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INEQUALITY, CREDIT MARKET IMPERFECTION, SEGMENTATION AND ECONOMIC GROWTH

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Inequality, Credit Market Imperfection, Segmentation, and Economic Growth

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Abstract

This paper investigates how initial inequality can causally a¤ect economic growth when moral hazard problems exist in credit markets. Two regimes of the credit markets aiming at overcoming the moral hazard problems are analyzed. The formal one such as bank relies on intermediary between borrowers and lenders by asking for collateral. The informal one relies on direct yet costly monitoring by the lenders themselves. However, from the social point of view both of them are unfavorable to certain segments of the agents in this heterogenous economy in terms of whether the individual potential productivity could be fully realized. Consequently, the permission of the coexistence of these two regimes could be growth enhancing. The dynamic rise and fall of the formal and informal regimes are implied along the growth process of per capita income. In the empirical part, the negative relationship between initial inequality and long run growth is discovered, using cross-province data in rural China rather than more often used cross-country data sets in literature. Interestingly, the policy dummy variable telling the permission or forbidding of the informal regime presents a positive sign. Both of these two results support our theoretical model empirically. Finally, we argue that this channel to bridge inequality and economic growth is more rural speci…c.

Keywords: inequality, formal and informal credit markets, moral hazard, economic growth

JEL classi…cation: E44, O16, O17

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1 Introduction

The Kuznets hypothesis tells us about dynamic changes of income distribution along the industrialization process. Basically, the Kuznets curve answers the question how development can in‡uence distribution. Other related literature examines this direction of causality as well. However, this is only one side of the coin. The recent concerns start increasingly to look at the reverse direction of the causality, trying to answer how distribution can a¤ect development and growth.

In this line of literature, there is already a traditional opinion that inequality is good for growth[1]. But at the same time, especially in the recent time, there has been a large increase in reconsiderations on this relationship challenging the conventional wisdom. From the theoretical aspect, many models construct the negative relationship between inequality and growth in the background of democratic and developed societies. From the empirical aspect, more and more evidences have been discovered, showing this negative relationship as well mostly by using the cross country data sets. In this paper, we are mainly motivated to add to these new reconsiderations both from the empirical side and from the theoretical side. Instead, not only is our theoretical model more suitable to be served as a rural model for developing countries and the political system does not play a role in this model, but also our empirical working data are from a cross section data set within one particular country.

According to neo-classical theory, the perfect capital or credit market is important in growth-enhancing. However, in many developing countries, especially in rural areas in developing countries, it is likely to observe imperfect credit markets. How important are these for growth?

> "The plot questionnaire does ask whether a given household would be willing to borrow more(presumably at prevailing interest rates) to …nance labor, fertilizer, or herbicide; that is, would pro…ts be increased? Here eight out of twelve farmers in Yang Pieng say yes, they are "credit constrained"; three say that they fear debt; two say that they are not brave enough to take the risk; two cite that no place to borrow or lack of money;..."(Townsend ,1995).
>
> "In rural credit market, high default rates have prevented the institutions from being self-…nancing: recurrent and often large injections of government funds have been required. And despite these subsidies, many of these credit programs have had little success in reaching farmers without collateral or with below-average income." (Ho¤ and Stigltz, 1990).

[1] There are several main arguments underlying this idea. One is the incentive consideration: if the actions undertaken by agents are unobservable, the equal distribution will obviously discourage them from making any e¤ort. Other considerations such as investment indivisibility and the trick-down theory strengthen this argument.

These quotations express implicitly that the insu¢ciency of the rural credit market has di¤erent impacts on individuals with di¤erent levels of income. It seems that if the dispersion of income distribution across individuals increase, this impacts could be ampli…ed. Motivated by the frequent observations such as the under-development of the rural credit market and increasing inequality in some developing countries, we try to answer in this paper how inequality can have negative e¤ects on growth if the credit markets are imperfect.

One particular consequence (we believe) of the rural credit market imperfection is the prevalence of the so called informal credit markets in rural developing countries. It is interesting to have noticed that most policy makers are simply against this kind way of rural …nancing and manage to take all kinds of measures to eradicate and forbid them. But reality shows that it is really not easy to e¤ectively enforce these policy measures. For example, in Zhejiang province of China, the rural informal credit market will emerge again sooner after the policy makers …nish their last …ght with it and start to overlook it. Motivated by this puzzling fact, in this paper we try to uncover this puzzle and evaluate the existing policy toward the informal credit markets in rural developing areas.

In the theoretical part of this paper, as mentioned above, our framework features imperfect credit markets and credit markets segmentation as the reason to explain the negative relationship between initial inequality and growth. The key argument is as follows. The agents di¤er in term of initial income. They have access to the credit markets to borrow or lend in order to undertake the optimal investment level, but the credit markets are imperfect in the form of moral hazard. There are potentially several di¤erent kinds of intermediaries' technologies to overcome this imperfection. One is from banks, this kind of intermediary o¢cially exists and uses monitoring technologies within the framework of the law or o¢cial documents. If we can call this intermediary as formal one and think it more or less exogenously given, the second kind of intermediary is more informal and emerges endogenously, i.e. if only formal credit market exists, there must be some agents distinguished by the initial income having incentives to promote the formation of the informal credit markets. It is not surprising that these informal markets have certain features to satisfy the demand of these deviators. The e¤ect of the initial income distribution on the segmentation of the credit markets is clear. Then under other assumptions, the income distributions will have clear e¤ect on growth. One of the assumptions is the diminishing returns to investment. Others will rely on the parameters for this economy.

In the empirical part of this paper, we use cross-province data in one country (rural data in China) instead of mostly often used cross-country data to check the relationship between initial inequality and growth. The advantage of one-country -cross-region data analysis is that it avoids the institutional and geographical disturbances that are inherently unavoidable when conducting cross-country data regressions. The robust negative relationship is still pinned down. So this particular one country case study adds to the existing empirical evidence because of this advan-

tage. Moreover, the policy dummy variable telling the permission or forbidding of the informal regime presents a positive sign.

Two important things are mentioned at the beginning. One is that we believe this particular model is more rural speci…c because many of the features in this model are derived from the stylized facts in rural areas. This rural speci…c model will just match the empirical …ndings also from rural areas in this paper. The other one is a little bit departure from the current debate on this relationship. Many of the models that aim at proving the negative relationship between inequality and growth are based on the relatively larger inequality. Instead, the aim of this model is to show that within the context of a particular theoretical framework inequality always has a negative e¤ect on growth, no matter the degree of inequality is large or small.

This paper is organized as follows. In section 2, we …rstly make a short literature review focusing on recent modelling reconsiderations. Then we address our particular model both for the static equilibrium and for the dynamic extensions. We also argue why our model is more rural speci…c. Moreover we emphasis the second feature of this model without further elaboration: in this model inequality always has a negative e¤ect on growth no matter the degree of inequality is large or small. In section 3, the empirical evidences are presented, drawing cross section data from rural China. In Section 4 we shows there are some issues more on the agenda and draws some conclusions.

2 The Model

2.1 Theoretical Literature Review

Before presenting our model, we will survey the currently existing theoretical literature focusing on the negative relationship between these two critical macroeconomic variables. We roughly divide them according to the following perspectives, respectively.

Political economy approach Basically, this approach adds to a political twist to the economic rationale of the …rst best. This approach is associated with work by Persson and Tabellini (1994) and Benabou (1996), as well as others. The main idea is that by lowering the income of the median voter or middle class relative to the national average, greater inequality increases the pressure for redistribution. This, in turn, discourages investment. In the political-economic equilibrium (Persson and Tabellini), if the median voter coincides with the average investor, he prefers to a non-redistributive policy, whereas he prefers to a tax (a subsidy) on investment if he is poorer (richer) than the average. Then distortions happen.

Neo-classical approach This approach embodies more economically based considerations. E¢ciency, as well as economic growth, is una¤ected by the initial distribution, if we assume convex preferences and production, and perfect information. In the absence of such nice assumptions, of course, e¢ciency may well be a¤ected. Firstly,

let us drop the assumption of the perfect information. Most frequently, one of the results from the imperfect information is the existence of the imperfect capital markets. At this moment,we simply check this mechanism by closing down the capital market. This is the extreme case studied by Aghion (1998). Now the poor people have no access to the capital market at all. Consequently they can't undertake the optimal investment level constrained by the initial wealth they have. This situation combined with the decreasing return to the marginal product will lead to a lower overall growth rate. This idea is just underlying what we will focus on in the next section. But there we will examine some more speci…c capital market imperfections besides this extreme case. Secondly, we can drop the assumption of convexity of the production function by asking for a …xed initial capital outlay in the "entrepreneurial" activity. This is one feature of Aghion and Bolton's paper (1997). This minimal investment requirement will make the poorer agents not be able to borrow, even if they want to borrow. What they can do now is to rely on the "backyard" activity because this activity requires no capital investment. As a result, the income distribution matters for the growth.

Social con‡ict approach This approach is based on the idea that the social con‡ict reduces the security of property rights, thereby discouraging accumulation. In particular, when the gap between rich and poor widens, the latter presumably have a greater temptation to engage in rent-seeking or predatory activities at the expense of the former. In Benabou (1996), he used a simple growth version of the prisoner's dilemma that captures the essence of this class of models. In his paper, the economy's maximum sustainable growth rate is shown to be negatively related to interest groups' rent-seeking abilities, as well as to income disparities between them. It may be pro…table for the rich to collectively transfer wealth to the poor through land reform, education subsidies, and trade protection. Moreover, we can think of this approach in the following way. A poor man has little to lose if caught thieving, reducing inequalities though redistribution helps to reduce envy and crime and again simulates investment and growth.

