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Inequality, Extractive Institutions, and Growth in Nondemocratic Regimes*

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Abstract

This study investigates the effect of inequality on economic growth in nondemocratic regimes. We provide a model in which a self-interested ruler chooses an institution that constrains his or her policy choice. The ruler must care about the support share of citizens in order 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 because of low public support. We show that inequality affects the ruler's trade-off between the expropriation of citizens' wealth and his or her hold on power. Large inequality among citizens makes the support share for the ruler inelastic with respect to his or her choice of institution. Thus, the ruler chooses an extractive institution, which impedes investment and growth. These results provide an explanation for the negative relationship between inequality and growth and the negative relationship between inequality and the quality of institutions, both of which are observed in nondemocratic countries.

JEL classification: O11, D31, P14, P16

Keywords: Dictatorship, Economic Growth, Inequality, Institutions

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1 Introduction

Recent studies examining the sources of economic growth have shown that good institutions, capable of securing property rights and enforcing contracts to encourage private investment, are crucial to successful economic development (Knack and Keefer 1995, Mauro 1995, Hall and Jones 1999, Acemoglu et al. 2001, Rodrik et al. 2004). Accordingly, the existence of "extractive institutions,"[1] under which the government has leeway to expropriate citizens' wealth, is seen as a major obstacle to economic success for many less developed countries.

The lack of political freedom is said to be one cause of extractive institutions (Acemoglu and Robinson 2012). However, the quality of institutions varies across nondemocratic countries, and constraints on rulers' behavior, such as binding legislatures and political parties, can emerge in nondemocratic regimes (Gandhi and Przeworski 2006, Wright 2008, Gehlbach and Keefer 2011). Furthermore, not all nondemocratic countries fail to attain economic development, and there are large variations in the economic performance of such countries (Glaeser et al. 2004, Besley and Kudamatsu 2008). For example, while some East Asian countries achieved rapid economic growth under nondemocracy (e.g., South Korea, Singapore, Indonesia, and China), many African countries fared less well under dictators who brought about economic stagnation or decline, rather than development.

This study provides a model to examine why some nondemocratic countries succeed in building good institutions, while others fail. We argue that income distribution is related to the variation in institutions and economic development of nondemocratic countries. Our theory reflects the fact that successful nondemocratic regimes have a more equal income distribution than failed nondemocratic regimes do. Figure 1 shows that per capita income among nondemocratic countries is negatively correlated with the measure of income inequality.[2] Moreover, as Table 1 shows, nondemocratic countries with a more equal income distribution tend to have a better quality of government than those with an unequal income distribution do.[3] With regard to East Asian countries, Birdsall et al. (1995) highlight income equality as a factor that led to the rapid growth of these countries.

In the model, a self-interested ruler chooses an institution that constrains his or her

[1] We borrow the term "extractive institutions" from Acemoglu et al. (2001, 2002). Acemoglu et al. (2002:1235) use the term to refer to institutions that "concentrate power in the hands of a small elite and create a high risk of expropriation for the majority of the population". We also consider institutions to be extractive when the property rights of citizens are not protected and the ruler in power can expropriate a large share of citizens' wealth.

[2] Based on the Polity IV data set (Center for Systemic Peace 2012), we classify the political regime of a country as follows. First, following Persson and Tabellini (2009), the regime of a country in a given year is classified as a nondemocracy if the score of the polity2 variable from the Polity IV data set is less than zero, and as a democracy otherwise. Then, we define a country as a nondemocracy if the periods of nondemocracy are longer than those of democracy between 1960 and 2005. The measure of inequality is the simple average of the Gini coefficients from 1960 to 2005, as provided by UNU-WIDER World Income Inequality Database (UNU-WIDER 2008). Note that controlling for different definitions of inequality, resulting from different units of observation, the definition of income, among others, does not change the results. Per-capita income is obtained from the Penn World Table 8.0 (Feenstra et al. 2015).

[3] The measure of inequality is the same as Figure 1. The measures of governance quality are from the Worldwide Governance Indicators (Kaufmann et al. 2011).

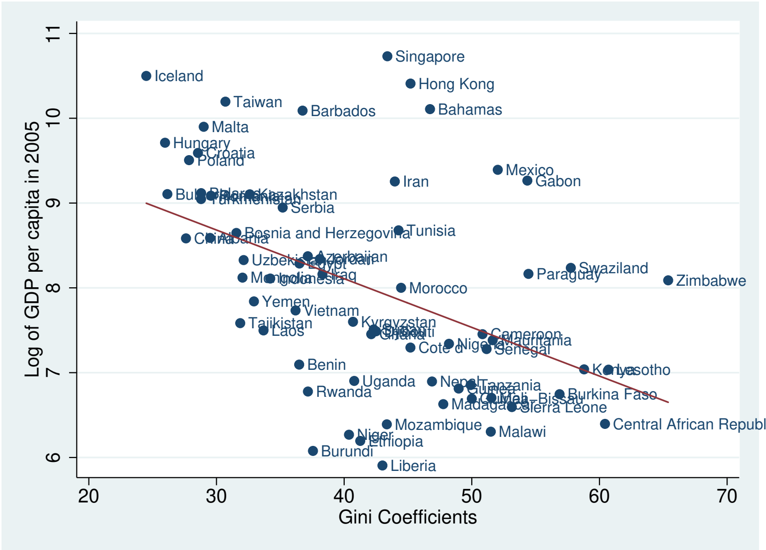

Figure 1: Inequality and log of GDP per capita in 2005 among nondemocratic countries

policy choice. The institution affects the leeway for the ruler to expropriate citizens' wealth, as well as his or her political survival, which depends on the share of citizens who support the ruler. A ruler who chooses an extractive institution can expropriate a large share of citizens' wealth, but faces a high probability of losing power by losing citizens' support. By introducing institutions that restrict the ruler's confiscatory behavior, the ruler can commit to a decrease in expropriation and gain support from citizens. Hence, the ruler faces a trade-off between expropriating citizens' wealth and holding on to power.

A similar trade-off for an autocratic ruler has been analyzed in previous studies (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). A common feature of the models in these studies is that the ruler chooses policies for personal

Table 1: Correlation between Gini coefficients and the quality of government in 2005 among nondemocratic countries (67 observations)

Variables	Correlation Coefficient	p-value
Government Effectiveness	-0.294	(0.016)
Regulatory Quality	-0.267	(0.029)
Rule of Law	-0.256	(0.036)
Control of Corruption	-0.205	(0.096)
Political Stability	-0.218	(0.076)
Voice and Accountability	-0.200	(0.104)

gain, but that the policy choices also affect the probability of the ruler staying in power.

