proof.** Note first that  $\lim_{\rho \rightarrow 0} K^D = \infty$  because  $\lim_{\rho \rightarrow 0} \bar{k}(\omega) = \lim_{\rho \rightarrow 0} \tilde{k} = \infty$ . Note further that both  $\tilde{\omega}$  and  $\tilde{k}$  go to 0 as  $\rho$  approaches infinity. Hence,  $\lim_{\rho \rightarrow \infty} K^D = 0$ . To determine the slope of the  $K^D$ -schedule we have to calculate  $d\bar{k}(\omega)/d\rho$ . Implicit differentiation of the equation  $\rho(k - \omega) = \lambda f(k)$  gives  $d\bar{k}(\omega)/d\rho = -(\bar{k} - \omega) / (\rho - \lambda f'(\bar{k})) < 0$ . Combining this with  $d\tilde{k}/d\rho < 0$  (from equation 3) we have  $dK^D/d\rho < 0$ . Since the  $K^S$ -schedule is perfectly inelastic, we conclude that there must be a unique equilibrium interest rate. ■

In view of equation (6), it is obvious that the equilibrium interest rate depends on the distribution of initial capital endowments,  $G(\omega)$ .



### 3 Redistribution and Efficiency

To study the impact of inequality on efficiency we proceed in two steps. First, we discuss under what condition the first-best outcome is reached even with unequal endowments and limited borrowing. Second, assuming that this condition is violated, we ask whether more inequality unambiguously reduces output.

#### 3.1 The First-Best Output

Suppose for the moment that there is no heterogeneity in initial endowments, i.e., suppose that  $\omega_i = K$ . Then, we must have  $k_i = K$ , and the equilibrium interest rate adjusts to  $f'(K)$  so that it is indeed optimal to run firms of size  $K$ . Finally, the aggregate output,  $Y \equiv \int_0^\infty f(k(\omega)) dG(\omega)$ , is given by

$$Y = f(K).$$

Note that  $Y$  takes its *first-best* value because no agent is credit-constrained in equilibrium and the marginal productivity of capital is equalized across firms.

Perfect equality, however, is not a necessary condition for aggregate output to be at its maximum.  $Y$  may achieve the first-best level even with inequality and imperfect enforcement of credit contracts if either the degree of creditor protection is not "too low" or the distribution of initial endowments is not "too unequal." To see this, assume that there are no credit-rationed individuals so that  $k_i = \tilde{k} = K$  and hence  $\rho = f'(K)$ . This situation will be the equilibrium allocation if the poorest agent's wealth, denote it by  $\underline{\omega} \geq 0$ , is not lower than  $\tilde{\omega}$ . Formally, from equation (4), we have  $Y = f(K)$  if the condition

$$\left(1 - \frac{\lambda}{\alpha(K)}\right) K \leq \underline{\omega} \tag{7}$$

holds. Condition (7) will be satisfied independently of the level of  $\underline{\omega}$  if  $\lambda \geq \alpha(K)$ , i.e., in case of relatively strong creditor protection; otherwise, if  $\lambda < \alpha(K)$ ,  $\underline{\omega}$  must be at least as high as  $\tilde{\omega} = (1 - \lambda/\alpha(K)) K < K$ . Put differently, the distribution of capital becomes relevant only if the imperfection on the credit market is sufficiently strong.

### 3.2 Redistribution and Aggregate Output

Suppose now that condition (7) is violated. Specifically, assume that a positive mass of individuals own less than  $(1 - \lambda/\alpha(K))K$  capital units. Then, there must be credit-constrained individuals in equilibrium and, consequently, aggregate output is lower than its first-best level.

How does aggregate output react to more inequality in such a situation? Consider a redistributive program "taxing" a positive mass of poorer individuals and distributing the proceeds among a set of richer individuals. Assume further that the poorer (i.e., "taxed") individuals are credit-constrained while the richer (i.e., "subsidized") individuals may or may not be.