Demand side approach The above summarized approaches are built on the theories that more or less focus on the supply side, there are also some papers trying to relate the income distribution with economic growth to the demand factors. The …rst example of this approach (Falkinger and Zweimuller, 1997) is the hierarchical structure of the consumer demand due to the di¤erent level of income. Engel's law states that the di¤erent categories of consumption do not expand proportionally with income. First the relatively more basic needs are satis…ed. Then, as people get richer, demand turns to new goods. So the distribution of income determines the demand structure and the product diversity, therefore a¤ects economic growth. The assumption of a positive relationship between product diversity and productivity implies that the long -run growth rate of an economy should be positively correlated with an unequal distribution of incomes. In their paper, they contrast this standard assumption, according to which productivity is not determined by product diversity

but by other factors, related to the nutrition of the work force, the infrastructure, or the degree of urbanization. With these alternative assumptions their model leads to the conclusion that growth rates should be negatively correlated with inequality. The second example (Murphy, Shleifer and Vishny, 1989) is that the distribution of income is of importance to industrialization, since the middle class are the natural consumers of manufactured goods. Extreme concentration of wealth in the hand of very rich will manifest itself in the demand for handmade and imported luxuries rather than for domestic manufactures. So this unequal distribution will slow down the industrialization and the economic growth.

2.2 Key Ingredients of the Model

There are several stylized facts in rural areas of developing countries. The key ingredients and structure of our model are actually derived from these stylized facts. That is why we think this model is more rural speci…c. We …rstly present these stylized facts and then explain how we incorporate them one by one into our model.

- Agricultural activities are more likely to exhibit diminishing marginal returns;
- The rural production activities need less set-up cost compared with the urban ones;
- Asymmetric information in credit markets is prevailing in the spatially large countryside; banks have di¢culties to monitor the activities undertaken by borrowers, so collateral asked by banks are popular; at the same time, the informal credit market is often prevalent in rural areas[2] ;
- The rural household is a consumption unit, also a production unit.

In the pioneering investigation at Northern Thai villages by Townsend (1995), his fundamental basis for theoretical inference is decreasing returns to capital investment. He argues that agricultural production activities have the nature of diminishing marginal return to capital prominently. In our model, diminishing return to capital investment is the central assumption as well. Our basic story is as follows. Diminishing marginal returns to capital input means that at low investment levels marginal returns are high. In other words, from the social optimal point of view, the production gain from one additional unit of investment by the poor will su¢ciently compensate (maybe more than) the production loss from the one unit decrease of investment by the rich. However, if credit constraints prevent the agents from smoothing their

[2]Examples of informal and semi-informal institutions are:
(1). Peasent funding associations in China
(2). "pawnshops" in Phillippine
(3). Rotating savings and credit associations (Tontines in Senegal, Key in Korea)
(4). Bishi in India (See Bouman, 1989, for intensive investigations)

di¤erences of investment, inequality will have a negative e¤ect on growth. The pioneering idea on this topic started with Loury (1981). Recently are Benabou (1996) and Aghion (1998).

Furthermore, it is also easily observed and understood that rural activities have less set-up cost requirement compared with modern factories. Correspondingly, in our model convexity of the production set is another key ingredient. If instead, investment involves a minimum project size, generating a threshold level of wealth below what agents do not invest, the poor will be excluded from investment because of this banner. Then probably wealth concentration could be growth enhancing, which means inequality could have a positive e¤ect on growth. Anyhow, what we want to focus on here is the credit constraints instead of the minimum sunk constraints. Non-convexity is the assumption in Aghion and Bolton (1997) and Galor and Zeira (1993). As pointed by Benabou(1996), in these models the e¤ects of inequality on growth depend critically on the initial distribution. Furthermore, non-convexity is also originally seen as a key ingredient in models with explicit credit rationing. In this paper, there is no credit rationing analyzed.

As far as the rural credit markets are concerned, many pioneering works describe them in a similar way. Many of them argue (see Ho¤ and Stiglitz, 1990) that banks in rural areas have found it di¢cult to screen and monitor borrowers directly and thereby rely heavily on collateral.[3] Informal intermediaries are also popular in the rural areas and their interest rates charged on the borrowers are higher than the formal credit market interest rates. Bouman (1989) argues that the prevalence of the informal credit market is the self-response for the "penny" rural economy. Correspondingly, both asymmetric information in credit markets and the coexistence and segmentation of "formal"and "informal"credit markets are two ingredients in our model. There are many ways to model the imperfections of credit markets. In this paper, we will focus on the asymmetric information taking the form of moral hazard. This simpli…cation makes the co-existence of formal and informal credit markets easily tractable. There is no interest rate spread in the formal credit market. This spread is the key element to the job choices between the poor and the rich (Galor and Zeira, 1993). Moreover, we try to model the coexistence of the informal and formal credit markets. Given the characteristics of the informal and formal credit markets respectively, the emergence of the informal credit market is somewhat self-responsing in our model. The modelling researches on the informal credit market are scarce, many of which are more descriptive although very instructive, such as Bouman (1989).

Lastly, our model is household-production-activity based, which is in line with the last stylized fact in rural areas. But why the rural households don't use their capital together? The diminishing returns can basically give answers. Townsend (1995) provides evidences of the decreasing returns which are central on the resulting

[3] In Stiglitz's paper, land is the main form of collateral in Tailand, "the sphere of operation of commercial banks and cooperatives... has been almost exclusively in the villages where land titles have been issued".

ine¢ciency: both in developing and developed rural areas the household is usually the most e¢cient unit of production. Similarly, another question arises: why can't one household hire the labor of other households? There are many justi…cations for this simpli…cation. The problem of labor contract enforcement in rural areas, the particular di¢culties in monitoring between principal and agent in agricultural activities, the far distance between households are amongst them. Although their production and consumption are separated in terms of the possibility to pool labor and capital input together, there is still one connecting point across the individual households: the credit market, if they can have access to it.

It is easily understood that other models reviewed in 2.1. are less rural speci…c, or only more or less rural related. Perhaps the most rural related model is the demand side approach by Murphy et.al. (1989). They use their model at the country level, predicting that higher inequality will lure the rich to buy imported luxuries instead of domestic goods. We can borrow their ideas to the rural-urban study, which means that high inequality in rural areas will lure the rich in rural areas to rely more on imported goods from the urban areas[4]. This will lead to less growth in the rural areas.

2.3 Environment

2.3.1 In Period t Household Behavior Description

In this economy there is only one good, which can be for either consumption or investment. There is a continuum of non-altruistic overlapping generations households, indexed by $i \in [0;1]$: Each member i lives in two sub-periods in period t. When young, she consumes c_t^i[5] and has to invest the amount k_t^i to obtain consumption when old. Consumption and investment is …nanced by each household's initially exogenously given endowment w_t^i and external source b_t^i (b_t^i ¸ 0 means borrowing). When old, the production is realized and she consumes at the amount d_t^i and makes repayment on her loan in the case of $b_t^i > 0$, or receive the interest rate repayment in the case of $b_t^i < 0$: The household does not care about her children, so no bequests are left. The households have identical preferences and intertemporal utility at time t is given by

$$U_t^i = \ln c_t^i + \gamma \cdot \ln d_t^i \tag{1}$$

,where γ is the discount factor.

[4] They also can buy imported goods from the rest of world.

[5] Because this paper focus on the one-period relationship between distribution and growth, all of the economic behavior within this period will be analyzed, including consumption. This is unlike other papers, such as Galor and Zeira (1993), in which only in second sub-period will the individuals consume. Their simpli…cation is necessary to pin down the dynamic interaction between the distribution and growth in the long run.

2.3.2 Technology

The household production function has the identical form at time t

$$y_t^i = s(k_t^i)^{\alpha} y_{t-1}^{1-\alpha} \tag{2}$$

where s is constant and bigger than one, y_{t-1} is the average production level produced in the previous period and k_t^i is the household specific investment level. This production function assumes that each household incorporates a common factor, i.e. the average production level of the previous period, as one production factor . We can understand this assumption as a spill-over effect between two consecutive periods or think that the previous production fruit will become the common production conditions for the current period. We call this a "scale effect". As usual, s could be regarded as "technology effect", which is held constant over time. The reasons why we put these two effects into the household production function will be further elaborated in the dynamic section of this paper.

We introduce the individual's production options and uncertainty as follows. There is no aggregate risk. However, each household's technology is subject to moral hazard like in Holmstrom and Tirole (1997). An household can choose between two projects: the less risky project and the more risky one. However, the more risky project offers a private benefit μ to the borrower: this is the source of moral hazard because the borrower has incentives to engage in the more risky activity that is undesirable from the lender's point of view. We depart from Holmstrom and Tirole (1997) by assuming that the private benefit is received only if the project is successful[6].

Less risky project:

$$y_t^i = \begin{cases} s(k_t^i)^{\alpha} y_{t-1}^{1-\alpha} & \text{with probability } p \\ 0 & \text{with probability } 1-p \end{cases}$$

More risky project:

$$y_t^i = \begin{cases} s(k_t^i)^{\alpha} [y_{t-1}^{1-\alpha} + \mu] & \text{with probability } q \\ 0 & \text{with probability } 1-q \end{cases}$$

Because all investment projects are identical there is no adverse selection in this economy. Only incentive issues are necessary to be considered. $p > q$ is the necessary condition to establish moral hazards.

2.3.3 Inequality Index

We introduce inequality simply by assuming that the households differ only in their exogenously given initial endowments

[6] This assumption avoids considering incentive and risk diversification together in the case of risk aversion borrowers. Risk aversion borrower is the case in this paper anyhow.

$$w_t^i = \varepsilon_t^i \cdot y_{t-1} \tag{3}$$

ε_t^i is an identically and independently distributed random shock that measures i's access to the previous output. We normalize the mean of ε^i at one, such that

$$\int_0^1 w_t^i di = y_{t-1} \tag{4}$$

We consider the initial endowment as exogenously determined in the sense that y_{t-1} is predetermined and the realized distribution of ε_t^i is also given.

2.4 Two Extremely Simple Case Studies

Till the section for dynamic extensions, we will omit s in production function and subscript t, both of which are dynamically related. We denote the previous production outcome as y_{-1}: Under the set-up established above, the relationship between distribution and growth can be analyzed. Before doing so, we can get a first intuition of this relationship from the basic set-up only.

