Inequality, extractive institutions, and growth in nondemocratic regimes

Mizuno, Nobuhiro and Naito, Katsuyuki and Okazawa, Ryosuke

6 August 2012

Inequality, Extractive Institutions, and Growth in Nondemocratic Regimes*

Nobuhiro Mizuno†

Faculty of Commerce and Economics, Chiba University of Commerce

Katsuyuki Naito‡

Institute of Economic Research, Kyoto University

Ryosuke Okazawa§

Osaka School of International Public Policy, Osaka University

Japan Society for the Promotion of Science

Last Revised: August 6, 2012

Abstract

This paper investigates the effect of inequality on economic growth in nondemocratic regimes. We provide a model where a self-interested ruler chooses an institution that constrains the policy choice of the ruler. The ruler must care about the support share of citizens to keep power. Under an extractive institution, the ruler can extract a large share of citizens' wealth, but faces a high probability of losing power due to low public support. We show that inequality affects the ruler's trade-off between his or her expropriation of citizens' wealth and hold on power. Larger inequality among citizens makes the support share for the ruler less responsive to the choice of the institution by the ruler. This situation allows the ruler to choose an extractive institution without a significant increase in the risk of losing power. Hence, large inequality leads to extractive institutions and impedes investment and growth. These results provide an explanation for the negative relationship between inequality and growth observed in nondemocratic countries and the negative relationship between inequality and quality of institutions.

JEL classification: O11, D31, P14, P16

Keywords: Dictatorship, Economic Growth, Inequality, Institutions

---

*We are grateful to Kenn Ariga, Akihisa Shibata, Koichi Futagami, Satoshi Ohira, Tetsuro Okazaki, and the participants of the Japanese Economic Association Meeting at Chiba University, ARISH-NUPRI Economics Workshop at Nihon University, and the workshop organized by the Japan Public Choice Society at the Tokyo Institute of Technology for their useful comments and suggestions. Of course, we alone are responsible for both the content and any errors. Okazawa gratefully acknowledges the financial support of the Grant-in-Aid for JSPS Fellows.

†E-mail Address: nobu.mizuno8@gmail.com

‡E-mail Address: k.naito.71@gmail.com

§E-mail Address: rokazawa@osipp.osaka-u.ac.jp

1 Introduction

The relationship between inequality and economic growth has attracted the interest of many economists; it has been investigated both empirically and theoretically. The seminal work of Alesina and Rodrik (1994), Persson and Tabellini (1994), and Perotti (1996) show using cross-country regression analysis that inequality is negatively related with the subsequent growth.[1] A number of studies explore the channel through which inequality affects economic growth, and the prevailing explanation in the literature is that credit market imperfections or redistributional policies (as a result of majority voting) link inequality with economic growth.[2]

However, more recent empirical studies that deal with econometric problems such as measurement error and omitted variable bias indicate the need for a different explanation on how inequality is related to the subsequent growth. Using a data set that improves the measure of inequality, Deininger and Squire (1998) reveal that inequality in assets has a negative impact on economic growth only in nondemocratic countries.[3] Moreover, Barro (2000) uses the panel data method and finds that the effect of inequality on growth is negative in poor countries but positive in rich ones.[4] Since poor countries are often less democratic than rich ones, this evidence suggests that the relationship between inequality and growth could depend on political regimes.

The purpose of this paper is to theoretically consider the relationship between inequality and growth in a nondemocracy in order to explain these empirical findings. As many empirical studies show a significant impact of institutions on growth,[5] the lack of institutions to constrain expropriation by the government, such as a checks and balances system, hinders steady economic growth. We consider how the quality of institutions (the level of property rights protection) is endogenously determined in an undemocratic political process and argue that inequality hinders economic growth since it creates bad institutions.

We provide a model where a self-interested ruler chooses an institution that constrains the policy choice of the ruler. The institution affects not only the leeway for the ruler to expropriate citizens' wealth but also the ruler's political survival, which depends on the share of citizens who support the ruler. The ruler who chooses an extractive institution can expropriate a large share of citizens' wealth, but faces a high probability of losing power since many citizens do not support him or her.[6] By introducing institutions that restrict

[1] See Benabou (1996) for a survey of this literature.

[2] See Galor and Zeira (1993) for the former approach, and see Alesina and Rodrik (1994) and Persson and Tabellini (1994) for the latter.

[3] It is well known that large cross-country differences in definitions and accuracy of income data yield serious measurement error problems. In order to improve data quality, Deininger and Squire (1996) compile a large panel data set based on stringent criteria to ensure consistency of data among countries.

[4] Forbes (2000) and Banerjee and Duflo (2003) also use panel data to study the impact of inequality on growth. Forbes (2000) finds a positive impact and Banerjee and Duflo (2003) finds a nonlinear impact. The different results between Barro (2000) and Forbes (2000) may come from the difference in the compositions of their samples. Forbes (2000) excludes very poor countries from the sample owing to data limitations.

[5] See, among others, Knack and Keefer (1995), Mauro (1995), Hall and Jones (1999), Acemoglu et al. (2001), and Rodrik et al. (2004).

[6] We borrow the term "extractive institutions" from Acemoglu et al. (2001, 2002). Acemoglu et al. (2002) use the term extractive institutions to refer to the institutions that "concentrate power in the hands of a

the ruler's confiscatory behavior, the ruler can commit to a decrease in expropriation and gains large support from citizens. The ruler hence faces a trade-off between expropriation of citizens' wealth and hold on power.

We consider inequality as an important factor that influences the ruler's trade-off and affects the institutional choice by the ruler and growth as a result. The central idea of this paper is that larger inequality among citizens makes the support for the ruler less responsive to the choice of the institution by the ruler. We assume that the incumbent ruler's hold on power depends on the support share of citizens. Citizens prefer to replace the incumbent ruler if the institution is sufficiently extractive. The threshold level of institutional quality at which a citizen is indifferent on whether the ruler remains in power depends on the citizen's income level and differs across citizens. When inequality among the citizens is large, the distribution of this threshold is dispersed. In this situation, the ruler can adopt an extractive institution without a significant increase in the risk of losing power. Hence, large inequality encourages the ruler to create an extractive institution, and thus impedes investment and growth.

Figure 1 illustrates this idea. The horizontal axis represents institutional quality. The two curves represent the density of the distribution of the threshold level of institutional quality at which a citizen is indifferent on whether to support the incumbent ruler. While one curve shows homogeneous political preferences, the other shows dispersed political preferences. Suppose that the vertical line X represents the institutional quality chosen by the incumbent ruler. If the institutional quality chosen by the incumbent ruler falls below the threshold of a citizen, the citizen does not support the ruler. The areas painted gray thus represent the share of citizens supporting the incumbent ruler. When the distribution of political preferences is dispersed, there is little increase in the share of citizens supporting the ruler even if the ruler improves the quality of the institution from X to Y. Since large inequality corresponds to dispersed political preferences, large inequality means a small marginal benefit from improving institutional quality for the ruler, which leads to extractive institutions and impedes growth.

The basic mechanism is similar to the probabilistic voting model (Lindbeck and Weibull 1987; Dixit and Londregan 1996; Persson and Tabellini 2000). As in the probabilistic voting model, the less dispersed the distribution of citizens' political preferences, the more the politicians must be concerned about their welfare since the share of supporters is more responsive to the policy choice.

There is some empirical support for the viewpoint that inequality affects institutions. Keefer and Knack (2002) find that inequality significantly decreases the level of property rights protection and that the deterioration of property rights protection is the primary channel of the effect of inequality on growth. You and Khagram (2005) find that income inequality has a positive and substantial impact on corruption. Easterly (2007) finds that inequality is negatively related to a quality measure of institutions that reflects governmental effectiveness, freedom from corruption, political stability, and so on. Chong and Gradstein

small elite and create a high risk of expropriation for the majority of the population" (p.1235). In the model of this paper, we say that institutions are extractive when the property rights of citizens are not protected and the ruler in power can expropriate a large share of citizens' wealth.

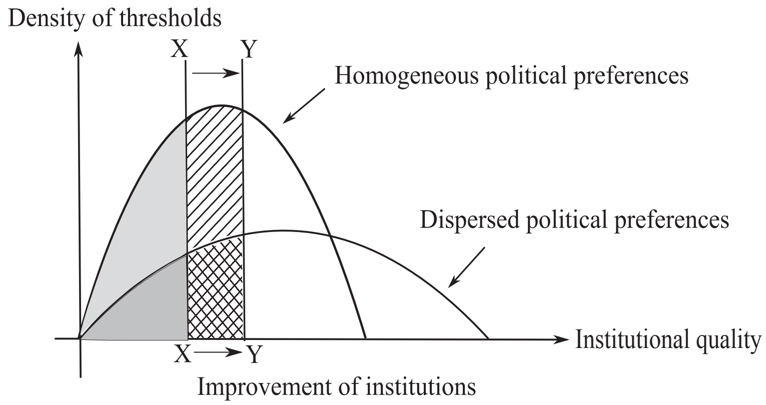

Figure 1: The marginal effect of institutional choice on support share.

(2007) confirm that there is a bidirectional causality between income inequality and poor institutions.

Our argument is also related to the research that explores the link between "middle class consensus" and economic development. Easterly (2001) defines the middle class consensus as "a situation of relative equality and ethnic homogeneity" (p.319), and finds that societies with a large homogeneous middle class attain higher economic growth.[7] Our argument provides one theoretical explanation why the middle class consensus is important for economic growth. Our model implies that when there is a large middle class that shares similar political preferences, a politician in power serves them since the citizens' support share is responsive to the politician's behavior. The existence of a middle class consensus thereby prevents the politician in power from exerting political power for his or her own sake and would be beneficial for economic development.

The rest of this paper is organized as follows. Section 2 relates this paper to the existing work. Section 3 builds the model and analyzes the effect of inequality on equilibrium growth. Section 4 provides some numerical examples to confirm that the predictions of the model do not change if we relax some assumptions. Finally, Section 5 concludes the paper.

