

# The Coevolution of Economic and Political Development from Monarchy to Democracy

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## Abstract

This paper establishes a simple model of long-run economic and political development that is driven by the inherent technical features of different production factors and the political conflicts among factor owners on how to divide the outputs. The main production factor in the economy evolves from land to physical capital and then to human capital, which enables their respective owners (landlords, capitalists, and workers) to gain political power in the same sequence, shaping the political development path from monarchy to oligarchy and finally to democracy with full suffrage. When it is too costly for any group of factor owners to repress others, political compromise is reached and economic progress is not blocked; otherwise, the political conflicts may lead to economic stagnation.

*JEL:* O10, O40, P16, N10.

*Key Words:* Democratization, Factor Composition, Monarchy, Oligarchy, Democracy, Suffrage Extension, Human Capital.

## 1 Introduction

The main story line of human history may be driven by the dynamic interactions between cooperative economic activities leading to greater aggregate wealth and political conflicts over its distribution. The current paper attempts to formalize this idea in a simple model of long-run economic and political development as illustrated in Figure 1. As the main factor of production shifts from land to physical capital and then to human capital, the relative economic and hence coercive power of landlords, capitalists, and workers shifts

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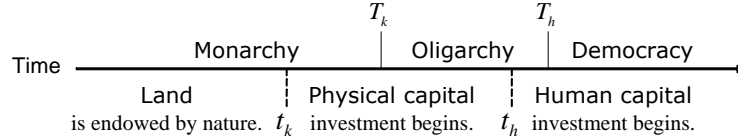


Figure 1: The Time Line of Economic and Political Development

accordingly, inducing the transition of the political system from monarchy to oligarchy (of landowners and capitalists) and finally to democracy with full suffrage. Every new political regime, by extending political power to the owners of the new form of capital and thus increasing their future economic gains from investment, speeds up economic progress. Such a smooth coevolution path of economic and political development happens only when political compromise is reached at both transition periods  $T_k$  and  $T_h$ ; otherwise, the political conflicts over output distribution may lead to repression and economic stagnation. These results are broadly consistent with historical evidence in Western Europe, especially England and France where the full time line in the model has been realized through autonomous transitions.<sup>1</sup>

The sequence of the economic development path is mainly determined in the model by the distinct technical features of production factors: land is endowed by nature and is difficult to create or destroy; physical capital, in contrast, has to be produced endogenously with material investment; the raw labor is endowed by nature, but human capital beyond this basic level has to be acquired through endogenous investment. The exogenous endowment of land and raw labor makes it beneficial to invest in physical capital first when savings become available, while the capital-skill complementarity will trigger human capital investment when the stock of physical capital is large enough (Galor and Moav 2006).

The establishment and transition of political regimes are driven by two assumptions. The first one is essentially *might-is-right* in that the agent or group with dominant coercive power becomes the ruler, where a group's coercive power depends on its economic strength and coordination effectiveness. Once in power, the incumbent ruler may preserve its political dominance by repressing any challenging group; this leads to the second assumption, *the incumbency advantage*, since the possibility to repress increases the incumbent's bargaining power above its coercive ability based upon economic strength. When the repression cost is neither too low nor too high, or when both repression and revolt costs are high, a political compromise between the

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<sup>1</sup>The model abstracts from international interactions such as colonization and thus may not be directly applicable to late-comers in development that were colonized or conquered. As Olson (1993) pointed out, although "there are a fair number of democracies, there have not been many spontaneous and entirely autonomous transitions from autocracy to democracy." England and France are arguably the main exceptions.

incumbent ruler and the challenging group would be reached in equilibrium so that the political transition is achieved smoothly and economic development is facilitated, as illustrated in Figure 1. Otherwise, repression or revolt may occur and economic development may be delayed.<sup>2</sup>

The model has several important implications concerning the relationship between economic growth and political development. First, the more fundamental force underlying democratization is not the income level *per se*, but the changing factor composition (where the predominant factor shifts from land to physical capital and finally to human capital), since the latter determines the changing economic and coercive power of different factor owners. In other words, the production factor composition is the common factor that affects *both* the income level and the nature of the political regime. The reason is as follows. Landowners are easily separated by force from their land without endangering the supply of land or badly hurting the overall productivity.<sup>3</sup> This induces constant fighting over land ownership, making it possible for some landlord to capture a large amount of land using coercive forces and become the monarch. The other side of the coin is that the absolute monarchy, by curbing the destructive rent-seeking behaviors necessarily prevalent in a land-dominant economy, actually facilitates economic development in comparison to anarchy and thus remains as a stable political regime for a very long time. In sharp contrast to land, confiscating the shops or factories of capitalists is not feasible in the long run, since their ultimate source, the capitalists' entrepreneurial skills, is difficult to capture by force. This implies that, with capital accumulation, the source of economic growth is now dispersed among individual capitalists and cannot be easily controlled or centralized by coercion as is the case of land or other natural resources. Moreover, the stock of physical capital increases as the economy grows, and it would eventually replace the relatively fixed land as the predominant source of wealth and enable its owners to gain political rights to protect their capital returns. The alternative is to repress the growing power of capital owners, which is not only economically unappealing but could also be politically dangerous for the monarch since an inefficient economy may induce domestic upheavals and foreign invasions. Thus the endogenous supply of physical capital is the fundamental driving force underlying the democratization process from monarchy to oligarchy; as the same logic also applies to

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<sup>2</sup>Note that the coercive ability is similar to the de facto power used by Acemoglu and Robinson (2006a), while the incumbent ruler's repression capacity has some similarity to the de jure power. From this perspective, an innovation of the current paper lies in the dynamic links between the de facto and de jure power: the group with dominant de facto power becomes the first ruler and hence acquires de jure power (the might-is-right assumption); the incumbent ruler can use de jure power to repress the ruled group to curtail its de facto power (the incumbency advantage). The political development path is mainly driven by the *dynamic consistency* between these two types of power: As the economy grows, the relative de facto power of different groups keeps changing, which eventually leads to a corresponding change in the allocation of de jure power, although in some circumstances the incumbent can delay such a process at the cost of having a stagnant economy and unstable political system.

<sup>3</sup>Such a technical feature of land also applies to natural resources, which seems to be the ultimate cause for the natural resource curse (Ross 1999, Boix and Stokes 2003, Lagerlof and Tangeras 2007).

human capital beyond the raw labor, the oligarchy of landowners and capitalists would finally give way to full democracy where workers as the owners of human capital also gain political rights and all factor owners earn competitive returns. This accounts for why both in history and current times, most democracies have industrialized economies where human capital is the dominant production factor, while in countries with natural resources as the main production factor, authoritarian political regimes are more likely to occur.<sup>4</sup>

The second implication is that political transition often makes a breakthrough in a short period of time although the groundwork, by means of economic development, usually takes a long time. This is consistent with the findings of Acemoglu et al. (2008), who cast doubt on the short-term causal effect of income on democracy after World War II, but find evidence that such a relationship may exist in a much longer horizon. Similarly, Boix and Stokes (2003) argue that it is the prewar period—from the late nineteenth century to the end of World War II—in which the impact of income on democracy is most powerful.

Third, economic growth is a necessary but insufficient condition towards political development, since the levels of repression and revolt costs during the crucial transitional periods, which may be affected by geopolitical, religious, ideological, and other ultra-economic elements, are also critical in determining the ultimate political outcome. For example, a country with faster economic growth but faced with much lower repression costs may end up in repression, while another country with slower growth but higher repression costs may make the political transition first.

This paper proceeds as follows. The main contributions of this paper to the related literature are discussed in the next section. The basic elements of the political economy model are introduced in Section 3, and the analysis of the model is in Section 4. The robustness of this paper's main results is checked against alternative modeling choices in Section 5. Related historical evidence is collected in Section 6 and some concluding remarks are offered in the final section. All proofs are relegated to the Appendix.

## 2 Related Literature

This paper belongs to a broad literature connecting growth, development, and institutions in a long-term perspective.<sup>5</sup> Its primary contribution is using a unified political economy framework to analyze the democratization process from monarchy to oligarchy and, finally, to democracy with full suffrage in the context of dynamic economic development. This framework appears to be very useful in uniting scattered results and

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<sup>4</sup>For evidence of such correlations see Lipset (1959), Huber et al. (1993), Burkart and Lewis-Beck (1994), Londregan and Poole (1996), Przeworski and Limongi (1997), Ross (1999), Boix (2003), and Epstein et al. (2006), among others, in the large modernization literature.

<sup>5</sup>See Bertocchi (2006b) for a survey of related literature.

reconciling conflicting views in a systematic way. To a certain extent, the model suggests that the history of human society is, in essence, an integrated democratization process in which each country, though following unique routes, moves within the same broad historical trend shaped by the changing predominance of land, physical capital, and human capital in the economy.

Owing to its immense importance and complexity the democratization process has been a major subject in comparative history. In a landmark study, Moore (1966, p. 429) found that “getting rid of agriculture as a major social activity is one prerequisite for successful democracy” and robust capitalist development is crucial in achieving this end. Moore’s conclusion on the role of the bourgeoisie as the primary agent of democracy, although widely shared by the orthodox Marxist and liberal social science view, is challenged by Rueschemeyer et al. (1992, p. 270). They, instead, conclude that “a key actor in the development of full democracy almost everywhere” is not capitalists but the organized working class, and the widely believed association of capitalist development with democracy is mainly because it strengthens the working class. These seemingly conflicting conclusions are, however, consistent with and neatly reconciled by the main results of the current paper: The focus of Moore is on the first political transition from monarchy to oligarchy (or, in more conventional terms, parliamentary democracy), while that of Rueschemeyer et al. is mainly on the second political transition from oligarchy to full democracy. Distinguishing these two transitional stages helps to clarify the crucial role of capitalists in breaking the absolute power of monarchy and initiating the parliamentary democracy at an earlier historical occasion, and the role of the working class, strengthened during the industrialization process, in pushing for further franchise expansion at a later time. To be sure, these two democratization stages inherently share some common features, which are also obvious in the model; distinguishing them analytically, however, seems to bring more insights than does ignoring their critical differences in the historical timing and economic bases (of physical capital and human capital, respectively).

The formal analysis of democratization started only recently in economics, with relatively few studies focusing on the first political transition from monarchy to oligarchy. Olson (1993) argues that, compared with anarchy, a tax-collecting monarch brings substantial benefits to the people and “permits a considerable development of civilization.” North and Weingast (1989) discuss the emergence of parliamentary democracy in the seventeenth century England and the corresponding improvement of property rights security after the Glorious Revolution. DeLong and Shleifer (1993) provide evidence which shows that absolutist princes, in comparison to representative governments, slowed down economic growth, especially in cities. Bertocchi (2006a) models the evolution of the land inheritance system from primogeniture to partition when landed

estates are replaced by capital as the primary source of wealth. These results are consistent with findings in the current paper, which shows that monarchy arises in equilibrium from anarchy among landowners and thus facilitates economic development and capital accumulation, and if it is later replaced by oligarchy due to the growing strength of capitalists and other landlords, commercial and industrial interests will be promoted, otherwise economic stagnation is the likely result.

There are a number of studies on how the voting franchise is further expanded from oligarchy to full suffrage. In a seminal study by Acemoglu and Robinson (2000), franchise expansion is used by the ruling elites to mitigate the revolutionary threat from workers. Following the same theme of conflict resolution, Bertocchi and Spagat (2001) find that the elites may want to co-opt a subset of the challenging group. In contrast, an alternative rationale for suffrage extension suggests that the elites may do it voluntarily in their own best interests (Lee 2003, Lizzeri and Persico 2004, Jack and Lagunoff 2006). Both views find support in historical evidence, either in different countries or at different times, which prompts further research to characterize conditions that give rise to distinct transition paths (Justman and Gradstein 1999, Boix 2003, Engerman and Sokoloff 2005, Llavador and Oxoby 2005, Cervellati et al. 2006, Gradstein 2007, Cervellati, Fortunato and Sunde 2008). The current paper contributes to this stream of literature by establishing a unified analytical framework where the *same* fundamental forces can account for the gradual suffrage extension from absolute monarchy to oligarchy by landlords and capitalists and, finally, to full democracy; it shows that this general historical trend of political power being shared among more people over time is ultimately driven by dynamic economic development in which the predominant source of wealth evolves from land to physical capital and later to human capital.

The long-term growth literature<sup>6</sup> typically abstracts from the political conflict that is the focus of the democratization literature. The economic development path in the current paper builds on the important insight of Galor and Moav (2006) that the complementarity between physical and human capital would eventually eliminate the class distinction between capitalists and workers. The effects of human capital accumulation and technological progress in moving the economy from agricultural to industrial production methods are also emphasized in Galor and Weil (2000) as well as Hansen and Prescott (2002). The current paper contributes to this literature by formally modeling the evolving composition of main production factors during the economic growth process, and highlighting the important role of political transitions in shaping distinct economic development paths across countries.

Another strand of related literature studies the effects of institutions on long-run growth. North (1981)

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<sup>6</sup>See Galor (2005) for a survey of the unified growth theory.

proposes a dynamic framework of political economy and substantiates it by rewriting Western history in its light. He recognizes not only the influence of technology advancement on institutions, especially property rights, but also the effects of political institutions on future technological and economic development. In some sense, the current paper is an attempt to formalize this dynamic framework in a simple model; it may thus shed light on current debates on whether technology or institutions are more important for long-run growth. Acemoglu et al. (2005) argue that institutions are the fundamental cause of long-run growth, while Glaeser et al. (2004) demonstrate that the level of human capital is more fundamental than institutions. In fact, both claims can be true in the chain of dynamic interactions between the economic fundamentals and political institutions shown in the current paper, depending on which specific segment is chosen for investigation. Among countries with similar institutional backgrounds, the initial gap in economic fundamentals may become the ultimate cause of their later divergence since institutions may evolve endogenously.<sup>7</sup> On the other hand, between countries with similar economic fundamentals, different institutions caused by exogenous factors may account for their later economic development gaps.<sup>8</sup>

To the extent that the cooperative and conflicting sides of human interactions are treated simultaneously, this paper is connected with Hirshleifer (1994), Grossman and Kim (1995), and Grossman (2002) among others. While the paper's analysis of the political conflicts among factor owners is similar to the Marxist approach of class struggles (Marx and Engels 1848), there is a major difference: The class conflicts are embedded here in the cooperative context of economic activities and eventually resolved under democracy where political rents disappear and each factor earns its competitive market returns. This result echoes Polany's (1944) view that a competitive market economy was brought forth *together* with political democracy for the first time in human history by the industrialization process. He observed that both harmony and conflicts are inherent in the economy, and they often lead to each other in a dynamic world. On this point, the current paper further suggests that the cooperative side dominates historical progress in the long run, although the conflicting side may change historical paths for some time and often in a stagnant direction.

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<sup>7</sup>Consistent with results in the current paper, Galor et al. (2006) find that the inequality of land ownership, although beneficial in earlier development, can be a major hurdle in the emergence of human capital promoting institutions, and hence negatively affect future economic performance. Similar views are also expressed by Engerman and Sokoloff (1997) and Rajan and Zingales (2006).

<sup>8</sup>In this paper, the same economy with different repression costs during the political transition periods may generate distinct political outcomes, which will affect the economic development path afterwards. This is similar in spirit to the findings of Acemoglu and Robinson (2006b) that the political security of the incumbent elites may determine whether they would block technological and institutional innovations that potentially undermine their incumbency advantages. In a related work along this line, Rodrik et al. (2004) find that conventional measures of geography have a strong indirect effect on incomes by influencing the quality of institutions.

### 3 The Political Economy Model

#### 3.1 The Economy

There are overlapping generations in the economy with a fixed population size.<sup>9</sup> Each individual lives for two periods, accumulating human capital in childhood and participating in production at adulthood.

**Preferences.** Individuals are identical in preferences, which are represented by a log-linear utility function

$$u_{ti} = (1 - \beta) \log c_{ti} + \beta \log(z + b_{ti}),$$

where  $c_{ti}$  is the adulthood consumption of individual  $i$  in generation  $t$ ,  $b_{ti}$  is his bequest for offspring,<sup>10</sup>  $\beta \in (0, 1)$  indicates the relative weight of bequest in utility, and  $z > 0$  is a constant. The budget constraint is  $c_{ti} + b_{ti} \leq I_{ti}$ , where  $I_{ti}$  is individual  $i$ 's income at adulthood.

As a result of utility maximization, the individual's optimal bequest is  $b_{ti} = \max\{\beta(I_{ti} - Z), 0\}$  where  $Z \equiv z(1 - \beta)/\beta$ . That is, only when an individual's income is higher than a certain subsistence level  $Z$ , would there be any resources left as bequest; this is a reasonable result given that the model economy starts from the agricultural era where many people live on the subsistence level and may not afford any savings.<sup>11</sup> The total bequest in society  $B_t$  is then

$$B_t = \sum_i b_{ti} = \sum_i \max\{\beta(I_{ti} - Z), 0\}. \quad (1)$$

**Final Output Production.** In every period the economy produces a single homogeneous good that can be used for consumption and investment. The production function at time  $t$  is

$$Y_t = A_t(L + K_t)^{1-\alpha} H_t^\alpha.$$

The knowledge stock  $A_t$  grows at an exogenous speed  $g > 0$  so that  $A_{t+1} = A_t(1 + g)$ , which is the ultimate growth engine.<sup>12</sup> The quantity of land  $L$  is fixed over time, while the stocks of physical capital  $K_t$  and

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<sup>9</sup>In an earlier version of the paper the population size was set to follow the broad demographic trends in history as in Hansen and Prescott (2002); the main results were the same.

<sup>10</sup>This bequest motive from the "joy of giving" is commonly adopted in the recent literature on income distribution and growth. See Altonji, Hayashi and Kotlikoff (1997) for related empirical evidence. This particular utility function is also used in Galor and Moav (2006) and Fishman and Simhon (2002) among others.

<sup>11</sup>The implication that the rich save more is consistent with empirical evidence (Dynan, Skinner and Zeldes 2004). If a homothetic utility function is used instead, individuals will leave positive bequests regardless of how low their incomes are, which does not seem to be reasonable in the context of this paper where the model starts from the agricultural period with subsistence levels of incomes. And furthermore, it will not change the main results because the economic development path is determined mainly by the distinct features of the three production factors.

<sup>12</sup>In a more general setting, the knowledge stock should be allowed to increase in the aggregate physical or human capital; this will speed up capital investment and thus political transitions, but will not change the main results. The assumption of a



human capital  $H_t$  depreciate fully after one period, which corresponds to one's adulthood (about twenty to thirty years). This production function is adopted only to simplify the exposition, since the main results are the same whether using a more general production function that allows complementarity between land and physical capital or using a detailed two-sector general equilibrium model, both of which are analyzed in Section 5.

**Endowment.** The initial endowment of land  $L$  is exogenously distributed among  $N_l$  landowners. There are  $N_c$  identical capitalists who are endowed with skills to generate physical capital  $K_t$  using material resources.<sup>13</sup> The majority are  $N$  workers each endowed only with raw labor. The initial state of the model economy corresponds to a time when agriculture is the dominant production method, the physical capital stock is zero, and people are not educated.<sup>14</sup>

**Production Functions of Physical and Human Capital.** The aggregate physical capital  $K_{t+1} \equiv N_c k_{t+1}$  is produced by  $N_c$  identical capitalists according to the production function

$$k_{t+1} = \kappa(m_t^k), \tag{2}$$

where  $m_t^k$  denotes the amount of material resources used in generating physical capital. The usual conditions  $\kappa' > 0$ ,  $\kappa'' \leq 0$ ,  $\lim_{m_t^k \rightarrow 0} \kappa' = +\infty$ , and  $\lim_{m_t^k \rightarrow +\infty} \kappa' = 0$  are assumed. Furthermore,  $\kappa(0) = 0$  holds so that a positive amount of material  $m_t^k > 0$  is necessary to produce any physical capital.