The aggregate production in the period is simply

$$y = \int_0^1 (k^i)^{\alpha} y_{-1}^{1-\alpha} di \tag{5}$$

Because $\alpha < 1$;the function $(k^i)^{\alpha}$ is concave. For a given aggregate capital stock, a greater dispersion of individuals' investment will reduce the aggregate output. Here $\alpha < 1$ is the key assumption underlying this first glance.

Assumption (1)

$$p y_{-1}^{1-\alpha} > q[y_{-1}^{1-\alpha} + \mu]:$$

The borrower prefers to the less risky project when self-finances. This means that we restrict our attention in this section on the periods thereafter $\bar{y}$; which stands for a sufficiently large economy, i.e.

$$y_t > \left(\frac{q\mu}{p - q}\right)^{\frac{1}{1-\alpha}} = \bar{y}:$$

In Figure 1 we present assumption (1) graphically. Since assumption (1) tells us that in the case of complete self finance the good project will generate more second period consumption than the bad one, correspondingly in this figure, on the vertical line the good project's consumption point lies above the point from the bad one. If the growth rate of this economy is positive, the initial penny economy will eventually reach the critical value $\bar{y}$ at a certain time.

2.4.1 The Perfect Capital Market Case

It is well known that the assumption of a perfect capital market is the key one in the Ramsey model. The perfect capital market means there are no transaction and information cost, so there is a single interest rate (no interest rate spread) and individuals' lending and borrowing face no constraint. Furthermore, this means that any kind of intermediary can monitor the projects undertaken by the borrowers perfectly and costlessly. This perfect monitor will force the borrowers to take on the less risky project. As far as the lenders, they will also take the less risky project by assumption (1). Now the perfect capital market will only result in the less risky project to be undertaken. The following has been proved by Ahgion et.al. (1998) (also see appendix for proof).

Proposition 1 If the capital market is perfect, all individuals end up investing the same amount of capital goods $k^i = k$ no matter what the initial distribution of previous production output across individuals.

This proposition basically means that $\frac{@k^i}{@w^i} = 0$ and $\frac{@b^i}{@w^i} < 0$. These results have straightforward meanings. Investment is the same across individuals. The poorer is, the more borrowing will be. The wealthier with $w^i > y_{i1}$ are lender and the wealthier is, the more lending will be. We know that in this ideal case, the perfect capital market plays a key role to equalize the investment between the poor and the rich. The growth rate in this case is

$$g = \ln \frac{y}{y_{i1}} = \ln \frac{\int_0^1 (k^i)^{®} y_{i1}^{1-®} di}{y_{i1}} = ® \ln \frac{½®}{1 + ½®} \tag{6}$$

which is independent on initial wealth distribution.

2.4.2 The Case of Closing Down the Capital Market

Closing down the capital market means that there is no borrowing and lending at all, even the agents have more or less incentives to do so. For example, this can happen if there is no way to enforce repayment. In this case, the agents have to self-…nance their investment, so all of them will prefer choosing the less risky project (by assumption (1)).

Proposition 2 If there is no capital market at all, equilibrium investment will remain unequal across individuals corresponding to the unequal initial wealth distribution. Not only will the distribution matters, but also the more unequal distribution is, the less growth rate will be.

The interaction between diminishing marginal capital production and closing down of the credit market makes the distribution matter for growth rate. we obtain

$$g = \ln \frac{y}{y_{i1}} = \frac{\int_0^1 (k^i)^{®} y_{i1}^{1-®} di}{y_{i1}} = ®[\ln \frac{½®}{1 + ½®} + \frac{1}{®} \ln \int_0^1 ("^i)^{®} di] \tag{7}$$

Recall equation 3, ε^i can be viewed as the inequality index. Because $\alpha < 1$; $(\varepsilon^i)^\alpha$ is a concave function. It is easy to understand that the more dispersed ε^i about 1; the less the growth rate will be. Without the capital market, inequality under-uses the poor's productivity, whereas over-using the rich's one, from the social optimal point of view. To show this, we will compare this case with the perfect capital market case because the perfect capital market case can be thought as the social optimal case[7]. From eq. 22 and 25 in appendix, the poorer is, the even lower investment compared with the perfect capital market case, whereas the richer undertakes the higher investment compared with the perfect capital market case. The change of these two cases are only neutral to the household possessing the mean initial endowment.

2.5 "Formal" and "Informal"Credit Markets

The above analyses are simple and extreme. In fact, the more common cases are the regimes of credit markets with imperfections, which are in between of these two extreme cases. We make an additional assumption (2) for studying two of this kind of regimes:

Assumption (2)

$$\alpha p(k^i)^{\alpha-1}y_1^{1-\alpha} - r < \alpha q[y_1^{1-\alpha} + \mu](k^i)^{\alpha-1} - \frac{qr}{p}$$

The borrower prefers to the more risky one whenever obtaining the loan from the bank. For the sake of notational simplicity, we denote $F_g = p(k^i)^\alpha y_1^{1-\alpha}$ and $F_b = q(k^i)^\alpha[y_1^{1-\alpha} + \mu]$ as the expected output undertaking the less risky project and more risky project respectively[8]. Then this assumption means

$$F_g' - r < F_b' - \frac{qr}{p}$$

In Figure 1 we also show assumption (2) graphically, with the good project's consumption line less steeper than the bad ones.

2.5.1 Regime 1: Separate "Formal" Credit Market With Moral Hazard

We will …rstly characterize one kind of technologies to overcome moral hazard by the so-called formal credit market. Banks are the main institutions in this formal market. By the two possible choices of projects and the assumptions (1) and (2), the borrowers always have incentives to undertake the more risky project whenever they are externally …nanced. But here we assume that banks can't monitor at all. What they can do is to ask for collateral from the borrowers to serve as an incentive

[7] So the center planner can redistribute w^i; such that $\varepsilon^i = 1$ for all i: The redistribution policy has the substituting function for the prefect capital market.

[8] The subscripts in F stand for "good" and "bad", from the bank's point of view.

mechanism because the risk of losing collateral enforces the selection of less risky project. The competitive banks will require $\frac{r}{p}$ from the borrowers, where r is the interest repayment rate to the lenders

Proposition 3 Under the framework described in this subsection, there exists a critical wealth level $\bar{w}$; such that if $w^i \geq \bar{w}$, individual i is a lender otherwise i is a borrower. In equilibrium, lenders choose the same investment level $\bar{k}$, while borrowers have different investment levels corresponding to their wealth levels.

The Problem now is:

$$\max_{b^i;k^i} \ln(w^i + b^i - k^i) + \tfrac{1}{2}\ln(F_g - p\frac{r}{p}b^i) \tag{8}$$

$$s.t. F_g - p\frac{r}{p}b^i \geq F_b - q\frac{r}{p}b^i \tag{9}$$

Equation 9 is the incentive compatibility constraint to prevent undertaking the more risky project. The complete proof of this proposition is in the appendix.

The following propositions describe the behavior of the rich and the poor separately in the equilibrium.

Proposition 4 The individuals with $w^i > \bar{w}$ are lenders. This set of i has $\frac{\partial b^i}{\partial w^i} < 0$. The individuals with $w^i < \bar{w}$ are borrowers. This set of i satisfies $\frac{\partial k^i}{\partial w^i} > 0$ and $\frac{\partial b^i}{\partial w^i} > 0$.

Proof: see appendix.

There is no surprise that the richer, the more lending will be ($b^i < 0$): For the individuals with $w^i < \bar{w}$; the less poorer makes more investment. This investment is partly financed by borrowing. One interesting result is that the less poorer has more loan borrowed. The reasonable explanation is that the less poorer has more wealth to serve as collateral in this asymmetric information credit market. Banks are willing to grant more loan to the relatively wealthier borrowers. At this moment, we arrive at an unfortunate situation: although the even poorer individuals have even higher marginal product of capital rate which makes sense to grant them more loans from the social optimal point of view, they have even lower ability to get access to the credit market. This situation will be most exacerbated for the poorest.

Lemma 5 The critical initial wealth level $\bar{w}$ is a function, $\bar{w} = w(y_{i1}; p; q; \mu)$: $\frac{\partial \bar{w}}{\partial y_{i1}} > 0$; $\frac{\partial \bar{w}}{\partial p} > 0$; $\frac{\partial \bar{w}}{\partial q} < 0$; $\frac{\partial \bar{w}}{\partial \mu} < 0$.

In this lemma, we state that this critical value is an increasing function of p; a decreasing function of q and μ. From Figure 2 the imperfection of credit market makes the critical value $\bar{w}$ move to the left of the mean wealth level y_{i1}; this situation comes

from the imperfection of the credit market. This shift means some of the borrowers playing in the perfect credit market case change their roles into lenders. The more of this imperfection (higher μ; lower di¤erence between p and q), the more such kind of former borrowers will prefer changing into lenders, i.e., the more leftward movement of this critical value. What's more, the relationship between this critical value and the initial total endowment is positive.

Figure 2 in the appendix compares this situation with the perfect market case, too. When the credit market is imperfect, the total loans granted will be lower than in the perfect credit market case, the interest rate will be higher. Consequently, the investment level of the lenders will be lower in the imperfect credit market case than in the perfect credit market case. So does the investment levels of the borrowers.

Proposition 6 Under the basic assumptions in this subsection, the more inequality of the initial wealth distribution, the less growth rate in this period will be.

As growth rate is

$$g = \ln \frac{y}{y_{i\,1}} = \ln \frac{\int_0^1 (k^i)^{\alpha} y_{i\,1}^{1-\alpha} di}{y_{i\,1}} = \ln \frac{p[\int_0^{i(w)} (k^i)^{\alpha} di + \int_{i(w)}^1 (\hat{k})^{\alpha} di]}{y_{i\,1}^{\alpha}} \qquad (10)$$

it is not easy to show the conclusion straightforward because in this society the equilibrium interest rate r (so the equilibrium $\hat{k}$) ,$i(w)$ and k^i(for the individuals, $i < i(w)$) will depend on the inequality index ε^i. But the net e¤ect is clear: the more dispersed wealth distribution, the more exacerbation of the accessibility to obtain the desirable loan for the poor and the less utilization of their productivity. Asking for collateral to prevent the borrower from moral hazard, the formal credit market presents some undesirable equilibrium, especially for the poorer individuals.