2 Related Literature

There are two major explanations on the relationship between inequality and growth. The first one focuses on credit market imperfections. Galor and Zeira (1993) argue that since large inequality makes the credit constraint binding for many poor agents, it decreases human capital investment and impedes economic growth. However, Barro (2000) finds that the extent of credit market development does not significantly influence the relationship between inequality and growth. The second major explanation focuses on the political economic mechanism. Alesina and Rodrik (1994) and Persson and Tabellini (1994) argue that large

[7]He argues that if societies lack a middle class consensus, the elite underinvest in education and infrastructure for fear of losing their political power.

inequality leads to large scale redistribution as a result of majority voting, discourages the incentive to invest, and hinders economic growth.[8] Although these theories predict a positive relationship between inequality and redistribution and a negative relationship between redistribution and economic growth, Perotti (1996) argues that both these relationships are not supported empirically.[9]

More recent studies also explain the negative relationship between inequality and growth based on political economic mechanism. Bourguignon and Verdier (2000) build a model of oligarchy where the elite choose whether or not to subsidize the education of the poor and argue that the elite block the development of education in order to prevent democratization when inequality between the elite and the poor is large. Galor et al. (2009) argue that large inequality in landownership prevents the provision of public education since great landowners are likely to oppose educational policies that promote the accumulation of human capital. This paper contributes to this literature by providing a new political economic mechanism relating inequality and growth.

This paper argues that inequality harms the protection of property rights and impedes investment and growth. In this sense, this paper is related to the studies that analyze the relationship between inequality and institutions (Cervellati et al. 2008; Engerman and Sokoloff 1997; Glaeser et al. 2003; Gradstein 2007; Sokoloff and Engerman 2000; Sonin 2003). This paper provides a new insight that when inequality is large, the ruler who designs institutions can build extractive institutions because the public support for the ruler is not responsive to the change in institutions.

This paper is also related to the literature on the political economy of dictatorship (Acemoglu et al. 2004; Acemoglu 2005; Besley and Kudamatsu 2008; Grossman and Noh 1994; Mcguire and Olson 1996; Overland et al. 2005; Padró i Miquel 2007; Shen 2007; Wintrobe 1990). The common feature between the present paper and these papers is that a ruler chooses a policy to pursue personal benefit but the policy choice affects the probability of the ruler staying in power.[10] However, the effects of inequality on this trade-off for the ruler have been largely unexplored. The work of Acemoglu et al. (2004) is a notable exception and they consider inequality as a factor making the ruler refrain from expropriation. Contrary to their results, this paper asserts that inequality allows a ruler to expropriate citizens' wealth easily.

Finally, since government expropriation is a sort of corruption, this paper is related to the studies on inequality and corruption (Alesina and Angeletos 2005; Eicher et al 2009) and the studies on corruption and growth (Barreto 2000; Dalgic and Long 2006; de la Croix and Delavallade 2009; Ehrlich and Lui 1999; Long and Sorger 2006; Mohtadi and Roe 2003).

[8] Similar models are presented by Perotti (1993), Bertola (1993), and Benabou (1996).

[9] Moreover, evidence that focuses on the political system does not support the redistribution approach. If the redistribution channel is crucial in the relationship between inequality and growth, the negative effect of inequality on growth would be larger in democratic countries. However, this is against the evidence found by Knack and Keefer (1997) and Deininger and Squire (1998). Knack and Keefer (1997) investigate the relationship between inequality and economic growth in democracies and nondemocracies, and conclude that the impact of inequality in nondemocracies is not significantly lower than that in democracies.

[10] This paper is also related to the literature on political agencies that explores whether citizens can prevent politicians in power from exhibiting opportunistic behavior (Barro 1973; Ferejohn 1986; Persson and Tabellini 2000; Besley 2006).

3 Model

3.1 Economic Environment

We consider an overlapping generations economy where citizens live for two periods. Each citizen has one child, and hence there is no population growth; the population of citizens in each generation is normalized to 1. In the first period, citizens form the human capital. In the second period, they produce consumption goods, consume them, and participate in political activities.[11]

The level of human capital of each citizen depends on his or her effort input in the first period of life and parental human capital. We assume a Cobb-Douglas-type human capital production function

$$h_{it+1} = \frac{1}{\phi}\, e_{it}^{\phi} h_{it}^{1-\phi}, \quad \phi \in (0,1), \tag{1}$$

where h_{it+1} denotes the human capital level of a citizen born at period t and belonging to dynasty i, and e_{it} is his or her effort input. The externality of parental human capital enables the economy to grow, and also reproduces the inequality of a generation in the succeeding generation.

Differences in human capital constitute the source of income inequality in the economy. We assume that the distribution of human capital in the initial generation is uniform with support:[12]

$$\left[1 - \frac{\xi}{2}, 1 + \frac{\xi}{2}\right], \quad \xi \in (0,2).$$

The mean of the distribution is normalized to 1, and the density is given by $1/\xi$. As we will see later, in equilibrium, the level of human capital of each citizen is proportional to his or her parental human capital. Thus, the distribution of human capital of each generation is uniform, in which the density depends inversely on ξ. Parameter ξ hence represents the degree of inequality in the economy. A large ξ corresponds to a high level of inequality.

In the second period of life, each citizen produces consumption goods with the following production technology:

$$y_{it} = A_t h_{it}, \tag{2}$$

where y_{it} denotes the production level of citizen i, and A_t denotes the productivity of the economy.

The utility of each citizen depends on his or her consumption and public goods. There are n types of public goods, and the citizens have different preferences for them. A citizen can benefit from only one type of public good. Hence, we can divide the citizens into n types according to their preferences for the public goods. Let $\Theta = \{\theta_1, \cdots, \theta_n\}$ denote the set of the types of public goods. Then, we can define the type of a citizen as $\theta \in \Theta$, which shows the type of public good that the citizen prefers. Let $g(\theta)$ denote the quantity of public good of type θ.

[11]We restrict political participation to the old generation for simplicity. This restriction does not play any crucial role in the following analysis.

[12]In Section 5, we replace the uniform distribution of human capital with a more realistic distribution.

The probability that the type of a citizen is θ is $1/n$ for all $\theta \in \Theta$. Thus, the population and income distribution in each type are equivalent. The citizens' preferences for public goods come from factors that are independent of their human capital levels. These factors include, for example, their districts of residence, religion, and ethnicity. If the type of a citizen $\theta \in \Theta$ represents their district in which the citizen resides, $g(\theta)$ would mean the quantity of public goods located in the district. A citizen can benefit only from the public goods located in his or her own district. We can also interpret θ as religion or ethnicity. Then, $g(\theta)$ would mean the quantity of religious institutions or the level of transfer targeted to a specific ethnic group. Religious institutions are valuable only for those citizens who believe in the particular religion. If a society is segregated by ethnicity, the government can make a policy that is favorable for a specific ethnic group.

The utility of a type-θ citizen in the first period of life is

$$U^1(e, g(\theta)) = -\gamma e + \beta g(\theta) \quad \beta < 1, \tag{3}$$

where $\gamma > 0$ is the marginal cost of effort input and β captures the importance of public goods. The utility of a type-θ citizen in the second period of life is

$$U^2(c, g(\theta)) = c + \beta g(\theta), \tag{4}$$

where c denotes consumption. The consumption level of citizen i is equal to his or her after-tax income, $(1-\tau)y_i$, where τ denotes the income tax rate. Citizens do not discount future utility and thereby invest in human capital so as to maximize $U^1 + U^2$. Because citizens take part in political processes in the second period of life, they make political choices to maximize U^2.

3.2 Political Process

In each generation, there is a set of politicians P. Politicians also live for two periods and are active only in the second period of life. The utility of politicians also depends on their consumption and public goods. As in the case for the utility of citizens, politicians also can benefit from only one type of public good and their preferences are also represented by (4). A type-θ politician represents the interests of type-θ citizens in the policy area of public goods provision. The probability that a randomly selected politician is type-θ is $1/n$ for all $\theta \in \Theta$.

In the beginning of each period t, a politician is chosen randomly from the old generation's set of politicians P and he or she occupies the seat of power. We call this politician the "incumbent ruler." Since our focus is not on the selection of a ruler but on the behavior of the selected ruler, we simply assume the random selection of a ruler.

After occupying the seat of power, the incumbent ruler designs the institution for the period. The ruler can make political and judicial reforms to get unconstrained power of decision in order to derive large private benefits. However, as we will see below, such a discretionary power enables the ruler to expropriate much of citizens' wealth and causes political instability. Conversely, by restricting the power of the government, the ruler can commit to not abusing power, which would make the position of the ruler stable. North and Weingast (1989), analyzing the institutions of seventeenth-century England, argue that a parliament constraining the ruler's behavior can make the ruler commit credibly to give up confiscatory behavior. Wright (2008) also argues that authoritarian regimes that need to facilitate investment create binding legislatures to commit credibly to restrict expropriation. We represent institution quality by the upper limit of the tax rate $\bar{\tau}_t$ that the ruler can levy. Any ruler in power cannot impose a tax on citizens' income that is higher than this upper limit. A low level of $\bar{\tau}_t$ means that the property rights of citizens are well protected. When $\bar{\tau}_t$ is high, we say that the institution is extractive. The ruler can decrease the upper limit of the tax rate by creating a well-functioning checks and balances system.

After observing the institution that the incumbent ruler chooses, each citizen decides whether or not to support the incumbent ruler. At this stage, the incumbent ruler cannot commit to a policy that he or she will implement after retaining power. Citizens hence make their political choices anticipating that the ruler in power will implement his or her most preferred policy. Whether the incumbent ruler can stay in power during the period depends on the share of citizens who support the incumbent ruler. Denoting the share of supporters as $s \in [0, 1]$, we represent the probability of the incumbent ruler staying in power as

$$p(s) = \begin{cases} 0 & 0 \leq s < \frac{1}{n} \\ \min\left\{\chi\left(s - \frac{1}{n}\right)^{\nu}, 1\right\} & \frac{1}{n} \leq s \leq 1, \end{cases} \tag{5}$$

where $\chi > 0$ and $\nu \in (0, 1]$. The probability $p(s)$ is nondecreasing in s.[13] While we assume that $\nu = 1$ for simplicity, we consider the case of $\nu < 1$ numerically in Section 5.

In equilibrium, the incumbent ruler gains the support of all citizens who are of the same type as the ruler. Therefore, the share of supporters s is not less than $1/n$ in equilibrium. Equation (5) states that if the incumbent ruler cannot gain any support from the citizens whose preference are different from the incumbent ruler, the survival probability is zero. This assumption is imposed to focus on the case in which the ruler cares about the support from citizens whose preference are different from the ruler.