With an education expenditure  $m_t^h$ , an individual may acquire human capital  $h_{t+1}$  according to

$$h_{t+1} = f(m_t^h), \tag{3}$$

where  $f' > 0$ ,  $f'' \leq 0$ , and  $\lim_{m_t^h \rightarrow +\infty} f' = 0$ . We assume  $f(0) = 1$  so that a worker is endowed with a basic unit of human capital, namely the raw labor, even without any education expenditure; to acquire human capital above the basic level, however, a positive amount of material is needed. And furthermore,  $f'(0) = \gamma < +\infty$  holds so that the human capital production function has a finite slope at zero investment.<sup>15</sup>

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slowly growing knowledge stock even when there is no human capital is also made by Galor and Weil (2000) and Hansen and Prescott (2002). Note that the exogenous growth rate  $g$ , though positive, can be arbitrarily close to zero in the model, which is not inconsistent with the almost zero growth rate found in the Malthusian era.

<sup>13</sup>The factories and machines may be confiscated by others, but the most important assets of capitalists in capital accumulation, such as their entrepreneurial skills, technical know-how, and business networks, are difficult to capture by force. Nor are these special talents of capitalists readily accessible to everyone in the population. Even at the present time, how to become a successful entrepreneur still eludes most people. The standard human capital, such as the skills to read, write, and calculate, in comparison, can be systematically acquired through education.

<sup>14</sup>Alternatively one may think of capitalists as emerging from either the landed class or workers; that is, with a certain exogenous probability  $N_c/(N_l + N)$  an individual is endowed with physical capital production skills. Though it is more realistic to allow families to change class, as long as such incidents are relatively few compared with those who remain in the same class, our assumption of fixed class lines serves as a reasonable approximation.

<sup>15</sup>The typically assumed Inada condition (i.e.  $\gamma$  is infinite) is designed to simplify the exposition by avoiding a corner solution,

**Capital Investment.** An individual may invest his bequest  $b_{ti}$  in physical capital or human capital for the next generation. Alternatively, it can be put in a storage process that yields  $\delta b_{ti}$  in the next period, where  $\delta \geq 0$ .

Note that only capitalists have the skills to produce physical capital; landowners and workers, however, may supply their savings  $b_{ti}$  to capitalists through the capital market to gain a return  $\widehat{\delta}_t b_{ti}$ , where  $\widehat{\delta}_t \geq \delta$ . That is, the return of investing in physical capital is at least as high as using the storage method. Each capitalist borrows resources from the capital market at the rate  $\widehat{\delta}_t$  to produce physical capital  $k_{t+1}$  and then rent it to the final output firms to get a return  $r_{t+1} k_{t+1}$ , where  $r_{t+1}$  is the rental rate of physical capital. Since capitalists as a group act as a monopolist in producing physical capital, and the exact value of  $\widehat{\delta}_t$  is not important for the main results,  $\widehat{\delta}_t = \delta$  is assumed to be true; and to further simplify the exposition,  $\delta = 0$  is used in the basic model.<sup>16</sup>

There is no credit market for human capital investment, which can only be financed by public education or by parental bequest. The public education expenditure  $M_t^h$  is financed through tax revenues by the ruler to maximize its own benefits, where an endogenously determined tax rate  $\tau_t^{h*}$  is imposed on each individual's bequest  $b_{ti}$  so that  $M_t^h = \tau_t^{h*} B_t$ .<sup>17</sup> Individuals then invest their disposable savings  $(1 - \tau_t^{h*}) b_{ti}$  in the capital market, and thus the total amount used in producing physical capital is  $M_t^k = (1 - \tau_t^{h*}) B_t = N_c m_t^k$ .

The sequence of the economic development path in Figure 1 is mainly determined by the distinct technical features of these three factors of production, where land and raw labor are endowed by nature, while physical capital and human capital have to be produced endogenously. The exact timing of the economic development stages, however, is also affected by institutional elements such as the political structure discussed below.

### 3.2 The Political Structure

The division of outputs among the production factor owners is determined by the political system, where the ruler may exploit ruled agents through taxes and confiscation. The establishment and transition of political regimes are shaped by the balance of political powers, which may experience fundamental changes during the economic development process. Consistent with the horizon of economic decisions in the overlapping

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but it is not necessarily a realistic assumption for human capital production given that individuals are already endowed with a unit of human capital.

<sup>16</sup>The case for  $\delta > 0$  is formally analyzed in Section 5. Note that the entrepreneurial skills of capitalists are crucial and indispensable in transforming savings to physical capital, and thus capitalists get the main proportion of capital returns while the capital market suppliers receive theirs as interest returns. This is in line with recent endogenous growth models where capitalists run firms producing intermediate goods in monopolistic competition (Acemoglu 2008).

<sup>17</sup>Imposing tax on bequests is equivalent to directly taxing incomes that are beyond the threshold  $Z$  because  $b_{ti} = \max\{\beta(I_{ti} - Z), 0\}$ .

generation model, the length of an individual’s adulthood, which corresponds to one period in the model, is also used as the horizon for political decisions.<sup>18</sup>

When there is no incumbent ruler, the political power of a group of  $N_G$  individuals coincides with its coercive capability  $v_{Gt} = \psi(N_G, e_t) \sum_{i=1}^{N_G} I_{ti}$ . The total income  $\sum_{i=1}^{N_G} I_{ti}$  of the group members indicates the overall economic strength of the group, which can be transformed to coercive power through supply of weapons and soldiers, for example.  $\psi(N_G, e_t)$  is the group’s organizing efficiency, which increases with  $e_t$ , the group-average capability to coordinate, but decreases with  $N_G$ , the number of individuals involved in collective actions, due to free-riding and information problems; that is,  $\psi_1 < 0$  and  $\psi_2 > 0$ . For simplicity, we assume  $e_t = h_t$  for workers and  $e_t = \bar{e} > 1$  for landlords and capitalists,<sup>19</sup> where  $\psi(1, \bar{e}) = 1$  holds by normalization. To be consistent with the historical evidence that workers as raw labor typically have lower collective coercive ability than landlords and capitalists,<sup>20</sup> the following condition about workers’ organization efficiency

$$\psi(N, 1) < \frac{(1 - \alpha)\varphi}{\alpha(1 + \varphi)} \tag{A1}$$

is assumed, where  $\varphi \equiv \psi(N_c + N_l - 1, \bar{e})$ . Under this assumption, workers lack enough coercive might to gain political rights before human capital investment starts.

The initial political regime is established based purely on *might-is-right*, where the dominant group becomes the first ruler and imposes tax on others.<sup>21</sup> The highest possible tax rate  $\tau \in (0, 1)$  is determined by the agents’ ability to hide their income, and the tax collecting cost is  $(1 - \eta) \in (0, 1)$  of the tax revenue. Note that this tax is purely exploitative and represents the economic benefit of possessing political power.

The transition of political regimes is modeled in the political game illustrated in Figure 2. In each period, a challenging group may choose either to obey the current political order or to revolt. In response to revolt, the incumbent ruler can always preserve its political dominance by repressing the challenging group;

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<sup>18</sup>Allowing longer horizons may alter the timing but not the qualitative results of the transition process. Acemoglu and Robinson (2006b), for example, find similar results for the political transition problem in a more abstract setting with infinite horizons. Due to the extremely long period (often in the magnitude of hundreds of years) the model covers, it is not realistic to assume that agents can take into consideration all of the future economic and political changes when they make decisions. For example, Moore (1966, p. 30) observed that “it is unlikely that more than a very few people had any but the haziest notions as to ... what kind of a society might lie over the horizon.” Moreover, most European monarchies were insecure, which prevents kings from taking a long view (DeLong and Shleifer 1993).

<sup>19</sup>The skills of the elite (landlords and capitalists) are exogenously given in this paper; they are formally analyzed in Huang (forthcoming).

<sup>20</sup>Until modern times, the peasant is an “object of history,” over which “historical changes pass but which contributes nothing to the impetus of these changes” (Moore 1966, p. 453).

<sup>21</sup>This is in line with North’s (1981, p. 21-22) theory of state, in which the key to understanding the state involves the potential use of violence to gain control over resources: “The contract theory assumes an equal distribution of violence potential amongst the principals. The predatory theory assumes an unequal distribution.”

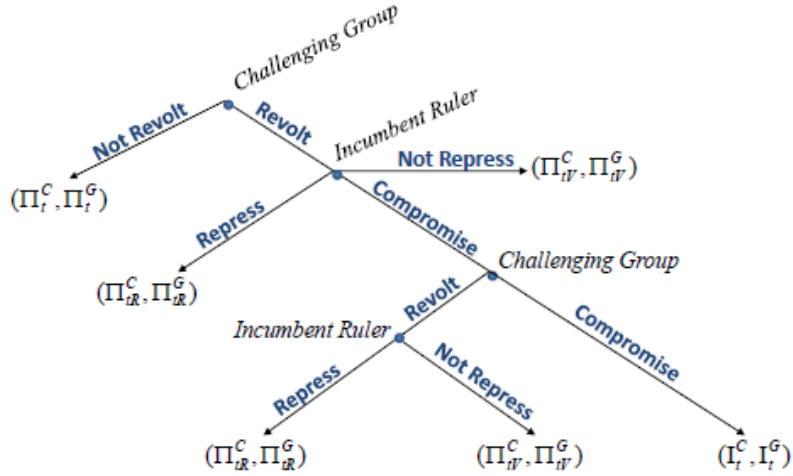


Figure 2: The Political Game between Challenging Group and Incumbent Ruler

this represents *the incumbency advantage*, since the capability to repress increases the incumbent's political power above its coercive ability. If the ruler does not repress the revolt, it carries on and succeeds when the coercive power of the challenging group is higher than that of the current ruler but fails if otherwise. The third option of the incumbent ruler is to compromise, which is extending political power to the challenging group so that no exploitative tax is imposed on their income; this will lead to the transition to a new and more democratic political regime if the challenging group accepts it. If compromise is rejected and the revolt carries on, the ruler can still choose whether to repress it or not.

Political repression can be very costly since the state machinery of police and army is needed to repress domestic unrest and fend off potential foreign invasions, and this is beyond the routine ruling cost already captured by the tax-collecting cost  $1 - \eta$ . The repression cost is represented by a stochastic parameter  $\theta_t$  with distribution  $F(\cdot)$ . The realization of  $\theta_t$  is affected by many elements; it is lower, for example, when the ruler is more effective in conditioning the mass to obey authority through religion, culture, school education, or even personal charisma, and it is higher if the state machine is badly damaged by a natural disaster or military defeat. The occurrence of at least some of these events usually changes over time and varies across countries in a stochastic manner. It is also reasonable for  $\theta_t$  to be positively correlated with the coercive power of the challenging group in that it is usually more costly to repress the revolt of a more powerful group. Similarly, revolt is also costly because it consumes resources and disturbs routine production; the cost of revolt is denoted by a stochastic parameter  $\mu_t$ .

While the exact payoffs of the game are derived in the next section, some general features of the game can be discussed here. Let  $I_t^C$  and  $I_t^G$  denote, respectively, the incomes of the challenging group and the incumbent ruler when there is no exploitative tax, which is exactly the case under mutual compromise; this implies that their payoffs when compromise is achieved are  $(I_t^C, I_t^G)$ . Under the current political order, however, the challenging group has to pay tax  $\tau I_t^C$  while the incumbent ruler receives a net tax revenue  $\eta\tau I_t^C$  given the tax collecting cost  $(1 - \eta)\tau I_t^C$ , and so their payoffs under no revolt are their after-tax incomes  $(\Pi_t^C, \Pi_t^G)$  where<sup>22</sup>

$$\begin{aligned}\Pi_t^C &= (1 - \tau)I_t^C, \\ \Pi_t^G &= I_t^G + \eta\tau I_t^C.\end{aligned}$$

To capture the idea that the cost of repression is positively correlated with the challenging group's violent potential, a dummy variable  $x$  is defined such that  $x = 1$  if the coercive power of the challenging group is higher than that of the current ruler and  $x = 0$  if otherwise. When  $x = 1$ , the two groups' incomes when revolt is repressed are  $(\Pi_t^C/\theta_t, \Pi_t^G/\theta_t)$ , where  $\theta_t > 1$  indicates the repression cost mentioned above; when  $x = 0$ , the challenging group is too weak to seriously threaten the incumbent ruler, and so without much loss of generality, we assume that the cost to repress any rebellious attempt is negligible so that the two groups' incomes are  $(\Pi_t^C, \Pi_t^G)$ , and when indifferent, the challenging group prefers Not Revolt to Revolt.<sup>23</sup> The incomes of the two groups when revolt is repressed are thus, respectively,

$$\begin{aligned}\Pi_{tR}^C &= x\Pi_t^C/\theta_t + (1 - x)\Pi_t^C, \\ \Pi_{tR}^G &= x\Pi_t^G/\theta_t + (1 - x)\Pi_t^G.\end{aligned}$$

When the incumbent ruler chooses not to repress, revolt is carried out with two possible outcomes. When  $x = 0$ , the revolt fails and the incomes of the two groups are  $(\Pi_t^C/\mu_t, \Pi_t^G/\mu_t)$ , where  $\mu_t > 1$  indicates the revolt cost; when  $x = 1$ , the revolt succeeds, which means the challenging group gains the political power while the incumbent group loses it, and so that their incomes are respectively  $(I_t^C + \eta\tau I_t^G)/\mu_t$  and

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<sup>22</sup>Note that under this assumption, the deadweight output loss under the current political order is equal to the tax collecting cost  $(1 - \eta)\tau I_t^C$ . This is a mere simplifying assumption and not crucial for the results. Presumably, the loss of output under repression can be much higher than the tax collection cost; this is the case, for example, when either physical or human capital accumulation is affected negatively by tax; this specific case is discussed in Section 5 and the main results remain the same.

<sup>23</sup>Without this simplifying assumption, "revolt and being repressed" is the other SPE outcome when  $x = 0$ , which leads to the same incomes and political outcome as "no revolt."

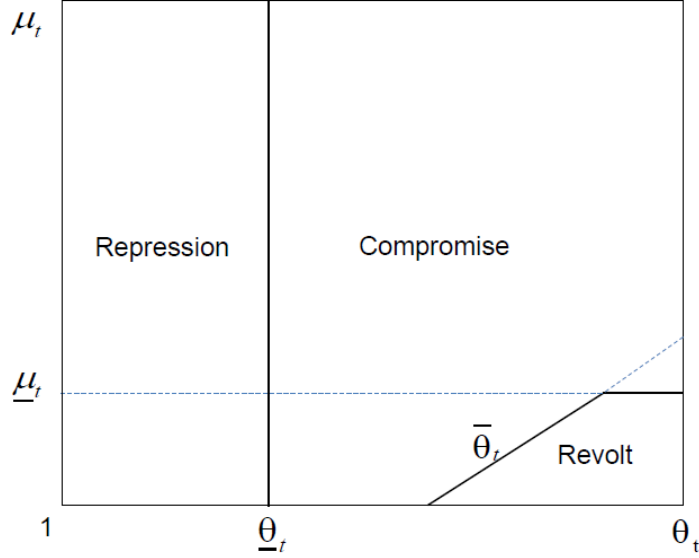


Figure 3: Subgame Perfect Equilibrium Outcomes When  $x = 1$

$(1 - \tau)I_t^G/\mu_t$ . The incomes of the two groups under revolt are thus

$$\begin{aligned}\Pi_{tV}^C &= x(I_t^C + \eta\tau I_t^G)/\mu_t + (1 - x)\Pi_t^C/\mu_t, \\ \Pi_{tV}^G &= x(1 - \tau)I_t^G/\mu_t + (1 - x)\Pi_t^G/\mu_t.\end{aligned}$$

The outcomes of Subgame Perfect Nash Equilibrium (SPE) are characterized in the following proposition.

**Proposition 1** *When the challenging group's coercive power is lower than that of the incumbent ruler, that is, when  $x = 0$ , the unique SPE outcome is no revolt and obeying the current political order. There are three types of SPE outcomes when  $x = 1$ : (i) (Repression) The incumbent ruler threatens to repress and no revolt occurs when the repression cost is low, that is, when  $\theta_t < \underline{\theta}_t$ , where  $\underline{\theta}_t \equiv 1 + \eta\tau I_t^C/I_t^G$ . (ii) (Compromise) Compromise is proposed and accepted so that a smooth transition of political regime takes place when the repression cost is neither too low nor too high, that is, when  $\theta_t \in [\underline{\theta}_t, \bar{\theta}_t]$  where  $\bar{\theta}_t \equiv \underline{\theta}_t\mu_t/(1 - \tau)$ , or when both repression and revolt costs are high, that is, when  $\theta_t > \bar{\theta}_t$  and  $\mu_t \geq \underline{\mu}_t$ , where  $\underline{\mu}_t \equiv 1 + \eta\tau I_t^G/I_t^C$ . (iii) (Revolt) The challenging group carries out revolt successfully and gains political power when the repression cost is high and the revolt cost is low, that is, when  $\theta_t > \bar{\theta}_t$  and  $\mu_t < \underline{\mu}_t$ .*

This proposition suggests that, in the equilibrium, the incumbent ruler is able to maintain its repressive ruling as long as it possesses the dominant coercive power or when the repression cost is low enough. When

neither of these two conditions holds, however, the old political regime cannot sustain any longer. The transition to a new political order can be either smooth or violent. When the repression cost is in the middle range or when both repression and revolt costs are high, a smooth transition of political regime is achieved in the equilibrium by extending political power to the challenging group. In this case, the change of coercive power (or de facto political power) is consolidated by the change of (de jure) political power in an efficient way such that the momentum of economic development is not interrupted; the corresponding developmental path is illustrated in Figure 1, which is the main focus of this paper. Such an ideal situation, however, is not achievable in equilibrium when the repression cost is high but the revolt cost is low, in which case revolution occurs and a new political regime replaces the old by violence. Figure 3 illustrates these three equilibrium outcomes in the space of the repression and revolt costs when the incumbent ruler's coercive power is not dominant anymore (i.e. when  $x = 1$ ).

## 4 The Economic and Political Development Path

### 4.1 Land and Monarchy: $[0, t_k]$

In the beginning of the model economy, agriculture is the dominant production method. The productivity is so low that no saving is available for capital accumulation, and capitalists are thus not distinguishable from the worker group.<sup>24</sup> There is no incumbent ruler so that people live in anarchy and resources are allocated by the principle of might-is-right. In this Hobbes' war of every man against every man, when two groups fight, we assume that the one with higher coercive power wins, and if they have equal coercive power, the one who initiates the fight wins, and each wins with an equal probability if both initiate the fight simultaneously. The winner in a fight can capture at most  $\tau$  of the latter's income  $I$  because  $(1 - \tau)I$  can be either hidden or destroyed by the defeated player; the winner, however, has to incur a fighting cost  $(1 - \hat{\eta})\tau I$  so that the net benefit of winning is  $\hat{\eta}\tau I$ , where  $\hat{\eta} \in (0, 1)$  and  $\hat{\eta} \leq \eta$ , i.e., fighting is more costly than tax collecting under an established political order.

