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Fali HUANG
Singapore Management University, flhuang@smu.edu.sg

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THE COEVOLUTION OF ECONOMIC AND POLITICAL DEVELOPMENT FROM MONARCHY TO DEMOCRACY*

By Fali Huang[1]

Singapore Management University, Singapore

This article establishes a unified political economy model to analyze the democratization process from monarchy to oligarchy and to democracy in the context of dynamic economic development. As the predominant source of wealth evolves from land to physical capital and finally to human capital, the relative economic and hence coercive power of land owners, capitalists, and workers shifts accordingly, inducing the transition of the political system where political power is expanded from landlords to capitalists and finally to workers. A smooth transition through political compromise facilitates efficient allocation of savings in physical capital followed by efficient investment in human capital.

1. INTRODUCTION

The main storyline 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. This article attempts to formalize this idea in a simple model of long-run economic and political development: As the main source of growth shifts from land to physical capital and then to human capital, the relative economic and hence coercive power of landlords, capitalists, and workers shifts 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. In other words, a smooth expansion of political power from the owners of land to the owners of capital and then to the owners of labor facilitates a smooth transition in investment, allowing for efficient allocation of savings in physical capital followed by efficient investment in human capital. Failure to expand political power to support expanding investment would lead to the retarding of economic development. 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.[2]

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 difficult to create or destroy; physical capital, in contrast, has to be produced endogenously by investment;

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[2] The model abstracts from international interactions such as colonization and thus may not be directly applicable to latecomers 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.

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, although the ever increasing stock of physical capital will eventually trigger human capital investment when the return to it becomes large enough (Galor and Moav, 2004, 2006).

The division of outputs among 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 is mainly driven by the assumption of *might is right*, that is, the political *right* of any group has to be obtained and secured by their coercive *might*, which is determined by the joint incomes and coordination effectiveness of its members.[3] This chain of economic strength, coercive might, and political right is the engine that pulls the coevolution train of dynamic economic and political development across different historical stages.[4] Specifically, the transition of political regime is modeled as an equilibrium outcome in a political game between the incumbent ruler and the challenging group, where the latter may choose either to obey the ruler or revolt, and then in response to revolt, the ruler may choose either to compromise or to repress. A smooth transition to a new political regime occurs under compromise, in which the ruler extends political power to the challenging group; otherwise an open fight breaks out, which may in a probabilistic manner lead to either repression or revolution depending on the balance of coercive power. In the equilibrium, the challenging group revolts only when its coercive power becomes large enough, and compromise is more likely to occur when the cost of fighting is higher, when the stake of political power (as represented by the net tax rate) is smaller, and when the incumbent's repressive apparatus is weaker.

The model economy starts from the agricultural era when there is no capital investment. The initial political regime is monarchy, where the exogenous and fixed supply of land makes it possible for an individual to capture and hold enough land to possess dominant coercive power over others and become the monarch.[5] The balance of economic and coercive power would remain stable under monarchy for a long time, until the endogenous capital accumulation becomes an important source of economic growth. In sharp contrast to land or other natural resources, the new form of wealth, namely, physical capital, cannot be easily centralized or controlled by the monarch through coercion, because its ultimate source is inherently dispersed among individual capitalists and difficult to capture by force.[6] As the stock of physical capital increases over time, it would eventually replace the relatively fixed land as the predominant source of wealth, and enable its owners to collectively acquire enough coercive power to obtain political rights and protect their capital returns. As the same logic applies to human capital beyond raw labor, workers as the owners of human capital will also gain political rights when their coercive power becomes sufficiently large. Thus, the endogenous accumulation of physical capital and human capital is the fundamental driving force underlying the democratization process from monarchy to oligarchy and then to democracy, along which the exploitative political rent gradually dissipates until all factor owners share political power and earn competitive market returns.

[3] This is in line with North's (1981, pp. 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 among the principals. The predatory theory assumes an unequal distribution."

[4] Note that the coercive might is similar to the de facto power used by Acemoglu and Robinson (2006a), although political power has some similarity to the de jure power. From this perspective, an innovation of this article is modeling the *dynamic* links between the de facto and de jure power.

[5] 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, 2008).

[6] 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 usually intangible and difficult to capture by coercion. 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.

The model has several useful 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 for economic growth shifts from land to physical capital and finally to human capital), because the latter determines the changing economic and coercive power of different factor owners. In other words, the production factor composition is the common element that affects *both* the income level and the nature of the political regime. This accounts for why in both history and current times, most democracies have industrialized economies where human capital is the dominant source of growth, although in countries with natural resources as the main form of wealth, authoritarian political regimes are more likely to occur.[7]

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 empirical findings of Acemoglu et al. (2008) as well as Boix and Stokes (2003). Third, economic growth is a necessary but insufficient condition toward political development, as the ultimate political outcome is affected by the balance of coercive power, the cost of fighting, and the probability of winning during the crucial transitional periods, which may depend on geopolitical, ideological, and other ultra-economic elements.