The contribution of this study is to propose that income distribution affects the aforementioned trade-off. We argue that a large inequality among citizens makes their support for a ruler inelastic to the choice of the ruler. When the elasticity of the ruler's survival probability with respect to the institutional level is low, the ruler has few incentives to build good quality institutions. Hence, a large inequality leads to an extractive institution and, thus, impedes investment and growth.

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, which, in turn, 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 (2007) confirm that there is bidirectional causality between income inequality and poor institutions.

As anecdotal evidence supporting the theoretical mechanism of our model, we examine the historical background of the emergence of good quality institutions in England after the Glorious Revolution. The explanation of our model on the relation between equality and good quality institutions is that an equal wealth distribution yields a great number of citizens with similar political interests, which makes the political support for a ruler responsive to the ruler's choice of institutions. Consistent with the theory, since the 16th century, radical economic and social changes in England made wealth distribution equal and yielded a sizable middle class with similar political interests. This, in turn, played a critical role in forcing the monarchy to accept constraints on royal power.

The rest of this paper is organized as follows. Section 2 relates this paper to existing work. Section 3 builds the model. Analyzing the model, Section 4 shows the effect of inequality on institutions and growth. Section 5 provides numerical examples to confirm that the predictions of the model do not change under an alternative assumption about the shape of income distribution. Section 6 provides historical evidence from England. Finally, Section 7 concludes the paper.

2 Related Literature

The relationship between inequality and economic growth has been investigated both empirically and theoretically. Findings on the empirical relationship between inequality and growth vary across studies. Alesina and Rodrik (1994), Persson and Tabellini (1994), Perotti (1996), and Easterly (2007) find that inequality is negatively related to growth. However, Forbes (2000) finds a positive impact of inequality on growth, and Banerjee and Duflo (2003) show a nonlinear impact. Moreover, Deininger and Squire (1998) reveal that asset inequality has a negative impact on economic growth, but only in nondemocratic countries, while Barro (2000) finds that the effects of inequality on growth are negative in poor countries, but positive in rich countries. The negative relationship between inequality and growth has been explained by theories as varied as credit market imperfections (Galor and Zeira 1993), redistributional policies as a result of majority voting (Alesina and Rodrik 1994, Persson and Tabellini 1994), and political opposition by landowners to public support for human capital formation (Galor et al. 2009).

We analyze how inequality affects the trade-off for a ruler between extracting citizens' wealth and holding on to power. In this sense, our work is related to that of Acemoglu et al. (2004) and Eicher et al. (2009).

Acemoglu et al. (2004) analyze how and when a ruler can expropriate citizens' wealth without being ousted by revolution. In their model, democratization replaces the ruler if producer groups cooperate to plot a revolution, while the ruler attempts to buy off a pivotal producer group to deter intergroup cooperation. When large intergroup inequality exists, the income of the richer producer group is high, and they attach a high value to ousting the kleptocratic ruler. Therefore, large inequality motivates the ruler to decrease the tax rate on the richer group. This result contrasts with our finding that a large degree of inequality allows a ruler to impose heavy taxes on all citizens.

In the model of Eicher et al. (2009), a policymaker expropriates citizens' wealth, and the probability of the corrupt policymaker being re-elected depends on the citizens' educational level. The policymaker can increase both production levels and corruption rents by expanding educational levels. However, increased educational levels force the policymaker to forgo future corruption rents, because educated citizens can detect corruption. A large income inequality decreases the income level of the poor, increases the necessary subsidies for the poor to receive education, and, thereby, affects the policymaker's choice of educational levels and economic development. In contrast to their study, we focus on the elasticity of citizens' support as the mechanism through which income inequality affects a ruler's policy choices and economic development.

Acemoglu and Robinson (2000) and Bourguignon and Verdier (2000) also consider an environment in which the policy choices of the elite affect their hold on power, and analyze how inequality affects their policy choices. Acemoglu and Robinson (2000) provide a model in which the elite attempt to prevent revolution by making concessions to citizens, such as a temporary income redistribution or franchise extensions. When the income inequality between the elite and the citizens is large, citizens have a large incentive to revolt, and the elite in power must offer major concessions to citizens to prevent this from occurring. Therefore, once the opportunity for revolution is realized, larger inequality leads to more favorable policies for citizens. This conclusion contrasts with our findings, as presented in this paper.[4] Bourguignon and Verdier (2000) propose a model in which the elite in power choose a fraction of the poor to receive education subsidies. While educating the poor enhances the income of the elite owing to the externality of education, it also brings about political participation by the educated poor. Extensive political participation by the poor

[4]Acemoglu and Robinson (2006) argue that concessions to citizens may be avoided if the elite can choose to repress a revolution. This is the case in which high inequality makes the cost of concessions higher than the cost of repression.

threatens the elite's political power and leads to income redistribution. Inequality affects the elite's policy choice through the amount of necessary subsidies and the scale of income redistribution.

We argue that inequality harms the protection of property rights and impedes investment and growth. In this sense, this study is related to those 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). Our findings provide new insight into the effect of inequality. When inequality is large, a ruler can build extractive institutions, because public support for the ruler is inelastic to a change in institutions.

Finally, since government expropriation is a type of corruption, this study is related to those on inequality and corruption (Alesina and Angeletos 2005, Eicher et al. 2009), as well as 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).

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 human capital. In the second period, they produce consumption goods, consume them, and participate in political activities.[5]

The level of human capital of each citizen depends both on his or her effort input in the first period of life and parental human capital. We assume the following 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 reproduces the inequality of a generation in the succeeding generation.

Differences in human capital constitute the source of income inequality in the economy. Let $F(\cdot)$ denote the cumulative distribution function of human capital distribution in the initial generation, and let $f(\cdot)$ denote its probability density function. We normalize the mean of the distribution to 1. The variance of this distribution represents the inequality in the economy.

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

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

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

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 on governmentally supplied goods (hereafter, called government goods). There are n types of government goods, and the citizens have different preferences for these goods. A citizen can benefit from only one type of government good. Hence, we can divide citizens into n types according to their preferences for the government goods. Let $\Theta = \{\theta_1, \cdots, \theta_n\}$ denote the set of types of government goods. Then, we can define the type of a citizen as $\theta \in \Theta$, which shows the type of government good that the citizen prefers. Let $g(\theta)$ denote the quantity of government good of type θ.