The survival probability of the incumbent ruler is introduced to analyze the trade-off between the ruler's expropriation of citizens' wealth and hold on power. We adopt this set-up to describe the politics in nondemocratic regimes. In nondemocratic regimes, the political function of elections is restricted, but the public opposition of citizens can threaten the power of rulers in a variety of ways.[14] Our assumption implies that a ruler is less likely to hold power when a larger share of citizens oppose the ruler. The negative relationship between a ruler's survival probability and the share of opposing citizens can be interpreted in several ways. First, when the opponents of a ruler appeal to arms, the force will be stronger when the number of opponents is larger. Second, even if a ruler has a strong army that can repress

[13] A similar formulation is used in Grossman and Noh (1994) and Overland et al. (2005). In both studies, as in this paper, a ruler derives utility from own consumption and faces the probability of losing power. The ruler's probability of retaining power depends on the expected utility of a representative producer in Grossman and Noh (1994) and on the level of domestic capital in Overland et al. (2005). We refer to this probability (given by (5)) as the "survival probability," as in Grossman and Noh (1994).

[14] Acemoglu and Robinson (2006) state that "The citizens are excluded from the political system in nondemocracy, but they are nonetheless the majority and they can sometimes challenge the system, create significant social unrest and turbulence, or even pose a serious revolutionary threat." (p.25).

anti-government demonstrations, the more citizens participate in a demonstration, the larger is the cost of repression for the ruler because a large number of victims of repression may result in sanctions from the international community, which can bring about a downfall of the ruler. Third, since the cost of participating in anti-government demonstrations decreases as the number of participants increases, demonstrations are more likely to take place when more citizens oppose the government. Fourth, if a military coup needs a pretext for replacing an incumbent ruler, a low share of support from citizens is a justifiable cause.

If the incumbent ruler loses power, a new ruler is chosen from P in a random manner. We assume that the incumbent ruler's utility is zero if he or she loses power. At the end of the period, the ruler in power chooses the tax rate $\tau_t \in [0, \bar{\tau}_t]$ and allocates tax revenue between public goods provision and private consumption. The ruler diverts a fraction of tax revenue r_t to private consumption. In the process of misuse of tax revenue, a fraction of tax revenue $C(r_t)$ disappears as the cost of appropriating public funds, represented by[15]

$$C(r_t) = \frac{\zeta r_t^{1+\eta}}{1+\eta}, \quad \eta > 0. \tag{6}$$

Let H_t denote the aggregate level of human capital and $Y_t = A_t H_t$ denote the aggregate output. The government budget constraint in period t is given by

$$r_t T_t + \sum_{\theta \in \Theta} g_t(\theta) = [1 - C(r_t)] T_t \tag{7}$$

$$T_t = \tau_t Y_t. \tag{8}$$

In the case of a change in power, the productivity of the economy decreases by a fraction $\delta \in (0, 1)$. This parameter represents the cost of political instability, which comes from, for example, a delay in policy decisions or disorder caused by an internal conflict. Let A denote the productivity when the incumbent ruler stays in power, and $\tilde{A} \equiv (1 - \delta)A$ denote the productivity when there is a change in power. Each citizen will support the incumbent ruler if and only if the utility under the incumbent regime is not less than the expected utility after a change in power.

The timing of events in the political process in period t is as follows:

1. A politician is chosen randomly from P to be the incumbent ruler.

2. The incumbent ruler chooses the upper limit of the tax rate $\bar{\tau}_t$ for the period.

3. Each citizen decides whether or not to support the incumbent ruler, and the ruler's probability of staying in power is determined.

4. If the incumbent ruler loses power, a new ruler rises to power. The ruler in power chooses the policy $(\tau_t, r_t, \{g_t(\theta)\}_{\theta \in \Theta})$.

[15]This cost includes, for example, the loss due to the inefficient allocation of government posts for the ruler's family members or the resources used for cover-up.

4 Equilibrium

We briefly define the equilibrium of this model. The politico-economic equilibrium must satisfy the following conditions.

- *Optimal human capital investment*: Given the expected return on human capital investment, each citizen must invest in human capital in order to maximize his or her utility.
- *Optimal policy making by the ruler in power*: The ruler in power chooses a policy to maximize his or her utility.
- *Sincere support of citizens*: Comparing the utility under the incumbent's regime and the expected utility after the change in power, each citizen sincerely chooses whether or not to support the incumbent.
- *Optimal institution for the incumbent ruler*: Taking into account the political action of citizens, the incumbent ruler chooses an institution in order to maximize the expected utility.
- *Perfect foresight*: All citizens have the same expectation about the return on human capital, and this expectation is met.

4.1 Human Capital Investment

First, we consider the optimal human capital investment of each citizen in the first period of life. The return on human capital investment depends on the political results in the second period of life. Thus, each citizen expects political results in the next period and makes effort input according to his or her expectation. Suppose that in period t, each citizen expects that the incumbent ruler in the next period will stay in power with probability $\hat{p}_{t+1}$ and will choose tax rate $\hat{\tau}_{t+1}$, and that the new ruler will choose tax rate $\hat{\tau}^N_{t+1}$. Then, the expected income of citizen i in period $t+1$ is

$$E[y_{it+1}] = [\hat{p}_{t+1}(1-\hat{\tau}_{t+1}) + (1-\hat{p}_{t+1})(1-\hat{\tau}^N_{t+1})(1-\delta)]Ah_{it+1}. \tag{9}$$

Now, let us define the expected return on human capital by $\hat{R}_{t+1} \equiv [\hat{p}_{t+1}(1-\hat{\tau}_{t+1}) + (1-\hat{p}_{t+1})(1-\hat{\tau}^N_{t+1})(1-\delta)]A$. Each citizen chooses the level of effort input to solve the following maximization problem:

$$\max_{e_{it}} \quad \hat{R}_{t+1}\frac{1}{\phi}e_{it}^{\phi}h_{it}^{1-\phi} - \gamma e_{it}. \tag{10}$$

Solving this problem, we obtain

$$e_{it} = \left(\frac{\hat{R}_{t+1}}{\gamma}\right)^{\frac{1}{1-\phi}} h_{it}, \tag{11}$$

$$h_{it+1} = \left(\frac{\hat{R}_{t+1}}{\gamma}\right)^{\frac{\phi}{1-\phi}} \frac{h_{it}}{\phi}. \tag{12}$$

Equation (11) shows that the optimal effort is increasing in the expected return on human capital $\hat{R}$, which is decreasing in $\hat{\tau}$ and $\hat{\tau}^N$. The effect of $\hat{p}$ on $\hat{R}$ depends on the magnitude relation between $(1-\hat{\tau})$ and $(1-\hat{\tau}^N)(1-\delta)$. If $(1-\hat{\tau}) > (1-\hat{\tau}^N)(1-\delta)$, which holds in equilibrium, the expectation of political stability positively affects human capital investment. The effort input is also increasing in the level of parental human capital h_{it} because of the intergenerational externality of parental human capital.

Equation (12) implies a positive linear relationship between the human capital of parents and children. This relationship makes the evolution of income distribution quite simple. The linear relationship in (12) implies that the relative human capital of a dynasty i to the aggregate human capital $\tilde{h}_{it} \equiv h_{it}/H_t$ is constant in all periods. Thus, $\tilde{h}_{it}$ follows the same distribution as h_{i0} since $H_0 = 1$.[16] In addition, if the distribution of human capital of a generation is uniform, that of the succeeding generation will also be uniform. Since we suppose that human capital in the initial generation follows a uniform distribution, the distribution of human capital in each generation will be uniform in equilibrium.

Lemma 1. *The optimal effort input of each citizen is represented by (11). Effort input e_{it} in human capital production is increasing in the expected return on human capital $\hat{R}$ and parental human capital. In equilibrium, the distribution of relative human capital $\tilde{h}_{it}$ is always uniform and the same as that of the initial generation*

$$U\left[\left(1-\frac{\xi}{2}\right), \left(1+\frac{\xi}{2}\right)\right]. \tag{13}$$

4.2 Political Process

The level of human capital in period t is determined by investment in the previous period. Given the distribution of human capital, we solve the political game in period t by backward induction. In the following, we omit the subscript t except when necessary.

4.2.1 Optimal Policy of the Ruler in Power

Assume that a type-$\theta' \in \Theta$ politician is in power. The ruler chooses a policy that solves the following problem:

$$\begin{aligned} &\max_{(\tau, r, \{g(\theta)\}_{\theta\in\Theta})} && rT + \beta g(\theta') \\ &\text{s.t.} && (7), (8), \text{ and } \tau \in [0, \bar{\tau}]. \end{aligned} \tag{14}$$

Clearly, it is suboptimal for the ruler to provide a positive amount of public good of any type other than θ'. Based on this fact and the government budget constraint (7), we see that the utility of the ruler is increasing in τ. Thus, the ruler sets the tax rate as $\bar{\tau}$ and allocates the tax revenue between private consumption and the public good of own type. The allocation is determined to equalize the marginal benefit from the appropriation of tax revenue to the marginal cost. A marginal increase in appropriation rate dr increases private consumption by Tdr but decreases the resources available to produce the public good $g(\theta')$

[16]Therefore, we do not consider the dynamics of inequality, which is beyond the scope of this paper.

by $(1 + C'(r))Tdr$. The ruler therefore chooses an allocation so that $1 = \beta(1 + C'(r))$. The optimal policy of the ruler $(\tau_t^*, r_t^*, \{g_t^*(\theta)\}_{\theta\in\Theta})$ can be summarized as follows.

Lemma 2. *A type-θ' ruler chooses the policy $(\tau_t^*, r_t^*, \{g_t^*(\theta)\}_{\theta\in\Theta})$ that satisfies the following:*

- *The tax rate is equal to the upper limit, that is, $\tau_t^* = \bar{\tau}_t$.*
- *The rate of rent extraction r_t^* is given by*

$$r_t^* = \left(\frac{1-\beta}{\zeta\beta}\right)^{\frac{1}{\eta}} \equiv \bar{r}. \tag{15}$$

- *The level of public good $g_t^*(\theta)$ is zero for any $\theta \neq \theta'$, and $g_t^*(\theta')$ is given by*

$$g_t^*(\theta') = \left(1 - \bar{r}\frac{1+\eta\beta}{(1+\eta)\beta}\right) T_t^*, \tag{16}$$

  where $T_t^* = \tau_t^* Y_t$.