2.5.2 Regime 2: Separate "Informal" Credit Market with Moral Hazard

We will now characterize the second kind of technologies to overcome moral hazard by the so-called informal credit market. Obviously, classifying an institution as "informal" or "formal" is to some extent an arbitrary choice. The aim is simply to o¤set banks' disadvantages in operating on the certain segments of the population lacking collateral. To keep the model simple, we do not consider the risk diversi…cation role of the informal market (Banks may allow better risk diversi…cation) and the interaction between formal-informal sector (see Pinaki Bose 1998 for this consideration).

A special feature of the informal credit market is the intermediaries in this market relying on a monitoring technology that solves the moral hazard problem rather than on collateral. This is just opposite to the banks. However, this monitoring activity is costly. Denoting C(l) as this cost if the loan size is l. By spending C(l); the intermediary can drop the private bene…t μ down to zero. This means that if the borrowers get loan from the informal credit market, they will undertake the less risky project for sure. We assume $C'(l) > 0$; $C''(l) > 0$: For simplicity, it takes the form

$$C(l) = \frac{1}{4}\phi \frac{l^2}{2} \tag{11}$$

Denote $R; R^{0}$ as payment rate for the lenders and borrowers in the informal credit market. The relationship between these two rates is established under the assumption of competitive informal intermediaries, so zero pro…t condition generates

$$pR^{0}l = C(l) + pRl \tag{12}$$

Therefore the borrowing rate is

$$R^{0} = \frac{\frac{1}{4}}{2p}l + R \tag{13}$$

Some interesting results emerging due to the characterizing of the informal credit market above.

Proposition 7 All of the lenders with $l^{i} < 0$ will end up at the same investment level. The richer is, the more lending will be. The borrowers with $l^{i} > 0$ undertake di¤erent levels of investment. $\frac{@k^{i}}{@w^{i}} > 0; \frac{@l^{i}}{@w^{i}} < 0$:

Proof: see appendix.

One exceptional result in this proposition is that the borrower will borrow less if she or he is relatively rich. This is opposite to the result of proposition 4. The reason is based on the assumption for $C(l)$: Our assumption that monitoring cost is an increasing quadratic function of the size of the loan makes the relatively rich borrowers borrow less from the informal credit market. Figure 3 compares this situation with the perfect market case. It is reasonable to claim that the more inequality is, the more monitoring cost will be spent in this credit market and therefore the less growth rate will be.

2.5.3 Regime 3: Co-existence of "Formal"and "Informal" Credit Market

In this subsection, we want to answer the following questions:

- Within the framework of the so called formal credit market regime described in section 2.5.1, who have the more incentives or possibilities to deviate from this existing formal …nancial market structure?
- Why are the basic characteristics of the emerging informal credit market described in 2.5.2 suitable for these potential deviators?

In the proof of proposition 3, we get

$$F_g^{'} > r$$

i.e.

$$\alpha p(k^i)^{\alpha-1} y_{i1}^{1-\alpha} > r \tag{14}$$

for the individuals with $w^i < \hat{w}$. By proposition 4, in the case of $w^i < \hat{w}$, the even poorer individual undertakes even less investment. So her or his marginal product of capital will be even higher than the interest rate. If given one unit of the additional loan, she or he will earn even more than the loan payment. So in the economy described in 2.5.1, all the individuals with initial endowment $w^i < \hat{w}$ must be eager to obtain more loan if possible. What's more, the poorest individual's eagerness is the highest. So we expect that there will be some other kinds of credit markets endogenously generated to meet their thirst. The poor is not able to get enough loan from the existing formal credit market only because they don't have correspondingly enough collateral. This makes sense that the emerging informal credit market grants loan not based on the collateral. In 2.5.2, we model the informal credit market's way to overcome moral hazard problem based on this logic.

If we allow that in this economy there are two kinds of intermediations' technologies existing at the same time[9], then we will arrive at the co-existence regime. What is the impact of initial wealth distribution on this segmentation of the financial market? Does this segmentation matter for growth? These are the questions we want to answer in this section. It seems that for the relatively rich borrowers the formal credit market is more attractive, whereas the informal credit market is more attractive for the relatively poor borrowers. These preferences from the borrowing side make the segmentation of the credit market possible. When making the decision where to enter, the borrowers will compare their utility level from either of the two intermediaries. By reasoning, we expect that

$$\frac{\partial U_{formy_{i1}}}{\partial w^i} > \frac{\partial U_{informy_{i1}}}{\partial w^i} \tag{15}$$

for all borrowers. This is the necessary condition for existence of $\hat{w}$, which satisfies that the individual prefers to informal credit market if $w^i < \hat{w}$.

To realize it and complete our picture, we will analyze whether the lenders are willing to act in the informal credit market and who will be more possible to enter into it. Becoming a moneylender in the informal credit market is more risky compared to save money in the banks. So we think that

$$pR = r \tag{16}$$

[9] In fact, this is exactly the situations in many developing countries, especially in rural areas.

is the necessary condition for their choosing informal credit market, otherwise nobody will save money in the informal credit market. However, because we assume that the individuals in this economy are risk-averse, this condition is not sufficient for entering. The further consideration is that the individuals' utility in this economy exhibits a decreasing absolute risk-aversion property[10]. This means that the wealthier individuals accept risk more easily. So if

$$pR = r + \acute{A} \tag{17}$$

where Á is strictly larger than zero, there must be individuals with higher wealth $w^i > w$ who prefer to informal credit market. Á is endogenously determined in the state of equilibrium..

Now the two credit markets will coexist. Before we describe the state of equilibrium, we give the definition of static equilibrium as follows.

Definition 1 In this economy, all of the individuals and both kinds of intermediaries will follow their own behavior rules: all the individuals choose the preferred credit market and maximize their overall utility respectively. Both kinds of intermediaries solve the moral hazard problem using their own mechanism and make zero profit respectively.

In the formal credit market:
For borrowers: eq. 27, eq. 26 and their bounded constraint :$F_g - p\frac{r}{p}b^i = F_b - q\frac{r}{p}b^i$
For lenders: eq. 27 evaluated at $\theta_i = 0$, eq. 26 evaluated at $\theta_i = 0$
Formal credit market clearing condition: $\int_w^{\bar{w}} b^i di = 0$

In the informal credit market:
For the borrowers: eq. 39, plus another FOC
For the lenders: eq. 37, plus another FOC
In formal credit market clearing condition: $\int_{\underline{w}}^{w_1} b^i di + \int_w^{+1} b^i di = 0$
Informal intermediaries competitive condition: $R' = \frac{\frac{1}{4}}{2p}l + R$

Interest rate connection condition
$pR = r + \acute{A}$

All of these conditions will determine $k^i; b^i (l^i$ as a different notation for the informal credit market); θ^i(for some i); $r; R; R'; \acute{A}$.

These conditions will generate the following equilibrium state:

[10] If $U(¢) = \ln x$;the absolute risk aversion is defined as

$$a = -\frac{U''(x)}{U'(x)} = \frac{1}{x}$$

a is a decreasing function of x:

In the equilibrium, there are three critical values of wealth level, $\hat{w} < \tilde{w} < w$: These three values segment the individuals into four intervals.

(1). The relatively poorer among the borrowers get loan from the informal credit market. The poorer is, the more borrowing will be.

(2). The relatively richer among the borrowers get loan from the formal credit market. The richer is, the more loan available.

(3). The relatively poorer among the lenders grant credit into the formal credit market. They have the same investment level, which makes the marginal capital production equal to r:

(4). The relatively richer among the lenders grant credit into the informal credit market. They have the same investment level, which makes the marginal capital production equal to pR;i.e. r + Á:

Figure 4 shows how the individuals are segmented according to their income levels and how the four segments of individuals meet each other in formal and informal credit markets. Figure 5 roughly shows in the equilibrium state the borrowing(lending) levels and investment levels across all of the poor and rich individuals.

The impact of this credit market segmentation on the growth rate is complex. On the one hand, the informal credit market will waste some resources during the costly monitoring activities. But on the other hand, it will make better use of the otherwise underused productivity of the poorer borrowers that happened in regime 1. Which e¤ects dominate will depend on the parameters in this economy.

2.6 Dynamic Extensions

Our model is a life cycle model, we can say, in the sense that it includes overlapping generations of …nitely lived households (here two) who do not care about their descendants. This is di¤erent from the dynastic model, in which agents live in…nitely and care for their descendants as if they were the agents themselves. In the dynastic model, the linkage between two generations are the bequests. The optimization choice by household in time period t results in the bequests she or he leaves for the next generation in time period t + 1. These intertemporal optimizations by all of the households generate the evolution of the income distribution in this economy. In fact, this bequest linkage is the key element in the endogenous evolution of income distribution (for example, see Galor and Zeira, 1993). In our model, the sel…sh parent households cut o¤ this possible dynamic evolution of income distribution. In the following analyses, we make the following assumption.

Assumption (3):

At the beginning of each period, the distribution of realized ε_t^i is independent of time t.

Now the only linkage between two generations is the previous y_{t-1} as the overall initial endowment for the new generation in time period t: We can alternatively understand this assumption, borrowing the ending-up equilibrium state in the Markov transition process. Suppose there is a initial realized ε_0^i for all i, there is a constant Markov transition matrix. One row of this matrix describes the probabilities of the household i from a previous position to all possible new positions in the next period. The matrix is constructed for all the individual households. After repeatedly multiplied by this matrix, ε_0^i will eventually reach a equilibrium state, denoted by the vector ε_t^i , then there is no change of the realization of the income distribution index anymore.