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 government goods come from factors that are independent of their human capital levels. For example, these factors include their districts of residence, religion, and ethnicity. If the type of a citizen $\theta \in \Theta$ represents the district in which the citizen resides, $g(\theta)$ refers to the quantity of local 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, $g(\theta)$ refers to the quantity of religious institutions or the level of transfer targeted to a specific ethnic group. Religious institutions are valuable only to those citizens who believe in that religion. If a society is segregated by ethnicity, the government can formulate a policy that is favorable for a specific ethnic group.

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

$$U^1(e, g(\theta)) = -\gamma e + \beta g(\theta), \quad \gamma > 0, \quad 0 < \beta < 1, \tag{3}$$

where γ is the marginal cost of effort input and β captures the importance of government 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 an income tax rate. Citizens do not discount future utility. Therefore they 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 depends on their consumption and government goods. As in the case of the utility of citizens, politicians can benefit from only one type of government good and their preferences are represented by (4). A type-θ politician represents the interests of type-θ citizens in the policy area of government goods provision. The probability that a randomly selected politician is type-θ is $1/n$ for all $\theta \in \Theta$.

At 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 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 gain unconstrained decision-making power in order to derive large private benefits. However, as we show below, such 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 makes the position of the ruler stable. North and Weingast (1989), analyzing the institutions of 17th-century England, argue that a parliament constraining the ruler's behavior can make the ruler commit credibly to giving up confiscatory behavior. Wright (2008) also argues that authoritarian regimes that need to facilitate investment create binding legislatures to commit credibly to restricting expropriation. We represent institution quality by the upper limit of tax rates $\bar{\tau}_t$ that the ruler can levy. No ruler can 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 tax rates by creating a well-functioning system of checks and balances.

After observing the institution that the incumbent ruler chooses, each citizen decides whether 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. Hence, citizens make their political choices anticipating that the ruler 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 this 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.[6] While we assume that $\nu = 1$ for simplicity, we consider the case of $\nu < 1$ 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 citizens whose

[6] 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).

preferences differ from his or her preferences, the survival probability is zero. This assumption is imposed to focus on the case in which the ruler cares about support from citizens with different preferences.

The survival probability of the incumbent ruler is introduced to analyze the trade-off between the ruler's expropriation of citizens' wealth and his or her hold on power. We adopt this setup 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.[7] Our assumption implies that a ruler is less likely to hold power when a larger share of citizens opposes 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 anti-government demonstrations, the more citizens that participate in a demonstration, the larger is the cost of repression for the ruler. This is because a large number of victims of repression may result in sanctions from the international community, which can bring about the downfall of the ruler. Third, since the cost of participating in anti-government demonstrations decreases as the number of participants increases,[8] 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 a tax rate $\tau_t \in [0, \bar{\tau}_t]$ and allocates tax revenue between government goods 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[9]

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

Let H_t denote the aggregate level of human capital and $Y_t = A_t H_t$ denote the aggregate output. Then, 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 may come from a

[7] Acemoglu and Robinson (2006:25) 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."

[8] Kuran (1989) analyzes such a strategic complementarity in the theory of revolution.

[9] For example, this cost includes losses due to the inefficient allocation of government posts for the ruler's family members or the resources used to hide the misappropriation of funds.

delay in policy decisions or disorder caused by internal conflict, among other reasons. 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 tax rates $\bar{\tau}_t$ 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 $(\tau_t, r_t, \{g_t(\theta)\}_{\theta\in\Theta})$.

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 policymaking 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 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 $\hat{\tau}_{t+1}$, while a new ruler will choose tax rate $\hat{\tau}^N_{t+1}$. Then, the expected consumption of citizen i in period $t+1$ is

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

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 of the 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 $H_0 = 1$.[10]

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 in parental human capital. In equilibrium, the distribution of relative human capital $\tilde{h}_{it}$ is the same as that of h_{i0}, and its c.d.f. and p.d.f. are given by $F(\cdot)$ and $f(\cdot)$ respectively.*

4.2 Political Process

The level of human capital in period t is determined by the 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.

[10]Therefore, we do not consider the dynamics of inequality, as it is beyond the scope of this study.

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:

$$\begin{aligned} \max_{(\tau, r, \{g(\theta)\}_{\theta\in\Theta})} \quad & rT + \beta g(\theta') \\ \text{s.t.} \quad & (7), (8), \text{ and } \tau \in [0, \bar{\tau}]. \end{aligned} \tag{13}$$

Clearly, it is suboptimal for the ruler to provide a positive amount of government 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 government 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 the appropriation rate dr increases private consumption by Tdr but decreases the resources available to purchase the government good $g(\theta')$ by $(1 + C'(r))Tdr$. Therefore, the ruler chooses an allocation so that $1 = \beta(1 + C'(r))$. The optimal policy of the ruler $(\tau_t^*, r_t^*, \{g_t^*(\theta)\}_{\theta\in\Theta})$ is summarized in the following lemma.[11]

Lemma 2. *A type-θ' ruler chooses 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*

$$r_t^* = \left(\frac{1-\beta}{\zeta\beta}\right)^{\frac{1}{\eta}} \equiv \bar{r}. \tag{14}$$

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

$$g_t^*(\theta') = \left(1 - \bar{r}\frac{1+\eta\beta}{(1+\eta)\beta}\right) T_t^*, \tag{15}$$

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 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 a change in power. If the incumbent ruler is replaced, a new ruler seizes power, which will benefit to citizens who prefer the same type of government good as the new ruler. However, a change in power decreases the productivity of the economy by δ.

[11] We assume an interior solution, which exists when ζ is sufficiently large.

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 a ruler will choose is given by lemma 2. 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

$$\begin{aligned} W(h_i, \theta) &= (1-\bar{\tau})\tilde{A}h_i + \frac{\beta}{n}\left(1 - \bar{r}\frac{1+\eta\beta}{(1+\eta)\beta}\right)\bar{\tau}\tilde{A}H \\ &= (1-\bar{\tau})\tilde{A}h_i + \bar{\tau}\Psi AH, \end{aligned} \tag{16}$$

where

$$\Psi \equiv \frac{\beta(1-\delta)}{n}\left(1 - \bar{r}\frac{1+\eta\beta}{(1+\eta)\beta}\right). \tag{17}$$

The first term in (16) is the after-tax income of citizen i, and the second term is the expected utility from the provision of government goods by the new ruler.