4.2.2 Political Choices of Citizens

Anticipating the policy $(\tau, r, \{g(\theta)\}_{\theta\in\Theta})$ that the ruler in power will choose, each citizen decides whether or not to support the incumbent ruler. We denote the type of the incumbent ruler as θ^I.

Each citizen supports the incumbent ruler if and only if the utility under the incumbent's policy is not less than the expected utility that the citizen obtains after the change in power. If the incumbent ruler is replaced, a new ruler seizes power, and this is beneficial to citizens who prefer the same type of public good as the new ruler. However, a change in power decreases the productivity of the economy by δ.

Since the new ruler is randomly chosen when the incumbent ruler is replaced, the probability that the type-θ politician becomes the new ruler is $1/n$ for all $\theta \in \Theta$. The policy that the ruler in power will choose is given by lemma 2, and therefore, the expected utility $W(h_i, \theta)$ that a type-θ citizen i obtains in the case of a regime change is given by

$$\begin{aligned} W(h_i,\theta) &= (1-\bar{\tau})\tilde{A}h_i + \frac{\beta}{n}\left(1 - \bar{r}\frac{1+\eta\beta}{(1+\eta)\beta}\right)\bar{\tau}\tilde{A}H \\ &= (1-\bar{\tau})\tilde{A}h_i + \bar{\tau}\Psi AH, \end{aligned} \tag{17}$$

where

$$\Psi \equiv \frac{\beta(1-\delta)}{n}\left(1 - \bar{r}\frac{1+\eta\beta}{(1+\eta)\beta}\right). \tag{18}$$

The first term in (17) is the after-tax income of citizen i and the second term is the expected utility from public good provision of the new ruler.

A type-θ citizen i supports the incumbent ruler if and only if

$$(1-\bar{\tau})Ah_i + g^*(\theta) \geq (1-\bar{\tau})\tilde{A}h_i + \bar{\tau}\Psi AH, \tag{19}$$

where $g^*(\theta)$ is the public good of type θ that the incumbent ruler will provide. When the incumbent ruler keeps power, the citizens with the same preference as the incumbent ruler receive the public good with probability one. When the incumbent ruler loses power, they receive the public good with probability less than one and incur a productivity loss due to political instability. Hence, the citizens with the same preference as the incumbent ruler always support the incumbent ruler. Since the incumbent ruler cannot commit to a policy that will be implemented at the end of the period, the incumbent ruler can credibly promise the provision of public good only to the citizens with the same preference as the incumbent ruler.[17]

The citizens whose preferences are different from θ^I will support the incumbent ruler if and only if

$$(1-\bar{\tau})Ah_i \geq (1-\bar{\tau})\tilde{A}h_i + \bar{\tau}\Psi AH. \tag{20}$$

We define α as $\alpha \equiv \Psi/\delta$. Then, we can rewrite this condition as

$$\tilde{h}_i \geq \frac{\alpha\bar{\tau}}{1-\bar{\tau}} \equiv \psi(\bar{\tau}), \tag{21}$$

where $\psi' > 0$ and $\psi'' > 0$.

The political choices of type-$\theta \neq \theta^I$ citizens are characterized by the threshold $\psi(\bar{\tau})$, and this threshold is increasing in $\bar{\tau}$. Citizens with a higher relative human capital $\tilde{h}_i$ than $\psi(\bar{\tau})$ would support the incumbent ruler. Hence, rich citizens tend to support the incumbent ruler but poor ones do not, and the number of supporters is decreasing in $\bar{\tau}$. The interpretation of this result is quite simple. On the one hand, there is a cost of regime change for citizens from the decrease in the return on human capital; this cost is proportional to the level of human capital. On the other hand, there is a benefit from regime change due to the provision of own type of public good that can be realized with probability $1/n$, and this benefit is equal for all citizens regardless of the level of human capital. Citizens with higher human capital thus tend to support the incumbent ruler. As the level of $\bar{\tau}$ increases, the budget scale allocated to the public good rises, and the benefit of regime change for type-$\theta \neq \theta^I$ citizens also goes up. Furthermore, since a large level of $\bar{\tau}$ means that a large share of income is levied as tax, the cost of political instability is small for citizens. Thus, a high level of $\bar{\tau}$ leads to a small support share among type-$\theta \neq \theta^I$ citizens. Conversely, the incumbent ruler can increase his or her political support by lowering $\bar{\tau}$. By designing a well-functioning checks and balances system, the incumbent ruler can make credible promises to protect citizens' property rights.

In equilibrium, the distribution of $\tilde{h}_i$ is as given in (13). Thus, from the above results, the share of supporters can be written as

$$s(\bar{\tau};\xi) = \frac{1}{n} + \frac{n-1}{n}\int_{\psi(\bar{\tau})}^{1+\frac{\xi}{2}} \frac{1}{\xi} d\tilde{h}_i \equiv \frac{1}{n} + \frac{n-1}{n}\varphi(\bar{\tau};\xi), \tag{22}$$

where

$$\varphi(\bar{\tau};\xi) = \begin{cases} 0 & \psi(\bar{\tau}) > 1+\frac{\xi}{2}, \\ \frac{1}{\xi}\left(1+\frac{\xi}{2}-\psi(\bar{\tau})\right) & \psi(\bar{\tau}) \in \left[1-\frac{\xi}{2}, 1+\frac{\xi}{2}\right], \\ 1 & \psi(\bar{\tau}) < 1-\frac{\xi}{2}. \end{cases} \tag{23}$$

The value of function $\varphi(\bar{\tau};\xi)$ represents the support share of type-$\theta \neq \theta^I$ citizens when the institution is $\bar{\tau}$.

[17]This formulation is based on the model of clientelism developed in Robinson et al. (2006).

Then, from (5) and (22), the incumbent ruler's probability of staying in power is given by

$$p(\bar{\tau}, \xi) = \min\left\{\frac{\chi(n-1)}{n}\varphi(\bar{\tau}; \xi), 1\right\}. \tag{24}$$

The survival probability represented in equation (24) captures the constraint that the incumbent ruler in a nondemocratic regime faces. If the ruler chooses an institution where the ruler can extract a larger share of citizens' income, more citizens will not support the ruler and it would become more difficult for the ruler to retain political power. Equation (24) shows the important trade-off between the incumbent ruler's expropriation and hold on power.

Inequality affects the effect of $\bar{\tau}$ on the survival probability. By differentiating p with respect to $\bar{\tau}$, we obtain

$$\frac{\partial p}{\partial \bar{\tau}}(\bar{\tau}; \xi) = \frac{\chi(n-1)}{n}\frac{\partial \varphi}{\partial \bar{\tau}}(\bar{\tau}; \xi) = -\frac{\chi(n-1)}{n}\frac{\psi'(\bar{\tau})}{\xi}. \tag{25}$$

The derivative $\partial p(\bar{\tau}; \xi)/\partial \bar{\tau}$ is negative and increasing in ξ. This means that the negative impact of $\bar{\tau}$ on the survival probability $p(\bar{\tau}; \xi)$ is small when inequality is large. We can illustrate this result by using Figure 2. Suppose that there are two economies, an equal economy and an unequal one. The distribution of relative human capital $\tilde{h}_i$ in the unequal economy is more dispersed with a small density of distribution. Thus, the political preferences of citizens are more dispersed in the unequal economy. In Figure 2, $1/\xi'$ denotes the density of the distribution in the equal economy, and $1/\xi$ the density in the unequal one. Since the threshold $\psi(\bar{\tau})$ is independent of the distribution of $\tilde{h}_i$ as shown in (21), the same threshold divides the political behavior of citizens in both the economies. However, a change in the incumbent's choice of institution has different impacts on survival probability in the two economies. Suppose that the incumbent ruler decreases the upper limit of tax rate from $\bar{\tau}$ to $\bar{\tau}'$. This change increases the support for the incumbent ruler, but the increase is lower in the unequal economy than in the equal one. This is because the density of the distribution of $\tilde{h}_i$ is low in the unequal economy. In the unequal economy where citizens' political preferences are dispersed, few citizens share similar political preferences. Thus, in the face of a change in institution, few citizens change their political attitude. Hence, when inequality is large, a marginal decrease in $\bar{\tau}$ has a small impact on the incumbent ruler's survival probability. The relationship between inequality and the incumbent ruler's institutional choice, which we will explain in the next subsection, depends crucially on this mechanism.

The above results are summarized in the following lemma.

Lemma 3. *In equilibrium, the citizens' political choices and the resulting survival probability of the incumbent ruler entail the following.*

- *All type-θ^I citizens support the incumbent ruler.*
- *Type-$\theta \neq \theta^I$ citizens support the incumbent if and only if*

$$\tilde{h}_i \geq \psi(\bar{\tau}),$$

where the threshold $\psi(\bar{\tau})$ is given by (21).