A landlord  $i$  owns land  $L_i$  and employs  $N_{ti}$  workers taking wage  $w_t$  as given, where  $\sum_{i=1}^{N_l} L_i = L$  and  $\sum_{i=1}^{N_l} N_{ti} = N + N_c$ . The size of a landlord's land  $L_i$  satisfies  $\bar{L} \geq L_i \geq \underline{L}$ . The higher bound  $\bar{L} < +\infty$  is determined by the managing capability of the landlord as well as other elements, beyond which the return is zero. The lower bound  $\underline{L} = \frac{L}{N+N_c} \frac{\alpha}{1-\alpha}$  is needed for a landlord's profit to be not lower than worker wage

<sup>24</sup>The assumption that capitalists do not emerge from landowners is consistent with historical evidence, although it has no effect on the qualitative results. Doepke and Zilibotti (2007), for example, show that the crucial characteristics of capitalists, such as patience and work ethics, were initially cultivated in certain working families but not in the landed class.

$w_t$ ; this combined with assumption (A1) guarantees that the landlord is dominant in coercive capability compared to his workers so that his total revenue is composed of not only pure land profit  $\pi_{ti}$ , but also the net wage tax  $\eta\tau N_{ti}^* w_t$ .<sup>25</sup> This is proved in the following lemma.

**Lemma 1** *For a landlord  $i$  with land  $L_i \in [L, \bar{L}]$ , the optimal profit is  $\pi_{ti}^* = \lambda A_t L_i$  and the total revenue is  $I_{ti} = \pi_{ti}^* + \eta\tau N_{ti}^* w_t^* = (1 + \frac{\alpha}{1-\alpha} \eta\tau) \lambda A_t L_i$ , where  $\lambda \equiv (1 - \alpha)(\frac{N+N_c}{L})^\alpha$ . Both are proportional to land size  $L_i$ .*

This lemma shows that a stable order is established for each landlord over his workers, which enables the landlords to focus on getting more income by fighting each other. Unlike physical and human capital, land is difficult to be hidden or destroyed and does not depreciate so that the winner in fighting can take the land and accumulate it. In particular, a landlord  $i$  with a dominant coercive capacity can grab the land of landlord  $j$  and get a net return  $\widehat{\eta}\tau I_{tj} > 0$ . Let  $\Omega$  be the set of all possible coalitions that can be formed among landowners, and let  $\omega \in \Omega$  denote a generic element of the set. A stable political regime may emerge as a Nash Equilibrium of this jungle economy such that nobody has incentives to fight anymore. The following proposition shows that monarchy achieves such an equilibrium where the monarch possesses the dominant coercive power.

**Proposition 2** *When land is the primary production factor, monarchy is the unique political equilibrium when  $\bar{L} > \max_{\omega \in \Omega} \{\psi(N_\omega, \bar{e}) \sum_{i \in \omega} L_i\}$ , where the monarch is the dominant landowner with land  $\bar{L}$ , imposes an income tax rate  $\tau$  on other factor owners and protects their property rights.*

This proposition suggests that the overwhelming power of the monarch enables him to enforce a stable political order to replace anarchy. The monarch also has incentives in doing so: By protecting landowners in return for tax, the net tax revenues are higher because no resources are wasted in fighting over land ownership. The property rights of land are thus much more secure under monarchy than anarchy. Since the large inequality of land ownership under monarchy shortens the time for society to begin capital investment, monarchy greatly facilitates economic development when land is the main production factor.

The monarch's total income at any period  $t \in [0, t_k]$  includes his land profit and tax revenues from other landlords and workers, which is  $I_{tm} = \lambda A_t \widehat{L}$ , where  $\widehat{L} \equiv (1 - \eta\tau)\bar{L} + \frac{\eta\tau}{1-\alpha} L$ . Since the monarch is the richest person and his income  $I_{tm}$  increases over time, a society starts to have positive bequests when  $I_{tm}$  reaches the threshold income  $Z$  in period  $t_k$ , which is uniquely determined by

$$I_{t_k, m} = \lambda \widehat{L} A_0 (1 + g)^{t_k} = Z. \quad (4)$$

<sup>25</sup>Though receiving the market wages  $w_t$ , workers still have to pay an exploitative tax  $\tau$  that makes it essentially equivalent to receiving a forced wage  $(1 - \tau)w_t$ .



It is obvious that  $t_k$  arrives earlier when  $\bar{L}$ ,  $L$ , and  $\tau$  are larger.

Since the coercive power of landowners is proportional to land size, the stable land distribution under monarchy means that the balance of coercive power is stable, and thus according to Proposition 1, there is no revolt under monarchy before  $t_k$ .

## 4.2 Physical Capital and Oligarchy: $(t_k, T_k]$

With surpluses available in society after  $t_k$ , capitalists start to use their special skills to produce physical capital. The *endogenous* supply of physical capital marks its fundamental difference from land; it reinforces the cooperative aspect and plays down the conflicting side of the relationship among factor owners. Such a change in the economic arena will induce corresponding adjustment in the political system.

To be consistent with historical evidence, we focus on the case where public education for workers is not provided under monarchy, which is formally characterized below in Proposition 4.<sup>26</sup> The total physical capital stock is thus  $K_t = N_c \kappa \left( \frac{B_t - 1}{N_c} \right)$  in any period  $t$  under monarchy. Individual landowners choose the optimal demand for capital and labor to maximize their profits, taking as given the capital rental rate  $r_t^*$  and wage  $w_t^*$ , which clear the capital and labor markets in equilibrium. Capitalists also have to pay  $\tau$  proportion of their income to the monarch.<sup>27</sup>

The ever increasing stock of physical capital induces faster growth in total output than before. The monarch benefits from capital accumulation through increased tax revenues and capital returns. Economic development, however, would gradually build up pressure to challenge the absolute power of the monarch because the joint income of the elites (capitalists and landowners) grows faster than that of the monarch and so does their coercive power.

**Lemma 2** *The coercive powers of the elites and the monarch become equal in period  $T_k$ , which is uniquely determined by*

$$K_{T_k} = \left(1 + \frac{1}{\varphi}\right) \bar{L} - L. \quad (5)$$

This lemma makes it clear that the driving force of the increasing coercive power of the elites is the ever increasing physical capital  $K_t$ , and when it becomes large enough, the elites are capable of challenging the monarch. Note that  $\varphi \equiv \psi(N_c + N_l - 1, \bar{e})$  is the coordination effectiveness of the elites, and when it is higher, the threshold  $K_{T_k}$  is smaller. This lemma also suggests that when  $\bar{L}$  is bigger, the political transition time  $T_k$

<sup>26</sup>The underlying reason is the much higher return of investing in physical capital than in human capital, given  $\lim_{M_t^k \rightarrow 0} \kappa' = +\infty$  and  $f'(0) = \gamma < +\infty$ .

<sup>27</sup>An endogenous tax rate on capitalists is considered in Section 5.

is reached later, although physical capital accumulation begins earlier (as  $t_k$  in (4) is smaller). It implies that an economy with higher inequality in the initial land distribution will start to accumulate physical capital earlier, but its political transition to oligarchy may be relatively late because the monarch is too powerful. Such a reversal of fortune is not uncommon in history.

Before period  $T_k$ , the monarch possesses the dominant coercive power so that the unique SPE in the political game in Figure 2 is no revolt. Starting from  $T_k$ , however, the elites (capitalists and landowners other than the monarch) become strong enough to challenge the monarch, and depending on the costs of repression and revolt, they may gain political power and a transition of political regime may occur. The mechanism of the game is the same as in Proposition 1, where the payoffs of the game are derived in detail here. In particular, if mutual compromise is reached, the political power is extended to the elites so that no tax is imposed on land and physical capital, and they share the total tax payment from workers. The equilibrium results of the game between monarch and the elites are summarized below.

**Proposition 3** *In the political game between the monarch and the elites, the unique SPE outcome is no revolt at any period before  $T_k$ , while the outcome at period  $T_k$  depends on the repression cost  $\theta_{T_k}$  and the revolt cost  $\mu_{T_k}$ : Monarchy continues when  $\theta_{T_k} < \underline{\theta}_{T_k}$ , while it is replaced by the oligarchy of landowners and capitalists when  $\theta_{T_k} \geq \underline{\theta}_{T_k}$ : the transition is achieved either by compromise (when  $\theta_{T_k} \in [\underline{\theta}_{T_k}, \bar{\theta}_{T_k}]$  or when  $\theta_{T_k} > \bar{\theta}_{T_k}$  &  $\mu_{T_k} \geq \underline{\mu}_{T_k}$ ) or by revolt (when  $\theta_{T_k} > \bar{\theta}_{T_k}$  &  $\mu_{T_k} < \underline{\mu}_{T_k}$ ), where*

$$\begin{aligned}\underline{\theta}_{T_k} &= 1 + \frac{\eta\tau}{\varphi(1-\alpha + \alpha\eta\tau)}, \\ \bar{\theta}_{T_k} &= \left[1 + \frac{\eta\tau(1+\varphi\alpha)}{\varphi(1-\alpha)}\right] \frac{\mu_{T_k}}{(1-\tau)}, \\ \underline{\mu}_{T_k} &= 1 + \frac{\eta\tau(\alpha + \varphi)}{1-\alpha}.\end{aligned}$$

This proposition suggests that the smooth transition of political regime from monarchy to oligarchy tends to take place when the repression cost  $\theta_{T_k}$  is in the middle range  $[\underline{\theta}_{T_k}, \bar{\theta}_{T_k}]$  or when the costs of repression and revolt are both too high; in this case, it is not worthwhile for either group to resort to violent means and thus mutually beneficial compromise is reached.<sup>28</sup> The following analysis assumes that this smooth transition is

<sup>28</sup>The coalition between capitalists and landowners seems more likely to happen than the co-option alternative in which the monarch divides the elites by co-opting either landowners or capitalists (Bertocchi and Spagat 2001). When compromise would have been reached in the political game analyzed here, the co-option payment to landowners or capitalists must be at least as large as their tax payment to the monarch, otherwise they should reject it and ally with each other; it must, however, be smaller than the joint tax revenue paid by both groups, otherwise the monarch would not benefit from co-option. But then the group that is not co-opted can bribe the other group by offering a transfer up to their tax payment. Thus co-option of one group is, at least weakly, dominated by the coalition between capitalists and landowners in the compromise case and it is strongly

achieved at  $T_k$  so that landlords and capitalists share political power and impose no tax on themselves from period  $T_k$  onwards; discussions of other outcomes are collected in Section 4.5.

### 4.3 Human Capital and Democracy: $(T_k, T_h]$

During the initial periods under the elite rule, workers are still raw labor and their after-tax wages are not high enough to have bequests.<sup>29</sup> The elites, however, may find it beneficial to start investing in human capital through public education in some period when the physical capital stock becomes so large that the return of investing more in it is relatively low. The following proposition provides the specific condition under which human capital is not invested under monarchy, and characterizes the first period  $t_h$  that human capital investment starts and the optimal tax rate  $\tau_t^{h*}$  for public education.

**Proposition 4** *Human capital investment does not start under monarchy if*

$$\kappa'(B_{T_k-1}/N_c) > \frac{\alpha(1+\varphi)\gamma\bar{L}}{\varphi(\xi-\alpha)} \quad (6)$$

where  $\xi \equiv (1+\varphi)/[1+\varphi+\varphi(1-\alpha)(1/\eta\tau-1)]$ . It starts under oligarchy in period  $t_h$  that is determined by

$$\alpha(L + K_{t_h})\gamma - (1-\alpha)\kappa'(B_{t_h-1}/N_c) = 0 \quad (7)$$

where  $K_{t_h} = N_c\kappa(B_{t_h-1}/N_c)$ . The optimal tax rate  $\tau_t^{h*}$  for public education is determined by

$$\alpha(L + K_t)f'(\tau_t^{h*}B_{t-1}/N) - (1-\alpha)h_t\kappa'(B_{t-1}(1-\tau_t^{h*})/N_c) = 0 \quad (8)$$

in any period  $t \geq t_h$ , where the public education expenditure  $M_t^{h*} = \tau_t^{h*}B_t$  is strictly increasing in  $B_t$ .

This proposition suggests that the tax rate for public education  $\tau_t^{h*}$  is optimally chosen by the ruling elites to balance the marginal returns of investing in physical and human capital. The increasing public education expenditure drives up the human capital level  $h_t = f(\tau_t^{h*}B_{t-1}/N)$  of workers, which in turn increases their wages and coordination effectiveness over time. As a result, the collective coercive power  $\psi(N, h_t)\alpha Y_t$  of workers will eventually match that of the elites,  $\psi(N_c + N_l, \bar{e})(1-\alpha)Y_t$ , in some period  $T_h$ , which leads to the following lemma.

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dominated when it is too costly for the monarch to repress. In the repression case, the monarch does not need to co-opt any group since it is more cost-effective to repress them.

<sup>29</sup>Although mass education by private financing is possible in principle (Bertocchi and Spagat 2004), in history it has not been the typical case due to the subsistence level of wages and the imperfection of credit markets (see Galor and Moav (2006) for more evidence).

**Lemma 3** *The coercive powers of workers and the elites become equal in period  $T_h$ , which is uniquely determined by*

$$\psi(N, h_{T_h})\alpha = \psi(N_c + N_l, \bar{e})(1 - \alpha). \quad (9)$$

Before period  $T_h$ , the elites still have the dominant coercive power so that the unique SPE in the political game between the elites and workers is no revolt. Starting from  $T_h$ , however, workers become strong enough to challenge the elite rule. With similar arguments as before, we get the following results.

**Proposition 5** *In the political game between the elites and workers, the unique SPE outcome is no revolt at any period before  $T_h$ , while the outcome at period  $T_h$  depends on the repression cost  $\theta_{T_h}$  and the revolt cost  $\mu_{T_h}$ : Oligarchy continues if  $\theta_{T_h} < \underline{\theta}_{T_h}$ , otherwise it will be replaced either by full democracy through compromise (if  $\theta_{T_h} \in [\underline{\theta}_{T_h}, \bar{\theta}_{T_h}]$  or if  $\theta_{T_h} > \bar{\theta}_{T_h}$  &  $\mu_{T_h} \geq \underline{\mu}_{T_h}$ ) or by the rule of workers through violence (if  $\theta_{T_h} > \bar{\theta}_{T_h}$  &  $\mu_{T_h} < \underline{\mu}_{T_h}$ ), where*

$$\begin{aligned} \underline{\theta}_{T_h} &= 1 + \frac{\eta\tau\alpha}{1-\alpha}, \\ \bar{\theta}_{T_h} &= \left(1 + \frac{\eta\tau\alpha}{1-\alpha}\right) \frac{\mu_{T_h}}{(1-\tau)}, \\ \underline{\mu}_{T_h} &= 1 + \frac{\eta\tau(1-\alpha)}{\alpha}. \end{aligned}$$

Similar as in the transition from monarchy to oligarchy, mutual compromise is reached between the elites and workers when the repression cost is in the middle or when both repression and revolt costs are high; in this case, the elites extend political power to workers in a smooth transition of political regime from oligarchy to full democracy, where no tax is imposed on wages, and as a result each factor earns its competitive return and the exploitative tax disappears. It turns out that under democracy the optimal tax rate  $\tau_t^{h*}$  for public education is also determined by equation (8), since the elites' joint income under oligarchy is proportional to the aggregate income.

#### 4.4 The Smooth Development Path: Summary

The development path in the model is driven by the technical features of different production factors and political conflicts among factor owners in dividing the outputs, while the effects of many elements (such as geography, culture, religion, ideologies, wars, and colonization) that bestow much richness to the actual history are mainly reflected by cross-sectional and intertemporal differences in the costs of repression and revolt. If at both transition times  $T_k$  and  $T_h$  the repression costs remain in the middle ranges or when the costs of repression and revolt are both high, a smooth economic and political development path, as illustrated

in Figure 1, is to be taken, where the political regimes adjust smoothly to the evolving factor composition of land, physical and human capital; England seems to be such a case, where political compromises were reached at these crucial moments. This type of coevolution path is summarized by the following proposition.

**Proposition 6** *When the repression costs are in the middle ranges ( $\theta_{T_k} \in [\underline{\theta}_{T_k}, \bar{\theta}_{T_k}]$  and  $\theta_{T_h} \in [\underline{\theta}_{T_h}, \bar{\theta}_{T_h}]$ ) or when the costs of repression and revolt are both high ( $\theta_{T_k} > \bar{\theta}_{T_k} \ \& \ \mu_{T_k} \geq \underline{\mu}_{T_k}$  and  $\theta_{T_h} > \bar{\theta}_{T_h} \ \& \ \mu_{T_h} \geq \underline{\mu}_{T_h}$ ), compromise between the incumbent ruler and the challenging group is reached at both transition times  $T_k$  and  $T_h$ , and the political economy evolves as follows. Physical capital accumulation starts at period  $t_k$  while human capital investment starts at  $t_h$ . Monarchy is the political equilibrium before  $T_k$ , then it is replaced by the oligarchy of landowners and capitalists, and finally, workers also gain political rights and hence full suffrage is realized after  $T_h$ . The time path  $t_k < T_k < t_h < T_h$  suggests that economic development leads to political transition, which in turn facilitates future economic development.*

**Table 1. The Smooth Development Path**

<b>The Political Transition</b>					
Time	$t \leq T_k$		$t \in (T_k, T_h]$		$t > T_h$
Political Regime	Monarchy		Oligarchy		Democracy
The Ruler	Dominant Landowner		Landowners & Capitalists		All Factor Owners
Exploitative Tax	$\tau$		$\tau$ on workers, 0 on others		0
Public Education Tax	0		0 in $t \leq t_h$ , $\tau_t^{h*} > 0$ after $t_h$		$\tau_t^{h*} > 0$

<b>The Economic Growth</b>					
Time	$t \leq t_k$	$(t_k, T_k]$	$(T_k, t_h]$	$[t_h, T_h]$	$t > T_h$
Physical Capital $\frac{K_t}{N_c}$	0	$\kappa(\frac{B_{t-1}}{N_c})$	$\kappa(\frac{B_{t-1}}{N_c})$	$\kappa(\frac{B_{t-1}(1-\tau_t^{h*})}{N_c})$	$\kappa(\frac{B_{t-1}(1-\tau_t^{h*})}{N_c})$
Human Capital $\frac{H_t}{N}$	$1 + \frac{N_c}{N}$	1	1	$f(\frac{\tau_t^{h*} B_{t-1}}{N})$	$f(\frac{\tau_t^{h*} B_{t-1}}{N})$
Growth Rate $\frac{Y_{t+1}/A_{t+1}}{Y_t/A_t}$	1	$\frac{(L+K_{t+1})^{1-\alpha}}{(L+K_t)^{1-\alpha}}$	$\frac{(L+K_{t+1})^{1-\alpha}}{(L+K_t)^{1-\alpha}}$	$\frac{(L+K_{t+1})^{1-\alpha} H_{t+1}^\alpha}{(L+K_t)^{1-\alpha} H_t^\alpha}$	$\frac{(L+K_{t+1})^{1-\alpha} H_{t+1}^\alpha}{(L+K_t)^{1-\alpha} H_t^\alpha}$

Note:  $t_k$ ,  $t_h$ ,  $T_k$ ,  $T_h$  and  $\tau_t^{h*}$  are determined by (4), (7), (5), (9), and (8) respectively.

This fast-track economic and political development is further described in Table 1. The exploitative tax  $\tau$  is imposed on all three production factors under monarchy because only the dominant landowner, the monarch, has political power. This tax is waived for both land and physical capital under oligarchy, and finally waived for workers' human capital under full democracy. Such sequential elimination of exploitative tax is driven by the corresponding change of coercive power of factor owners and made permanent by the gradual extension of political power; it reduces the waste of resources associated with tax collecting, and more importantly, strengthens the security of property rights and thus increases incentives for more capital investment. This efficiency gain is reflected by the ever increasing economic growth rates along the path.