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

$$(1-\bar{\tau})Ah_i + g^*(\theta) \geq (1-\bar{\tau})\tilde{A}h_i + \bar{\tau}\Psi AH, \tag{18}$$

where $g^*(\theta)$ is the government 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 government good with probability one. When the incumbent ruler loses power, they receive the government good with probability less than one and incur a productivity loss owing to political instability. Hence, 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, he or she can credibly promise to provide the government good only to those citizens who share his or her preference.[12]

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

$$(1-\bar{\tau})Ah_i \geq (1-\bar{\tau})\tilde{A}h_i + \bar{\tau}\Psi AH. \tag{19}$$

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

$$\tilde{h}_i \geq \frac{\alpha\bar{\tau}}{1-\bar{\tau}} \equiv \psi(\bar{\tau}), \tag{20}$$

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 $\psi(\bar{\tau})$ support the incumbent ruler. Hence, rich citizens tend to support the incumbent ruler, but poor citizenss do not. Furthermore, 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 to citizens of a regime change from the decrease in the return on human capital, and this cost is proportional to the level of human capital. On the other hand, there is a benefit of a regime change owing to the provision of the own type of government good that can be realized with probability

[12] This formulation is based on the models of clientelism developed in Robinson and Torvik (2005) and Robinson et al. (2006).

$1/n$, and this benefit is the same for all citizens, regardless of the level of human capital. Thus, citizens with higher human capital tend to support the incumbent ruler. As the level of $\bar{\tau}$ increases, the budget scale allocated to the government good rises, and the benefit of a regime change to type-$\theta \neq \theta^I$ citizens also increases. 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 decreasing $\bar{\tau}$. By designing a well-functioning system of checks and balances, the incumbent ruler can make credible promises to protect citizens' property rights.

From the above results, the equilibrium share of supporters can be written as

$$s(\bar{\tau}) = \frac{1}{n} + \frac{n-1}{n}\left(1 - F\left(\psi(\bar{\tau})\right)\right). \tag{21}$$

From (5) and (21), the incumbent ruler's probability of staying in power is given by

$$p(\bar{\tau}) = \min\left\{\frac{\chi(n-1)}{n}\left(1 - F\left(\psi(\bar{\tau})\right)\right), 1\right\}. \tag{22}$$

The survival probability represented in equation (22) captures the constraint faced by the incumbent ruler in a nondemocratic regime. If the ruler chooses an institution that allows him or her to extract a larger share of citizens' income, fewer citizens will support the ruler, and it will become more difficult to retain political power. Equation (22) shows the important trade-off between the incumbent ruler's expropriation and his or her hold on power.

The above results are summarized in the following lemma.

Lemma 3. *In equilibrium, 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 ruler if and only if*

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

  where the threshold $\psi(\bar{\tau})$ is given by (20).

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

$$p(\bar{\tau}) = \min\left\{\frac{\chi(n-1)}{n}\left(1 - F\left(\psi(\bar{\tau})\right)\right), 1\right\}.$$

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 $[\bar{r} + \beta(1 - \bar{r} - C(\bar{r})]\bar{\tau}AH$. Thus the problem of the incumbent ruler is given by

$$\max_{\bar{\tau}} \quad p(\bar{\tau})\bar{\tau}. \tag{23}$$

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

$$p'(\bar{\tau}^*)\bar{\tau}^* + p(\bar{\tau}^*) = 0. \tag{24}$$

Equation (24) states that the incumbent ruler balances the trade-off between expropriation and political survival. On the one hand, a marginal increase in $\bar{\tau}$ decreases the survival probability and reduces the incumbent ruler's payoff by $-p'(\bar{\tau})\bar{\tau}$. On the other hand, a marginal increase in $\bar{\tau}$ raises tax revenue and increases the ruler's payoff by $p(\bar{\tau})$. The incumbent ruler will choose the institution that balances the marginal benefit and marginal cost. Equation (24) can be rewritten as

$$\epsilon_T = \epsilon_p(\bar{\tau}^*), \tag{25}$$

where

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

The left-hand side of (25), ϵ_T, is the elasticity of tax revenue with respect to $\bar{\tau}$, which is always equal to 1. That is, if the ruler increases the upper limit of tax rates by one percent, then the tax revenue also increases by one percent. On the other hand, an increase in the tax limit also increases the risk of being replaced. The right-hand side, $\epsilon_p(\bar{\tau})$, is the elasticity of the survival probability with respect to $\bar{\tau}$. If the ruler increases the upper limit of tax rates by one percent, then the survival probability decreases by ϵ_p percent. Since the incumbent ruler wants to maximize the expected revenue, he or she will choose $\bar{\tau}$ that equalizes these two elasticities.

Since $\epsilon_p(\bar{\tau})$ is proportional to the hazard rate of the distribution of relative human capital, $f(\psi(\bar{\tau}))/[1 - F(\psi(\bar{\tau}))]$, the shape of the income distribution affects the level of institutions. When $\epsilon_p(\bar{\tau})$ is a monotonically increasing function, $\bar{\tau}^*$ that satisfies the first-order condition uniquely exists. Equation (25) states that the ruler chooses a high upper limit $\bar{\tau}$ when the survival probability is inelastic with respect to the institutional choice of the ruler. Hence, a downward shift of the hazard rate function increases $\bar{\tau}^*$.

Proposition 1. *Assume that $\epsilon_p(\bar{\tau})$ is monotonically increasing function. Then, the equilibrium institutional level $\bar{\tau}^*$ is uniquely determined by condition (25), and downward shift of the hazard rate function makes the incumbent ruler choose more extractive institutions.*

Proposition 1 holds under the general form of the income distribution. The hazard rate of the income distribution affects the equilibrium institutional level through its impact on the elasticity of the survival probability. In the following, we adopt a simple distributional form to derive the relation between inequality and the equilibrium level of institution. In Section 5, we will confirm that our results are still valid under the log-normal distribution, which is commonly used as an approximation to income distribution.