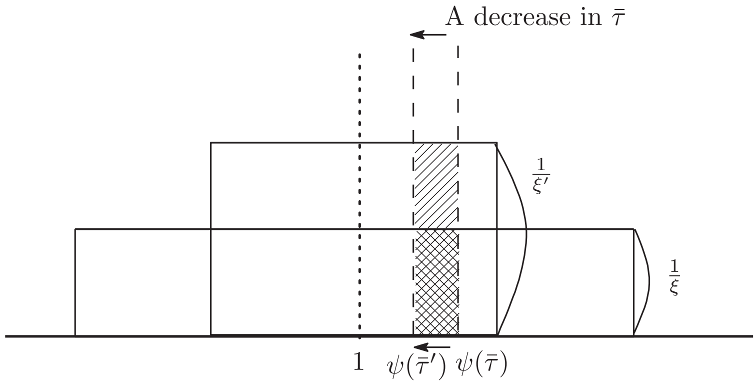

Figure 2: Marginal effects of $\bar{\tau}$ on $p(\bar{\tau};\xi)$

- *The probability of the incumbent ruler staying in power is*

$$p(\bar{\tau},\xi) = \min\left\{\frac{\chi(n-1)}{n}\varphi(\bar{\tau};\xi), 1\right\},$$

where $\varphi(\bar{\tau};\xi)$ is the support share of citizens with preferences other than θ^I and is given by

$$\varphi(\bar{\tau};\xi) = \int_{\psi(\bar{\tau})}^{1+\frac{\xi}{2}} \frac{1}{\xi} d\tilde{h}_i.$$

- *Probability $p(\bar{\tau};\xi)$ is decreasing in $\bar{\tau}$, and the increase in $p(\bar{\tau};\xi)$ due to a decrease in $\bar{\tau}$ is small when the degree of inequality ξ is large.*

4.2.3 Optimal Institution for the Incumbent Ruler

Finally, we proceed to investigate the problem of the incumbent ruler. If the incumbent ruler loses power, his or her payoff is zero. If the incumbent ruler retains power, he or she chooses a policy as described in lemma 2. In this case, the payoff of the incumbent ruler is given by $[\bar{r} + \beta(1 - \bar{r} - C(\bar{r})]\bar{\tau}AH$. The problem of the incumbent ruler can thus be given by

$$\max_{\bar{\tau}} \quad p(\bar{\tau};\xi)\bar{\tau}. \tag{26}$$

Note that it is suboptimal for the incumbent ruler to choose an institution such that $\psi(\bar{\tau}) > 1 + \xi/2$ and $\psi(\bar{\tau}) < 1 - \xi/2$. If $\psi(\bar{\tau}) > 1 + \xi/2$, the survival probability and payoff of the ruler will be zero. If $\psi(\bar{\tau}) < 1 - \xi/2$, the ruler can increase $\bar{\tau}$ without decreasing his or her survival probability.

Assuming an interior solution ($p(\bar{\tau}^*;\xi) < 1$), from the first-order condition, the optimal institution for the incumbent ruler $\bar{\tau}^*$ satisfies

$$p'(\bar{\tau}^*;\xi)\bar{\tau}^* + p(\bar{\tau}^*;\xi) = 0. \tag{27}$$

Equation (27) states that the incumbent ruler balances the trade-off between expropriation and political survival. While on the one hand, a marginal increase in $\bar{\tau}$ decreases the survival probability and reduces the incumbent ruler's payoff by $-p'(\bar{\tau};\xi)\bar{\tau}$, on the other, a

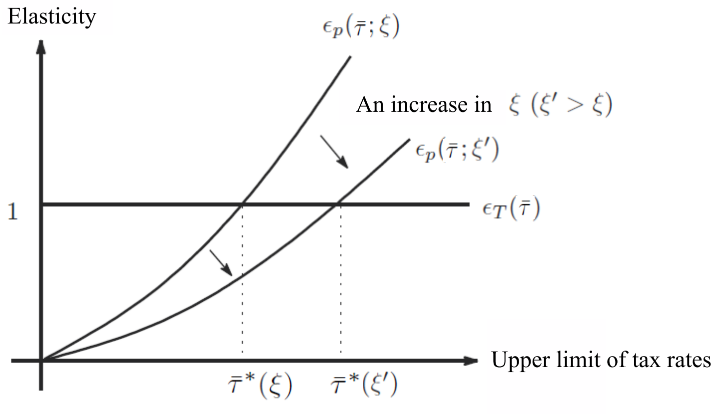

Figure 3: Equilibrium quality of the chosen institution

marginal increase in $\bar{\tau}$ raises tax revenue and increases the ruler's payoff by $p(\bar{\tau};\xi)$. The incumbent ruler will choose the institution that balances the marginal benefit and marginal cost. Equation (27) can be rewritten as

$$\epsilon_T = \epsilon_p(\bar{\tau}^*;\xi), \tag{28}$$

where

$$\epsilon_T = 1, \quad \epsilon_p(\bar{\tau}^*;\xi) = -\frac{p'(\bar{\tau}^*;\xi)\bar{\tau}^*}{p(\bar{\tau}^*;\xi)}.$$

The left-hand side of (28), ϵ_T, is the elasticity of tax revenue with respect to $\bar{\tau}$, which is always equal to 1, and the right-hand side, $\epsilon_p(\bar{\tau};\xi)$, is the elasticity of the survival probability with respect to $\bar{\tau}$. The incumbent ruler will choose $\bar{\tau}$ that equalize these two elasticities. The elasticity of the survival probability is decreasing in the degree of inequality ξ due to the mechanism that we mentioned previously.[18] When the degree of inequality is large, the survival probability will not be responsive to a change in $\bar{\tau}$, and the incumbent ruler can increase $\bar{\tau}$ with little threat to power. Inequality will hence tend to increase $\bar{\tau}$ that the incumbent ruler chooses.

Figure 3 illustrates the equilibrium institution that the incumbent ruler chooses. The elasticity of tax revenue, ϵ_T, is represented by the horizontal line and that of the survival probability $\epsilon_p(\bar{\tau};\xi)$ is the upward-sloping curve. The equilibrium institution is determined at the intersection of the two graphs. Since an increase in ξ shifts the curve of $\epsilon_p(\bar{\tau};\xi)$ downward, the equilibrium degree of extractive institution $\bar{\tau}^*$ is increasing in ξ.

We can analytically solve the first-order condition with respect to $\bar{\tau}^*$ and obtain

$$\bar{\tau}^*(\xi) = 1 - \sqrt{\frac{\alpha}{\alpha + 1 + \frac{\xi}{2}}}. \tag{29}$$

[18]From (21), (23), and (24), we derive

$$\epsilon_p(\bar{\tau};\xi) = -\frac{p'(\bar{\tau};\xi)\bar{\tau}}{p(\bar{\tau};\xi)} = \frac{\bar{\tau}}{1 + \xi/2 - \psi(\bar{\tau})}\frac{\alpha}{(1-\bar{\tau})^2}.$$

We see that $\epsilon_p(\bar{\tau};\xi)$ is increasing in $\bar{\tau}$ and decreasing in ξ.

Equation (29) shows that $\bar{\tau}^*(\xi)$ is indeed increasing in ξ.

Proposition 1. *The larger the degree of inequality ξ, the more extractive the institution that the incumbent ruler chooses.*

Since we assume an interior solution, the equilibrium survival probability of the incumbent ruler is given by[19]

$$p^*(\xi) = \frac{\chi(n-1)}{n\xi}\left(1 + \frac{\xi}{2} + \alpha - \alpha\sqrt{1 + \frac{1+\frac{\xi}{2}}{\alpha}}\right). \tag{30}$$

The effect of inequality on political stability is ambiguous. An increase in ξ leads to a more extractive institution (higher $\bar{\tau}^*$) and decreases the support share (institutional effect). In addition, an increase in ξ transforms the distribution of relative human capital. Keeping the threshold $\psi(\bar{\tau})$ fixed, an increase in ξ changes the share of citizens with higher relative human capital than $\psi(\bar{\tau})$, thus changing the support share (distributional effect). This effect is negative when $\psi(\bar{\tau}) < 1$ and is positive when $\psi(\bar{\tau}) > 1$. Thus, if $\psi(\bar{\tau}^*(\xi)) \leq 1$, the effect of ξ on $p^*(\xi)$ is negative. Otherwise, the sign of the effect is determined by the magnitude relation between these two opposing effects. The following proposition indicates the U-shaped relationship between inequality and political stability.

Proposition 2. *The effects of inequality on political stability depend on the institutional and distributional effects. Inequality will decrease political stability if and only if*

$$\frac{1+\alpha}{\sqrt{\alpha}} > \frac{1+\alpha+\frac{\xi}{4}}{\sqrt{1+\alpha+\frac{\xi}{2}}}. \tag{31}$$

Since the right-hand side of (31) is increasing in ξ, the relationship between inequality and political stability is non-monotonic and U-shaped.

Proof. See Appendix A. □

The intuition behind Proposition 2 is as follows. Consider the population share of citizens whose income is higher than a certain threshold level. If the threshold is the average, the population share is the same in the equal economy and the unequal economy because the distribution is now uniform. If the threshold is higher than the average, the population share of citizens whose income is higher than the threshold level is larger in the unequal economy, and the difference increases with the threshold level. The distributional effect is hence strong when the threshold $\psi(\bar{\tau}^*(\xi))$ is high. If the threshold $\psi(\bar{\tau}^*(\xi))$ is equal to or less than 1, both the institutional and distributional effects are negative, and political stability is decreasing in ξ. When the threshold $\psi(\bar{\tau}^*(\xi))$ is higher than 1 but low enough, the institutional effect dominates the distributional effect, and thus, an increase in inequality reduces political stability.[20] A further increase in inequality increases $\bar{\tau}^*(\xi)$ and $\psi(\bar{\tau}^*(\xi))$. Then, the distributional effect becomes important and dominates the institutional effect. In this situation, an increase in inequality brings about more political stability.

[19] To ensure the interior solution $p(\bar{\tau}^*(\xi);\xi) < 1$, the parameter χ must be sufficiently small. Note that $p(\bar{\tau}^*(\xi);\xi) < 1$ when $\chi = 1$.

[20] Alesina and Perotti (1996) find that inequality is negatively related with political stability.

4.3 Equilibrium Growth Rate and Inequality

In the previous subsection, we showed that inequality yields an extractive institution. Now, we investigate the effects of inequality on economic growth.

The equilibrium return on human capital is

$$R^*(\xi) = (1 - \bar{\tau}^*(\xi))[p^*(\xi) + (1 - p^*(\xi))(1 - \delta)]A. \tag{32}$$

Equation (32) shows that $R^*(\xi)$ is decreasing in $\bar{\tau}^*(\xi)$ and increasing in $p^*(\xi)$. Since political changes lead to productivity loss, a high probability of political changes would decrease the return.

The effects of inequality on the return of human capital $R^*(\xi)$ are decomposed into two effects. First, an increase in ξ leads to more a extractive institution (i.e., a higher $\bar{\tau}^*(\xi)$), and decreases $R^*(\xi)$. Second, an increase in ξ affects the political stability $p(\bar{\tau}^*(\xi); \xi)$, and thereby, affects $R^*(\xi)$. As shown in Proposition 2, this effect of ξ on $p(\bar{\tau}^*(\xi); \xi)$ is ambiguous. However, as the following lemma states, the overall effects of ξ on $R^*(\xi)$ are always negative.