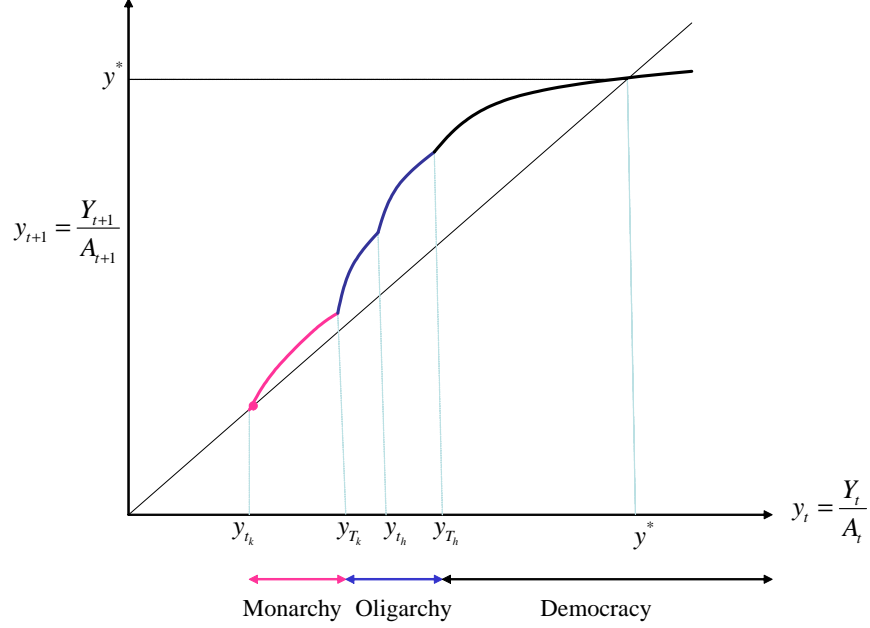


Figure 4: The Evolution of Detrended Output on the Smooth Development Path

The evolution of the total output  $\{Y_t\}_{t=0}^{+\infty}$  is characterized by the increasing stocks of physical and human capital, which are in turn determined by the total bequest  $\{B_t\}_{t=0}^{+\infty}$  in the economy that is increasing due to knowledge accumulation, new capital investment, and also the adapting political schemes. The detrended output  $y_{t+1} = Y_{t+1}/A_{t+1}$  is strictly increasing and concave in  $y_t = Y_t/A_t$  for any  $t \geq t_k$ , and it will eventually converge to a stable and unique steady state  $y^* = (L + N_c k^*)^{1-\alpha} (N h^*)^\alpha$ , where  $\lim_{B_t \rightarrow +\infty} k_{t+1} = k^*$  and  $\lim_{B_t \rightarrow +\infty} h_{t+1} = h^*$ . The detrended economic growth rate  $y_{t+1}/y_t$  is higher in each new political regime and when a new capital form is invested, which makes the final steady state output  $y^*$  much higher than those that would have been achieved in the old economic and political regimes. These results are formally shown in the proof of Proposition 6 and illustrated in Figure 4.

#### 4.5 Development Paths with Repression or Revolution

The smooth development path characterized above serves as the benchmark case to be compared with various deviations; it happens when the repression and revolt costs are “just right”. When the repression costs are too low during the political transition ( $\theta_{T_k} < \underline{\theta}_{T_k}$  or  $\theta_{T_h} < \underline{\theta}_{T_h}$ ), the unique SPE is no revolt, and then the same political game is played in each following period  $t$ . Though this situation may continue for a long time, the probability of its continuation in period  $t$ , which is  $F(\underline{\theta}_{T_j})^{t+1-T_j}$  for  $j \in \{k, h\}$  because  $\theta_t \sim F(\cdot)$ ,

gradually decreases as time goes on, and sooner or later there will be a period when the repression cost  $\theta_t$  is increased by some random shock, such as a natural disaster or foreign invasion, that forces the incumbent to either share political power with the challenging group in a political compromise or yield it to the latter in a revolution. The political transition is then achieved.

The revolution case happens when the repression cost is high but the revolt cost is low. When it occurs in the transition process from monarchy to oligarchy, the result differs little from the compromise case since in both cases the political power is shared among landowners and capitalists, while only one landowner's treatment (namely, the monarch) is different. When it happens under the elite rule, workers become the new ruler and impose tax  $\tau$  on land and physical capital.

In both cases of repression and revolution, the economic development lags behind that of the benchmark case since resources are wasted in tax collection and revolts. Although different in the specific timing, the sequence of the developmental stages is the same in all scenarios: land endowment precedes physical capital investment, which in turn precedes human capital investment, and the correspondence between land predominance and monarchy, physical capital predominance and oligarchy, and finally, human capital predominance and democracy (or majority rule) is maintained. In other words, the dynamic compatibility between the economic and political development illustrated in Figure 1, which is the main insight of the paper, holds for all scenarios.

## 5 Robustness Check: Alternative Modeling Assumptions

The political economy model analyzed so far is extremely simplified in order to highlight the fundamental mechanism at work. The main results of this model, however, are robust to alternative modeling assumptions. To illustrate this, some alternative modeling choices and the resulting changes are discussed briefly in this section, while the detailed results and proofs are in Appendix B.

The production function in the basic model is an extreme case ( $\rho = 1$ ) of the more general production function  $Y_t = A_t(L^\rho + K_t^\rho)^{\frac{1-\alpha}{\rho}}(H_t)^\alpha$ , where land and physical capital are imperfect substitutes in production. When this general functional form is used, as shown in Appendix B, the resulting quantitative changes have no effect on the main results of the basic model. In other words, the exact degree of substitution between land and physical capital is not crucial for the dynamic evolution of the economy.

For a theory that analyses the transition from an agrarian economy to industrial production, the structural change in the economy is important. This is reflected in the basic model by the changing importance of

the three factors, where land is initially the only production factor besides raw labor, then physical capital accumulation starts and gradually replaces land as the prominent factor, and finally human capital investment starts and becomes the most important factor in the economy. Such a dynamic change of factor composition is actually the driving force behind the structural shifting from agricultural to industrial production and the associated change in workforce from unskilled raw labor to skilled workers with human capital.

To show this more explicitly, a two-sector general equilibrium model is worked out in Appendix B, where there are two goods in the economy: one is an agricultural good  $Y_t^L$  produced using land and human capital, the other is a manufacturing good  $Y_t^K$  produced by physical capital and human capital. The production functions at time  $t$  are, respectively,

$$\begin{aligned} Y_t^L &= A_t L^{1-\alpha} (\sigma_t N h_t)^\alpha, \\ Y_t^K &= A_t (K_t)^{1-\alpha} ((1-\sigma_t) N h_t)^\alpha, \end{aligned}$$

where  $\sigma_t$  is the proportion of workers working in the agriculture sector. Individuals are identical in preferences, which are represented by

$$v_{ti} = (1 - \beta) \log[(c_{ti}^L)^\rho + (c_{ti}^K)^\rho]^{\frac{1}{\rho}} + \beta \log(z + b_{ti}),$$

where  $c_{ti}^L$  and  $c_{ti}^K$  denote respectively the individual consumption of agricultural and manufacturing goods. The budget constraint is  $c_{ti}^L + p_t c_{ti}^K + b_{ti} = I_{ti}$ , where  $p_t$  is the relative price of the manufacturing good, and  $b_{ti}$  is still the individual bequest. In the general equilibrium of this two-sector economy, the proportion  $\sigma_t^*$  of workers working in the agriculture sector declines over time, and so does the total profit of landlords, while that of capitalists increases over time; these changes are indeed driven by the increasing stock of physical capital. All the main results go through as in the basic model.

When there is a positive return rate  $\delta > 0$  for savings invested in the capital market, this will change the individual incomes but not the time trend that the total income of capitalists grows faster than that of landowners, and that the coercive power of the elites will eventually match that of the monarch. Thus sharing capital returns with other factor owners affects only the quantitative results, while the basic structure of the model, and hence the main results, are not affected by the exact value of  $\delta$  as long as it is not too big (see Appendix B for detailed results).

The pure exploitative tax rate  $\tau$ , which represents the economic benefit of being the political ruler, is determined in the basic model by the exploitation technology where at most  $\tau$  of the income of ruled agents can be grabbed by force. In an earlier version of this paper, a more realistic model of endogenous



taxation was adopted where the incentives to accumulate physical and human capital are reduced when tax rates are higher, and the ruler has to choose distinct optimal tax rates on these two types of capital to maximize its total revenue. The main results of the paper are robust to this approach, since the endogeneity of the exploitative taxes imposes further discipline on the ruler against high tax rates, and this enables the ruled agents to accumulate an increasing amount of capital to eventually threaten the ruler. The case for endogenous tax on physical capital is shown in Appendix B.

In the basic model the occupational choice of capitalists is assumed to be exogenous in the sense that they start physical capital production automatically at  $t_k$  once savings become available in society. This can be relaxed to allow for endogenous occupational choice; for example, an individual capitalist may decide to switch from working as raw labor to physical capital production only when the return of the latter is higher. Appendix B shows that in this case, the equilibrium number of operating capitalists, denoted by  $n_{tk}^*$ , will increase over time and reach  $N_c$  in some period, that is, eventually all who have the skills to produce physical capital will be doing so, after which things will be the same as in the basic model.

## 6 Historical Evidence

Roughly speaking, most OECD countries have experienced all the developmental stages in the model and are now beyond  $T_h$ , although their paths may not be as smooth as that in England. This section gathers some historical evidence in western Europe to convince the reader that the simple model analyzed above is consistent with broad historical facts and is useful in organizing our thoughts on long-run economic and political development. The main focus is the history of England, France, and Germany, where the full time line suggested in the model has been realized, and political compromise was reached in time to avoid prolonged economic stagnation. A systematic analysis of other countries is best left for future research.

### 6.1 A Brief Overview

The evolving dominance of production factor from land to physical capital and finally to human capital is the main feature of economic development in the model, and it is an almost indisputable fact. From the beginning of settled agriculture, the predominance of land in production lasted thousands of years (Cipolla 1976). Gradually, commercial and industrial sectors replaced agriculture to become dominant economic activities, leading to the Industrial Revolution in the last half of the eighteenth century (North 1981). By the early twentieth century, the modern concept of the wealth of nations had emerged: “It was that capital embodied in the people – human capital – mattered” (Goldin 2001).

The dynamic compatibility between the evolving composition of production factors in the economy and the transition of political regimes, which is the main contribution of the paper, is also observed in history. After the fall of the Roman Empire in the fifth century up to the year 1000, Europe was stagnant both in income and population. The introduction of feudalism in the ninth century enabled Europe to gradually emerge from anarchy and develop a political-economic structure that produced sufficient order and stability and led to a concomitant expansion of both population and economic activity (North 1981). Feudal landlords directed all their attention and efforts to the maintenance and expansion of their inherited lands, which were the most important form of wealth and power. “The rising territorial rulers, the kings and emperors of the tenth to the thirteenth century, were in essence nothing more than the winners in the free-for-all for control over the sparse surpluses of a still relatively unproductive agricultural economy” (Blockmans 1998, p. 72). These are consistent with Proposition 2 which demonstrates the establishment of monarchy and its role in facilitating development.<sup>30</sup>

As more surpluses from agriculture became available, towns started to grow in the tenth century, in parallel with the formation and consolidation of kingdoms. Princes benefited from this process by receiving extra revenues from the cities. As economic development strengthened the business and profession classes, the citizenry struggled for autonomy and independence. The survival of effectively functioning representative bodies, however, depended on both external pressures and domestic structures. The development of parliamentary democracy was made easier in England by its relatively weak repressive apparatus compared to continental monarchies and by the joint force of the landowners and bourgeoisie (the upper stratum of town dwellers) against the monarch (Moore 1966, p. 32). After the Glorious Revolution in 1688 “Parliament became more sympathetic and accessible to the aspirations of merchants, masters and manufacturers, farmers and landowners” (O’Brien 1994). The Industrial Revolution started first in England around the mid-eighteenth century, and many years later spread to other countries. The industrialization process brought forth fundamental economic and political transformations across Europe, especially after the French Revolution. Although different in timing and format across countries, the propertied class in Western Europe had acquired substantial political powers during the nineteenth century and transformed the traditional absolute monarchies into an essentially oligarchical rule of landowners and capitalists, which corresponds to results in Proposition 3.

The Industrial Revolution created a large working class concentrated in urban neighborhoods and work-

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<sup>30</sup>Through numerous conflicts, alliances, and combinations among the many political units of Western Europe strong national monarchies gradually emerged. By 1500 much of the political ground plan of modern Europe was already established, in which England and France were recognizable in their modern forms.

places free of segmental feudal control, greatly enhancing the coordination efficiency among workers. In its second phase, the demand for skilled workers was driven up, which induced massive education reforms (corresponding to Proposition 4) in many European countries during the latter half of the nineteenth century (Galor and Moav 2006). The rising human capital of workers and their increasing ability to coordinate in collective actions eventually led to franchise expansion in several European countries (Acemoglu and Robinson 2000). In the early twentieth century, at the end of the First World War, the agrarian societies of peasants and craftsman in many European countries had already been turned into industrialized societies of machine-tenders and bookkeepers, and correspondingly, oligarchical rule was replaced eventually by democratic institutions with full suffrage (as in Proposition 5).

## 6.2 England

The English development path seems to fit best into the benchmark case of smooth development, where a national monarchy was established early to provide a stable and peaceful environment, and political compromises were achieved in a relatively peaceful way and timely enough to reflect the evolving composition of production factors in the economy and the corresponding change of power balance among factor owners. The economic development was thus greatly facilitated in England, which became the first nation to start the industrialization and democratization process that has fundamentally transformed the world.

The experience of England can be stated more explicitly in the terms of the model: The early establishment of a stable monarchy in 1066 facilitated economic development in England (which is consistent with the implications of Proposition 2). The growth of commerce and the joint force of landowners and capitalists (upper stratum town dwellers) forced the monarch to make a political compromise with the parliament in 1688, which marks the transition from monarchy to oligarchy, and the new political regime greatly promoted commercial and industrial interests (Lemma 2 and Proposition 3). Human capital investment did not begin until the 1830s when the physical capital stock was large enough in the second phase of the Industrial Revolution (Proposition 4), and it eventually led to full suffrage where workers were granted political power in 1918 (Proposition 5).

England has been a unified state since 1066 when William the Conqueror invaded Anglo-Saxon England and became its monarch. The monarch's power was based upon the economy of the crown lands, especially that of its concentrated location and productive capacity. In order to retain control over both the territory and his human resources, William the Conqueror made sure that the lands of his greatest vassals were located in the distant corners of his newly conquered country. In the following five hundred years, the

essential integrity of the monarchy was not compromised although there were some royal concessions by minorities and weak kings to the magnates (Roberts 2002, p. 506). Agricultural productivity began to increase under the stable political order, and the rise in food production enabled towns to develop steadily.

The growth of commerce in the towns during the sixteenth and seventeenth centuries had created a market for agricultural products in the English countryside, thereby setting in motion a process leading towards commercial and capitalist agriculture in the countryside itself. The joint force of the landowners and the upper stratum of town dwellers was an important cause of the Civil War and the ultimate victory of the parliamentary enterprise. Another important element in the success of parliament over the monarch is the latter's lack of strong repressive apparatus, such as an effective bureaucracy and a strong army. This may possibly be due to the previous evolution of the monarchy and the reliance on the navy rather than on the army (Moore 1966, p. 32).

The Glorious Revolution in 1688 marked the fundamental political transition in England from monarchy to the parliamentary rule of landowners and bourgeois, while the crown still kept considerable political power within the parliament. From then on, England was governed by oligarchies representing the effective possessors of social and economic power, who constantly took care "to defend the commercial interests of the country and accepted the leadership and guidance in this of the collective wisdom of the City of London" (Roberts 2002, p. 566). As a consequence, commercial and industrial interests were well reflected in governmental policies, and economic development was greatly facilitated in eighteenth-century England (North and Weingast 1989).

Inside the framework provided by prosperity and English political institutions, technical progress was continuous. By 1750 the most advanced techniques were practiced and the integration of agriculture with a commercial market economy had progressed furthest in England. The profits were then invested in capital to further improve productivity. An expanding overseas commerce generated further profits for investment, and the growing financial institutions enhanced the process. Thus it is no coincidence that the Industrial Revolution began first in England in the middle of the eighteenth century, and it fundamentally transformed a primarily agrarian society to a mature industrial society within a century.<sup>31</sup>

The value of human capital in production was still limited in the first phase of the Industrial Revolution, when workers developed skills primarily through on-the-job training, and child labor was highly valuable. Under Elizabethan and Stuart statutes which remained unreformed between 1688 and 1815, the state retained

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<sup>31</sup>Note that the growth of commercial and industrial sectors preceded the political transition to parliamentary rule in 1688, which in turn led to further economic growth as exemplified by the Industrial Revolution. Such timing is consistent with the model predictions.

considerable power in determining wages and conditions of employment; such statutes and the common law strengthened the authority of employers and depressed wages (O'Brien 1994). Not surprisingly, workers still received very low wages, and their living standards showed no clear improvement before 1820 (Lindert 1994).

Fairly soon, however, employers realized that they needed more than just a labor force that was available, since the contribution of workers to superior economic performance is dependent upon both their skills and attitudes. The increasing importance of human capital in the second phase of the Industrial Revolution prompted a sequence of education reforms in England from the 1830s, which were designed primarily to satisfy increasing skill requirements (Galor and Moav 2006). Realizing that workers would only expend high levels of effort in the production process if they expected to receive a “fair share” of the consequent returns, employers became receptive to sharing power with workers’ organizations rather than fighting unionization. The employers’ acceptance of collective bargaining, in turn, opened the way for political transformation. “In the eyes of the British political elite of the 1860s and 1870s the advent of cooperative industrial relations under the aegis of business-minded union leaders transformed craft workers from uncontrollable subversive into responsible citizens. One result was the 1867 extension of the right to vote to the better-paid of the workers” (Lazonick 1994). Full suffrage was finally realized in Britain in 1918 for men and in 1928 including women.

### **6.3 France**

The French experience is less smooth and clear-cut than that of England. The national monarchy was established in France much later than in England, and its commerce and manufacturing also lagged behind. Its political transition from absolute monarchy to oligarchy was accomplished by violent upheavals and revolutions (starting from 1789), while the subsequent transition to democracy with full suffrage was delivered by the military defeat of war (in 1871). The state’s high repressive capacity seems to be the main reason behind its difference from England. This was probably due to the necessity of a strong army to establish a central monarchy in the first place, and to survive the conflicts with other Continental European states. It seems likely that the repression and economic stagnation might have remained longer in France if it had been left alone without competition from the advanced economy of neighboring England. Fortunately, the revolutions broke the grip of the old regime early enough for France to catch up with the industrialization and democratization process ahead of many other nations.

The French kingdom was initially very decentralized. In the middle of the fifteenth century France gradually evolved from a feudal country to an increasingly centralized state organized around a powerful

absolute monarchy. All the main structural variables and historical trends in French society differed sharply from those in England between the sixteenth and eighteenth centuries. The final political outcome, however, was quite similar in the nineteenth and twentieth centuries.