We assume that the distribution of h_{i0} is uniform with support:

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

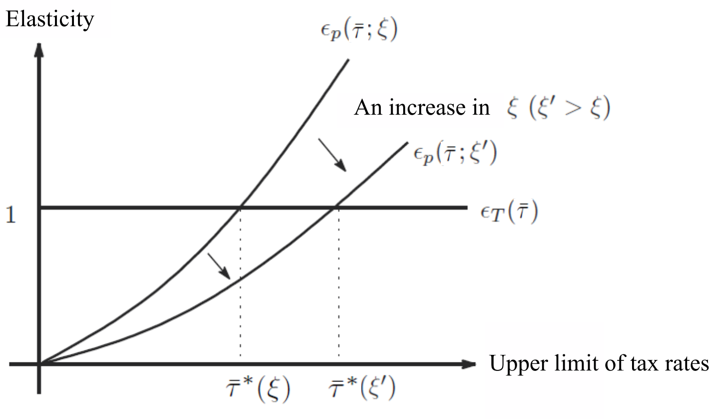

Figure 2: Equilibrium quality of the chosen institution

The variance of this distribution is $\xi/12$, and the parameter ξ represents the degree of inequality in the economy. A large ξ corresponds to a high level of inequality. In this case, the hazard rate function is given by

$$f(\psi(\bar{\tau}))/[1 - F(\psi(\bar{\tau}))] = \frac{1}{1 + \frac{\xi}{2} - \psi(\bar{\tau})}, \tag{26}$$

which is decreasing in the level of inequality ξ.[13] Hence, $\epsilon_p(\bar{\tau})$ is increasing in $\bar{\tau}$ and decreasing in ξ. When the degree of inequality ξ is large, the survival probability is inelastic to the change in $\bar{\tau}$.

Figure 2 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 institutional level 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 the extractive institution $\bar{\tau}^*$ is increasing in ξ.

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

$$\bar{\tau}^*(\xi) = 1 - \sqrt{\frac{\alpha}{\alpha + 1 + \frac{\xi}{2}}}. \tag{27}$$

Equation (27) shows that $\bar{\tau}^*(\xi)$ is indeed increasing in ξ.

Proposition 2. *The larger the degree of inequality ξ, the more extractive is the institution chosen by the incumbent ruler.*

The following illustrates the intuition behind the mechanism through which inequality affects the ruler's institutional choice. By differentiating the survival probability p with

[13] 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.

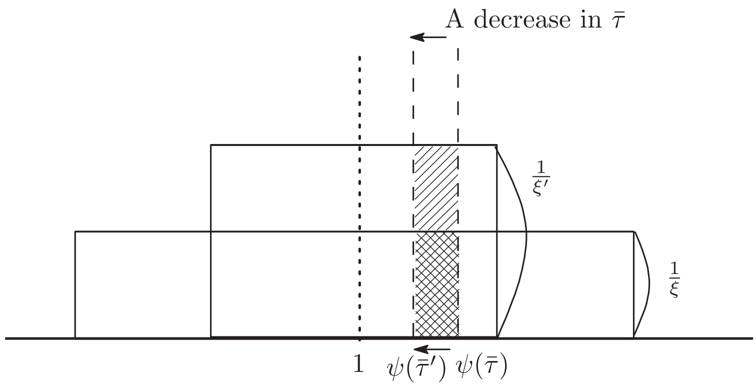

Figure 3: Marginal effects of $\bar{\tau}$ on $p(\bar{\tau};\xi)$

respect to $\bar{\tau}$, we obtain

$$\frac{\partial p}{\partial \bar{\tau}}(\bar{\tau};\xi) = -\frac{\chi(n-1)}{n}\frac{\psi'(\bar{\tau})}{\xi}. \tag{28}$$

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 using Figure 3. Suppose that there are two economies, namely an equal economy and an unequal economy. 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 3, $1/\xi'$ denotes the density of the distribution in the equal economy, and $1/\xi$ is the density in the unequal economy. Since the threshold $\psi(\bar{\tau})$ is independent of the distribution of $\tilde{h}_i$, as shown in (20), the same threshold divides the political behavior of citizens in both economies. However, a change in the incumbent ruler's choice of institution has different impacts on his or her survival probability in the two economies. Suppose that the incumbent ruler decreases the upper limit of tax rates from $\bar{\tau}$ to $\bar{\tau}'$. This change increases the support for the ruler, but the increase is lower in the unequal economy than it is in the equal economy. 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.[14] In this situation, the ruler has few incentives to build good quality institutions.

Since we assume an interior solution, the equilibrium survival probability of the incum-

[14] This mechanism is similar to the probabilistic voting model (Lindbeck and Weibull 1987; Dixit and Londregan 1996; Persson and Tabellini 2000). 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.

bent ruler is given by[15]

$$p^*(\xi) \equiv p(\bar{\tau}^*(\xi);\xi) = \frac{\chi(n-1)}{n\xi}\left(1+\frac{\xi}{2}+\alpha-\alpha\sqrt{1+\frac{1+\frac{\xi}{2}}{\alpha}}\right). \tag{29}$$

The effect of inequality on political stability is ambiguous. An increase in ξ leads to a more extractive institution (i.e., higher $\bar{\tau}^*$) and decreases the share of support (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 whose relative human capital is greater than $\psi(\bar{\tau})$, thus, changing the share of support (distributional effect). This effect is negative when $\psi(\bar{\tau}) < 1$, but 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 of the relation between these two opposing effects. The following proposition indicates the U-shaped relationship between inequality and political stability.

Proposition 3. *The effects of inequality on political stability depend on the institutional and distributional effects. Inequality will decrease political stability if and only if*

$$\frac{1+\alpha}{\sqrt{\alpha}} > \frac{1+\alpha+\frac{\xi}{4}}{\sqrt{1+\alpha+\frac{\xi}{2}}}. \tag{30}$$

Since the right-hand side of (30) 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 3 is as follows. Consider the population share of citizens whose relative human capital 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 is larger in the unequal economy, and the difference increases with the threshold level. Hence the distributional effect is 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 the 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.[16] 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.

[15] 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 $\chi = 1$.

[16] 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

$$R^*(\xi) = (1 - \bar{\tau}^*(\xi))[p^*(\xi) + (1 - p^*(\xi))(1 - \delta)]A. \tag{31}$$

Equation (31) shows that $R^*(\xi)$ is decreasing in $\bar{\tau}^*(\xi)$ and increasing in $p^*(\xi)$. Since political change leads to a decrease in productivity, a high probability of political change 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 a more 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 3, 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 $R^*(\xi)$ 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

$$\frac{H^*_{t+1}}{H^*_t} = \frac{1}{\phi}\left(\frac{R^*}{\gamma}\right)^{\frac{\phi}{1-\phi}}. \tag{32}$$

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

The equilibrium aggregate output is given by

$$Y^*_t = \begin{cases} AH^*_t & \text{with probability} \quad p^*(\xi), \\ (1-\delta)AH^*_t & \text{with probability} \quad 1 - p^*(\xi). \end{cases} \tag{33}$$

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

$$E(Y^*_t) = (1 - (1 - p^*)\delta)AH^*_t. \tag{34}$$

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 4. *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.*