Lemma 4. *The effects of inequality ξ on the equilibrium return of human capital are negative.*

Proof. See Appendix B. □

In equilibrium, citizens predict the future political results correctly, and therefore, $\hat{R} = R^*$. Then, from (12), the growth rate of the aggregate human capital is given by

$$\frac{H^*_{t+1}}{H^*_t} = \frac{1}{\phi} \left(\frac{R^*}{\gamma} \right)^{\frac{\phi}{1-\phi}}. \tag{33}$$

The growth rate of aggregate human capital depends positively on $R^*(\xi)$.

The equilibrium aggregate output is given by

$$Y^*_t = \begin{cases} AH^*_t & \text{with probability} \quad p^*(\xi), \\ (1-\delta)AH^*_t & \text{with probability} \quad 1 - p^*(\xi). \end{cases} \tag{34}$$

Therefore, the expected level of output $E(Y^*_t)$ is

$$E(Y^*_t) = (1 - (1 - p^*)\delta)AH^*_t. \tag{35}$$

Let us define the average growth rate of output between periods t and $t+1$ such that $E(Y^*_{t+1})/E(Y^*_t)$. Then, the average growth rate of output is equal to the growth rate of aggregate human capital and is increasing in $R^*(\xi)$. Thus, we derive the following proposition on the effects of inequality on the growth rate.

Proposition 3. *The growth rate of human capital and the average growth rate of output $E(Y^*_{t+1})/E(Y^*_t)$ are decreasing in inequality ξ.*

5 Numerical Examples

In the previous sections, we assumed that the distribution of relative human capital is uniform so that one could analyze the model in a simple way. However, the assumption of uniform distribution may seem a bit unrealistic, and one may doubt whether our results hold when we assume a more realistic distribution. In order to answer this question, this section provides some numerical examples with a more realistic distribution of relative human capital.

We suppose that the distribution of relative income y_{it}/Y_t follows a log-normal distribution, $F(\cdot)$, which is commonly used as an approximation to income distribution.[21] In the model, the relative human capital $\tilde{h}_{it}$ coincides with the relative income. Furthermore, when the relative income follows a log-normal distribution, the shape of the distribution of income y_i is the same as the distribution of y_i/Y except for the mean. The mean of F is equal to 1 since F is a distribution of relative income. We examine the different variances of relative income in the range where the corresponding Gini coefficients are close to the actual ones.[22] Figure 4 shows the shapes of relative income distribution with the same mean but different dispersions. The solid line represents the density of relative income in the economy where the Gini coefficient is 0.30, which is close to the coefficients in East Asian countries.[23] The dotted line represents the density of relative income in the more unequal economy where the Gini coefficient is 0.50, which is close to the coefficients in Latin American countries.[24] The dashed line represents the distribution of relative income in the economy with an intermediate level of inequality. As Figure 4 clearly shows, a more equal income distribution will have a larger density in a considerable part of the range of relative income, especially around the mean. Since the main mechanism of our model is driven by the link between inequality and the small density of income distribution, we feel that our basic results hold even if we assume a log-normal distribution. Using a parameterized model, we confirm this conjecture numerically and examine how a change in inequality could affect the equilibrium tax rate and equilibrium support share.

Before a detailed specification, we must emphasize the following. Since our model is not for quantitative analysis and it is difficult to find plausible empirical targets for some parameters, we do not offer quantitative predictions. Our focus is on whether the mechanism of the model is robust to alternative shapes of income distribution. Thus, we focus mainly on the direction in which an increase in inequality could change the tax rate and political stability.

We specify the values of the model's parameters to make our numerical analysis as plausible as possible. We must choose three parameters of the model in order to calculate the numerical values of the equilibrium tax rate and equilibrium share of supporters.[25] It is

[21] Note that the distribution of relative human capital remains unchanged through generations regardless of the shape of distribution in the initial period.

[22] We provide more detailed explanations in Appendix C.

[23] According to Deininger and Squire (1996), the average Gini coefficient is 34.19 in South Korea (1953-1988), 33.49 in Indonesia (1964-1993), 29.62 in Taiwan (1964-1993), and 40.12 in Singapore (1973-1989).

[24] Deiniger and Squire (1996) report that the mean of Gini coefficients is 57.32 in Brazil(1960-1989), 51.84 in Chile (1968-1994), 51.51 in Columbia (1970-1991), and 47.99 in Peru (1971-1994).

[25] We do not calculate the equilibrium survival probability since it would need to specify the values of n and χ.

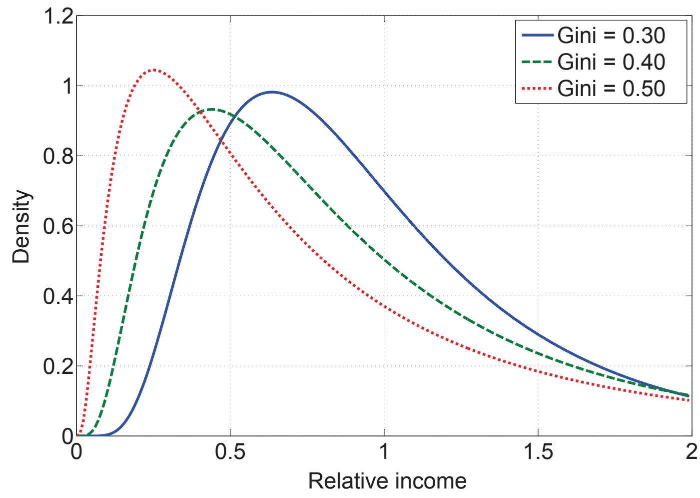

Figure 4: Log-normal distributions

Parameter	Value	Description
δ	0.05	Productivity loss of political instability
Ψ	0.25	Expected gain of political turnover
ν	0.5	Parameter of political stability function

Table 1: Value of parameters

enough to calculate the share of supporters for identifying the direction in which an increase in inequality changes the survival probability. The benchmark parameters are shown in Table 1. We set the parameter δ based on existing empirical research. We set the productivity loss from political instability, δ, as 5%, which is the average output loss from a political crisis in poor countries, as estimated by Cerra and Saxena (2008).

On the remaining two parameters, we examine several values since we have little empirical evidence. We can interpret the expected gain of political turnover Ψ as the degree of political conflict over public expenditure allocation. In the benchmark model, we set $\Psi = 0.25$, which takes the equilibrium tax rate to around 18%. Tanzi and Zee (2000) report that the average share of tax revenue to GDP in developing countries is about 18%. We examine cases when $\Psi = 0.20$ and $\Psi = 0.33$. Parameter ν reflects the elasticity of the probability of political stability with respect to the number of supporters. We set $\nu = 0.5$ in the benchmark, but also examine the cases where $\nu = 0.33$ and $\nu = 0.66$.

Since the upper limit of the tax rate $\bar{\tau}$ always binds, the equilibrium tax rate is a solution of the first-order condition (28). We graphically show how the trade-off that the incumbent ruler faces would change under a log-normal income distribution, which corresponds to Figure 3 in Section 4. In Figure 5, we plot the values of the elasticity of tax revenue with respect to $\bar{\tau}$, which is always equal to one, and the values of the elasticity of survival probability with

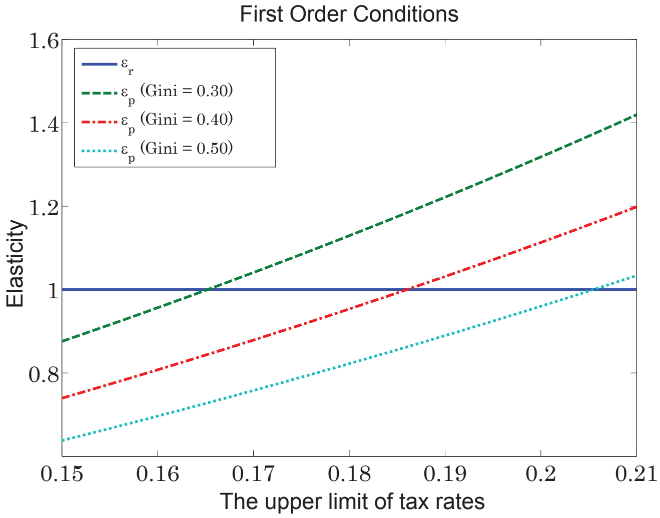

Figure 5: Equilibrium tax rates

respect to $\bar{\tau}$ under the benchmark parameter values. We examine three economies with Gini coefficients 0.30, 0.40, and 0.50. Figure 5 is consistent with the main results of the model that the survival probability is more sensitive to institutional changes in more equal economies and that the equilibrium tax rate is lower in these economies. Thus, this numerical example suggests that the mechanism of our model does not depend on the assumption of uniform income distribution.

In Figure 6, we plot the equilibrium tax rates and the equilibrium share of supporters for various values of Ψ. Although the expected gain of political turnover Ψ affects the levels of tax rate and share of supporters, the qualitative relationship between these variables and inequality does not change. An increase in inequality would increase the tax rate and reduce the share of supporters. Similarly, Figure 7 examines the different values of ν. Figure 7 indicates the quantitative importance of the elasticity of survival probability for the choice of the incumbent ruler. When the survival probability is sensitive to the support share, the ruler would avoid choosing a high $\bar{\tau}$ and gain more support from the citizens. However, the positive relationship between inequality and tax rate would hold irrespective of the value of ν.

Our quantitative exercise shows that the qualitative prediction of the model does not change even though we assume a realistic income distribution. This is because a large inequality would decrease the number of middle class individuals whose income is around the mean, as shown in Figure 4.