**Proposition 2** *Redistribution from the poor to the rich as defined above decreases the equilibrium interest rate,  $\rho$ .*

**Proof.** *From Lemma 1 and equation (5) we know that  $k(\omega)$  is strictly concave for  $\omega < \tilde{\omega}$ . Hence, for a given  $\rho$ , taxing credit-constrained agents and redistributing the proceeds towards richer entrepreneurs decreases capital demand, and the claim immediately follows. ■*

The intuition behind Proposition 2 can be seen by looking at equations (2) and (5). An additional unit of own wealth rises a beneficiary's maximum amount of investment only to a low extent while a poor individual's maximum investment decreases strongly ( $d^2\bar{k}/d\omega^2 < 0$ ). Moreover, given the borrowing rate, rich agents already investing  $\tilde{k}$  units do not invest more in response to an increase in own resources and a higher borrowing limit. As a result, the  $K^D$ -schedule shifts to the left and the borrowing rate has to fall in order to restore the equality of capital demand and capital supply.

The fact that the interest rate falls in response to regressive redistribution is the reason why an unambiguous prediction with respect to output is in general not possible. The only exception is when the poorest individuals are affected. To see these results, consider a regressive redistributive program involving a positive measure of the *poorest agents* in the economy. Specifically, assume that

these agents are *equally endowed* with capital and that they are all taxed by the same amount. Then, according to Proposition 2, the interest rate must fall, and since  $d\bar{k}(\omega)/d\rho < 0$  and  $d\tilde{k}/d\rho < 0$ , the individuals belonging to the remaining part of the population (i.e., the subsidized agents and those not directly affected) increase their amount of capital invested. Because aggregate gross capital supply is fixed, the taxed individuals invest less in the new equilibrium. Since each of the downsized firms had (and has) a higher marginal productivity of capital than each of the other firms, aggregate output must decrease.

For all other types of regressive redistributive programs, however, we may not reach such a clear-cut prediction. If we redistribute away from a set of credit-constrained agents not belonging to the poorest part of the population, aggregate output may well increase. Due to the lower interest rate, the poorest agents (who are not involved into the transfer by assumption) have better access to credit and will run larger firms. Put differently, redistribution from individuals with higher marginal returns to individuals with lower marginal returns does not necessarily reduce output because the lower interest rate softens the borrowing constraint for other high-return firms.<sup>6</sup> The proposition summarizes these facts.

**Proposition 3** *Let a positive measure of individuals be endowed with  $\underline{\omega} > 0$ . Taxing each of these poorest agents by an equal amount and distributing the proceeds to richer agents unambiguously reduces aggregate output,  $Y$ . Other types of regressive redistributive programs may increase  $Y$ .*

**Proof.** *The first part of the proposition has been proven in the text. We will prove the second part by use of an example (see Subsection 3.3). ■*

For  $\lambda = 0$ , i.e., when the credit market is completely closed, the second part of Proposition 3 does no longer hold. In this limiting case, each entrepreneur

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<sup>6</sup>A related argument can be found in Banerjee and Newman (1998). In their dual-economy model, the borrowers in the traditional sector - facing comparatively low returns but only weak incentives to default - induces the lenders to charge high interest rates - which tightens the borrowing-constraints in the high-return (i.e., modern) sector.

simply invests his initial wealth endowment,  $\omega$ , and the size-distribution of firms coincides with the wealth distribution. Aggregate output is then given by  $Y = \int_0^\infty f(\omega) dG(\omega)$  which is, due to the strict concavity of  $f(\cdot)$  and Jensen's inequality, smaller than  $f(K)$ . It follows from the definition of second order stochastic dominance that each regressive transfer unambiguously leads to a lower aggregate output. Intuitively, the relationship between inequality and output is monotonic because the interest rate effect is absent when the credit market is inexistent.

### 3.3 A Simple Example

We demonstrate by means of a simple example that the relationship between inequality and output may be non-monotonic even if borrowing is limited and the technology is convex.