Commerce and manufacturing in France lagged behind that of England. Under the seventeenth century monarchy, the bourgeoisie was heavily dependent on royal favor, subject to royal regulation, and oriented toward the production of arms and luxuries for a restricted clientele. The practice of selling positions in the bureaucracy, by converting the bourgeoisie into an aristocracy, diminished the bourgeois drive toward property and political independence. Commercial influences that penetrated into the French countryside, unlike those in England, did not undermine or destroy the feudal framework. There were no important technical innovations in agriculture, which continued to be carried out in fundamentally the same technical and social framework that had existed during the Middle Ages. The landed proprietor was not yet a full-blown capitalist farmer, while his earlier functions in the feudal system were taken over by royal officials; what he possessed were essentially claims to a specific share of the economic surplus enforceable through the repressive apparatus of the state.

The growth of the French monarchy had largely deprived the landed upper classes of political responsibility and diverted much of the bourgeois impulse to its own purposes, which made it unlikely for French society to generate a parliament of landlords with bourgeois overtones from the cities in the English fashion (Moore 1966, p. 62). The French situation was not alone in Continental Europe. The representative institutions that had appeared in many countries in the later Middle Ages experienced a nearly universal decline in the sixteenth and eighteenth centuries. By 1789, most of Western Europe was ruled by monarchs little hindered by representative bodies, the main exception being Great Britain (Roberts 2002, p. 572).

However, the ancient regime, which diverted energy and resources from commerce and industry and hence was repressive in terms of economic development, was already under severe strain and soon to be mortally wounded in 1789 by the French Revolution. "Hitherto, political power had been virtually a noble monopoly. Between 1789 and 1799, however, France was governed and reformed by overwhelmingly bourgeois assemblies, largely elected by bourgeois voters. No subsequent regime was ever able substantially to reverse these advances" (Doyle 1992, p. 376). The Revolution seriously weakened the whole interlocking complex of aristocratic privilege: monarchy, landed aristocracy, and seigniorial rights, a complex that constituted the essence of the ancient regime. The ultimate outcome of all the forces at work was a victory for an economic system of private property and a political system based upon equality before the law, the essential features in Western parliamentary democracies. Although not a bourgeois revolution in the restricted sense of the

seizure of political power by a bourgeoisie that already had won the commanding heights of economic power, historians generally agree that the French Revolution was a triumph for the bourgeoisie (Moore 1966, p. 109).

The right to vote in France was still severely restricted under the restored Bourbons from 1815 to 1830; the electorate included only the largest property owners. After the July Revolution of 1830, the number of voters doubled; at this point the old aristocracy disappeared as a coherent and effective political group. Then the French industrial revolution started, a century later than in Britain. Although universal suffrage for all adult male citizens was introduced as a result of the revolutionary upheavals of 1848, it did not function normally in the Second Empire from 1852 to 1870. Throughout this period industrial expansion continued, which strengthened the economic and political power of the working classes. The old regime collapsed upon defeat in the 1871 war, indicating the start of a lasting democratic constitution entailing universal male suffrage.

## 6.4 Germany

Germany as a modern nation state was unified only in 1871 when the German Empire was forged with the kingdom of Prussia as its largest constituent. The long-term fragmentation among German states contributed to their late industrialization compared with England and France, and as a result the democratization process was interwoven with nation building in a complicated manner that shaped its distinct conservative modernization path led by authoritarian governments. Stable democracy was finally realized only after the authoritarian state's strong repression capacity was destroyed by major military defeats.<sup>32</sup> The German experience illustrates that, the later that a country develops, the more complex its developmental path is, since it is likely to be greatly affected by other advanced countries. Nonetheless, the dynamic coevolution between economic and political development can still be clearly seen, and the broad historical trend illustrated in Figure 1 is also evident.

By the middle of the fourteenth century, Prussia still resembled Western Europe where peasants were prosperous and relatively free. Towards the end of this century, however, certain changes began that later led to enserfment of the peasants. One of the most important changes was the introduction of grain exports. In the following two centuries, the German Junkers established a labor repressive system in order to grow grain for export, and at the same time reduced the towns to dependence by short-circuiting them with their exports. In the seventeenth and eighteenth centuries the result was a militarized fusion of royal bureaucracy

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<sup>32</sup>In this regard the experiences of Italy and Japan were similar.

and landed aristocracy.<sup>33</sup>

The low repression costs were perhaps the main reason why a labor repressive agrarian system was adopted in Germany. The resistance to such a system from peasants and towns was limited and easily suppressed. Early in the nineteenth century, when the industrialization started to gather momentum, a strong movement of liberal and democratic opposition began forming in the German states. It culminated in the Revolution of 1848 but was quickly suppressed. A fundamental reason is that the commercial and industrial class was still too weak and dependent to take political power, in part due to its need for authoritarian state support to unify the national market and compete with the advanced industrial economies.

The 1848 revolution also failed because it attempted to create democratization and national unification simultaneously. Nonetheless, it helped pave the way for the eventual achievement of its goals in a sequential matter. It “carried the rural social revolution, launched sixty years earlier in France, to its conclusion in central and most of eastern Europe” (Roberts 2002, p.753). In 1849, the Prussian three-class franchise system that greatly favored the wealthy class was introduced, and was carried over to the unified Germany until the Weimar Republic was formed in 1918. The coalition of “Iron and Rye” was formed in the 1850s “combining authoritarianism with bourgeois elements, against the menace of peasant and proletariat” (Trebilcock 1981). This alliance between the landed class and the rising industrial class created a climate more favorable to industrial advancement. The unification of Germany was finally achieved in 1871, when the Prussian army destroyed the last monarchical regime in France and created the German Empire or the Second Reich, a constitutional monarchy with a parliament of very limited power.

Germany’s industrial proletariat had increased in size as the result of intensive industrialization since the 1850s, and workers started to organize a socialist party and trade unions in 1869. Feeling threatened by a potentially revolutionary force, the state issued repressive laws against socialist organizations, while at the same time extending suffrage and establishing a social welfare system to win over the poor masses. Full democracy, however, was to be achieved mainly as the consequence of military defeats. In 1918, at the end of World War I, the Weimar constitution came into effect, which transformed the German Empire into a democratic republic, albeit a fragile one. The establishment of a stable liberal parliamentary republic had to wait until after World War II in West Germany, and in East Germany until the reunification of Germany in 1990. “Without the defeat, it seems quite likely that Germany would not have become a democracy for decades, until something created a decisive shift in the balance of class forces” (Rueschemeyer et al. 1992,

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<sup>33</sup>England, in contrast, developed agricultural commercialization without tying peasants to the land and hence facilitated the development of town life. “Much of the subsequent history of the two countries goes back to this homely difference” (Moore 1966, p. 460).



p. 109).

## 7 Concluding Remarks

This paper establishes a simple model in which the coevolution of economic and political development is driven by the inherent technical features of different production factors and the political conflicts among factor owners in output distribution. The dynamic economic progress transforms the main production factor from land to physical capital and then to human capital, enables their respective owners, landlords, capitalists, and workers to gain political power in the same sequence, and consequently shifts the political regime from monarchy to oligarchy of landowners and capitalists and then to democracy with full suffrage. When it is too costly for any group of factor owners to repress others, political compromise is reached during the transition periods so that the economic progress is not blocked; otherwise, political conflicts may lead to repression of some factor owners and economic stagnation.

A main insight to emerge from the paper is the dynamic compatibility of economic and political development, which has two implications. First, it brings a developmental perspective into the discussions of appropriate or growth-enhancing political institutions. For instance, the paper suggests that when natural resources are the main factor in production, monarchy is probably the stable political equilibrium that facilitates growth, while imposing democracy may induce anarchy and stagnation. Only when human capital becomes predominant in the economy, which often happens after a society has a large enough physical capital stock, would a political democracy be more likely to sustain itself. Second, it highlights the importance of a society's capacity for smooth political transitions in facilitating economic development. Such a capacity, which is captured in the model by the repression and revolt costs at major transitional occasions, can be influenced by many elements, such as religions, cultures, geopolitical situations, and historical events; different combinations of these non-economic elements may lead to distinct paths of individual nations. For example, the willingness and ability to make political compromise may have greatly facilitated economic progress in the history of England, which had that "most elusive yet decisive institutional feature that makes for economic success: the flexibility to adapt its economic and legal institutions without political violence and disruptions" (Mokyr 2005). Unfortunately, in many societies institutions are quite rigid and difficult to change from within; ultimate changes are often forced upon them by intense global competition, which imposes outside threats to inefficient economies and hence reduces the feasibility of repressive political regimes.

The paper’s analytical framework may prove useful in understanding related long-run development issues. For instance, it can be readily extended to study the effects of international forces, such as war, colonization, and globalization, on the development process either of an individual country or at different historical times, while taking into consideration that the changing motivation, format, and frequency of these international activities may also reflect the shifts of factor composition in production. This may generate new insights into the relationship between democracy and war: If democratic countries have human capital as the dominant production factor, which is often true, it is not surprising that they seldom wage wars against each other. What is the point of conquering a nation whose main wealth is human capital? The relevant parties could have been better off by engaging each other in peaceful international trade. The model can also be extended by endogenizing the state’s repression capacity and costs. For example, the virtually perfect correlation between country size and landlord strength is no accident, since only strong landlords had the coercive power to conquer more lands and establish large monarchies; this may help explain the distinct developmental paths of small countries. The evolution of education system, in terms of both contents and financing methods, may also be shaped by similar driving forces as in the model, including the evolving factor composition and the changing power balance among factor owners.

## APPENDIX A: Proofs

### **Proposition 1.**

**Proof.** When  $x = 0$ , the strategy profile with (Not Revolt, Compromise) for the challenging group and (Repress, Repress) for the incumbent ruler is the unique SPE, which leads to the outcome of no revolt and the continuation of the current political regime. It is easy to check that nobody has incentives to deviate at any subgame: At the last node, Repress leads to a higher income than Not Repress for the ruler given that  $\Pi_t^G > \Pi_t^C/\mu_t$  holds due to  $\mu_t > 1$ ; at the third node Compromise is better than Revolt for the challenging group since  $I_t^C > \Pi_t^C/\theta_t$ ; at the second node Repress is again better than Not Repress and also better than Compromise for the ruler because  $\Pi_t^G > I_t^C$ ; in the first node, Revolt is not better than Not Revolt for the challenging group in terms of payoffs and thus Not Revolt is strictly preferred.

When  $x = 1$ , there is also a unique SPE, which varies according to the cost levels of repression and revolt. When  $\theta_t \in [\underline{\theta}_t, \bar{\theta}_t]$ , the strategy profile with (Revolt, Compromise) for the challenging group and (Compromise, Repress) for the incumbent ruler is the unique SPE, which leads to the outcome of compromise. Again we check that nobody has incentives to deviate at any subgame: At the last node, Repress leads to a

higher income than Not Repress for the incumbent ruler if  $\Pi_t^G/\theta_t \geq (1-\tau)I_t^G/\mu_t$  holds, which is equivalent to

$$\theta_t \leq \bar{\theta}_t, \quad \text{where } \bar{\theta}_t \equiv \mu_t \Pi_t^G / (1-\tau) I_t^G = \frac{\mu_t}{(1-\tau)} (1 + \eta\tau I_t^C / I_t^G).$$

Given this, at the third node, Compromise is better than Revolt for the challenging group due to  $I_t^C > \Pi_t^C/\theta_t$ . At the second node, Compromise is better than Repress for the ruler if  $I_t^G > \Pi_t^G/\theta_t$ , which is equivalent to

$$\theta_t \geq \underline{\theta}_t, \quad \text{where } \underline{\theta}_t \equiv \Pi_t^G / I_t^G = 1 + \eta\tau I_t^C / I_t^G;$$

note that  $\underline{\theta}_t < \bar{\theta}_t$  because  $\mu_t/(1-\tau) > 1$ . And Compromise also dominates Not Repress because the latter is dominated by Repress when  $\theta_t \leq \bar{\theta}_t$ . Finally, at the first node for the challenging group, Revolt is better because  $I_t^C > \Pi_t^C$ . An alternative strategy profile leads to the same outcome, which has (Revolt, Compromise) for the challenging group and (Compromise, Not Repress) for the incumbent ruler when  $\theta_t > \bar{\theta}_t$  and  $\mu_t \geq \underline{\mu}_t$ ; here the difference lies in the last three nodes. At the last node, Not Repress leads to a higher income than Repress for the ruler if  $\theta_t > \bar{\theta}_t$ , and given this choice, at the third node Compromise is better than Revolt for the challenging group if  $I_t^C \geq (I_t^C + \eta\tau I_t^G)/\mu_t$ , which is equivalent to

$$\mu_t \geq \underline{\mu}_t, \quad \text{where } \underline{\mu}_t \equiv 1 + \eta\tau I_t^G / I_t^C.$$

At the second node, Compromise dominates the other two options for the incumbent ruler when  $\theta_t \geq \underline{\theta}_t$ , which is satisfied when  $\theta_t > \bar{\theta}_t$  holds.

When  $\theta_t < \underline{\theta}_t$ , revolt does not occur because the strategy profile with (Not Revolt, Compromise) for the challenging group and (Repress, Repress) for the incumbent ruler is the unique SPE. At the last node, Repress leads to a higher income than Not Repress for the ruler if  $\theta_t \leq \bar{\theta}_t$ , and given this choice, at the third node Compromise is better than Revolt for the challenging group due to  $I_t^C > \Pi_t^C/\theta_t$ ; at the second node for the ruler, Repress dominates both Not Repress and Compromise when  $\theta_t < \underline{\theta}_t$ ; and finally, at the first node, Not Revolt is better for the challenging group because  $\Pi_t^C > \Pi_t^C/\theta_t$ . Since  $\theta_t < \underline{\theta}_t$  implies  $\theta_t \leq \bar{\theta}_t$ , the first condition is sufficient for the outcome.

In the case of  $\theta_t > \bar{\theta}_t$  and  $\mu_t \leq \underline{\mu}_t$ , revolt carries on in the SPE where the strategy profile is composed by (Revolt, Revolt) for the challenging group and (Compromise, Not Repress) for the incumbent ruler. At the last node, Not Repress leads to a higher income than Repress for the ruler given  $\theta_t > \bar{\theta}_t$ , and then the challenging group carries out the revolt to gain political power and an income  $(I_t^C + \eta\tau I_t^G)/\mu_t$ ; given this, at the third node Revolt is better than Compromise for the challenging group if  $(I_t^C + \eta\tau I_t^G)/\mu_t > I_t^C$  or equivalently  $\mu_t < \underline{\mu}_t$ ; consequently, at the second node for the ruler, Compromise (getting  $(1-\tau)I_t^G/\mu_t$  in the

end) weakly dominates Not Repress, which is better than Repress when  $\theta_t > \bar{\theta}_t$ ; and finally, at the first node, Revolt (getting  $(I_t^C + \eta\tau I_t^G)/\mu_t$  in the end) is better for the challenging group when  $(I_t^C + \eta\tau I_t^G)/\mu_t > \Pi_t^C$  or equivalently  $\mu_t < \underline{\mu}_t/(1-\tau)$ , which is satisfied if  $\mu_t < \underline{\mu}_t$  holds. An alternative strategy profile with (Revolt, Revolt) for the challenging group and (Not Repress, Not Repress) for the incumbent ruler also leads to the same outcome. ■

**Lemma 1.**

**Proof.** The landlord's profit maximization problem is  $\max_{N_{ti}} A_t(L_i)^{1-\alpha} N_{ti}^\alpha - w_t N_{ti}$ , taking the wage rate  $w_t$  as given. The first order condition (FOC)  $\alpha A_t(L_i)^{1-\alpha} N_{ti}^{\alpha-1} = w_t$  leads to the optimal labor demand  $N_{ti}^* = (\frac{\alpha}{w_t} A_t)^{\frac{1}{1-\alpha}} L_i$ . When the labor market clears,  $\sum_{i=1}^{N_t} N_{ti}^* = N + N_c$  must hold, which yields the equilibrium wage rate  $w_t^* = \alpha A_t (\frac{L}{N+N_c})^{1-\alpha}$ . Then we get  $N_{ti}^* = \frac{(N+N_c)L_i}{L}$  and the optimal profit is  $\pi_{ti} = (1-\alpha)(\frac{N+N_c}{L})^\alpha A_t L_i \equiv \lambda A_t L_i$ .

The coercive ability of an individual worker,  $\psi(1, 1)w_t^*$ , is lower than that of the landlord,  $\psi(1, \bar{e})\pi_{ti}$ , since  $\psi(1, 1) < \psi(1, \bar{e})$  holds due to  $\psi_2 > 0$  and  $\bar{e} > 1$ , while  $w_t^* \leq \pi_{ti}$  holds given  $L_i \geq \underline{L}$ . The total income of landlord  $i$ 's workers is  $N_{ti}^* w_t^* = \frac{\alpha}{1-\alpha} \lambda A_t L_i$ ; the aggregate coercive ability of workers is thus  $\psi(N, 1) \frac{\alpha}{1-\alpha} \lambda A_t L_i$ , which is smaller than the landlord's coercive ability  $\psi(1, \bar{e}) \lambda A_t L_i$  under assumption (A1). With a dominant coercive ability, the landlord can grab a proportion  $\tau$  of wages based on might-is-right and get a total revenue  $I_{ti} = \pi_{ti} + \eta\tau N_{ti}^* w_t^* = (1 + \frac{\alpha}{1-\alpha} \eta\tau) \lambda A_t L_i$ . ■

**Proposition 2.**

**Proof.** The monarchy is indeed an equilibrium since there are no profitable deviations. No coalition is able to challenge the monarch given  $\bar{L} > \max_{\omega \in \Omega} \{\psi(N_\omega, \bar{e}) \sum_{i \in \omega} L_i\}$  because the coercive power of the monarch,  $(1 + \frac{\alpha}{1-\alpha} \eta\tau) \lambda A_t \psi(1, \bar{e}) \bar{L}$ , is higher than that of any coalition  $\omega$  of other landowners, which is  $(1 + \frac{\alpha}{1-\alpha} \eta\tau) \lambda A_t \psi(N_\omega, \bar{e}) \sum_{i \in \omega} L_i$ . It is also the unique political equilibrium. Any scenarios where some landlords are more powerful than others but no one is dominant as a monarch will not be an equilibrium because the more powerful landlords have incentives to grab the others' land. The coexistence of a number of equally powerful landlords is not an equilibrium because some may make a coalition with each other to grab the land of the others. When there are only two equally powerful landlords left, both of them will find it beneficial to initiate the fight, where one wins the battle and becomes the monarch.