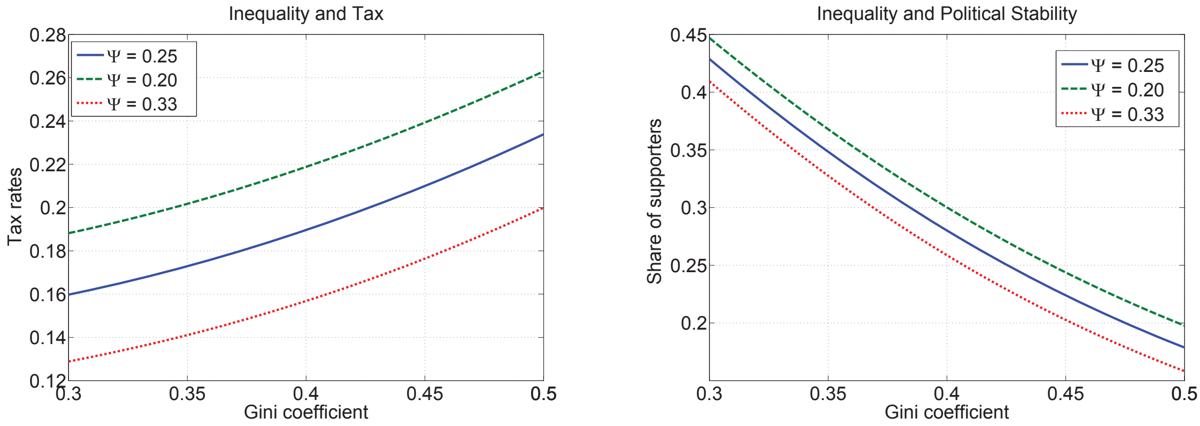

Figure 6: Impact of Inequality ($\nu = 0.5$)

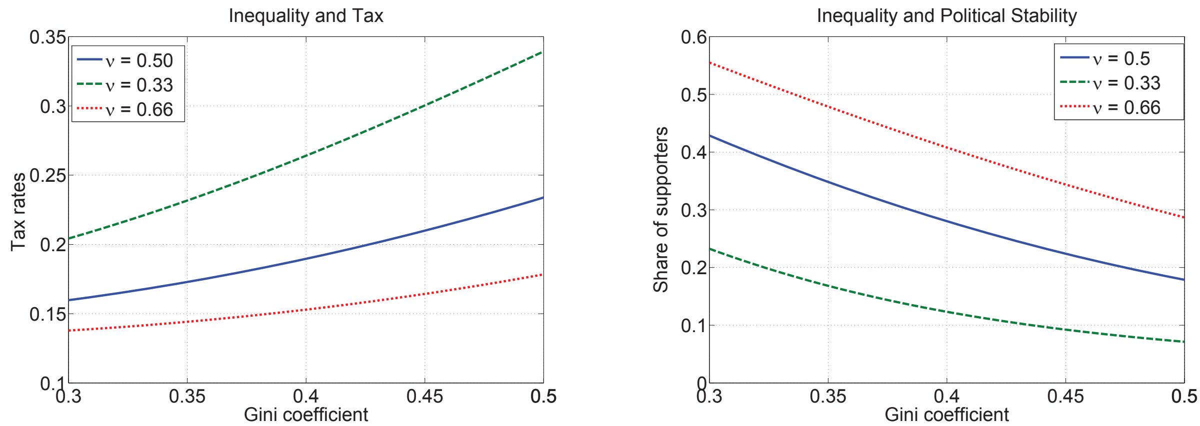

Figure 7: Impact of Inequality ($\Psi = 0.25$)

6 Conclusion

This paper provides a model that explains the negative effect of inequality on economic growth in nondemocratic countries. The ruler in a nondemocratic regime chooses institutions that constrain the policy choice of the ruler. When choosing his or her institutions, the ruler faces a trade-off between expropriation of citizens' wealth and hold on power. If the ruler adopts good institutions that prevent the ruler from expropriating citizens' wealth, the ruler is more likely to retain political power, but obtains small private benefit.

We show that inequality makes the ruler choose extractive institutions and hence discourages investment by citizens. This is because political preferences of citizens would be largely dispersed if inequality among citizens is large. The dispersed political preferences render public support for the incumbent ruler less responsive to the change in institutions. In this situation, the marginal effects of introducing good institutions on the ruler's survival probability are small. Thus, large inequality leads to extractive institutions and impedes investment and economic growth.

The results of this paper are based on the assumption that equal income distribution has a large density. This relationship holds to a considerable extent under a log-normal distribution, which is a standard approximation to income distribution. We provide some numerical examples to show that the results obtained under the assumption of uniform income distribution also hold under a log-normal distribution.

These results provide an explanation for the negative relationship between inequality and growth observed in nondemocratic countries. The prediction of the model that economic inequality is negatively related with the quality of institutions is also consistent with recent empirical studies.

References

Acemoglu, D., 2005. Politics and economics in weak and strong states. Journal of Monetary Economics, 52, 1199-1226.

Acemoglu, D., Johnson, S., Robinson, J.A., 2001. The colonial origins of comparative development: an empirical investigation. American Economic Review, 91, 1369-1401.

Acemoglu, D., Johnson, S., Robinson, J.A., 2002. Reversal of fortune: geography and institutions in the making of the modern world income distribution. American Economic Review, 117, 1231-1294.

Acemoglu, D., Robinson, J.A., 2006. Economic Origins of Dictatorship and Democracy. Cambridge University Press.

Acemoglu, D., Verdier, T., Robinson, J.A., 2004. Kleptocracy and divide-and-rule: a model of personal rule. Journal of the European Economic Association, 2, 162-192.

Alesina, A., Angeletos, G.M., 2005. Corruption, inequality, and fairness. Journal of Monetary Economics, 52, 1227-1244.

Alesina, A., Perotti, R., 1996. Income distribution, political instability, and investment. European Economic Review, 40, 1203-1228.

Alesina, A., Rodrik, D., 1994. Distributive policies and economic growth. Quarterly Journal of Economics, 109, 465-490.

Banerjee, A., Duflo, E., 2003. Inequality and growth: what can the data say? Journal of Economic Growth, 8, 267-299.

Barreto, R.A., 2000. Endogenous corruption in a neoclassical growth model. European Economic Review, 44, 35-60.

Barro, R., 1973. The control of politicians: an economic model. Public Choice, 14, 19-42.

Barro, R., 2000. Inequality and growth in a panel of countries. Journal of Economic Growth, 5, 5-32.

Benabou, R., 1996. Inequality and growth. NBER Macroeconomics Annual, 11, 11-74.

Bertola, G., 1993. Factor shares and savings in endogenous growth. American Economic Review, 83, 1184-1198.

Besley, T., 2006. Principled Agents?: The Political Economy of Good Government. Oxford University Press.

Besley, T., Kudamatsu, M., 2008. Making autocracy work, in: Helpman, E. (Eds.), Institutions and Economic Performance. Harvard University Press, pp. 452-510.

Bourguignon, F., Verdier, T., 2000. Oligarchy, democracy, inequality and growth. Journal of Development Economics, 2, 285-313.

Cervellati, M., Fortunato, P., Sunde, U., 2008. Hobbes to Rousseau: inequality, institutions and development. Economic Journal, 118, 1354-1384.

Cerra, V., Saxena, S.C., 2008. Growth dynamics: the myth of economic recovery. American Economic Review, 98, 439-457.

Chong, A., Gradstein, M., 2007. Inequality and institutions. Review of Economics and Statistics, 89, 454-465.

Dalgic, E., Long, N.V., 2006. Corrupt local governments as resource farmers: the helping hand and the grabbing hand. European Journal of Political Economy, 22, 115-138.

de la Croix, D., Delavallade, C., 2009. Growth, public investment and corruption with failing institutions. Economics of Governance, 10, 187-219.

Deininger, K., Squire, L., 1996. A new data set measuring income inequality. World Bank Economic Review, 10, 565-591.

Deininger, K., Squire, L., 1998. New ways of looking at old issues: inequality and growth. Journal of Development Economics, 57, 259-287.

Dixit, A., Londregan, J., 1996. The determinants of success of special interests in redistributive politics. Journal of Politics, 58, 1132-1155.

Easterly, W., 2001. The middle class consensus and economic development. Journal of Economic Growth, 6, 317-336.

Easterly, W., 2007. Inequality does cause underdevelopment: insights from a new instrument. Journal of Development Economics, 84, 755-776.

Ehrlich, I., Lui, F.T., 1999. Bureaucratic corruption and endogenous economic growth. Journal of Political Economy, 107, 270-293.

Eicher, T., García-Peñalosa, C., van Ypersele, T., 2009. Education, corruption, and the distribution of income. Journal of Economic Growth, 14, 205-231.

Engerman, S., Sokoloff, K., 1997. Factor endowments, institutions, and differential paths of growth among new world economies, in: Haber, S. (Eds.), How Latin America Fell Behind. Stanford University Press, pp. 260-304.

Ferejohn, J., 1986. Incumbent performance and electoral control. Public Choice, 50, 5-25.

Forbes, K., 2000. A reassesment of the relationship between inequality and growth. American Economic Review, 90, 869-887.

Galor, O., Zeira, J., 1993. Income distribution and macroeconomics. Review of Economic Studies, 60, 35-52.

Galor, O., Moav, O., Vollrath, D., 2009. Inequality in landownership, the emergence of human-capital promoting institutions, and the great divergence. Review of Economic Studies, 76, 143-179.

Glaeser, E., Scheinkman, J., Shleifer, A., 2003. The injustice of inequality. Journal of Monetary Economics, 50, 199-222.

Gradstein, M., 2007. Inequality, democracy, and the protection of property rights. Economic Journal, 117, 252-269.

Grossman, H.I., Noh, S.J., 1994. Proprietary public finance and economic welfare. Journal of Public Economics, 53, 187-204.

Hall, R.E., Jones, C.I., 1999. Why do some countries produce so much more output per worker than others? Quarterly Journal of Economics, 114, 83-116.

Keefer, P., Knack, S., 2002. Polarization, politics and property rights: links between inequality and growth. Public Choice, 111, 127-154.

Knack, S., Keefer, P., 1995. Institutions and economic performance: cross-country tests using alternative institutional measures. Economics & Politics, 7, 207-227.

Knack, S., Keefer, P., 1997. Does inequality harm growth only in democracies? A replication and extension. American Journal of Political Science, 41, 323-332.

Lindbeck, A., Weibull, J., 1987. Balanced-budget redistribution as the outcome of political competition. Public Choice, 52, 273-297.

Long, V.N., Sorger, G., 2006. Insecure property rights and growth: the role of appropriation costs, wealth effects, and heterogeneity. Economic Theory, 28, 513-529.

Mauro, P., 1995. Corruption and growth. Quarterly Journal of Economics, 110, 681-712.

McGuire, M.C., Olson, M., 1996. The economics of autocracy and majority rule: the invisible hand and the use of force. Journal of Economic Literature, 34, 72-96.