This article proceeds as follows. The main contributions of this article 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. Related historical evidence is collected in Section 5, and some concluding remarks are offered in the final section. All proofs are relegated to the Appendix.[8]

2. CONTRIBUTIONS TO RELATED LITERATURE

This article belongs to a broad literature connecting growth, development, and institutions in a long-term perspective.[9] 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 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 this article: The focus of Moore is on the first political transition from monarchy to oligarchy (or parliamentary democracy), whereas that of Rueschemeyer et al. is mainly on the second political transition from oligarchy to full democracy. Distinguishing these

[7] 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.

[8] The robustness of this article's main results is checked against alternative modeling choices in the working paper version.

[9] See Bertocchi (2006b) for a survey of related literature.

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 that when landed estates are replaced by capital as the primary source of wealth. These results are consistent with findings in this article, which shows that the large inequality of land under monarchy is necessary to maintain a stable political rule and to facilitate capital investment, although the growing strength of capitalists will eventually replace monarchy by oligarchy that promotes industrial and commercial interests.

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 et al., 2008). This article 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[10] typically abstracts from the political conflict that is the focus of the democratization literature. The economic development path in this article 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. In a related study, Galor and Moav (2004) examine the endogenous replacement of physical capital accumulation by human capital investment as a prime engine of economic growth in the transition from industrial sectors to modern growth based on services, although Galor and Weil (2000) as well as Hansen and Prescott (2002) emphasize the effects of technological progress in moving the economy from agricultural to industrial production methods. This article 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) 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, this article 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, whereass 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 this article, 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 as institutions may evolve endogenously.[11] On the other hand, between countries with similar economic fundamentals, different institutions caused by exogenous factors may account for their later economic development gaps.[12]

To the extent that the cooperative and conflicting sides of human interactions are treated simultaneously, this article is connected with Hirshleifer (1994), Grossman and Kim (1995), and Grossman (2002) among others. Although the article'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 Polanyi'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, this article 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.

3. THE POLITICAL ECONOMY MODEL

3.1. *The Economy*. There are overlapping generations in the economy with a fixed population size.[13] Each individual lives for two periods, accumulating human capital in childhood and participating in production at adulthood.

3.1.1. *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,[14] $\beta \in (0, 1)$ indicates the relative

[11] Consistent with results in this article, Galor et al. (2009) 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 (2009).

[12] In this article, the same economy with different fighting costs during the political transition periods may generate distinct political outcomes, which will affect the economic development path afterward. 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.

[13] 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.

[14] This bequest motive from the "joy of giving" is commonly adopted in the recent literature on income distribution and growth. See Altonji et al. (1997) for related empirical evidence. This particular utility function is also used in Galor and Moav (2006) and Fishman and Simhon (2002), among others.

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 level Z, would there be any resources left as bequest;[15] this is a reasonable result given that the model economy starts from the agricultural era where many people live at the subsistence level and may not afford any savings. The total bequest in society B_t is then

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

3.1.2. *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.[16] The quantity of land L is fixed over time, although the stocks of physical capital K_t and human capital H_t depreciate fully after one period, which corresponds to one's adulthood (about 20–30 years). This production function is adopted only to simplify the exposition, as 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 the working paper version.

3.1.3. *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 final outputs.[17] 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.

3.1.4. *Production functions of physical and human capital.* The aggregate physical capital $K_t \equiv N_c m_t^k$ is produced by N_c identical capitalists, where m_t^k denotes the amount of output used in generating physical capital. With an education expenditure m_t^h, an individual may acquire human capital h_t according to

$$h_t = f(m_t^h), \tag{2}$$

where $f' > 0, f'' \leq 0$, and $\lim_{m_t^h \to +\infty} f' = 0$. 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;

[15] The implication that the rich save more is consistent with empirical evidence (Dynan et al., 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 article 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.

[16] 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 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.

[17] 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, the assumption of fixed class lines serves as a reasonable approximation.

to acquire human capital above the basic level, however, a positive amount of output is needed. And furthermore, $f'(0) = \gamma < +\infty$ holds so that the human capital production function has a finite slope at zero investment.[18]

3.1.5. *Capital investment.* An individual may invest his bequest in physical capital or human capital for the next generation. There is no credit market for human capital investment, which can only be financed by public education or by parental bequest. To simplify the exposition, the option of private schooling is not considered in the model.[19] 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 τ_t^{h*} is imposed on parental bequests so that $M_t^h = \tau_t^{h*} B_{t-1}$.[20] Individuals then invest their disposable savings in the capital market, and thus the total amount used in producing physical capital is $M_t^k = (1 - \tau_t^{h*})B_{t-1}$.