The monarch would not grab other landlords' land, since imposing a tax rate  $\tau$  yields more revenue than fighting, and increasing land size beyond  $\bar{L}$  brings zero revenue by assumption. Other landowners would accept the tax because they are not powerful enough to win a fight against the monarch either as individuals or as groups. The landlords would not fight each other because the winner in the fight is

to be punished by the monarch, who benefits more from them paying tax than fighting each other and destroying resources. Workers would pay wage tax  $\tau N_t^* w_t^*$  to the monarch since their collective coercive power  $\psi(N, 1) \frac{\alpha}{1-\alpha} \lambda A_t L$  is dominated by the monarch's  $\lambda A_t \bar{L}$  by assumption (A1) and  $\bar{L} > \frac{\varphi}{1+\varphi} L$ ; this is implied by  $\bar{L} > \max_{\omega \in \Omega} \{\psi(N_\omega, \bar{e}) \sum_{i \in \omega} L_i\}$  because one coalition is made up by all the other landowners, whose collective coercive power is proportional to  $\psi(N_l - 1, \bar{e})(L - \bar{L})$ ; that is,  $\bar{L} > \psi(N_l - 1, \bar{e})(L - \bar{L})$  must hold, but then  $\psi(N_l - 1, \bar{e}) > \psi(N_l - 1 + N_c, \bar{e}) \equiv \varphi$  since  $\psi_1 < 0$ , which implies  $\bar{L} > \varphi(L - \bar{L})$  or equivalently  $\bar{L} > \frac{\varphi}{1+\varphi} L$ . ■

**Lemma 2.**

**Proof.** Landlord  $i$ 's objective function is

$$\pi_{ti}^* = \max_{N_{ti}, k_{ti}} A_t (L_i + k_{ti})^{1-\alpha} N_{ti}^\alpha - w_t N_{ti} - r_t k_{ti}.$$

The optimal demands for labor and physical capital are determined by

$$\begin{aligned} w_t &= \alpha A_t (L_i + k_{ti}^*)^{1-\alpha} (N_{ti}^*)^{\alpha-1}, \\ r_t &= (1 - \alpha) A_t (L_i + k_{ti}^*)^{-\alpha} (N_{ti}^*)^\alpha. \end{aligned}$$

The labor market clearing condition implies

$$w_t^* = \alpha A_t \left( \frac{L + K_t}{N} \right)^{1-\alpha}$$

and  $N_{ti}^* = N \frac{L_i + k_{ti}^*}{L + K_t}$ . Plug  $N_{ti}^*$  into the condition of  $r_t$  we get

$$r_t^* = (1 - \alpha) A_t \left( \frac{N}{L + K_t} \right)^\alpha,$$

and  $k_{ti}^* = \frac{L_i}{L} K_t$  clears the physical capital market.

A landlord's profit  $\pi_{ti}^*$  is proportional to his land size  $L_i$ :  $\pi_{ti}^* = (1 - \alpha) A_t \left( \frac{N}{L + K_t} \right)^\alpha L_i$ . A landlord's after-tax income is thus  $I_{ti} = (1 - \tau) \pi_{ti}^*$ . The joint income of capitalists is

$$I_{tc} = (1 - \tau) r_t^* K_t.$$

The aggregate income of workers is  $(1 - \tau) w_t^* N_t^* = (1 - \tau) \alpha Y_t$ . The total income of the monarch is

$$\begin{aligned} I_{tm} &= A_t \left( \frac{N}{L + K_t} \right)^\alpha [(1 - \alpha)(\bar{L} + \eta\tau(L - \bar{L})) + (1 - \alpha)\eta\tau K_t + \alpha\eta\tau(L + K_t)] \\ &= r_t^* [(1 - \eta\tau)\bar{L} + \frac{\eta\tau}{1 - \alpha}(L + K_t)], \end{aligned}$$

which includes the monarch's land profit plus tax revenues from other landlords, capitalists and workers.

The aggregate before-tax income of the elites (the capitalists and landlords)

$$\tilde{I}_t \equiv [(N_l - 1)I_{tl} + I_{tc}]/(1 - \tau) = (1 - \alpha)A_t\left(\frac{N}{L + K_t}\right)^\alpha(L - \bar{L} + K_t) \quad (10)$$

grows faster than the monarch's, and so does their coercive power  $\varphi\tilde{I}_t$  compared with the monarch's  $(1 - \alpha)A_t\left(\frac{N}{L + K_t}\right)^\alpha\bar{L}$ . They must be equal to each other in a certain period denoted by  $T_k$  such that

$$(1 - \alpha)A_t\left(\frac{N}{L + K_{T_k}}\right)^\alpha\bar{L} = \varphi\tilde{I}_{T_k},$$

which implies that  $\bar{L} = \varphi(L - \bar{L} + K_{T_k})$  or equivalently  $K_{T_k} = (1 + \frac{1}{\varphi})\bar{L} - L$ , where  $(1 + \frac{1}{\varphi})\bar{L} - L > 0$  is proved in Proposition 2. Since  $K_t$  is strictly increasing in time,  $T_k$  is uniquely determined. Note that if after-tax incomes are used instead to calculate coercive powers, the result is the same qualitatively where the relevant condition is  $K_{T_k} = [\bar{L} - \varphi(1 - \tau)(L - \bar{L})]/[\varphi(1 - \tau) - \eta\tau/(1 - \alpha)]$ . ■

**Proposition 3.**

**Proof.** The mechanism of the game is the same as in Proposition 1, while the detailed incomes are as follows. If mutual compromise is reached, the political power is extended to the elites so that no tax is imposed on land and physical capital, and the ruling group shares the total tax payment from workers according to their asset. Hence the monarch's income shrinks from  $\Pi_t^G$  to  $I_t^G$  where

$$\begin{aligned} \Pi_t^G &= I_{tm} = (1 - \alpha)A_t\left(\frac{N}{L + K_t}\right)^\alpha[(1 - \eta\tau)\bar{L} + \frac{\eta\tau}{1 - \alpha}(L + K_t)], \\ I_t^G &= (1 - \alpha)A_t\left(\frac{N}{L + K_t}\right)^\alpha[\bar{L} + \frac{\alpha\eta\tau}{(1 - \alpha)}(L + K_t)\frac{\bar{L}}{(L + K_t)}] \\ &= (1 - \alpha + \alpha\eta\tau)A_t\left(\frac{N}{L + K_t}\right)^\alpha\bar{L}. \end{aligned}$$

If the compromise is rejected and the monarch chooses Not Repress, the elites would gain the ruling power at the end of period  $T_k$  based on might-is-right and impose a tax rate  $\tau$  on the monarch. The monarch's net income with Not Repress and successful revolt is

$$\Pi_{tV}^G = (1 - \tau)(1 - \alpha)A_t\left(\frac{N}{L + K_t}\right)^\alpha\bar{L}/\mu_t,$$

which is even lower than  $I_t^G$  since the monarch not only loses his share of the tax payment but also has to pay tax himself. The monarch's income with Repress is  $\Pi_{tR}^G = \Pi_t^G/\theta_{T_k}$  when  $x = 1$ , where  $\theta_{T_k}$  is the repression cost in period  $T_k$ . And so the two threshold levels of repression costs in period  $T_k$  are

$$\begin{aligned} \underline{\theta}_{T_k} &\equiv \Pi_{T_k}^G/I_{T_k}^G = 1 + \frac{\eta\tau}{1 - \alpha + \alpha\eta\tau} \frac{L + K_{T_k} - \bar{L}}{\bar{L}} = 1 + \frac{\eta\tau}{\varphi(1 - \alpha + \alpha\eta\tau)}, \\ \bar{\theta}_{T_k} &\equiv \mu_{T_k} \Pi_{T_k}^G/\Pi_{tV}^G = \frac{\mu_{T_k}}{(1 - \tau)} [(1 - \eta\tau) + \frac{\eta\tau}{1 - \alpha} \frac{L + K_{T_k}}{\bar{L}}] = \frac{\mu_{T_k}}{(1 - \tau)} [1 + \frac{\eta\tau(1 + \varphi\alpha)}{\varphi(1 - \alpha)}]. \end{aligned}$$

Similarly, we get the threshold revolt cost in period  $T_k$

$$\underline{\mu}_{T_k} \equiv \Pi_{T_k V}^C / I_{T_k}^C = 1 + \frac{\eta\tau(\alpha + \varphi)}{1 - \alpha},$$

where  $I_{T_k}^C = \tilde{I}_{T_k}$  in (10) is the joint income of the elites under compromise and  $\Pi_{T_k V}^C$  is that under revolt.

Note that

$$\begin{aligned} \Pi_{tV}^C &= \tilde{I}_t / \mu_t + \eta\tau(1 - \alpha)A_t \left( \frac{N}{L + K_t} \right)^\alpha \bar{L} + \eta\tau\alpha A_t (L + K_t)^{1-\alpha} N^\alpha / \mu_t \\ &= (1 - \alpha)A_t \left( \frac{N}{L + K_t} \right)^\alpha [L - \bar{L} + K_t + \eta\tau\bar{L} + \frac{\alpha\eta\tau}{1 - \alpha}(L + K_t)] / \mu_t, \end{aligned}$$

which implies

$$\Pi_{T_k V}^C = (1 - \alpha)A_{T_k} \left( \frac{N}{L + K_{T_k}} \right)^\alpha \bar{L} \frac{1 - \alpha + \alpha\eta\tau + \varphi\eta\tau}{\varphi(1 - \alpha)} / \mu_{T_k}$$

in period  $T_k$ . ■

**Proposition 4.**

**Proof.** The objective function of the elites in period  $t$  is

$$\max_{\tau_t^h} I_{e,t} \equiv (1 - \alpha + \alpha\eta\tau)A_t(L + K_t)^{1-\alpha}(Nh_t)^\alpha,$$

taking as given  $M_{t-1}^h = \tau_t^h B_{t-1}$ ,  $h_t = f(\frac{M_{t-1}^h}{N})$ , and  $K_t = N_c k_t = N_c \kappa(\frac{B_{t-1} - M_{t-1}^h}{N_c})$ . The FOC for  $\tau_t^{h*}$  is

$$\alpha(L + K_t)f'(\tau_t^{h*} B_{t-1}/N) - (1 - \alpha)h_t \kappa'(B_{t-1}(1 - \tau_t^{h*})/N_c) = 0 \text{ if } \tau_t^{h*} > 0, \quad (11)$$

$$\alpha(L + K_t)\gamma - (1 - \alpha)\kappa'(\frac{B_{t-1}}{N_c}) \leq 0 \text{ if } \tau_t^{h*} = 0, \quad (12)$$

where  $f'(0) = \gamma$  and  $f(0) = 1$  are substituted in (12). The *LHS* in (12) strictly increases in the total surplus  $B_{t-1}$  since

$$\frac{\partial LHS}{\partial B_{t-1}} = \frac{\alpha\kappa'(\frac{B_{t-1}}{N_c})\gamma - (1 - \alpha)\kappa''(\frac{B_{t-1}}{N_c})}{-SOC} > 0,$$

and it would eventually arise to zero at certain period  $t_h$ , after which human capital investment starts.  $t_h$  is thus defined by (12) at equality.

The FOC for  $M_{t-1}^h$  is the same as that of  $\tau_t^{h*}$ ; for interior solutions based on (11) we have

$$\frac{\partial M_{t-1}^{h*}}{\partial B_{t-1}} = \frac{\alpha\kappa' f' - (1 - \alpha)h_t \kappa''}{-SOC} > 0.$$

When the capital stock at  $T_k$ ,  $K_{T_k}$  in (5), is too small, human capital investment will start after the elite rule replaces monarchy at  $T_k$ . The monarch's objective function at any  $t \in (t_k, T_k]$  is

$$\max_{\tau_t^h} I_{tm} \equiv A_t \left( \frac{Nh_t}{L + K_t} \right)^\alpha [(1 - \alpha)\hat{L} + \eta\tau K_t].$$

The FOC is

$$\alpha(L + K_t)f'_t - (\xi_t - \alpha)h_t\kappa'_t \leq 0,$$

where  $\xi_t \equiv (L + K_t)/(\frac{1-\alpha}{\eta\tau}\widehat{L} + K_t)$ , and thus  $\xi_{T_k} = \frac{1+\varphi}{1+\varphi+\varphi(1-\alpha)(1/\eta\tau-1)}$ . So human capital investment will not start under monarchy when the above inequality holds strictly at  $T_k$ :  $\alpha(L + K_{T_k})\gamma - (\xi_{T_k} - \alpha)\kappa'_{T_k} < 0$ , which leads to (6). ■

**Proposition 5.**

**Proof.** The mechanism of the game is the same as in Proposition 1, while the detailed incomes are as follows. If a compromise is reached where workers are allowed to share political power and thus pay zero tax, the elites' income shrinks from  $\Pi_t^G$  to  $I_t^G$  where

$$\begin{aligned}\Pi_t^G &= [(1 - \alpha) + \eta\tau\alpha]Y_t, \\ I_t^G &= (1 - \alpha)Y_t.\end{aligned}$$

The implicit assumption is that the total bequest in society is not reduced by the transition of political regime, which requires workers to have positive bequests at least from period  $T_h$ . When this is not true, the elites have more incentives to repress workers and hence may delay the transition, while the main results still hold.

If the compromise is rejected and the elites choose Not Repress, workers would gain the ruling power at the end of period  $T_h$  based on might-is-right and impose a tax rate  $\tau$  on the elites. The elites' net income with Not Repress and successful revolt is

$$\Pi_{tV}^G = (1 - \tau)(1 - \alpha)Y_t/\mu_t.$$

The elites' income with Repress is  $\Pi_{T_h R}^G = \Pi_t^G/\theta_{T_h}$  when  $x = 1$ , where  $\theta_{T_h}$  is the repression cost in period  $T_h$ . And so the two threshold levels of repression costs in period  $T_h$  are

$$\begin{aligned}\underline{\theta}_{T_h} &\equiv \Pi_{T_h}^G/I_{T_h}^G = 1 + \frac{\eta\tau\alpha}{1 - \alpha}, \\ \bar{\theta}_{T_h} &\equiv \mu_{T_h} \Pi_{T_h}^G/\Pi_{T_h V}^G = \frac{\mu_{T_h}}{(1 - \tau)}\left[1 + \frac{\eta\tau\alpha}{1 - \alpha}\right].\end{aligned}$$

Similarly, we get the threshold revolt cost in period  $T_h$

$$\underline{\mu}_{T_h} \equiv \Pi_{T_h V}^C/I_{T_h}^C = 1 + \eta\tau(1 - \alpha)/\alpha,$$

where  $I_{T_h}^C = \alpha Y_t$  is the joint income of workers under compromise and

$$\Pi_{tV}^C = [\alpha + \eta\tau(1 - \alpha)]Y_t/\mu_t$$



is that under revolt. ■

**Proposition 6.**

**Proof.** The evolution of the total output  $\{Y_t\}_{t=0}^{+\infty}$  is characterized by the total bequest  $\{B_t\}_{t=0}^{+\infty}$  in the economy, which is affected by the political schemes and their associated tax rates. In any period  $t \leq t_k$  there is no capital accumulation, and the total output grows at a constant rate  $g$  due to the exogenous increase of knowledge stock  $A_t$ ; this implies

$$Y_{t+1} = A_{t+1}(L)^{1-\alpha}(N + N_c)^\alpha = Y_t(1 + g)$$

at  $t \leq t_k$ .

During the period  $(t_k, T_k]$ , the economy is productive enough to have savings to invest in physical capital  $K_{t+1} = N_c k_t = N_c \kappa (B_t^{MK} / N_c)$ , where

$$\begin{aligned} B_t^{MK} &= b_{tm} + b_{tl} + b_{tc} \equiv I_{tm} - Z + (N_l - 1) \max\{I_{tl} - Z, 0\} + \max\{I_{tc} - N_c Z, 0\} \\ &= \eta\tau Y_t + r_t^*(1 - \eta\tau)\bar{L} - Z + \max\{(1 - \tau)r_t^*(L - \bar{L}) - (N_l - 1)Z, 0\} + \max\{(1 - \tau)r_t^*K_t - N_c Z, 0\} \\ &\leq (1 - \alpha + \alpha\eta\tau)Y_t - (N_l + N_c)Z - (1 - \eta)(1 - \alpha)\tau\left(1 - \frac{\bar{L}}{L + K_t}\right)Y_t; \end{aligned}$$

the last line in the above expression measures the total saving  $B_t^{MK}$  when all landlords and capitalists have positive bequests. Physical capital accumulation presents a new channel for growth so that the economy grows faster than  $g$ . The total output is

$$Y_{t+1} = A_{t+1}(L + K_{t+1})^{1-\alpha}N^\alpha = A_{t+1}(L + N_c\kappa(B_t^{MK}/N_c))^{1-\alpha}N^\alpha \equiv \Psi_t(B_t^{MK})$$

at  $(t_k, T_k]$ .

During the period  $(T_k, t_h]$ , monarchy is replaced by oligarchy of landlords and capitalists, and the total saving is higher than before due to less waste in tax collection. The total output is now

$$Y_{t+1} = A_{t+1}\left(L + N_c\kappa\left(\frac{B_t^{OK}}{N_c}\right)\right)^{1-\alpha}N^\alpha \equiv \Psi_t(B_t^{OK})$$

at  $(T_k, t_h]$ , where  $B_t^{OK} = (1 - \alpha + \alpha\eta\tau)Y_t - (N_l + N_c)Z$ . It is easy to see that  $B_t^{OK} > B_t^{MK}$  and hence  $\Psi_t(B_t^{OK}) > \Psi_t(B_t^{MK})$ . It is straightforward to show that  $y_{t+1} = Y_{t+1}/A_{t+1}$  is strictly increasing and concave in  $y_t = Y_t/A_t$ , and

$$\frac{y_{t+1}}{y_t} = \left(\frac{L + K_{t+1}}{L + K_t}\right)^{1-\alpha} \quad \text{at } t \in (t_k, t_h].$$

After  $t_h$ , a new channel of growth, namely, human capital accumulation, is open. The total output is

$$Y_{t+1} = A_{t+1}\left(L + N_c\kappa\left(\frac{(1 - \tau_t^{h*})B_t^{OH}}{N_c}\right)\right)^{1-\alpha}N^\alpha f\left(\frac{\tau_t^{h*}B_t^{OH}}{N}\right)^\alpha \equiv \widehat{\Psi}_t(B_t^{OH}),$$

where  $B_t^{OH} = (1 - \alpha + \alpha\eta\tau)Y_t - (N_l + N_c)Z + \max\{\alpha(1 - \tau)Y_t - NZ, 0\}$ . Note that  $\tau_t^{h*} = \arg \max_{\tau_t^h} Y_{t+1}$ , which implies  $\widehat{\Psi}_t(B_t^{OH}) > \Psi_t(B_t^{OK})$ , that is, the total output is higher with human capital investment than without. Note that  $y_{t+1} = Y_{t+1}/A_{t+1}$  is again strictly increasing and concave in  $y_t = Y_t/A_t$ , and

$$\frac{y_{t+1}}{y_t} = \left(\frac{L + K_{t+1}}{L + K_t}\right)^{1-\alpha} \left(\frac{H_{t+1}}{H_t}\right)^\alpha \quad \text{at } t > t_h.$$

After  $T_h$ , the oligarchy of landlords and capitalists is replaced by democracy, where no exploiting tax is imposed so that the total saving is higher than before due to less waste in tax collection. The optimal tax rate  $\tau_t^{h*}$  for public education again maximizes the total output as before. The total output is now

$$Y_{t+1} = A_{t+1}(L + N_c\kappa\left(\frac{(1 - \tau_t^{h*})B_t^{DH}}{N_c}\right))^{1-\alpha} N^\alpha f\left(\frac{\tau_t^{h*}B_t^{DH}}{N}\right)^\alpha \equiv \widehat{\Psi}_t(B_t^{DH}),$$

where  $B_t^{DH} = Y_t - (N_l + N_c + N)Z$ . Similar as before,  $y_{t+1} = Y_{t+1}/A_{t+1}$  is strictly increasing and concave in  $y_t = Y_t/A_t$ :

$$\begin{aligned} \frac{dy_{t+1}}{dy_t} &= (L + K_{t+1})^{-\alpha} N^\alpha h_{t+1}^\alpha A_t [(1 - \alpha)(1 - \tau_t^{h*})k'_{t+1} + \alpha(L + K_{t+1})(h_{t+1})^{-1} \frac{\tau_t^{h*}}{N} h'_{t+1}] > 0, \\ \frac{d^2 y_{t+1}}{d^2 y_t} &= (L + K_{t+1})^{-\alpha} N^\alpha h_{t+1}^\alpha (A_t)^2 [(1 - \alpha)(1 - \tau_t^{h*})^2 k''_{t+1} + \alpha(L + K_{t+1})(h_{t+1})^{-1} \left(\frac{\tau_t^{h*}}{N}\right)^2 h''_{t+1} \\ &\quad - \alpha(1 - \alpha)(L + K_{t+1})^{-1} (k'_{t+1}(1 - \tau_t^{h*}))^2 - \alpha(1 - \alpha)(L + K_{t+1})(h_{t+1})^{-2} \left(\frac{\tau_t^{h*}}{N} h'_{t+1}\right)^2] < 0, \end{aligned}$$

and in the limit it converges to the steady state  $y^* = (L + N_c k^*)^{1-\alpha} N^\alpha h^*$ , where  $\lim_{B_t \rightarrow +\infty} k_{t+1} = k^*$  and  $\lim_{B_t \rightarrow +\infty} h_{t+1} = h^*$ . ■

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## APPENDIX B: Results under Alternative Assumptions in Section 5

**1. The case with a general production function**  $Y_{ti} = A_t(L_i^\rho + k_{ti}^\rho)^{\frac{1-\alpha}{\rho}} N_{ti}^\alpha$ .