Notice that even in the perfect credit market case, the constant growth rate is negative[11]. So from now on we add "technology effect" s into the production function. Whenever $s > (\frac{1+\delta}{\delta})^{\alpha}$ this inclusion will easily generate positive growth rate, which means that $\frac{\partial y_t}{\partial t} > 0$:

2.6.1 Risky and Miserable Era before

Throughout the above one period analyses, we are under the assumption (1),

$$py_{t-1}^{1-\alpha} > q[y_{t-1}^{1-\alpha} + \mu]:$$

The borrower prefers to the less risky project when merely self-financing. This means that we restrict our attention on the one period static analysis from the period when the total production increases sufficiently above the critical value $\hat{y}$

$$y_t > (\frac{q\mu}{p - q})^{\frac{1}{1-\alpha}} = \hat{y}:$$

What happens before? Here our first dynamic consideration is that the time periods or era before the assumption (1) could be satisfied. Our conclusion is that this era is a miserable one in the sense that it is full of risk. In this era, even when the household is self-financed completely, she or he will prefer the risky project[12], and let alone whenever she or he could obtain the external finance. In fact, when

$$y_t < \hat{y}:$$

assumption (2) will always hold, which means that in this era when she or he can get external finance, she or he will undertake the more risky project without doubt.

[11] Firstly, this is because we assume complete depreciation of capital input. Secondly, we can understand this by this way: if we assume there is no consumption at all, this will result in constant total production and there will be no growth(see eq. 6). In our model, part of the total production is consumed, which will lead to negative growth rate.

[12] This is because the total size of the economy is so small compared to the private benefit μ generated from undertaking the more risky project. Here the "scale effect" matters.

We can expect that in this era there will be no formal credit market because the situation of full of risk makes the incentive compatibility constraint always violated. We can see when $F_g < F_b$; the constraint 9 will always be violated. For the objective to o¤er incentives making the borrowers choose the less risky project, the collateral will become useless at all.

In this era, if we simply don't permit the informal credit market to be operating, this situation will be the case of closing down the credit market. Both no access to the credit market and the pursuit of the more risky project make this era miserable. Fortunately, because we assume that the growth rate in this economy is positive, this economy can eventually realize transition from the risky choice to the less risky one, and then satis…es the assumption (1). After the transition is realized, the formal credit market can emerge and the economy is under the "modern" way[13].

Alternatively, in this era it is really possible that the informal credit market will emerge. This is because this kind of intermediary can enforce the borrowers to undertake the less risky project (by dropping the private bene…t μ down to zero) although this monitoring activity is increasingly costly. Firstly, we can expect that this cost is so high and e¤ectively wastes the resources in this economy and leads to a long run zero growth rate. Then this economy will end up at this undesirable equilibrium, something similar to "poverty trap". The higher unequal initial endowment distribution will more likely reach this trap. In this equilibrium there is no formal banking at all. Under other conditions, for example, in such a situation that the monitoring cost is not so high, we also can lead this economy eventually to the emergency of the formal banking. Then we have the era of coexistence of formal and informal credit markets.

2.6.2 Dynamics of the Coexistence of "Formal? and "Informal" Credit markets Era After

Moreover, in the one period static analyses, we feature the static equilibrium as the coexistence of the formal and informal intermediaries. The dynamic share change of formal and informal credit markets along the growth of y (y has grown su¢ciently above $\hat{y}$; after which the coexistence of two credit markets becomes possible) is an interesting question to be addressed. Here we only give some intuitive analyses without mathematically accurate proofs.

In equation 11 we assume that monitoring cost is an increasing quadratic function w.r.s.t. the size of the loan. We also have the borrowing and lending interest rates equation 13. This way to describe the informal credit market is somewhat in line with the reality: the charged interest rates on borrowers in many informal rural credit markets are the higher, the bigger of the loan sizes they get, since more cost

[13] As an intuitive understanding of this era, we look the India case. In the initial stage of economic development (after independence), the share of the formal sector in total agricultural credit was very low. In 1950-51 it was only 7%.

need to be spent on monitoring for the bigger size of loan. As the economy grows in terms of total production y; the loan size will increase accordingly. Then the above feature of the informal credit market makes it even more costly. This means that the informal credit market could become less and less attractive compared with the formal counterpart along with the growth process. Consequently, the resulted informal credit market share in each period over time could be decreasing. The rate of the decreasing will depend on ¼ and the extent of inequality. High inequality will retard this decreasing trend since high inequality makes the informal credit market more needed. Of course, high ¼ will accelerate this decreasing trend since the informal credit market is more costly.

We summarize the two eras analyzed above into Figure 6. Again policy makers should have understood that the emergence of the informal credit market is somewhat inherent and the growth process itself can shrink the share of the informal credit market. In the stage of the natural coexistence of the formal and informal credit markets, the simply hostile policy against informal credit market could be growth reducing. Since the decreasing trend of the informal credit market will depend on the degree of inequality, redistributive policy could be more preferable when policy makers do want to decrease the informal credit market.

3 Empirical Evidence

A number of recent empirical results showing the negative relationship between initial inequality and economic growth were initiated from the puzzle raised by Lucas (1993)[14]. Then more evidences were presented by Clarke (1993), and Persson and Tabellini (1994). Benabou (1996) made an intensive and extensive review of these …ndings. However, these existing empirical studies use cross country data unavoidably to be involved into cultural, political and geographical disturbances, although some of these studies try to control these disturbances, such as using geographical dummy variables (Deininger and Spuire (1995)). Anyhow, if using the cross regional data within a single country,we can still pin down the similar result, then these kinds of disturbances can be avoided in some degree. This will be the main task of this section. The similar consideration we have as cross-country growth regressions is robustness of the results. In this exercise, the sensitivity analysis will use reasonable extreme bound analysis by Granger and Uhlig (1990). As a lost, we have to be more cautious of spatial autocorrelation in cross-region regression. In this exercise, the Lagrange multiplier error dependence test is used. In addition, we introduce the dummy

[14] Lucas pointed out a fact. In 1960, the Philippines and South Korea had about the same standard of living and a lot of similar initial conditions. Yet, From 1960 to 1988, GDP per capita in Philippines grew at about 1.8 percent per year, whereas GDP per capita grew at 6.2 percent per year in Korea. One proposed explanation on this huge di¤erence is the initial income distribution e¤ects. The high initial inequality measured by many ways in Philippines is sharply opposite to the situation in Korea.

variable telling the di¤erent policy attitudes towards the informal credit market to check whether we have empirical evidence that can …t the policy implications derived from the modelling part of this paper.

3.1 Data Description

Most of the data are from the China State Statistical Bureau. The analyzed period will start from 1988 and last till 1997. The cross-section data are drawn from 22 provinces, 3 municipalities (such as Beijing) and 4 autonomous regions (Tibet, although as an autonomous region, is excluded due to missing data). The following variables are introduced in this paper.

ANNUGROW: annual growth rate of rural household per capita net income from 1988 to 1997 in constant prices

GINI88: rural Gini coe¢cient in 1988 measured by Lorenz curve (by Zhu and Wen, 1994)

INVEST: average investment to GDP ratio from 1988 to 1997

LABGROW: annual growth rate of rural labor from 1978 to 1987 (the reason to use ten years before is explained later)

EDUCA88: average received years of education by rural labor force in 1988

LNFIXCAP: log value of productive …xed assets per capita in 1988

EMPLOY88: ratio of employee in TVE[15] (including part time employee) to the total labor force in 1988

LNPOPU88: log amount of the total rural population in 1988

DUMMY: dummy is equal to 1, if the policy towards the informal rural credit market is relatively friendly, or even supportive, or if there is no policy concerning about informal rural credit market at all, or although having, the enforcement ability is very poor; otherwise, dummy is equal to 0 if the policy attitude towards the informal credit market is hostile and there are visible and e¤ective adverse impacts on the rural informal credit markets(market) due to the policy.

GINI88 is our 'focus' variable. INVEST and LABGROW are to explain the role of di¤erent factor supplies, in line with the neoclassical approach. Here we use labor growth rate ten years before in order to avoid the endogenity problem. Since saving tendency is relatively exongenous and we measure INVEST by the ratio instead of total volume, less endogenity problem of INVEST will occur. EDUCA88 is initial human capital stock and LNFIXCAP is the initial physical capital stock instead. And both stocks tell the degree of relative maturity or backwardness in addition to test the hypothesis that a low starting point allows to catch up possibilities. EMPLOY88 has an approximate function to distinguish the strength of leading or lagging sectors. LNPOPU88 is the indicator of the initial size of the economy that is expected to relate to market size, degree of externalities and so on. DUMMY is another fucus

[15] TVE means Township and Village Enterprises.

variable. If its sign is positive, then our model could to some extent be supported empirically (see appendix for more detailed data statistic descriptions).

3.2 Basic Model

Before conducting the basic model, we will …rstly show a scatter-plot …gure of Gini88 and ANNUGROW to obtain …rst impression. From Figure 7 in the appendix, we can get an impression of the negative relationship between initial income distribution and growth in rural China across provinces.

Besides GINI88, we will use INVEST, LABGROW and EDUCA88 as the explanatory variables in the basic model. Table 1 is the result.

Table 1 Basic Model

Variables	Coe¢cients	Std. Error	t-value
Constant	0.005	0.028	0.186
GINI88	-0.149	0.063	-2.349
INVEST	0.094	0.044	2.136
LABGROW	0.567	0.248	2.286
EDUCA88	0.012	0.004	3.002

F=5.332 P-value=0.002 R^2=0.459

This result shows that all the included variables are signi…cant at 5% level (except constant). GINI88 has negative e¤ects on growth after controlling three variables. As we expect, education level and investment rate have signi…cant positive e¤ects on long-run growth, so does labor supply. Because of only 29 cases, the …rst concern is that one or two outlier may be driving the result. To show this is not the case, a partial scatter of the residuals from growth and the Gini coe¢cient regressed on the rest three variables is presented in Figure 8. This appears to con…rm that the result is not driven by outliers. Another concern is heteroskedasticity. This hypothesis is tested by using Breusch-Pagan test. The H_o hypotheses can't be rejected at 5% level.