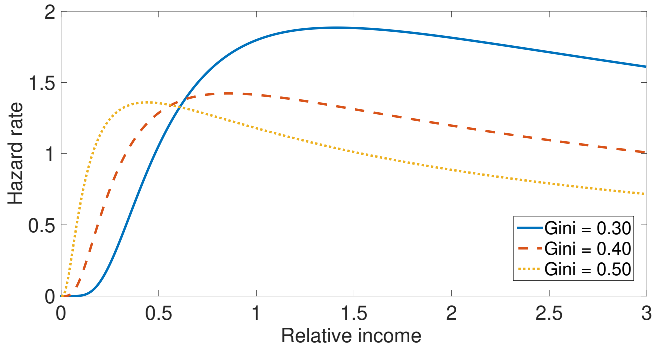

Figure 4: Log-normal distributions

5 Numerical Examples

In the previous section, we assumed that the distribution of relative human capital is uniform in order to analyze the model in a simple way. However, the assumption of a uniform distribution may be unrealistic, leading to doubts about whether our results hold if we assume a more realistic distribution. In order to answer this question, this section provides numerical examples with a more realistic distribution of relative human capital.

We suppose that the distribution of relative human capital h_{it}/H_t follows a log-normal distribution, which is commonly used as an approximation to income distribution.[17] In the model, the relative human capital coincides with the relative income y_{it}/Y_t. 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 the distribution of relative human capital is always 1, because the population in each generation is normalized to 1. Here, we examine different variances in the range where the corresponding Gini coefficients are close to the actual values.[18]

Figure 4 shows the graphs of hazard rates of relative human capital distributions. The distributions have the same mean, but different dispersions. The solid line represents the hazard rates in an economy with a Gini coefficient of 0.30, which is close to the coefficients in East Asian countries.[19] The dotted line represents the hazard rates of the more unequal economy, where the Gini coefficient is 0.50. This is close to the coefficients in Latin American countries.[20] The dashed line represents the hazard rates of the economy with an intermediate level of inequality.

As Figure 4 clearly shows, a more equal income distribution will have larger hazard rates

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

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

[19] According to Deininger and Squire (1996), the average Gini coefficient is 0.342 in South Korea (1953-1988), 0.335 in Indonesia (1964-1993), 0.296 in Taiwan (1964-1993), and 0.401 in Singapore (1973-1989).

[20] Deiniger and Squire (1996) report that the mean of Gini coefficients is 0.573 in Brazil(1960-1989), 0.518 in Chile (1968-1994), 0.515 in Columbia (1970-1991), and 0.480 in Peru (1971-1994).

in a considerable part of the range. Since the main mechanism of our model is driven by the link between large inequality and small hazard rates of relative human capital distribution, our basic results will hold in many cases, even if we assume a log-normal distribution.

Although the hazard rate of an equal economy is lower than that of an unequal economy in the range where relative income is small, we do not consider this to be a serious problem in terms of our results. The equilibrium institutional level is affected by the level of the hazard rate *around the relative income of the threshold citizen.* It is natural to think that autocratic rulers need less political support than democratic leaders. Hence, the relative income of the threshold citizen would be greater than the average level. Figure 4 shows that the range where the negative relationship between inequality and the hazard rate holds includes the mean.

Before a detailed specification, we must emphasize the following. Since our model is not intended for a 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 the alternative shape of the income distribution. Thus, we focus on the direction in which an increase in inequality could change the tax rate and political stability. Assuming log-normal distribution, we will numerically show that greater inequality leads to a higher tax rate (a more extractive institution) and to lower support share.

We specify the values of the model's parameters as plausibly as possible. We must specify three parameters of the model in order to calculate the numerical values of the equilibrium tax rate and the equilibrium share of supporters.[21] It is sufficient to calculate the share of supporters in order to identify the direction in which an increase in inequality changes the survival probability. The benchmark parameters are shown in Table 2. Based on existing empirical research, we set the productivity loss from political instability, δ, as 5%. This is the average output loss from a political crisis in poor countries, as estimated by Cerra and Saxena (2008).

With regard to the remaining two parameters, we examine several values, because we have little empirical evidence. We can interpret the expected gain of political turnover Ψ as the degree of political conflict over the public expenditure allocation. In the benchmark model, we set $\Psi = 0.25$, which makes the equilibrium tax rate around 18%. Tanzi and Zee (2000) report that the average share of tax revenue to GDP in developing countries is about 18%. We also examine cases where $\Psi = 0.20$ and $\Psi = 0.33$. Parameter ν reflects the elasticity of the survival probability with respect to the share 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 $\bar{\tau}$ is always binding, the equilibrium tax rate is a solution of the first-order condition (25). In Figure 5, which corresponds to Figure 2 in Section 4, 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 respect to $\bar{\tau}$

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

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 2: Value of parameters

under the benchmark parameter values. We examine three economies with Gini coefficients of 0.30, 0.40, and 0.50, respectively. Figure 5 is consistent with the main results of the model that the survival probability is more elastic 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 main result of our model does not change in the case of a log-normal 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 the tax rate and the share of supporters, the qualitative relationship between these variables and inequality does not change. An increase in inequality increases the tax rate and reduces the share of supporters. Similarly, Figure 7 examines different values of ν. Figure 7 indicates the quantitative importance of the elasticity of survival probability with respect to support share for the choice of the incumbent ruler. When the survival probability is elastic to the support share, the ruler would avoid choosing a high $\bar{\tau}$ and, thus, gain more support from the citizens. However, the positive relationship between inequality and the equilibrium tax rate and the negative relationship between inequality and the equilibrium support share would hold irrespective of the value of ν.

Our quantitative exercise shows that the qualitative predictions of the model do not change even though we assume a log-normal distribution. This is because the hazard rate of the relative human capital distribution is decreasing in inequality in most of the range, as shown in Figure 4.