Note that only capitalists have the skills to produce physical capital; landowners and workers, however, may supply their savings $b_{t-1,i}$ to capitalists through the capital market to gain a return $\widehat{\delta}_t b_{t-1,i}$, where $\widehat{\delta}_t \geq 0$. Each capitalist borrows resources from the capital market at the rate $\widehat{\delta}_t$ to produce physical capital k_t and then rent it to the final output producers to get a return $r_t k_t$, where r_t is the rental rate of physical capital. Because capitalists as a group act as a monopolist in producing physical capital, and as the exact value of $\widehat{\delta}_t$ is not important for the main results, $\widehat{\delta}_t = 0$ is assumed in the basic model.[21] So the aggregate physical capital is equal to

$$K_t = (1 - \tau_t^{h*})B_{t-1}.$$

The sequence of the economic development path is mainly determined by the distinct technical features of these three factors of production, where land and raw labor are endowed by nature, although 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 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 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.[22]

[18] The typically assumed Inada condition (i.e., γ is infinite) is designed to simplify the exposition by avoiding a corner solution, but it is not necessarily a realistic assumption for human capital production given that individuals are already endowed with a unit of human capital.

[19] 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).

[20] Imposing tax on bequests is equivalent to directly taxing incomes beyond the threshold Z because $b_{ti} = \max\{\beta(I_{ti} - Z), 0\}$.

[21] The case for $\widehat{\delta}_t = \delta > 0$ is formally analyzed in the working paper version. 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 although 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).

[22] 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).

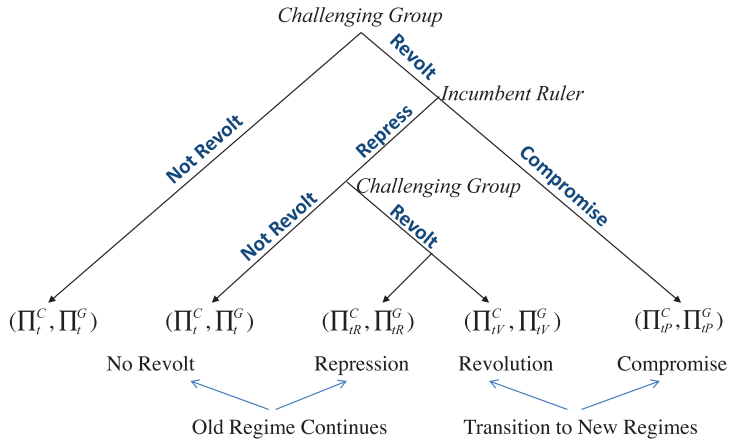

FIGURE 1

THE POLITICAL GAME BETWEEN CHALLENGING GROUP AND INCUMBENT RULER

3.2.1. *Coercive capability.* The coercive capability of a group of N_j individuals is

$$v_t = \psi(N_j, e_t) \sum_{i=1}^{N_j} I_{ti}. \tag{3}$$

The total income $\sum_{i=1}^{N_j} I_{ti}$ 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. $\psi(N_j, e_t)$ is the group's organizing effectiveness, which increases with e_t, the group-average capability to coordinate, but decreases with group size N_j 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,[23] where $\psi(1, \bar{e}) = 1$ holds by normalization.

3.2.2. *Political transition.* 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. The highest possible tax rate $\tau \in (0, 1)$ is determined by an individual's ability to hide his 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 follows the political game illustrated in Figure 1. 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 has two options: One is to repress the revolting group, the other is to compromise. When compromise is proposed and accepted,[24] the ruler will extend political power to the challenging group so that no exploitative tax is imposed on their incomes, and this will lead to a peaceful transition to a new and more democratic political regime.

When the ruler chooses to repress, the challenging group may either surrender immediately so that the old regime continues as before or continue to revolt so that an open fight breaks out, where the result of fighting is determined by the two fighting parties' coercive capabilities as given by (3). Let $v_t^C \equiv \psi_t^C I_t^C$ and $v_t^G \equiv \psi_t^G I_t^G$ denote the coercive capability of the challenging group and the ruler, respectively, where I_t^C and I_t^G are their before-tax incomes. Then the

[23] The skills of landlords and capitalists are exogenously given in this article; they are formally analyzed in Huang (2012).