3.3 Full Model

3.3.1 Reasonable Extreme Bounds Analysis

Following the Barro-type growth model, recent empirical literature on economic growth has identi…ed a substantial number of variables that are partially related to the rate of economic growth. But one problem faced by empirical growth models is that both the sign and signi…cance of the 'focus' variable are sensitive to the inclusion, or exclusion of other explanatory variables(Sala-i-Martin, 1997 and Levine, 1992). This problem was initially suggested by Leamer (1983). To be understandable, let us think of the following model:

$$y = \beta_I X_I + \beta_B X_B + \beta_p X_p + u \tag{18}$$

X_I is the variable of interest, so does β_I. X_B is the vector of the variables which are in some degree generally accepted by many econometric models. For example, they could be the initial per capita GDP or initial human capital resource. Noticeably, X_p is the subset of the variable pool. In this variable pool are the variables potentially related to the dependent variable or less accepted variables. u is $N(0; \sigma^2 -)$. After all of these three kinds of variables have been included, we arrive at the full model. Model 18 is the general form of the full model. There is no surprise that the focus coefficient β_I will vary with respect to the change of the combinations of X_p:

An initial answer to this question was given by Leamer himself. He took the extremes taken by the alternative specification as the "extreme bounds". The extent of these bounds are viewed as measuring the fragility of the estimate of β_I as alternative specifications are used. However, one criticism of the use of extreme bounds is that the actual extremes may come from models that most economists would find unreasonable in some way. For a particular example, extremes could be obtained from the specification having a lower R^2 value. This consideration lures us revisit the paper by Granger and Uhlig (1990). In their original work, they enable the research with a "continuum" of choice between classical econometrics and Leamer's extreme bound analyses. They restrict the range of reasonable specifications by restriction on R^2[16]

It is common known that the basic model will have the lowest R^2 value due to lest variables included, whereas the full model will generate the highest R^2. It may be thought that specifications that achieve R^2 values not too far from R^2_{max}would produce narrower extreme bounds for β_I. They express the R^2 value achieved in a certain specification of this full model by

$$R^2 = (1 - \pm)R^2_{max} + \pm R^2_{min} \tag{19}$$

Their restrictions on R^2 will now rely on $\pm$ that means that for small $\pm$ these may be considered as being "reasonable" specification because they are not far away from the best "full" model in terms of goodness-of-fit. The mentioned "continuum" feature of this approach is in the sense that we will return to the classical econometric principle by setting $\pm = 0$ and go to the extreme bounds by setting $\pm = 1$:

3.3.2 The Full Model Setup

In order to set up the full model and conduct sensitivity analysis, we carefully choose other 4 variables. All of them are relatively significant and have different explanatory angles. These four variables are as introduced before: LNFIXCAP, EMPLOY88, LNPOPU88 and DUMMY. Now we arrive at the full model. Table 2 is the results.

[16] Granger and Uhlig don't argue that R^2 is an ideal measure of the quality of the model, but they state that it is a possible relevant statistic and some exact results are achievable using it.

Table 2 Full Model

Variables	Coe¢cient	Std.Error	t-value
Constant	-0.221	0.077	2.870
GINI88	-0.173	0.076	2.276
INVEST	0.081	0.040	2.025
LABGROW	0.312	0.183	1.705
EDUCA88	0.007	0.003	2.290
LNFIXCAP	0.018	0.010	1.800
EMPLOY88	0.053	0.042	1.262
LNPOPU88	0.012	0.005	2.400
DUMMY	0.015	0.009	1.667

$F = 6.700$ Sig $= 0.001$ $R^2 = 0{:}802$

From these results, we know that the basic four variables still have the same sign and remain signi…cant at 10%. Although EMPLOY88 has small t values, it seems that the tolerance level of this small sampling is higher. So we still leave them in this full model. As the indicator of the initial capital stock per capita across regions, LNFIXCAP has a positive e¤ect on the long-run growth. This result shows that in the more matured areas measured by per capita …x assets will have higher growth. Instead, if we regard this indicator as an approximate measurement of initial per capita income, then we have divergence instead of convergence. Initial population size presents a signi…cant positive e¤ects (e¤ect)on growth. Noticeably, the policy dummy has positive sign. This means that in rural China for the period from 1988 till 1997 the informal credit market had some positive e¤ect on growth. In the provinces with hostile policy against the informal credit market the growth would be lower, holding other variables constant.

3.3.3 Spatial Autocorrelation

Before conducting the reasonable extreme bound analysis, we will check the validity of the assumptions underlying the full regression model. Three things are important, the normal distribution of residuals, homoskedasiticity and spatial autocorrelation. From the histogram of residuals from the full model, we can approximately think the residuals are normally distributed. Again we use Breusch-Pagan test to check the H_0 hypothesis of homoskedasticity and …nd that we can accept it. The third consideration is spatial autocorrelation which (that)is considered to lie at the core of the disciplines of regional science and geography.

Herewith we will use the very popular test, the Lagrange Multiplier Error Dependence, in this exercise. For simplicity, we will use contiguity or connectivity matrix as spatial weights matrix W. In this matrix, each observation is represented both as a row and as a column. In each row, the nonzero column elements correspond to contiguous regions. This simpli…cation only regards that the "contiguous border" is

important. Furthermore, we will sign the same weight to each region contiguous to a considered region. Because of these two simpli…cations, the sum of each row of W is 1 and the nonzero elements in each row are equal. As a presentation, the …rst row of this spatial weights matrix is for the capital Beijing, which looks like:

$$(0 \ \frac{1}{2} \ \frac{1}{2} \ 0 \ 0 \ ... \ ... \ 0)$$

Beijing has two contiguous provinces, Tianjing and Hebei, numbered as the second and third observation, respectively. And both of these two continguous provinces have been assigned the equal weights. The LM-ERR statistic is distributed as $\hat{A}^2$ with one degree of freedom. The statistic value for the full model is 2.879, which is smaller than the critical value at 5%. We will accept the H_0 that there is no spatial autocorrelation.

In summary, under the assumptions on the W matrix, the spatial autocorrelation across the 29 regions in rural China is so low that it can be neglected. One possible reason is the rural areas in each province are relatively independent. The restrict regulation of residence registration over farmers makes the rural labor ‡ow more di¢cult. In addition, the less development of the national capital markets makes the capital ‡ow across regions less e¢cient.

3.3.4 Sensitivity Analysis

This section employs the reasonable extreme bound analysis as the approach in sensitivity analysis. This approach gives the extreme bounds of the coe¢cient of interest subject to restricting R^2 to be in the top certain percentage of the range of all the possible R^2, for example 10%. As a result, this will produce even narrower extreme bounds for focus coe¢cient. In order to conduct it, the residual's covariance matrix $¾^2$ - is assumed to be known for the time being. Anyhow, the above results based on the validity of the assumptions of homoskedasiticity of no spatial autocorrelation make us approximate - = I. In addition, one might set $¾^2 = 1$ to simplify the calculation because the bounds do not depend on it. Table 3 is the result.

Table 3. Sensitivity Analysis on the Focus Coe¢cient of GINI88

	± = 1:0	± = 0:1	± = 0:4	± = 0:0
Upper	-0.024	-0.087	-0.124	-0.173
Lower	-0.313	-0.285	-0.203	-0.173

From this result, we know that the focus coe¢cient remains the same sign in the restricted R^2 (at the top 10% level and top 40% level) sensitivity analysis, as well as the conventional unrestricted extreme bound analysis. These results con…rm a robust and negative relationship between initial inequality and growth.

4 Conclusions and Discussions

The conventional wisdom on the relationship between income distribution and growth currently faces the challenges both from the theoretical aspect and from the empirical aspect. This paper aims at constructing an additional rural speci…c model and presenting additional country speci…c evidence to strengthen these challenges. Unlike other models,whose challenges are based on the larger enough inequality, this model always generates negative relationship between inequality and growth unless there is asymmetric information in credit markets, no matter inequality is large or small. As an unique feature, this model is more rural speci…c. In addition, this model roughly generates the interactions among the income distribution, credit market imperfection and segmentation, and economic growth. In fact, these interactions are complex in the sense that they are simultaneously related. In this model, we more like to keep the evolution of income distribution as given and focus on the static and some dynamic e¤ects of inequality on growth. In the one period static study, the so-called informal credit market is somewhat self responsive by the agents in this economy given the merely existence of the formal credit market. In the dynamic extensions, the evolution of these two kinds of credit markets are presented. Compared with those of other existing empirical literature the advantages of the cross-region data within one country reinforce the challenges from the empirical perspective.

Some future researches are put into agenda. From the theoretical perspective, several things need further study. An important shortcoming of this model is that we implicitly assume that each individual household can only enter one kind of credit markets, either formal or informal. This exclusively entering assumption seems more reasonable for the segment of the poorest households and the segment of the intermediately richer households. The former really have nothing to serve as collateral and the latter do not want to bear the high risk in the informal credit market.. But this exclusive entering assumption seems less reasonable for the other two types of households ($w < w^i < \bar{w}$ and $w^i > w$): Secondly, we assume that there is no interaction between these two credit markets, i.e. the informal credit market can't obtain loan from the formal credit market, or reversely. Thirdly, we need more tractable and accurate study on the dynamic evolution of the credit market structure along with the growth of per capita income under the given income distribution. If possible, the evolution of the income distribution can be endogenized.

From the empirical perspective, section 3 actually puts more weights on testing the general relationship between initial income distribution and growth than on o¤ering empirical support on this particular channel of connecting this relationship: the credit market imperfections and segmentations. Although we include the dummy variable into the regressions, seriously speaking, this is not su¢cient and only a starting line. So this kind of more detailed empirical work is needed. There are several proposals for future. Can we get the empirical positive relationship between the initial income distribution and the informal credit market share in the whole credit market? Can

we …nd the appropriate measurement of the degree of credit market imperfections and test whether the less severer of this problem, the less negative impacts will be by inequality on growth?