Let the production function be of the Cobb-Douglas type:  $f(k) = k^\alpha$ , with  $0 < \alpha < 1$ . Assume further that there are three types of individuals. A measure  $\beta_P$  of the population is "poor",  $\beta_M$  individuals belong to the "middle class", and the remaining  $1 - \beta_P - \beta_M$  agents are "rich". The individuals' wealth endowments are given by  $\theta_i K$ ,  $i \in \{P, M, R\}$ ,  $\theta_P < \theta_M < \theta_R$ , and  $\theta_R = (1 - \beta_P \theta_P - \beta_M \theta_M) / (1 - \beta_P - \beta_M)$  because  $\sum_{i=1}^3 \beta_i \theta_i = 1$ . Finally, we choose  $\theta_P$  and  $\theta_M$  sufficiently low so that the poor and the members of the middle class are credit-constrained in equilibrium.

According to Proposition 3, a reduction of  $\theta_P$  diminishes aggregate output since this redistributive program involves the set of the poorest individuals. By contrast, decreasing  $\theta_M$  and redistributing towards the rich does not take anything away from the poor. Hence, although inequality unambiguously rises, the impact of such a redistributive program on output is a priori unclear.

Panel *a* of Figure 1 shows aggregate output as a function of  $\theta_P$  ( $\theta_M$  is held constant at 0.9). As predicted by the theory, making the poorest even poorer decreases output. Panels *b* and *c* of Figure 1 show the impact of a change of  $\theta_M$  ( $\theta_P$  is held constant at 0.2) in a society with a broad middle

class ( $\beta_P = 0.3$  and  $\beta_M = 0.5$ ) and in a "polarized" society ( $\beta_P = 0.65$  and  $\beta_M = 0.3$ ), respectively. We see that more inequality may increase output in both economies. The equality-output relationship is positive at low levels of  $\theta_M$  but it becomes negative as  $\theta_M$  increases. Note that for values of  $\theta_M$  higher than 0.95 (Panel *b*) and 1.47 (Panel *c*) output is independent of  $\theta_M$  because the members of the middle class are no longer credit-constrained.

*Figure 1 here*

Although both Panel *b* and *c* suggest a non-monotonic relationship between inequality and output, the two figures convey different messages with respect to the effect of large changes in inequality. In the polarized economy (Panel *c*), output is higher when the middle-class individuals invest the same amount as the poor do (i.e., if  $\theta_M = \theta_P = 0.2$ ) as compared to the case where they invest the same as the rich (i.e., if  $\theta_M \geq 1.47$ ). Equivalently, Panel *c* shows that in a two-group economy (with only poor and rich agents) efficiency would improve as the fraction of the poor population increases from 0.65 to 0.95.<sup>7</sup> In Panel *b*, by contrast, output is higher with an unconstrained middle class (i.e., if  $\theta_M \geq 0.95$ ). Put differently, in a two-group economy, output would fall as the fraction of the poor increases from 0.3 to 0.8. Hence, if an already polarized economy (Panel *c*) becomes even more polarized, output tends to increase while the reverse is true when a relatively equal society becomes more uneven (Panel *b*). To get an intuition for this result, let us consider the much simpler case of a two-group economy in more detail.

*Figure 2 here*

Denote the size of the single poor group by  $\beta_P$ . Again, an increase in  $\beta_P$  does not affect the wealth endowment of a poor agent. A higher  $\beta_P$  (which

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<sup>7</sup>Note that with  $\theta_M > 1.47$  our three-group economy in Panel *c* generates the same output as a two-group economy with  $\beta_P (= 0.65)$  poor individuals and  $1 - \beta_P$  rich individuals since the members of the middle class and the rich invest the same amount. Similarly, with  $\theta_M = 0.2$  the output in the three-group economy is on the same level as in a two-group economy with  $\beta_P + \beta_M (= 0.65 + 0.3)$  poor individuals.

increases inequality in the Lorenz sense) means that some of the rich agents get even richer and that some of them lose and end up at a wealth level similar to that of a poor agent. Figure 2 plots output against  $\beta_P$ . As discussed above, output shrinks as, e.g.,  $\beta_P$  rises from 0.3 to 0.8 (Panel *b* of Figure 1) but it rises as  $\beta_P$  increases from 0.65 to 0.95 (Panel *c*).