(1) The new version of **Lemma 2**.

*The coercive power of the elites equates the monarch's in period  $T_k$ , which is uniquely determined by*

$$K_{T_k} = \left( \left(1 + \frac{1}{\varphi}\right) \bar{L} - L \right)^{\frac{1}{\rho}} L^{1-\frac{1}{\rho}}. \quad (13)$$

**Proof.** We first prove the following results. In any period  $t \in (t_k, T_k]$ , the incomes of a landlord, a capitalist, and the monarch are respectively

$$\begin{aligned} I_{tl} &= (1 - \tau) r_t^* \left( \frac{K_t}{L} \right)^{1-\rho} L_i, \\ I_{tc} &= (1 - \tau) r_t^* \frac{K_t}{N_c}, \\ I_{tm} &= r_t^* \left[ \left( \frac{K_t}{L} \right)^{1-\rho} \widehat{L} + \frac{\eta\tau}{1-\alpha} K_t \right]. \end{aligned}$$

where the market-clearing rate of capital return is

$$r_t^* = (1 - \alpha) A_t^\alpha \left[ \frac{N}{(L^\rho + K_t^\rho)^{\frac{1}{\rho}}} \right]^\alpha (K_t)^\rho{}^{-1}.$$

The aggregate wage of workers is  $Nw_t^* = \alpha Y_t$ , where

$$Y_t \equiv A_t [(L^\rho + K_t^\rho)^{\frac{1}{\rho}}]^{1-\alpha} N^\alpha = \frac{1}{1-\alpha} r_t^* (L^\rho + K_t^\rho) (K_t)^{1-\rho}$$

is the aggregate output in the economy.

Landlord  $i$ 's objective function is

$$\pi_{ti}^* = \max_{N_{ti}, k_{ti}} A_t (L_i^\rho + k_{ti}^\rho)^{\frac{1-\alpha}{\rho}} N_{ti}^\alpha - w_t N_{ti} - r_t k_{ti}.$$

The optimal demands for labor and physical capital are determined by

$$\begin{aligned} w_t &= \alpha A_t (L_i^\rho + k_{ti}^\rho)^{\frac{1-\alpha}{\rho}} (N_{ti}^*)^{\alpha-1}, \\ r_t &= (1 - \alpha) A_t (L_i^\rho + k_{ti}^\rho)^{\frac{1-\alpha}{\rho} - 1} k_{ti}^{\rho-1} (N_{ti}^*)^\alpha. \end{aligned}$$

The labor market clearing condition implies  $w_t^* = \alpha A_t [\sum_i (L_i^\rho + k_{ti}^\rho)^{\frac{1}{\rho}}]^{1-\alpha} N^{-1+\alpha}$  and  $N_{ti}^* = \left( \frac{\alpha A_t}{w_t} \right)^{\frac{1}{1-\alpha}} (L_i^\rho + k_{ti}^\rho)^{\frac{1}{\rho}} = N (L_i^\rho + k_{ti}^\rho)^{\frac{1}{\rho}} / \sum_i (L_i^\rho + k_{ti}^\rho)^{\frac{1}{\rho}}$ . Plugging  $N_{ti}^*$  into the condition of  $r_t$  we get

$$r_t^* = (1 - \alpha) A_t N^\alpha \frac{(L_i^\rho + k_{ti}^\rho)^{\frac{1}{\rho}}}{\left( \sum_i (L_i^\rho + k_{ti}^\rho)^{\frac{1}{\rho}} \right)^\alpha} \frac{k_{ti}^{\rho-1}}{L_i^\rho + k_{ti}^\rho}.$$



Solving  $k_{ti}$  from  $r_t^*$  equation and with some algebra we get  $k_{ti}^* = \frac{L_i}{L} K_t$  and

$$r_t^* = (1 - \alpha) A_t^\alpha \left[ \frac{N}{(L^\rho + K_t^\rho)^{\frac{1}{\rho}}} \right]^\alpha (K_t)^\rho = (1 - \alpha) \frac{(K_t)^{\rho-1}}{L^\rho + K_t^\rho} Y_t,$$

where  $Y_t \equiv A_t N^\alpha [(L^\rho + K_t^\rho)^{\frac{1}{\rho}}]^{1-\alpha}$  is the aggregate output in the economy.

The landlord's profit level  $\pi_{ti}^*$  only depends on his land size  $L_i$ ,  $\pi_{ti}^* = (1 - \alpha) Y_t \frac{L^\rho}{L^\rho + K_t^\rho} \frac{L_i}{L} = r_t^* (\frac{K_t}{L})^{1-\rho} L_i$ , so that  $I_{ti} = (1 - \tau) \pi_{ti}^* = (1 - \tau) r_t^* (\frac{K_t}{L})^{1-\rho} L_i$ . The joint income of capitalists is  $I_{tc} = (1 - \tau) r_t^* K_t$ . The aggregate income of workers is again  $w_t^* N_t^* = \alpha Y_t$ . The total income of the monarch is

$$I_{t,m} = r_t^* \left[ \left( \frac{K_t}{L} \right)^{1-\rho} (\bar{L} + \eta\tau(L - \bar{L})) + \eta\tau K_t + \frac{\alpha\eta\tau}{1-\alpha} (L^\rho + K_t^\rho) K_t^{1-\rho} \right] = r_t^* \left[ \left( \frac{K_t}{L} \right)^{1-\rho} \bar{L} + \frac{\eta\tau}{1-\alpha} K_t \right],$$

which includes the monarch's land profit plus tax revenues from other landlords, capitalists and workers.

The coercive power of the elites  $\varphi r_t^* [\sum I_{ti} + I_{tc}] = \varphi r_t^* \left[ \left( \frac{K_t}{L} \right)^{1-\rho} (L - \bar{L}) + K_t \right]$  is equal to or larger than that of the monarch's when

$$\varphi \left[ \left( \frac{K_t}{L} \right)^{1-\rho} (L - \bar{L}) + K_t \right] \geq \left( \frac{K_t}{L} \right)^{1-\rho} \bar{L}$$

holds, which boils down to

$$(K_t)^\rho \geq \frac{(1 + \varphi) \bar{L} - \varphi L}{\varphi L^{1-\rho}},$$

where the equality leads to condition (13) determining  $K_{T_k}$ . Note that when  $\rho = 1$ , this condition coincides with (5) in the basic model. ■

(2) The new version of **Proposition 4**.

*Under the elite rule human capital investment starts in period  $t_h$  that is determined by*

$$\alpha(L^\rho + K_{t_h}^\rho)^{\frac{1}{\rho}} \gamma - (1 - \alpha) K_{t_h}^{\rho-1} K'_{t_h} = 0;$$

*the optimal tax rate  $\tau_t^{h*}$  for public education in any period  $t \geq t_h$  is determined by*

$$\alpha(L^\rho + K_t^\rho)^{\frac{1}{\rho}} h'_t - (1 - \alpha) h_t K_t^{\rho-1} K'_t = 0;$$

*the public education expenditure  $M_t^{h*} = \tau_t^{h*} B_t$  is strictly increasing in  $B_t$ . Human capital investment does not start under monarchy if*

$$k'_{T_k} > \frac{\alpha\gamma}{\tilde{\xi}_{T_k} - \alpha} \frac{1 + \varphi}{\varphi} \left( \frac{(1 + \varphi) \bar{L}}{\varphi L} - 1 \right)^{\frac{1}{\rho} - 1} \bar{L} \quad (14)$$

*holds, where  $\tilde{\xi}_{T_k} \equiv \rho / (1 + \frac{(1-\alpha)\varphi\bar{L}}{\eta\tau(1+\varphi)\bar{L}})$ .*

**Proof.** The objective function of the elites in period  $t$  is

$$\max_{\tau_t^h} I_{e,t} \equiv (1 - \alpha + \alpha\eta\tau) A_t [(L^\rho + K_t^\rho)^{\frac{1}{\rho}}]^{1-\alpha} N^\alpha,$$

taking as given  $M_{t-1}^h = \tau_t^h B_{t-1}$ ,  $h_t = f(\frac{M_{t-1}^h}{N})$ , and  $K_t = N_c \kappa(\frac{B_{t-1} - M_{t-1}^h}{N_c})$ . The FOC for  $\tau_t^{h*}$  is

$$\alpha(L^\rho + K_t^\rho)^{\frac{1}{\rho}} h_t' - (1 - \alpha) h_t K_t^{\rho-1} K_t' = 0 \text{ if } \tau_t^{h*} > 0, \quad (15)$$

$$\alpha(L^\rho + K_t^\rho)^{\frac{1}{\rho}} \gamma - (1 - \alpha) K_t^{\rho-1} K_t' \leq 0 \text{ if } \tau_t^{h*} = 0, \quad (16)$$

where  $h'(0) = \gamma$  and  $h(0) = 1$  are substituted in the second line. The *LHS* in (16) strictly increases in the total surplus  $B_{t-1}$  since

$$\frac{\partial LHS}{\partial B_{t-1}} = \frac{\alpha(L^\rho + K_t^\rho)^{\frac{1}{\rho}-1} K_t' \gamma - (1 - \alpha) K_t^{\rho-1} K_t'' + (1 - \alpha)(1 - \rho) K_t^{\rho-1} (K_t')^2}{-SOC} > 0.$$

and it would eventually arise to zero at a certain period  $t_h$ , after which human capital investment starts.  $t_h$  is thus defined by (16) at equality.

The FOCs for  $M_{t-1}^h$  are the same as those of  $\tau_t^{h*}$ ; for interior solutions based on (15) we have

$$\frac{\partial M_{t-1}^{h*}}{\partial B_{t-1}} = \frac{\alpha(L^\rho + K_t^\rho)^{\frac{1}{\rho}-1} K_t' h_{t+1}' - (1 - \alpha) h_t K_t^{\rho-1} K_t'' + (1 - \alpha)(1 - \rho) K_t^{\rho-1} (K_t')^2}{-SOC} > 0.$$

When the capital stock at  $T_k$ ,  $K_{T_k}$  in (13), is too small, human capital investment will start after the elite rule replaces monarchy at  $T_k$ . The monarch's objective function is

$$\max_{\tau_t^h} I_{m,t} \equiv (1 - \alpha) A_t N^\alpha h_t^\alpha [(L^\rho + K_t^\rho)^{\frac{1}{\rho}}]^{1-\alpha} \left( \frac{\bar{L}}{L^{1-\rho}} + \frac{\eta\tau}{1-\alpha} K_t^\rho \right).$$

The FOC is

$$\alpha(L^\rho + K_t^\rho) h_t' - K_t^{\rho-1} h_t (\tilde{\xi}_t - \alpha) K_t' \leq 0,$$

where  $\tilde{\xi}_t \equiv \rho(L^\rho + K_t^\rho) / (\frac{\hat{L}}{L} \frac{1-\alpha}{\eta\tau} L^\rho + K_t^\rho)$  and  $\tilde{\xi}_{T_k} = \rho(1 + \frac{\hat{L}}{L} \frac{(1-\alpha)\varphi}{\eta\tau(1+\varphi)})^{-1}$  by (13). So human capital investment will not start under monarchy when the above inequality holds strictly at  $T_k$ :  $\alpha(L^\rho + K_{T_k}^\rho) \gamma - (K_{T_k})^{\rho-1} (\tilde{\xi}_{T_k} - \alpha) K_{T_k}' < 0$ , which leads to (14). ■

## 2. A Two-Sector General Equilibrium Model.

(1) Consumer's optimal choices.

**Lemma 4** *An individual's optimal choices are*

$$\begin{aligned} b_{ti}^* &= \max\{\beta(I_{ti} - Z), 0\}, \\ c_{ti}^{L*} &= \frac{I_{ti} - b_{ti}^*}{1 + (p_t)^{\frac{\rho}{\rho-1}}}, \\ c_{ti}^{K*} &= \frac{(I_{ti} - b_{ti}^*)(p_t)^{\frac{1}{\rho-1}}}{1 + (p_t)^{\frac{\rho}{\rho-1}}}. \end{aligned}$$

**Proof.** An individual's objective function can be written as

$$\max_{b_{ti}, c_{ti}^K} (1 - \beta) \frac{1}{\rho} \log[(I_{ti} - p_t c_{ti}^K - b_{ti})^\rho + (c_{ti}^K)^\rho] + \beta \log(z + b_{ti}).$$

The FOCs (for interior solutions) are

$$\begin{aligned} \frac{(I_{ti} - p_t c_{ti}^K - b_{ti})^{\rho-1} p_t}{(I_{ti} - p_t c_{ti}^K - b_{ti})^\rho + (c_{ti}^K)^\rho} &= \frac{(c_{ti}^K)^{\rho-1}}{(I_{ti} - p_t c_{ti}^K - b_{ti})^\rho + (c_{ti}^K)^\rho} \\ \Rightarrow c_{ti}^{K*} &= \frac{(I_{ti} - b_{ti})(p_t)^{\frac{1}{\rho-1}}}{1 + (p_t)^{\frac{\rho}{\rho-1}}} \\ \Rightarrow c_{ti}^{L*} &= I_{ti} - b_{ti} - p_t c_{ti}^{K*} = \frac{I_{ti} - b_{ti}}{1 + (p_t)^{\frac{\rho}{\rho-1}}}, \end{aligned}$$

and

$$\begin{aligned} \frac{\beta}{z + b_{ti}} &\leq \frac{(1 - \beta)(c_{ti}^L)^{\rho-1}}{(c_{ti}^L)^\rho + (c_{ti}^K)^\rho} \\ \Rightarrow b_{ti}^* &= \max\left\{\beta\left(I_{ti} - \frac{1 - \beta}{\beta}z\right), 0\right\} = \max\{\beta(I_{ti} - Z), 0\}. \end{aligned}$$

Suppose  $b_{ti}^* = b_{ti}^{L*} + p_t b_{ti}^{K*}$ , where  $b_{ti}^L$  and  $b_{ti}^K$  denote the bequests of agriculture and manufacturing goods, respectively. Since only the sum is determined, let  $b_{ti}^{L*} = \epsilon c_{ti}^{L*}$  and  $b_{ti}^{K*} = \epsilon c_{ti}^{K*}$ , then  $\epsilon^* = \frac{\beta I_{ti} - (1 - \beta)z}{(1 - \beta)(I_{ti} + z)}$ . ■

(2) Producers' optimal choices and the general equilibrium results.

**Lemma 5** *In the general equilibrium of the two sector economy, the proportion of workers working in the agriculture sector is*

$$\sigma_t^* = \left[1 + \left(\frac{K_t}{L}\right)^{\frac{(1-\alpha)\rho}{1-\rho\alpha}}\right]^{-1},$$

where  $\frac{\partial \sigma_t^*}{\partial K_t} < 0$  if  $\rho\alpha < 1$ ; i.e.,  $\sigma_t^*$  declines over time as the capital stock goes up. The price of manufacturing good is  $p_t^* = \left(\frac{L}{K_t}\right)^{\frac{(1-\alpha)(1-\rho)}{1-\rho\alpha}}$ . The total profit of capitalists  $\pi_t^K = (1 - \alpha)A_t((1 - \sigma_t^*)N)^\alpha K_t^{1-\alpha}$  is increasing over time, while that of landlords  $\pi_t^L = (1 - \alpha)A_t L^{1-\alpha}(\sigma_t^* N)^\alpha$  is decreasing.

**Proof.** The profit maximization problems with  $h_{ti} = 1$  are solved below; the solutions are the same when  $h_{ti} > 1$ . An individual landlord's objective function is

$$\pi_{ti}^L = \max_{N_{ti}^L} A_t L_i^{1-\alpha} (N_{ti}^L)^\alpha - w_t^L N_{ti}^L.$$

The FOC is

$$\begin{aligned} w_t^L &= \alpha A_t L_i^{1-\alpha} (N_{ti}^L)^{\alpha-1} \\ \Rightarrow w_t^{L*} &= \alpha A_t L^{1-\alpha} (\sigma_t N)^\alpha \Rightarrow N_{ti}^{L*} = \sigma_t N \frac{L_i}{L}. \end{aligned}$$

So the landlord's profit is

$$\pi_{ti}^L = (1 - \alpha)A_t L^{1-\alpha} (\sigma_t N)^\alpha \frac{L_i}{L}.$$

An individual capitalist's objective function is

$$\pi_{ti}^K = \max_{N_{ti}^K} p_t A_t k_{ti}^{1-\alpha} (N_{ti}^K)^\alpha - w_t^K N_{ti}^K - r_t k_{ti}.$$

The FOCs are

$$\begin{aligned} w_t^K &= \alpha p_t A_t k_{ti}^{1-\alpha} (N_{ti}^K)^{\alpha-1} \\ \Rightarrow w_t^{K*} &= \alpha p_t A_t K_t^{1-\alpha} ((1 - \sigma_t)N)^{\alpha-1} \\ \Rightarrow N_{ti}^{K*} &= (1 - \sigma_t)N \frac{k_{ti}}{K_t}; \end{aligned}$$

and

$$r_t^* = (1 - \alpha)p_t A_t k_{ti}^{-\alpha} (N_{ti}^K)^\alpha = (1 - \alpha)p_t A_t \left(\frac{(1 - \sigma_t)N}{K_t}\right)^\alpha.$$

So the capitalist's profit is

$$\pi_{ti}^K = (1 - \alpha)p_t A_t K_t^{1-\alpha} ((1 - \sigma_t)N)^\alpha \frac{k_{ti}}{K_t}.$$

The labor market should have the same wage level if in equilibrium  $\sigma_t \geq 0$ ; this implies

$$w_t^{K*} = w_t^{L*} \Rightarrow \sigma_t^* = \frac{L}{L + (p_t^*)^{\frac{1}{1-\alpha}} K_t}.$$

The final element to pin down is the equilibrium price  $p_t$ , which will clear the two final goods markets.

The total demand for the agriculture good is equal to its total supply when

$$\begin{aligned} \frac{\sum (1 + \mu) p_t c_{ti}^{K*}}{\sum (1 + \mu) c_{ti}^{L*}} &= \frac{p_t A_t K_t^{1-\alpha} ((1 - \sigma_t)N)^\alpha}{A_t L^{1-\alpha} N^\alpha (\sigma_t)^\alpha} \\ \Rightarrow p_t^* &= \left(\frac{L}{K_t}\right)^{\frac{(1-\alpha)(1-\rho)}{1-\rho\alpha}}. \end{aligned}$$

So we have

$$\sigma_t^* = \frac{L}{L + (p_t^*)^{\frac{1}{1-\alpha}} K_t} = \frac{1}{1 + (p_t^*)^{\frac{\rho}{\rho-1}}} = \frac{1}{1 + \left(\frac{K_t}{L}\right)^{\frac{(1-\alpha)\rho}{1-\rho\alpha}}},$$

where  $\frac{\partial \sigma_t^*}{\partial K_t} < 0$ , i.e, the proportion of workers working in the agriculture sector is declining over time as the capital stock goes up. The total profit of capitalists  $\pi_t^K = (1 - \alpha)A_t ((1 - \sigma_t^*)N)^\alpha K_t^{1-\alpha}$  is increasing over time, while that of landlords  $\pi_t^L = (1 - \alpha)A_t L^{1-\alpha} (\sigma_t^* N)^\alpha$  is decreasing. ■

(3) The new version of **Lemma 2**.