From the policy perspective, one of them is especially worthy noticing: what is the scienti…c positive evaluation of the informal credit market? In our paper, the informal credit market will become undesirable from the social e¢ciency point of view under certain parameters in this model, such as higher ¼; higher q; and lower μ. These either make the cost of the informal credit market become higher (absolutely undesirable) or make the incentive constraint loosed in the formal credit market (so make the informal one relatively undesirable). In fact, for other parameters, the informal one perhaps has a positive e¤ect. Moreover if the economy is so under-developed and very poor, i.e. in the so-called risky and miserable era, the informal credit market will be the only mean to smooth inequality and positively stimulate the total production. So the policy-makers must be careful when deciding their attitude to the informal credit market, especially when shaping rural credit policy. As we repeated in section 2, in order to be good for growth of the rural areas in developing countries, redistributive policy will be more preferable and can be put into the policy package with less doubt.

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6 Appendix

6.1 Proofs of the Model

Proof of Proposition 1

Individual i with initial endowment w^i will optimize k^i and b^ichosen in the …rst sub-period to maximize the overall utility

$$\ln(w^i + b^i ¡ k^i) + ½\ln(y^i ¡ rb^i) \tag{20}$$

We simply check the FOCs with respect to $k^i$and b^i;respectively

$$\frac{1}{w^i + b^i ¡ k^i} = \frac{½®\frac{y^i}{k^i}}{y^i ¡ rb^i}$$

$$\frac{1}{w^i + b^i ¡ k^i} = \frac{½r}{y^i ¡ rb^i}$$

Using the loan market clearing condition $\int_0^1 b^i di = 0$; the interest rate r; k (k^i ´ k); and b^i can be determined endogenously by these three equations

$$r = ® ¢ (\frac{1}{½®} + 1)^{1 ¡ ®} \tag{21}$$

which is the marginal product of capital in equilibrium.

$$k^i = k = \frac{½®}{1 + ½®} ¢ y_{¡1} \tag{22}$$

$$b^i = \frac{½}{1 + ½} ¢ (y_{¡1} ¡ w^i) \tag{23}$$

Proof of Proposition 2

Proof[17]:In this case, the problem is

$$\max_{k^i} \ln(w^i ¡ k^i) + ½\ln y^i \tag{24}$$

[17]Here we prove it explicitly and directly, rather than through using the tex rate as an indirect channel to bridge this relationship. This is the methods taken in Aghion et.al. (1998).

the FOC gives

$$\frac{1}{w^i - k^i} = \frac{\alpha}{k^i}$$

then

$$k^i = \frac{\alpha}{1+\alpha} w^i \tag{25}$$

This means that each separated individual has to optimize his investment subject to his initial wealth endowment and the wealthier is, the more investment will be undertaken. Simply here $b^i = 0$.

Proof of Proposition 3

Denote λ_i as the multiplier. the FOCs are

$$\frac{-1}{w^i + b^i - k^i} + \frac{\alpha}{2}\frac{F_g^0}{F_g - rb^i} + \lambda_i(F_g^0 - F_b^0) = 0 \tag{26}$$

$$\frac{1}{w^i + b^i - k^i} - \frac{\alpha}{2}\frac{r}{F_g - rb^i} + \lambda_i(-r + q\frac{r}{p}) = 0 \tag{27}$$

By assumption (2) if b^i 0(the lenders), the constraint 9 must be held with strictly inequality. So for these i, $\lambda_i = 0$:Otherwise by assumption (3), the constraint will bind and for these individuals $\lambda_i > 0$: In these two cases plus the condition of the credit market's clearing. We just have the same number of equations as the number of unknowns, $\lambda_i; k^i; b^i$and r:

When $b^i = 0$;by assumption (2) $\lambda_i = 0$;correspondingly. This individual's wealth level is $\hat{w}$:Easily we get his investment is

$$\hat{k} = \frac{\alpha}{1+\alpha}\hat{w} \tag{28}$$

All the individuals with $w^i > \hat{w}$ make the same investment choice as this individual. Referring to them,

$$F_g^0 = r \tag{29}$$

But the individuals with $w^i < \hat{w}$ satisfy

$$F_g^0 > r \tag{30}$$

because referring to them,

$$\frac{\alpha}{2}\frac{1}{F_g - rb^i}(F_g^0 - r) + \lambda_i[\alpha p(k^i)^{\alpha-1} y_{i1}^{1-\alpha} - r - \alpha q[y_{i1}^{1-\alpha} + \mu](k^i)^{\alpha-1} + \frac{qr}{p}] = 0 \tag{31}$$

By assumption (3) and $\lambda_i > 0$;we can get $F_g^0 > r$: All the poor facing their binded incentive constraints have different investment levels contingent on their wealth levels.

Proof of Proposition 4

For the individuals with $w^i > \bar{w}$, it is easy to get from the FOCs of this problem

$$b^i = \frac{P y_{-1}^{1-\alpha}(\bar{k})^{\alpha} - \gamma r(w^i - \bar{k})}{r(1+\gamma)} \tag{32}$$

For the individuals with $w^i < \bar{w}$;substitute the incentive constraint into the problem. Find the FOC for optimization of k^i;i.e.$\frac{@(:)}{@k^i} = 0$:Di¤erentiate this equation w.r.p.to k^i;then we obtain:

$$[(1-\frac{q}{p})r\frac{@w^i}{@k^i} + F_g^{'} - F_b^{'} - (1-\frac{q}{p})r]\cdot\gamma\cdot[F_b^{'} - \frac{q}{p}F_g^{'}] + [w^i(1-\frac{q}{p})r + F_g - F_b - k^i(1-\frac{q}{p})r]$$
$$\cdot\gamma\cdot[F_b^{''} - \frac{q}{p}F_g^{''}] + (F_g^{''} - F_b^{''})(F_b - \frac{q}{p}F_g) + (F_g^{'} - F_b^{'} - r(1-\frac{q}{p}))(F_b^{'} - \frac{q}{p}F_g^{'}) \text{ equal to } 0 \tag{33}$$

by assumption (2) and(3), we get the result $\frac{@k^i}{@w^i} > 0$:To show the second part of this proposition, we get from the binded constraint,

$$b^i = \frac{F_g - F_b}{r(1-\frac{q}{p})} \tag{34}$$

so

$$\frac{@b^i}{@w^i} = \frac{F_g^{'} - F_b^{'}}{r(1-\frac{q}{p})}\cdot\frac{@k^i}{@w^i} > 0: \tag{35}$$

Proof of Proposition 7:

For lenders, the problem is

$$\max \ln(w^i + l^i - k^i) + \gamma \ln(F_g - pRl) \tag{36}$$

The FOCs give

$$F_g^{'} = pR \tag{37}$$

So (1).

For borrowers, the problem is

$$\max \ln(w^i + l^i - k^i) + \gamma \ln(F_g - pR^{'}l) \tag{38}$$

There is no constraint for the borrower because of the complete monitoring technology in the informal credit market. The FOCs give

$$F_g^{'} = pR + \mu l^i \tag{39}$$

From this, express k^i as l^i and substitute it into FOCs. After some calculation, we get

$$\frac{@l^i}{@w^i} < 0 \tag{40}$$

So for k^i:

6.2 Data Description

Table 1 Data Description

Variables	Obs.	Minimum	Maximum	Mean	Std.Deviation
ANNUGROW	29	0.0106	0.0720	0.0484	0.0154
GINI88	29	0.2010	0.3250	0.2640	0.0362
INVEST	29	0.3025	0.4455	0.3872	0.0412
LABGROW	29	-0.0218	0.0287	0.0102	0.0129
EDUCA88	29	4.2632	8.2912	6.4795	0.9418
LNFIXCAP	29	5.7902	8.0942	6.8238	0.5711
EMPLOY88	29	0.0912	0.6300	0.2517	0.1349
LNPOPU88	29	5.6795	9.1203	7.6078	1.0261
DUMMY	29	0.0000	1.0000	0.3679	0.4234