Why does efficiency improve as  $\beta_P$  tends towards unity and the society becomes very unequal? Notice that in order to satisfy the equilibrium condition on the credit market,

$$\beta_P \bar{k}(\theta_P K; \rho) + (1 - \beta_P) (\alpha/\rho)^{1/(1-\alpha)} = K,$$

the interest rate must remain strictly positive. In particular,  $\rho$  cannot be lower than  $\lambda K^{\alpha-1}/(1 - \theta_P)$  since  $\bar{k}(\theta_P K; \lambda K^{\alpha-1}/(1 - \theta_P)) = K$ .<sup>8</sup> But this implies that the firm size of the rich,  $\tilde{k} = (\alpha/\rho)^{1/(1-\alpha)}$ , is finite. Consequently, the firm size of the poor,  $\bar{k}(\theta_P K; \rho)$ , must approach  $K$  as  $\beta_P$  tends towards unity. Put differently, the borrowing rate has to fall to a level that allows the poor to invest exactly the first-best amount which means that the social optimum is reached in the limit.

## 4 Discussion and Conclusions

Many empirical studies on inequality and growth refer to credit market imperfections as a key channel through which an uneven distribution negatively affects economic performance. The argument is that, at least with convex technologies, credit constraints prevent less affluent individuals from investing the efficient amount. The inefficiencies are generally considered to become more pronounced as inequality - usually measured by a single summary statistic - goes up. The present paper, though, suggests that the theoretical support for

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<sup>8</sup>For a more general production function this result holds when the marginal product of capital is sufficiently decreasing as  $k$  goes to infinity. In particular, Inada conditions are sufficient but not necessary. To see this, note that for the poor to invest  $K$ , the interest rate must equal  $\rho = \frac{\lambda}{1-\theta_P} \frac{f(K)}{K}$  which is strictly positive.

this view is rather weak. We show that even with imperfect credit markets and convex technologies there is no unambiguous relationship between inequality and economic performance. Rising inequality by redistributing from the middle class may actually boost aggregate output because the associated decline in the interest rate softens the borrowing constraint of the poor. We find, however, that the relationship between relative poverty and efficiency is more clear-cut. Redistributing away from the poorest individuals is clearly bad for output and, in a dynamic perspective, for economic growth.

To judge the generality of the present analysis, we discuss the two key conditions for our results to hold. The first important feature of our model is the *shape of the investment function*,  $\bar{k}(\omega; \rho)$ . The amount of investment must be strictly concave in wealth and, of course, decreasing in the borrowing rate. These attributes ensure that the interest rate falls in response to regressive transfers (provided that capital supply is not perfectly elastic). In the present contribution, the function's properties are due to the combination of a convex technology and limited sanctions in case of default. Note, however, that a wider range of micro-foundations of limited borrowing leads to such properties. Consider, for instance, the case of non-enforceable effort supply. Also here higher initial wealth allows for larger investments because the incentives to supply effort are stronger; but the impact of additional wealth is decreasing because the cost of effort is convex or marginal utility from consumption is falling.<sup>9</sup> In such a framework, regressive transfers from the middle class would also reduce the interest rate and hence give the poor stronger incentives to supply effort. Again, this interest rate effect may be stronger than the negative direct effect of more inequality in the middle of the distribution. The model's second important feature is the *shape of the capital supply schedule*,  $K^S$ . For the interest rate to fall in response to lower capital demand, the  $K^S$ -curve must have a positive slope. Essentially, this means that the borrowing rate must not be fixed by world market conditions.

Two main conclusions can be drawn from our analysis. First, provided

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<sup>9</sup>Such a continuous-effort model is presented in Piketty (1992), for instance.

that the model's two key features are relevant, redistributive policies aimed at dampening the adverse effects of credit market imperfections should involve the poorest individuals. Redistributing from the rich in favor of the middle class (and neglecting those in the bottom end of the distribution) is less effective or may even cause larger inefficiencies. Our numerical example highlights that - especially in polarized economies - promoting the middle class may have a significant negative impact on the investment opportunities of the poorest part of society. Second, the present analysis has implications for future empirical research on the inequality-growth nexus. Our theory suggests that the heterogeneous-returns argument is actually better suited to explain a negative relationship between *relative poverty* and the growth rate rather than a relationship between inequality in the middle (or at the top end) of the distribution and economic performance. Hence, future empirical work interested in the impact of credit market imperfections and inequality should rely on specific measures of relative poverty and not on measures of "overall" inequality such as the Gini index.