The coercive power of the elites equates the monarch's in period  $T_k$ , which is uniquely determined by

$$K_{T_k} = \left[ \left(1 + \frac{1}{\varphi}\right) \bar{L} - L \right]^{\frac{1-\rho\alpha}{1-\alpha}} L^{\frac{-\alpha(1-\rho)}{1-\alpha}}. \quad (17)$$

**Proof.** The coercive power of the elites is

$$\begin{aligned} & \varphi(1-\alpha)A_t L^{1-\alpha} (\sigma_t N)^\alpha \frac{L-\bar{L}}{L} + \varphi(1-\alpha)A_t ((1-\sigma_t^*)N)^\alpha K_t^{1-\alpha} \\ = & \varphi(1-\alpha)A_t N^\alpha [(\sigma_t)^\alpha L^{1-\alpha} \frac{L-\bar{L}}{L} + (1-\sigma_t^*)^\alpha K_t^{1-\alpha}] \end{aligned}$$

which is equal to or larger than that of the monarch's  $(1-\alpha)A_t L^{1-\alpha} (\sigma_t N)^\alpha \frac{\bar{L}}{L}$  when

$$\varphi [(\sigma_t^*)^\alpha L^{1-\alpha} \frac{L-\bar{L}}{L} + (1-\sigma_t^*)^\alpha K_t^{1-\alpha}] \geq (\sigma_t^*)^\alpha L^{1-\alpha} \frac{\bar{L}}{L}$$

holds, which boils down to  $K_t \geq \left[ \left(1 + \frac{1}{\varphi}\right) \bar{L} - L \right]^{\frac{1-\rho\alpha}{1-\alpha}} L^{\frac{-\alpha(1-\rho)}{1-\alpha}}$  and then leads to condition (17). ■

(4) The new version of **Proposition 4**.

Under the elite rule human capital investment starts in period  $t_h$  that is determined by

$$\alpha K_{t_h} \gamma - (1-\alpha) k'_{t_h} \left[ 1 - \sigma_t^* + \frac{1}{1-\alpha\rho} (\sigma_{t_h}^* - \tilde{\sigma}_{t_h}) \right] = 0;$$

the optimal tax rate  $\tau_t^{h*}$  for public education in any period  $t \geq t_h$  is determined by

$$\alpha K_t h'_t - (1-\alpha) h_t k'_t \left[ 1 - \sigma_t^* + \frac{1}{1-\alpha\rho} (\sigma_t^* - \tilde{\sigma}_t) \right] = 0;$$

where  $\tilde{\sigma}_t = \left(1 + \left(\frac{K_t}{L}\right)^{\frac{1-\alpha}{1-\rho\alpha}}\right)^{-1}$ . The public education expenditure  $M_t^{h*} = \tau_t^{h*} B_{t-1}$  is strictly increasing in  $B_{t-1}$ . Human capital investment does not start under monarchy if

$$k'_{T_k} > \frac{(1-\alpha\rho)\alpha\gamma K_{T_k}}{(1-\alpha)(1-\hat{\sigma}_{T_k} - \alpha\rho(1+\sigma_{T_k}^*))}, \quad (18)$$

where  $K_{T_k}$  is in (17),  $\sigma_{T_k}^* = \frac{1}{1 + \left[\left(1 + \frac{1}{\varphi}\right) \frac{\bar{L}}{L} - 1\right]^\rho}$ , and  $\hat{\sigma}_{T_k} = \frac{1}{1 + \tilde{L} \left[\left(1 + \frac{1}{\varphi}\right) \frac{\bar{L}}{L} - 1\right]}$  where  $\tilde{L} = (1-\alpha)(1-\eta\tau) \frac{\bar{L}}{L} + \eta\tau$ .

**Proof.** The objective function of the elites in period  $t$  is

$$\max_{\tau_t^h} I_{e,t} \equiv (1-\alpha + \alpha\eta\tau) A_t (N h_t)^\alpha \left[ (1-\sigma_t^*)^\alpha K_t^{1-\alpha} + L^{1-\alpha} (\sigma_t^*)^\alpha \right],$$

taking as given  $M_{t-1}^h = \tau_t^h B_{t-1}$ ,  $h_t = f\left(\frac{M_{t-1}^h}{N}\right)$ , and  $K_t = N_c k_t = N_c \kappa \left(\frac{B_{t-1} - M_{t-1}^h}{N_c}\right)$ . The FOC for  $\tau_t^{h*}$  is

$$\alpha K_t h'_t - (1-\alpha) h_t k'_t \left[ 1 - \sigma_t^* + \frac{1}{1-\alpha\rho} (\sigma_t^* - \tilde{\sigma}_t) \right] = 0 \text{ if } \tau_t^{h*} > 0, \quad (19)$$

$$\alpha K_t \gamma - (1-\alpha) k'_t \left[ 1 - \sigma_t^* + \frac{1}{1-\alpha\rho} (\sigma_t^* - \tilde{\sigma}_t) \right] \leq 0 \text{ if } \tau_t^{h*} = 0, \quad (20)$$

where  $\tilde{\sigma}_t = (1 + (\frac{K_t}{L})^{\frac{1-\alpha}{1-\rho\alpha}})^{-1} \leq \sigma_t^*$  for  $\rho \leq 1$ , and  $h'(0) = \gamma$  and  $h(0) = 1$  are substituted in (20). The *LHS* in (20) strictly increases in the total surplus  $B_{t-1}$  since

$$\frac{\partial LHS}{\partial B_{t-1}} = \frac{\alpha k_t' \gamma - (1-\alpha)k_t''[1 - \sigma_t^* + \frac{1}{1-\alpha\rho}(\sigma_t^* - \tilde{\sigma}_t)] - \frac{(1-\alpha)}{1-\alpha\rho}k_t'(\alpha\rho\frac{\partial\sigma_t^*}{\partial K_t} - \frac{\partial\tilde{\sigma}_t}{\partial K_t})}{-SOC} > 0,$$

and it would eventually arise to zero at a certain period  $t_h$ , after which human capital investment starts.  $t_h$  is thus defined by (20) at equality. The FOCs for  $M_{t-1}^h$  are the same as those of  $\tau_t^{h*}$ ; for interior solutions based on (19) we have

$$\frac{\partial M_{t-1}^{h*}}{\partial B_{t-1}} = \frac{\alpha k_t' h_t' - (1-\alpha)h_t k_t''[1 - \sigma_t^* + \frac{1}{1-\alpha\rho}(\sigma_t^* - \tilde{\sigma}_t)] - \frac{(1-\alpha)}{1-\alpha\rho}h_t k_t'(\alpha\rho\frac{\partial\sigma_t^*}{\partial K_t} - \frac{\partial\tilde{\sigma}_t}{\partial K_t})}{-SOC} > 0.$$

When the capital stock at  $T_k$ ,  $K_{T_k}$  in (17), is too small, human capital investment will start after the elite rule replaces monarchy at  $T_k$ . The monarch's total revenue is

$$\begin{aligned} & (1-\alpha)A_t L^{1-\alpha}(\sigma_t N h_t)^\alpha \frac{\bar{L}}{L}(1-\eta\tau) + \eta\tau[A_t L^{1-\alpha}(\sigma_t N h_t)^\alpha + p_t A_t K_t^{1-\alpha}((1-\sigma_t)N h_t)^\alpha] \\ & = A_t L^{1-\alpha}(\sigma_t N h_t)^\alpha \tilde{L} + \eta\tau p_t A_t K_t^{1-\alpha}((1-\sigma_t)N h_t)^\alpha \end{aligned}$$

where  $\tilde{L} = (1-\alpha)(1-\eta\tau)\frac{\bar{L}}{L} + \eta\tau$ . The FOC to maximize the revenue is

$$\alpha K_t h_t' - (1-\alpha)k_t' h_t [1 - \sigma_t^* + \frac{1}{1-\alpha\rho}(\sigma_t^* - \hat{\sigma}_t)] \leq 0.$$

where  $\hat{\sigma}_t = (1 + \tilde{L}(\frac{K_t}{L})^{\frac{1-\alpha}{1-\rho\alpha}})^{-1}$ . So human capital investment will not start under monarchy when the above inequality holds strictly at  $T_k$ :  $\alpha K_{T_k} \gamma - (1-\alpha)k_{T_k}'[1 - \sigma_{T_k}^* + \frac{1}{1-\alpha\rho}(\sigma_{T_k}^* - \hat{\sigma}_{T_k})] < 0$ , which leads to (18). ■

### 3. The case with $\delta > 0$ .

The optimization problems for the elites and the monarch with regard to human capital investment are the same with  $\delta > 0$  as in the basic model, which means Proposition 4 remains unchanged. The new version of **Lemma 2** with  $\delta > 0$  is as follows.

*The coercive power of the elites equates the monarch's in period  $T_k$ , which is uniquely determined by*

$$A_{T_k}(L + K_{T_k})^{1-\alpha}[\varphi - \frac{(1+\varphi)\bar{L}}{L + K_{T_k}}] = \frac{\delta(1+\varphi)b_{T_k-1,m}}{(1-\alpha)N^\alpha}. \quad (21)$$

**Proof.** The optimization problem is the same as in the basic model; the only difference here is that landlords now share the capital returns with capitalists. The  $N_l - 1$  landlords now get a capital return  $\delta b_{t-1,l}$  where  $b_{t-1,l} = \sum \max\{I_{t-1,l} - Z, 0\}$ , while the monarch's investment return from capital market is  $\delta b_{t-1,m}$ , where  $b_{t-1,m} = I_{t-1,m} - Z$ . In any period  $t \in (t_k, T_k]$ , the joint income of all capitalists is thus

$$I_{tc} = (1-\tau)[r_t^* K_{ti} - \delta b_{t-1,l} - \delta b_{t-1,m}].$$

The income of the monarch and the joint income of the other landlords are, respectively,

$$\begin{aligned} I_{tm} &= r_t^* (\widehat{L} + \frac{\eta\tau}{1-\alpha} K_t) + (1-\tau)\delta b_{t-1,m}, \\ I_{tl} &= (1-\tau)[r_t^*(L - \bar{L}) + \delta b_{t-1,l}], \end{aligned}$$

where the market-clearing rate of capital return is

$$r_t^* = (1-\alpha)A_t \left( \frac{N}{L + K_t} \right)^\alpha.$$

The coercive power of the elites is thus

$$\varphi[I_{tc} + I_{tl}]/(1-\tau) = \varphi[r_t^*(L - \bar{L} + K_t) - \delta b_{t-1,m}],$$

which increases over time at a faster speed than that of the monarch's  $r_t^* \bar{L} + \delta b_{t-1,m}$ . The difference between them

$$\nabla \equiv r_t^*[\varphi(L + K_t) - (1 + \varphi)\bar{L}] - \delta(1 + \varphi)b_{t-1,m}$$

will thus become smaller in absolute value, and eventually reaches zero at a certain period  $T_k$ , which leads to (21). To further check this, note that

$$\begin{aligned} b_{t-1,m} &= I_{t-1,m} - Z \\ &= r_{t-1}^* (\widehat{L} + \frac{\eta\tau}{1-\alpha} K_{t-1}) + (1-\tau)\delta b_{t-2,m} - Z \\ &< r_{t-1}^* (\widehat{L} + \frac{\eta\tau}{1-\alpha} K_{t-1}) + (1-\tau)\delta b_{t-1,m} - Z, \end{aligned}$$

which leads to  $b_{t-1,m} < r_{t-1}^* (\widehat{L} + \frac{\eta\tau}{1-\alpha} K_t)/(1 - \delta + \delta\tau)$ . Then the coercive power difference is

$$\begin{aligned} \nabla &> r_t^*[\varphi(L + K_t) - (1 + \varphi)\bar{L} - \frac{\delta(1 + \varphi)}{(1 - \delta + \delta\tau)(1 + g)}(\widehat{L} + \frac{\eta\tau}{1-\alpha} K_t)] \\ &= r_t^*(1 + \varphi)[(\frac{\varphi}{1 + \varphi} - \frac{\eta\tau\delta}{(1 - \alpha)(1 - \delta + \delta\tau)(1 + g)})(L + K_t) - (1 - \frac{\delta(1 - \eta\tau)}{(1 - \delta + \delta\tau)(1 + g)})\bar{L}] \end{aligned}$$

where the equality is due to  $\widehat{L} = (1 - \eta\tau)\bar{L} + \frac{\eta\tau}{1-\alpha}L$ . It is easy to see that, as long as  $\delta$  is not too large, the ever increasing  $K_t$  will push  $\nabla > 0$  to hold after some time. ■

#### 4. The case with an endogenous income tax $\tau_t^k$ on physical capital investment.

Suppose the physical capital production function is  $k_t = \kappa(\frac{M_{t-1}^k}{N_c}, \tau_t^k)$ , where  $\frac{\partial k_t}{\partial \tau_t^k} \leq 0$ ,  $\frac{\partial^2 k_t}{\partial (\tau_t^k)^2} \leq 0$  and  $\frac{\partial^2 k_t}{\partial \tau_t^k \partial M_{t-1}^k} < 0$ .  $\tau_t^k$  is the tax rate imposed on the income of ruled agents. In each period  $t \in (t_k, T_k]$ , the monarch first announces  $\tau_t^k$ , then capitalists produce physical capital according to  $k_t = \kappa(\frac{M_{t-1}^k}{N_c}, \tau_t^k)$ , and

finally landlords decide how much physical capital to rent and how many workers to employ. Their optimal choices are given in Lemma 2, where the total income of the monarch is

$$I_{tm} = A_t \left( \frac{N}{L + K_t} \right)^\alpha [(1 - \alpha)\bar{L} + \eta\tau_t^k(L + K_t - (1 - \alpha)\bar{L})],$$

where  $K_t = N_c \kappa \left( \frac{M_{t-1}^k}{N_c}, \tau_t^k \right) = N_c \kappa \left( \frac{B_{t-1}}{N_c}, \tau_t^k \right)$  for  $t \leq T_k$ .

The monarch's objective function is  $\max_{\tau_t^k} I_{tm}$ . The FOC is

$$(L + K_t)(L + K_t - (1 - \alpha)\bar{L}) + (1 - \alpha) \frac{\partial K_t}{\partial \tau_t^k} \Upsilon = 0,$$

where  $\Upsilon \equiv \tau_t^k(L + K_t + \alpha\bar{L}) - \alpha\eta^{-1}\bar{L}$ . Note that

$$\begin{aligned} \frac{\partial K_t}{\partial B_{t-1}} &= \frac{\partial K_t}{\partial M_{t-1}^k} + \frac{\partial K_t}{\partial \tau_t^k} \frac{\partial \tau_t^k}{\partial M_{t-1}^k} \\ &= \frac{1 - \alpha}{-SOC} \left[ -\frac{\partial K_t}{\partial M_{t-1}^k} \frac{\partial K_t}{\partial \tau_t^k} (L + K_t + \alpha\bar{L}) + \left( \frac{\partial K_t}{\partial \tau_t^k} \frac{\partial^2 K_t}{\partial \tau_t^k \partial M_{t-1}^k} - \frac{\partial K_t}{\partial M_{t-1}^k} \frac{\partial^2 K_t}{\partial (\tau_t^k)^2} \right) \Upsilon \right] > 0, \end{aligned}$$

so  $K_t$  is again strictly increasing over time as in the basic model, and thus the main results are robust to the endogeneity of the income tax.

## 5. Endogenous occupational choice of capitalists.

This is to show that the equilibrium number of operating capitalists, denoted by  $n_{tk}^*$ , will increase over time and reach  $N_c$  in some period.

Suppose there are  $n_{tk}$  operating capitalists in period  $t$ . Then the total number of workers is  $N + N_c - n_{tk}$ . A landlord  $i$ 's objective function is the same as in the proof of Lemma 2:

$$\pi_{ti}^* = \max_{N_{ti}, k_{ti}} A_t (L_i + k_{ti})^{1-\alpha} N_{ti}^\alpha - w_t N_{ti} - r_t k_{ti}.$$

The optimal demands for labor and physical capital are thus determined by

$$\begin{aligned} w_t &= \alpha A_t (L_i + k_{ti}^*)^{1-\alpha} (N_{ti}^*)^{\alpha-1}, \\ r_t &= (1 - \alpha) A_t (L_i + k_{ti}^*)^{-\alpha} (N_{ti}^*)^\alpha. \end{aligned}$$

The labor market clearing condition implies

$$w_t^* = \alpha A_t \left( \frac{L + K_t}{N + N_c - n_{tk}} \right)^{1-\alpha}$$

and  $N_{ti}^* = (N + N_c - n_{tk}) \frac{L_i + k_{ti}^*}{L + K_t}$ . Plug  $N_{ti}^*$  into the condition of  $r_t$  we get

$$r_t^* = (1 - \alpha) A_t \left( \frac{N + N_c - n_{tk}}{L + K_t} \right)^\alpha,$$



and  $k_{ti}^* = \frac{L_i}{L} K_t$  clears the physical capital market. Note that  $K_t = n_{tk} \kappa(\frac{B_{t-1}}{n_{tk}})$  holds since all capitalists have identical skills, the physical capital production function is concave, and there is free entry among capitalists. Then the return of becoming an operating capitalist is

$$r_t^* k_t = (1 - \alpha) A_t \left( \frac{N + N_c - n_{tk}}{L + n_{tk} \kappa(\frac{B_{t-1}}{n_{tk}})} \right)^\alpha \kappa(\frac{B_{t-1}}{n_{tk}}),$$

which increases in the total bequest  $B_{t-1}$  but decreases in  $n_{tk}$ . The market wage  $w_t^*$ , however, is increasing in  $n_{tk}$ . And so the equilibrium  $n_{tk}^*$  will equalize  $r_t^* k_t$  and  $w_t^*$ ; in other words, if we ignore the slight adjustment needed for  $n_{tk}$  to be an integral,  $n_{tk}^*$  is uniquely determined by  $r_t^* k_t = w_t^*$ , which is equivalent to

$$(N + N_c - \frac{n_{tk}^*}{1 - \alpha}) \kappa(\frac{B_{t-1}}{n_{tk}^*}) = \frac{\alpha}{1 - \alpha} L.$$

Based on this expression, we get

$$\frac{\partial n_{tk}^*}{\partial B_{t-1}} = - \frac{(N + N_c - \frac{n_{tk}^*}{1 - \alpha}) \kappa'(\frac{B_{t-1}}{n_{tk}^*})}{-(N + N_c - \frac{n_{tk}^*}{1 - \alpha}) \kappa'(\frac{B_{t-1}}{n_{tk}^*}) \frac{B_{t-1}}{(n_{tk}^*)^2} - \frac{1}{1 - \alpha} \kappa'(\frac{B_{t-1}}{n_{tk}^*})} > 0,$$

which means that more capitalists switch to physical capital production over time as  $B_{t-1}$  is increasing. And sooner or later,  $n_{tk}^* = N_c$  will be realized and then we are back to the basic model.