6.3 Figures

Figure 1: Two Assumptions of the Model

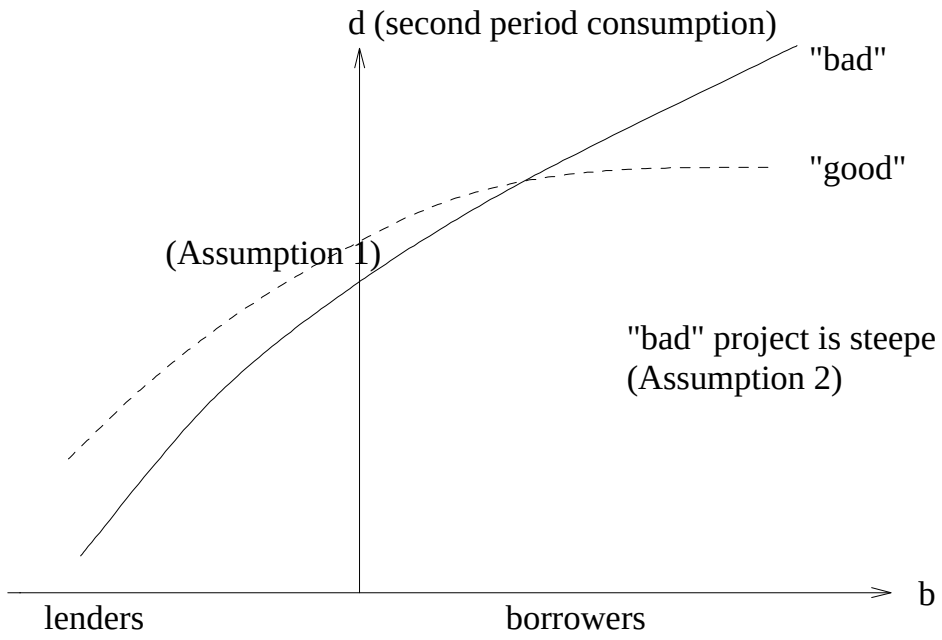
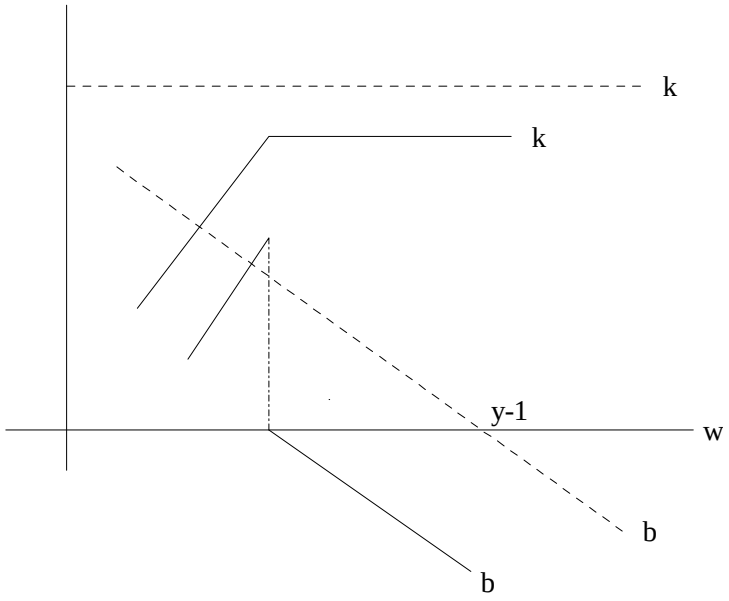
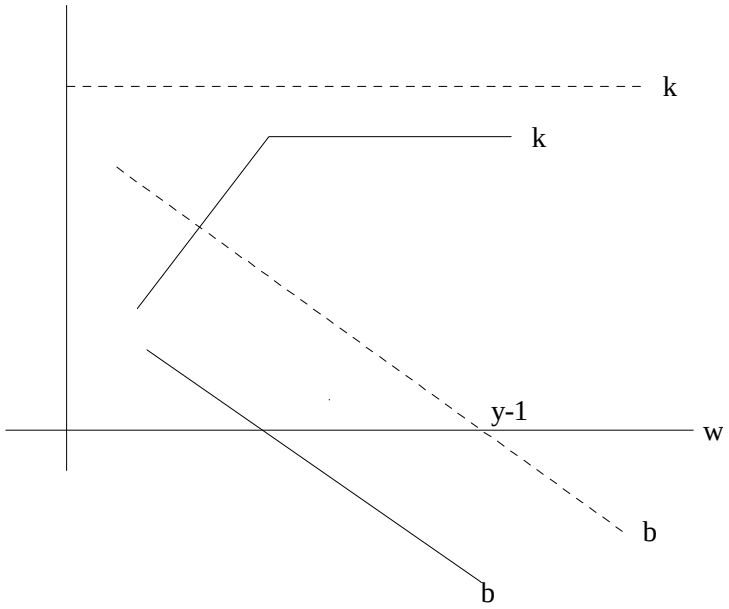


Figure 2: Comparisons of the Single Formal Credit Market Regime with the perfect Market Case



(The dashed lines are for the perfect market case)

Figure 3: Comparisons of the Single Informal Credit Market Regime with the Perfect Market Case



(The dashed lines are for the perfect market case)

Figure 4: Regime 3: Credit Markets Segmentation and Markets Participants

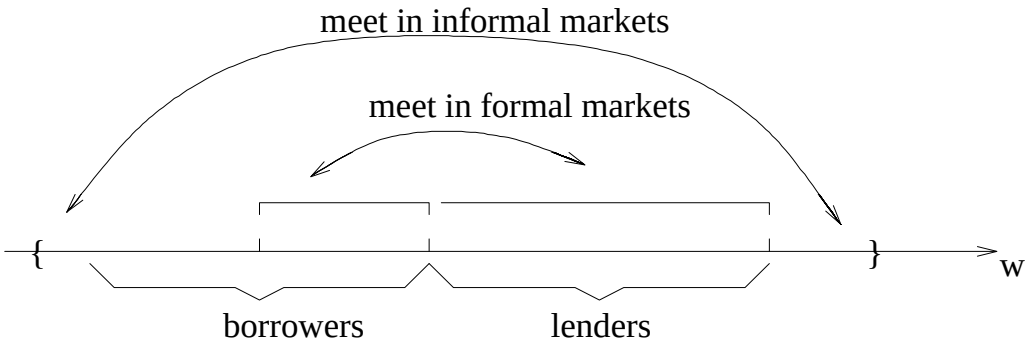


Figure 5: Investment and Borrowing Levels in Segmented Credit Markets

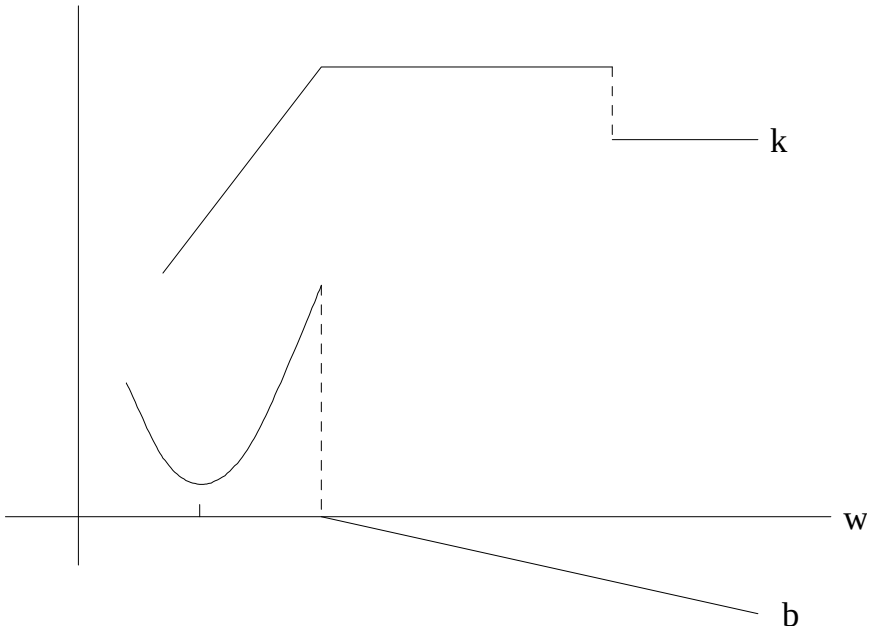


Figure 6: Dynamic Rise and Fall of Formal and Informal Credit Markets

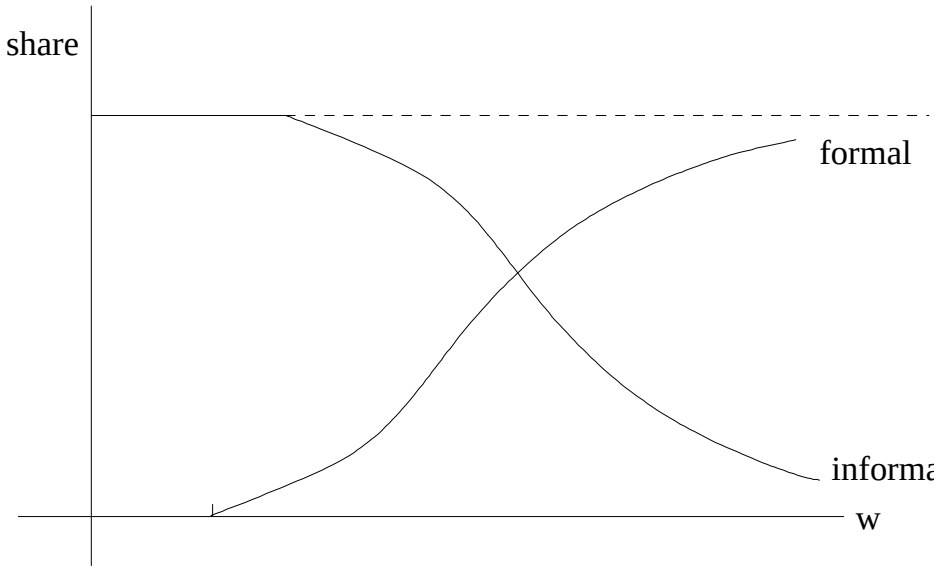


Figure 7: Scatter Plot of Initial Inequality and Growth Rate Across Regions

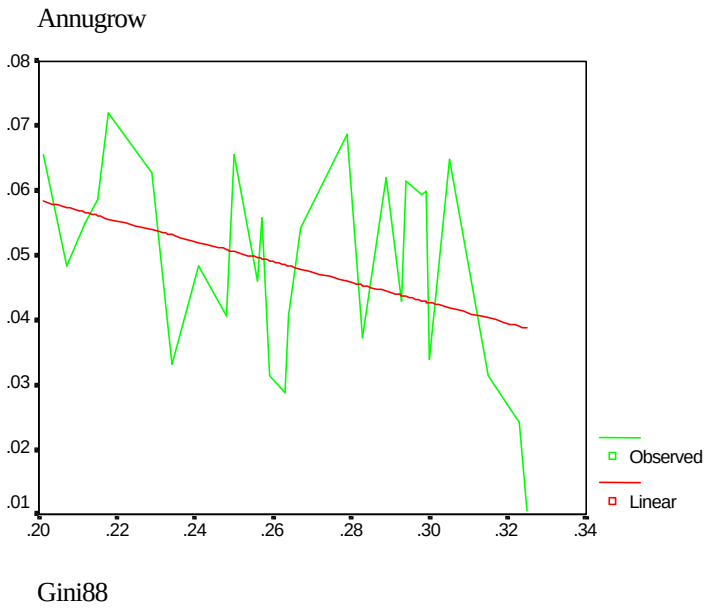


Figure 8: No Outlier Driven