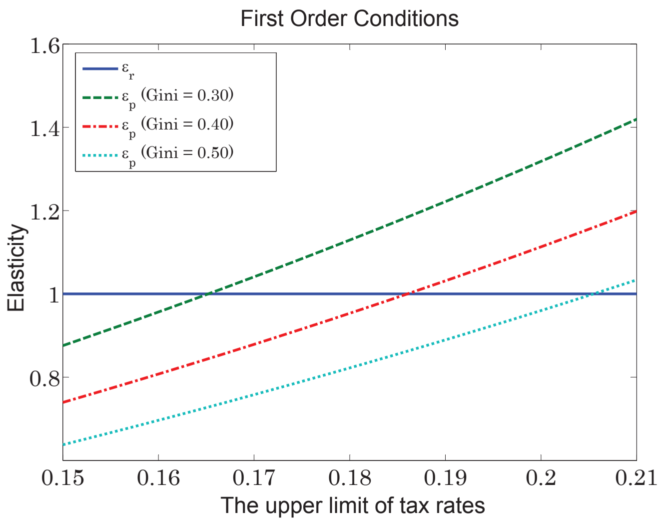

Figure 5: Equilibrium tax rates

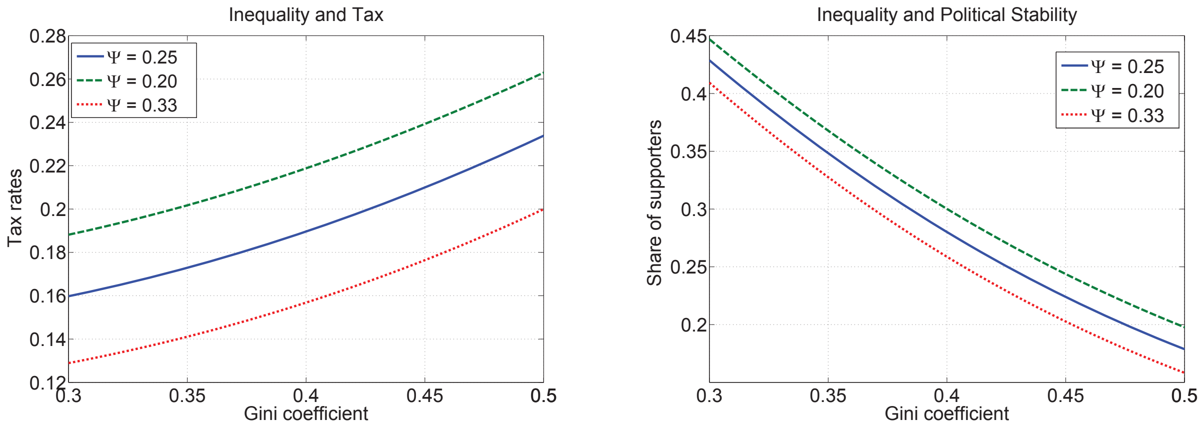

Figure 6: Impact of Inequality ($\nu = 0.5$)

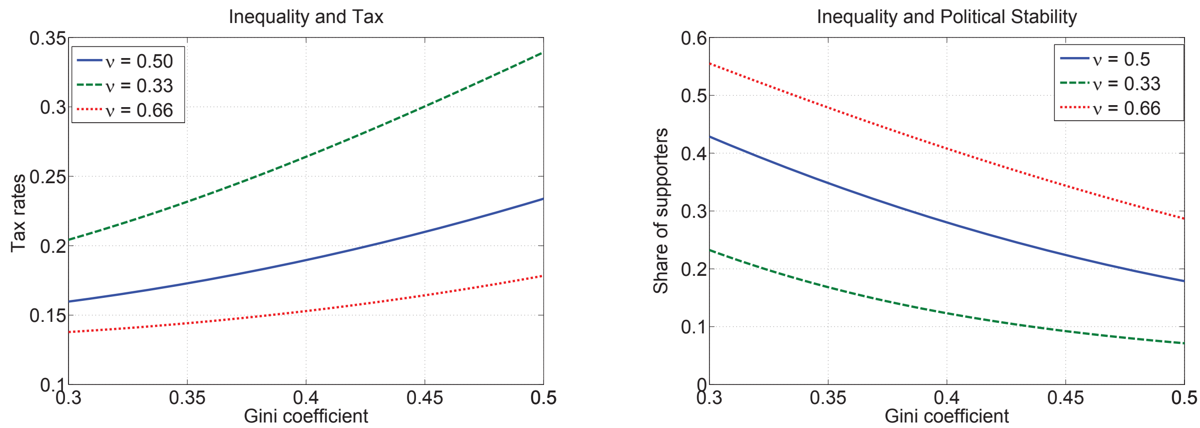

Figure 7: Impact of Inequality ($\Psi = 0.25$)

6 A Historical Example

This section briefly reviews the historical background of the emergence of good quality institutions in 17th-century England as supportive anecdotal evidence of the theoretical mechanism described in the previous sections. The main message of the theory is that having a large number of citizens with similar political interests, yielded by an equal income distribution, makes the political support for a ruler responsive to a change in institutions. In this situation, the ruler chooses good quality institutions. Consistent with the theory, since the 16th century, radical economic and social changes in England created a sizable middle class with similar political interests. This social class was critical in building the institutions that constrained the power of the monarchy.

Two important events are noteworthy in terms of the radical change in the social class in England since the 16th century. The first is England Reformation. As a result of the confrontation between the Pope and Henry VIII, which was caused by the problem of a royal divorce, Henry VIII passed the Act of Supremacy and established the Church of England in 1534. The Catholic churches were dissolved and their assets and lands were confiscated by the government. Since the government faced a chronic fiscal deficit, a large part of confiscated land was sold to compensate for this deficit. The rapid increase in the supply of land made the land market active. Hill (1969:64) argues that, "In the century and a quarter after 1530 land was more freely bought and sold in England than ever before. The Reformation threw monastic and chantry lands on the market. . . . Meanwhile monastic lands had been sold, and crown lands to the value of £2 1/4 million between 1558 and 1640."

The active land market increased the mobility of land and caused a massive reallocation of land resources from landlords to more efficient land managers. The gentry, a newly emerging class with a talent for entrepreneurial activities, occupied a substantial part of the land at the end of the 16th century. On the other hand, the sharp rise in prices in Europe, the so-called Price Revolution, reduced the real value of fixed land rent. The traditional management system of manors came to a crisis because of these changes, and many aristocrats who were not able to adapt to these changes had major difficulties. [22] Hill (1969:61-62) states that, "Those with fixed incomes were in difficulties– e.g. landlords who had let their lands on long leases, though when the leases fell in they would get a windfall fine, a loan in advance."

As an inevitable consequence, the reallocation of land resources had a significant influence on wealth distribution. Overall, it redistributed land resources from the rich landlords to the middle-class gentry. On the impact of the active land market on wealth distribution, Tawney (1941:33-34) argues that:

> "the tendency of an active land-market was, on the whole, to increase the number of medium-sized properties, while diminishing that of the largest. . . . as the number of great properties was levelled down, and that of properties of moderate size levelled up, the upper ranges of English society came to resemble less a chain of high peaks than an undulating table-land."

[22] Stone (1965) closely examines the situations and causes of the crises faced by the aristocrats.