Mohtadi, H., Roe, T.L., 2003. Democracy, rent seeking, public spending and growth. Journal of Public Economics, 87, 445-466.

North, D.C., Weingast, B.R., 1989. Constitutions and commitment: the evolution of institutional governing public choice in seventeenth-century England. Journal of Economic History, 49, 803-832.

Overland, J., Simons, K.L., Spagat, M., 2005. Political instability and growth in dictatorships. Public Choice, 125, 445-470.

Padró i Miquel, G., 2007 The control of politicians in divided societies: the politics of fear. Review of Economic Studies, 74, 1259-1274.

Perotti, R., 1993. Political equilibrium, income distribution, and growth. Review of Economic Studies, 60, 755-776.

Perotti, R., 1996. Growth, income distribution, and democracy: what the data say. Journal of Economic Growth, 1, 148-187.

Persson, T., Tabellini, G., 1994. Is inequality harmful for growth? American Economic Review, 84, 600-621.

Persson, T., Tabellini, G., 2000. Political Economics: Explaining Economic Policy. MIT Press.

Robinson, J.A., Torvik, R., Verdier, T., 2006. Political foundations of the resource curse. Journal of Development Economics, 79, 447-468.

Rodrik, D., Subramanian, A., Trebbi, F., 2004. Institutions rule: the primacy of institutions over geography and integration in economic development. Journal of Economic Growth, 9, 131-165.

Shen, L., 2007 When will a dictator be good? Economic Theory, 31, 343-366.

Sokoloff, K., Engerman, S., 2000. Institutions, factor endowments, and paths of development in the new world. Journal of Economic Perspectives, 14, 217-232.

Sonin, K., 2003. Why the rich may favor poor protection of property rights. Journal of Comparative Economics, 31, 715-731.

Tanzi, V., Zee, H.H., 2000. Tax policy for emerging markets: developing countries. National Tax Journal, 53, 299-322.

Wintrobe, R., 1990. The tinpot and the totalitarian: an economic theory of dictatorship. American Political Science Review, 84, 849-872.

Wright, J., 2008. Do authoritarian institutions constrain? How legislatures affect economic growth and investment. American Journal of Political Science, 52, 322-343.

You, J.S., Khagram, S., 2005. A comparative study of inequality and corruption. American Sociological Review, 70, 136-157.

Appendix

A. Proof of Proposition 2

We derive condition (31) for $p^*(\xi)$ to be decreasing in ξ. Since $\varphi(\xi) \equiv \varphi(\bar{\tau}^*(\xi); \xi)$ is given by

$$\varphi(\xi) = \frac{1}{\xi}\left(1 + \frac{\xi}{2} + \alpha - \alpha\sqrt{1 + \frac{1+\frac{\xi}{2}}{\alpha}}\right), \tag{A1}$$

we derive

$$\begin{aligned}\varphi'(\xi) &= -\frac{1}{\xi^2}\left(1 + \frac{\xi}{2} + \alpha - \alpha\sqrt{1 + \frac{1+\frac{\xi}{2}}{\alpha}}\right) + \frac{1}{\xi}\left(\frac{1}{2} - \frac{1}{4}\sqrt{\frac{\alpha}{1+\alpha+\frac{\xi}{2}}}\right) \\ &= -\frac{1}{\xi^2}\left(1 + \alpha - \alpha\sqrt{1 + \frac{1+\frac{\xi}{2}}{\alpha}} + \frac{\xi}{4}\sqrt{\frac{\alpha}{1+\alpha+\frac{\xi}{2}}}\right).\end{aligned} \tag{A2}$$

Therefore, $\varphi'(\xi) < 0$ if and only if

$$\begin{aligned}1 + \alpha &> \alpha\sqrt{1 + \frac{1+\frac{\xi}{2}}{\alpha}} - \frac{\xi}{4}\sqrt{\frac{\alpha}{1+\alpha+\frac{\xi}{2}}} \\ &= \sqrt{\frac{\alpha}{1+\alpha+\frac{\xi}{2}}}\left(\alpha\frac{1+\alpha+\frac{\xi}{2}}{\alpha} - \frac{\xi}{4}\right) \\ &= \sqrt{\frac{\alpha}{1+\alpha+\frac{\xi}{2}}}\left(1+\alpha+\frac{\xi}{4}\right).\end{aligned} \tag{A3}$$

By arranging (A3), we get (31).

B. Proof of Lemma 4

We rewrite the equilibrium return on human capital (32) as

$$\begin{aligned}R^*(\xi) &= [p^*(\xi)(1-\bar{\tau}^*(\xi)) + (1-p^*(\xi))(1-\bar{\tau}^*(\xi))(1-\delta)]A \\ &= \delta Q(\xi)A + (1-\bar{\tau}^*(\xi))(1-\delta)A,\end{aligned} \tag{B1}$$

where $Q(\xi)$ is given by

$$Q(\xi) = (1-\bar{\tau}^*(\xi))p^*(\xi). \tag{B2}$$

We show that $Q(\xi)$ is decreasing in ξ, which implies that $R^*(\xi)$ is also decreasing in ξ since $(1-\bar{\tau}^*(\xi))(1-\delta)A$ is decreasing in ξ.

From (29), (30), and (B2), we have

$$\begin{aligned}Q(\xi) &= \frac{(n-1)\chi}{n\xi}\sqrt{\frac{\alpha}{\alpha+1+\frac{\xi}{2}}}\left(1 + \frac{\xi}{2} + \alpha - \alpha\sqrt{1 + \frac{1+\frac{\xi}{2}}{\alpha}}\right) \\ &= \frac{(n-1)\chi}{n\xi}\sqrt{\alpha}\left(\sqrt{1+\alpha+\frac{\xi}{2}} - \sqrt{\alpha}\right).\end{aligned} \tag{B3}$$

By differentiating (B3), we have

$$\begin{aligned}
Q'(\xi) &= -\frac{(n-1)\chi}{n\xi^2}\sqrt{\alpha}\left(\sqrt{1+\alpha+\frac{\xi}{2}}-\sqrt{\alpha}\right)+\frac{(n-1)\chi}{n\xi}\sqrt{\alpha}\left(\frac{1}{4\sqrt{1+\alpha+\frac{\xi}{2}}}\right) \\
&= -\frac{(n-1)\chi}{n\xi^2}\sqrt{\alpha}\left(\sqrt{1+\alpha+\frac{\xi}{2}}-\sqrt{\alpha}-\frac{\xi}{4\sqrt{1+\alpha+\frac{\xi}{2}}}\right) \\
&= -\frac{(n-1)\chi}{n\xi^2}\sqrt{\alpha}\left(\frac{1+\alpha+\frac{\xi}{4}}{\sqrt{1+\alpha+\frac{\xi}{2}}}-\sqrt{\alpha}\right).
\end{aligned} \tag{B4}$$

(B4) implies that $Q'(\xi) < 0$ if and only if

$$\sqrt{\alpha}\sqrt{1+\alpha+\frac{\xi}{2}} < 1+\alpha+\frac{\xi}{4}. \tag{B5}$$

We show that (B5) holds for any $\xi > 0$. Now, we define $\Gamma(\xi)$ by

$$\Gamma(\xi) = 1+\alpha+\frac{\xi}{4}-\sqrt{\alpha}\sqrt{1+\alpha+\frac{\xi}{2}}. \tag{B6}$$

Since $\Gamma(0) = 1+\alpha-\sqrt{\alpha}\sqrt{1+\alpha} > 0$ and

$$\Gamma'(\xi) = \frac{1}{4}\left(1-\frac{\sqrt{\alpha}}{\sqrt{1+\alpha+\frac{\xi}{2}}}\right) > 0, \quad \forall\xi > 0, \tag{B7}$$

$\Gamma(\xi) > 0$ for all $\xi > 0$. This means that $Q'(\xi) < 0$ for all $\xi > 0$, i.e., $Q(\xi)$ is decreasing in ξ.

C. Procedure of Numerical Analysis

We assume that relative human capital $\tilde{h}_i$ follows a log-normal distribution. For numerical analysis, we must choose the parameters (μ, σ) of the density function of the log-normal distribution, which is given by

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma x}e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}. \tag{C1}$$

The distribution function is

$$F(x) = \Phi\left(\frac{\ln x-\mu}{\sigma}\right), \tag{C2}$$

where Φ is the distribution function of a standard normal distribution. The corresponding mean and variance are given by

$$E(x) = e^{\mu+\frac{\sigma^2}{2}}, \quad V(x) = e^{2\mu+\sigma^2}(e^{\sigma^2}-1).$$

Since the mean of relative human capital is always equal to one, we must choose parameters so that $E(x) = 1$. Therefore, we choose μ so as to satisfy

$$\mu = -\frac{\sigma^2}{2}. \tag{C3}$$

We identify parameter σ from the target Gini coefficients. It is known that the Gini coefficient under a log-normal distribution depends only on σ and is given by

$$G = 2\Phi\left(\frac{\sigma}{\sqrt{2}}\right) - 1. \tag{C4}$$

From (C3) and (C4), we can choose (μ, σ) uniquely if we have the target value of Gini coefficients, G.

Using (C1) and (C2), we calculate the equilibrium tax rate. When $\tilde{h}_i$ follows a log-normal distribution, equation (23) (which represents the support share of citizens with preferences other than θ^I) is replaced by

$$\varphi(\bar{\tau}) = \int_{\psi(\bar{\tau})}^{\infty} f(x)dx = 1 - F(\psi(\bar{\tau})). \tag{C5}$$

From (C2), (C3), and (C5), the first-order condition (28) is replaced by

$$\begin{aligned} 1 &= \frac{\nu\psi'(\bar{\tau})}{\varphi(\bar{\tau})} f(\psi(\bar{\tau}))\bar{\tau} \\ &= \left[1 - \Phi\left(\frac{\ln\psi(\bar{\tau})}{\sigma} + \frac{\sigma}{2}\right)\right]^{-1} \frac{\nu\alpha}{(1-\bar{\tau})^2} f(\psi(\bar{\tau}))\bar{\tau}. \end{aligned} \tag{C6}$$

From equations (C5) and (C6), we can calculate the equilibrium institution, which is equal to the equilibrium tax rate, and the equilibrium share of supporters.