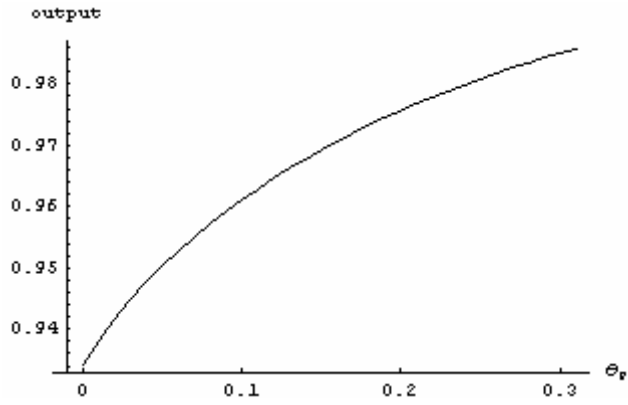
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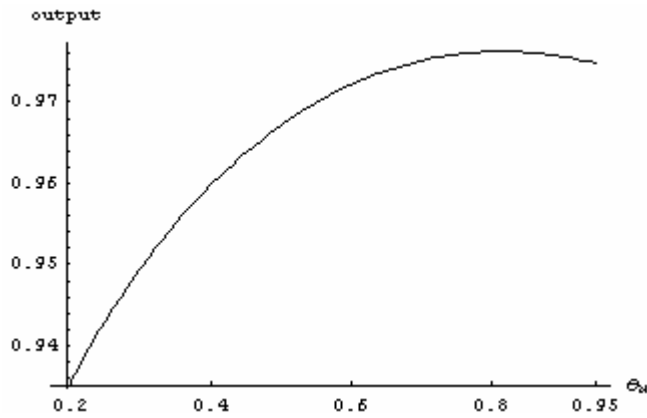
**Figure 1 – A three group society**

(Default values:  $K = 1$ ,  $\alpha = 0.4$ ,  $\lambda = 0.1$ ,  $\beta_P = 0.3$ ,  $\beta_M = 0.5$ ,  $\theta_P = 0.2$ ,  $\theta_M = 0.9$ )

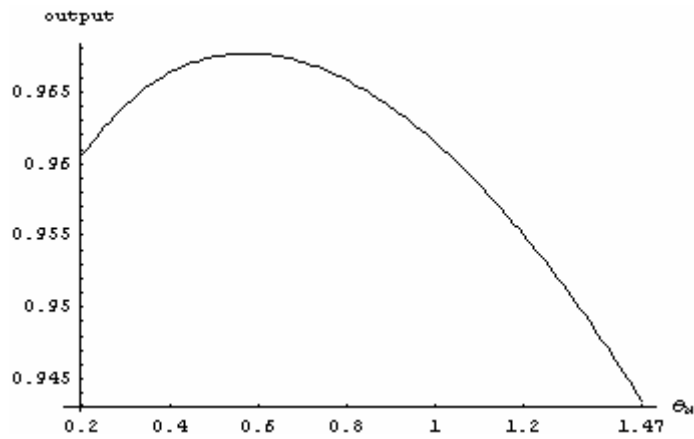
Panel a  
Redistribution from the rich to the poor



Panel b  
Redistribution from the rich to the middle class



Panel c  
Redistribution from the rich to the middle class (polarized society with  $\beta_P = 0.65$ ,  $\beta_M = 0.3$ )



**Figure 2 – A two group society**

(Default values:  $K = 1$ ,  $\alpha = 0.4$ ,  $\lambda = 0.1$ ,  $\beta = 0.7$ ,  $\theta = 0.2$ )