[24] Because accepting compromise always leads to a higher payoff than other alternatives for the challenging group, which is to be formally proved in Proposition 1, the game ends when compromise is chosen by the ruler in order to simplify the exposition.

relative coercive power of the challenging group is denoted by

$$x_t \equiv \frac{v_t^C}{v_t^G} = \frac{\psi_t^C I_t^C}{\psi_t^G I_t^G}.$$

The probability of the ruler winning the fight and preserving the current political regime with repression is determined by a standard contest function (Tullock, 1980; Skaperdas, 1992):

$$\frac{\chi v_t^G}{\chi v_t^G + v_t^C} = \frac{1}{1 + \chi^{-1} x_t} \equiv q(x_t),$$

where $\chi > 1$ indicates the effectiveness of the ruler's repressive apparatus, which is also a form of incumbency advantage as it increases the incumbent's winning probability in the fight beyond its coercive capability v_t^G. Note that $q'(x_t) < 0$ holds, implying that the ruler is less likely to win when the challenging group's relative coercive power is higher.[25] When the ruler loses, which happens with probability $1 - q(x_t)$, such revolution leads to a violent transition to a new political regime where the challenging group becomes the new ruler imposing tax on others.

3.2.3. *Equilibrium.* Although the exact payoffs in the game are derived in the next section, some general features of the game can be discussed here. Let I_t^O denote the before-tax joint income of the neutral group, which is composed of all the other individuals outside the challenging and ruling groups. Under the current political order, the challenging group has to pay tax τI_t^C, although the incumbent ruler receives a net tax revenue $\eta\tau(I_t^C + I_t^O)$, and so their payoffs under no revolt are their after-tax incomes $(\Pi_t^C, \Pi_t^G) = ((1-\tau)I_t^C, I_t^G + \eta\tau I_t^C + \eta\tau I_t^O)$.

When compromise is achieved, the challenging group gains political power; this means it stops paying the exploitative tax τI_t^C, and in addition, it will share the total tax revenue $\eta\tau I_t^O$ with the ruler, where the sharing rule is based on its relative economic power. Specifically, their payoffs under compromise are $(\Pi_{tP}^C, \Pi_{tP}^G) = (I_t^C + \eta\tau I_t^O \frac{I_t^C}{I_t^C + I_t^G}, I_t^G + \eta\tau I_t^O \frac{I_t^G}{I_t^C + I_t^G})$.

When the revolt is repressed, the two groups' incomes are $(\Pi_{tR}^C, \Pi_{tR}^G) = (\Pi_t^C/\theta, \Pi_t^G)$, where $\theta > 1$ indicates the fighting cost. Fighting is costly because it consumes resources and disturbs routine production, and for simplicity, we assume that the loser has to pay the fighting cost.[26] When the revolt succeeds, the challenging group gains political power although the incumbent group loses it so that their incomes are $(\Pi_{tV}^C, \Pi_{tV}^G) = (I_t^C + \eta\tau I_t^G + \eta\tau I_t^O, (1-\tau)I_t^G/\theta)$.

The outcomes of subgame perfect Nash equilibrium (SPE) are characterized in the following proposition.

Proposition 1. *When $x_t \le x_t^*(\theta)$ holds, the current political order continues [((Not Revolt, Not Revolt), Repress) is the SPE], where $x_t^*(\theta) = \omega_0 - \eta(1 + \frac{I_t^O}{I_t^G})\frac{\psi_t^C}{\psi_t^G}$, $\omega_0 = \chi(\frac{1}{\tau} - 1)(1 - \frac{1}{\theta})$, and $x_t^{*\prime}(\theta) > 0$.*

When $x_t > x_t^*(\theta)$ holds, the challenging group revolts, and compromise is realized [((Revolt, Revolt), Compromise) is the SPE] if $\theta \ge \theta_t^*(\eta, \tau, \chi)$ is true, where

$$\theta_t^*(\eta, \tau, \chi) = \frac{1-\tau}{1 - \eta\tau\left(1 + \frac{\chi\psi_t^G/\psi_t^C - 1}{1 - I_t^O/Y_t}\right)},$$

otherwise an open fight occurs [((Revolt, Revolt), Repress) is the SPE], which leads to either repression or revolution, where the probability of revolution increases in x_t.

[25] Because this property is also true for alternative contest functions (Besley and Persson, 2011), the main qualitative results of political transition are robust.

[26] As long as the loser has to bear a large proportion of the fighting cost, which is often the case because the winner can always demand compensation, the results go through.