The second important event was the expansion in Atlantic trade since the 16th century. Trade with North America and the West Indies brought economic advancement in England. Various manufacturing industries emerged in this period, such as cloth manufacturing, mining, glassware, pottery, and shipbuilding. Furthermore, economic development caused urban development in London and other cities, which became major bases of manufacturing industries and the Atlantic trade (Pincus 2009, chap. 3).

The development in trade and industries changed the distribution of wealth and power, and raised the economic and political status of merchants. Pincus and Robinson (2011:18) state that, "The newly dynamic economy shifted the social balance. Manufacturers, urban dwellers, and colonial traders became much more wealthy. Most thought that as England became a nation of tradesmen and shopkeepers, there had been a shift of political power." As a result, the common people became a counterbalance to the king (Tawney 1941, Pincus and Robinson 2011).

The wealth of the gentry and the merchants raised their political power and led to the emergence of institutions that constrained the king's confiscatory behavior and protected citizens' property rights.[23] Acemoglu et al. (2005a:393) state that:

> "By the seventeenth century, the growing prosperity of the merchants and the gentry, based both on internal and overseas, especially Atlantic, trade, enabled them to field military forces capable of defeating the king. This de facto power overcame the Stuart monarchs in the Civil War and Glorious Revolution, and led to a change in political institutions that stripped the king of much of his previous power over policy. These changes in the distribution of political power led to major changes in economic institutions, strengthening the property rights of both land and capital owners and spurred a process of financial and commercial expansion."

The social classes created by the reallocation of land and Atlantic trade were not only powerful, but also sizable and broad. As Stone (1966:29) points out, these economic changes led to "a greater equality among the upper classes". Stone (1966:29) further states that "firstly the wealth and power of the greater gentry increased relative to those of the aristocracy; and secondly members of the trades and professions rose in wealth, numbers and social status relative to the landed classes." Stone (1964:71) also states that the economic changes since the 16th century caused an income redistribution "at the expense of the topmost and bottommost layers of the social pyramid", and that "[a]bsolutely and relatively, the middle segment of society was increasing in numbers and in wealth". Acemoglu and Robinson (2012:210) point out the broad opposition against the king as a critical factor leading to the emergence of good quality institutions in England:

[23] Acemoglu et al. (2005b) provide empirical evidence that the expansion of Atlantic trade encouraged economic growth in the Western world. They argue that in countries with better access to Atlantic trade, the large profit they accrued enhanced the political power of merchant classes, which brought about an institutional change to protect property rights.

> "Perhaps most critically, the emergence and empowerment of diverse interests–ranging from the gentry, a class of commercial farmers that had emerged in the Tudor period, to different types of manufacturers to Atlantic traders–meant that the coalition against Stuart absolutism was not only strong but also broad."

Acemoglu and Robinson (2012) argue that the broad opposition to the monarchy contributed to the emergence of good quality institutions because it prevented the winning opposition from creating institutions for a specific interest.

The model proposed in this study sheds light on another aspect of the broad opposition against the Stuarts. The central point of the model is that large numbers of citizens with similar interests, yielded by an equal wealth distribution, makes the political support for a ruler responsive to the change of constraints on a ruler's confiscatory behavior. In this situation, the ruler chooses good quality institutions. As we have noted, the economic changes since the 16th century yielded an equal wealth distribution and a large middle class, and this new social class formed a powerful force opposing the monarchy. The theoretical mechanism of this paper is consistent with these facts, and provides an explanation as to why good quality institutions emerged in 17th-century England.

As Pincus and Robinson (2011) and Acemoglu and Robinson (2012) note, William III readily accepted the decrease in the king's power and the increase in parliament's power after the Glorious Revolution. However, we cannot attribute the reason for the king's behavior to his personality. As Pincus and Robinson (2011:20-21) note:

> "William was no closet republican. In fact, he had come to come to power in the United Provinces in 1672 after a wave of popular anti-republican riots. He emerged as the Stadholder, or political leader of the United Provinces, only after the republican leaders John and Cornelius De Witt had been publicly lynched by Orangist (monarchist) mobs. William was, like his uncle James II, a Stuart with every reason to want a strong monarchy."

The model proposed in this study indicates that the responsiveness of political support for the king to his institutional choice was the reason why William accepted the constraints on his power.

7 Conclusion

This study provides a model to show that large inequality leads to extractive institutions and impedes economic growth. In the model, a ruler chooses an institution that constrains his or her policy choice. The ruler who chooses an extractive institution can expropriate a large share of citizens' wealth, but faces a high probability of losing power owing to a lack of citizen support. Hence, the ruler faces a trade-off between expropriating citizens' wealth and holding on to power. We argue that a large inequality among citizens makes the ruler's survival probability inelastic to his or her choice. In this situation, the ruler has a large incentive to build an extractive institution, which impedes investment and growth.

Our results are based on the negative relationship between inequality and the hazard rates of the income distribution. This relationship holds to a considerable extent under a log-normal distribution, which is one of standard approximations to income distribution. Here, we provide numerical examples to illustrate that our results obtained under a 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 the findings of recent empirical studies. Moreover, the history of England in the 16th-17th centuries is consistent with the theory. The radical economic and social changes in England created a large middle class, which was critical to building the institutions that constrained the power of monarchy.

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Appendix

A. Proof of Proposition 3

We derive condition (30) for $p^*(\xi)$ to be decreasing in ξ. Since

$$\varphi(\xi) \equiv 1 - F\left(\psi(\bar{\tau}^*(\xi))\right) = \frac{1}{\xi}\left(1 + \frac{\xi}{2} + \alpha - \alpha\sqrt{1 + \frac{1+\frac{\xi}{2}}{\alpha}}\right), \tag{A1}$$

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 (30).

B. Proof of Lemma 4

We rewrite the equilibrium return on human capital (31) 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 (27), (29), 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 the 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 the 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 the 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.

In the case of log-normal distribution, the first-order condition (25) is replaced by

$$\begin{aligned} 1 &= \frac{f(\psi(\bar{\tau}))}{1 - F(\psi(\bar{\tau}))}\nu\psi'(\bar{\tau})\bar{\tau} \\ &= \left[1 - \Phi\left(\frac{\ln\psi(\bar{\tau})}{\sigma} + \frac{\sigma}{2}\right)\right]^{-1} \frac{\nu\alpha}{(1-\bar{\tau})^2} f(\psi(\bar{\tau}))\bar{\tau}, \end{aligned} \tag{C5}$$

where the second equality comes from (C2) and (C3). From (C1) and (C5), we can calculate the equilibrium institution, which is equal to the equilibrium tax rate, and the equilibrium share of supporters.