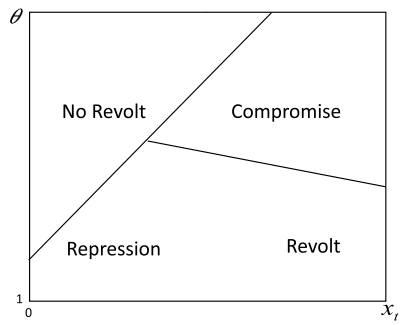

FIGURE 2

SUBGAME PERFECT EQUILIBRIUM OUTCOMES

This proposition says that the current political regime continues peacefully when the challenging group is still relatively weak (that is, when x_t is smaller than the threshold $x_t^*(\theta)$); when it becomes strong enough, however, the old political regime may not be able to sustain any longer. The transition to a new political order can be either smooth or violent. When it is too costly to engage in fighting (that is, when $\theta \geq \theta_t^*(\eta, \tau, \chi)$), compromise between the ruler and the challenging group is the equilibrium outcome, where a smooth transition of political regime is achieved 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 without interrupting economic development, which is the main focus of this article.

Such an ideal situation of smooth political transition, however, is not achievable in equilibrium when it is not so costly to fight (that is, when $\theta < \theta_t^*(\eta, \tau, \chi)$). In this case, the ruler and the challenging group will engage in an open fight for political power. If the ruler wins, then the old regime continues by repressing revolts; if the challenging group wins, revolution occurs that leads to a violent transition to a new political regime. The fight is more likely to end up with revolution when the challenging group is more powerful, which is not surprising.

Figure 2 illustrates these equilibrium outcomes in the space of the fighting cost θ and the challenging group's relative coercive power x_t. Given that $x_t^*(\theta)$ is increasing in θ, a stable political regime with no revolt is more likely to continue in places where the coercive power of the challenging group is still small or where it is more costly to fight. The fact that $\theta_t^*(\eta, \tau, \chi)$ is increasing in $\eta\tau$ and χ implies that compromise is more likely to arise when the stake of political power (represented by the net tax rate $\eta\tau$) or when the incumbent's repressing capacity χ is smaller. In other words, among countries with the same fighting cost θ, those with lower tax rates and weaker repressive apparatus have a larger likelihood to reach political compromise.[27]

4. THE ECONOMIC AND POLITICAL DEVELOPMENT PATH

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). To be consistent with such historical evidence, $|\psi_1|$ and ψ_2 are assumed to be large enough so that workers lack enough coercive might to gain political rights by themselves before human capital investment starts, and they will not be invited to join any challenging group by other factor owners. The underlying reason is that the large size and low coordination skills of workers may reduce the coercive capability of any group including them.[28]

[27] A reduced-form version of the political model without the game tree can also be used to derive the main results if one is more interested in the economy side of development. For example, one can simply assume conditions similar to the equilibrium results in Proposition 1 to hold exogenously. Detailed results are shown in the working paper version.

[28] The exact conditions can be formally derived in all relevant cases, which are omitted because they do not contribute additional insights.

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 thus capitalists are not distinguishable from the worker group.[29] The initial political regime is monarchy where a dominant landowner with land L_m is the ruler, who imposes tax τ on landowners and workers. A landlord i owns land L_i and employs N_{ti} workers taking wage w_t as given,[30] where $\sum_{i=1}^{N_l} L_i = L$ and $\sum_{i=1}^{N_l} N_{ti} = N + N_c$.

LEMMA 1. *The optimal profit for a landlord i with land L_i is $I_{ti} = \lambda A_t L_i$, where $\lambda \equiv (1-\alpha)(\frac{N+N_c}{L})^{\alpha}$. The monarch's total income $I_{tm} = \lambda A_t[(1-\eta\tau)L_m + \frac{\eta\tau}{1-\alpha}L]$ includes his land profit and tax revenues from other landlords and workers.*

Because the coercive power of landowners is proportional to land size, the fixed amount of land implies that no landlords are able to challenge monarchy as long as the monarch owns large enough land.

PROPOSITION 2. *When land is the main source of wealth, monarchy continues without any revolt as long as $L_m \geq \omega_1 L$, where $\omega_1 \equiv \frac{1+\eta\alpha/(1-\alpha)}{1-\eta+\omega_0/\psi(N_l-1,\bar{e})}$.*

This proposition suggests that the overwhelming power of the monarch, which is derived from his dominant land size L_m, enables him to enforce a stable political order without challenge from others. Because 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

$$I_{t_k,m} = A_0\lambda\left[(1-\eta\tau)L_m + \frac{\eta\tau}{1-\alpha}L\right](1+g)^{t_k} = Z. \tag{4}$$

It is obvious that t_k arrives earlier when L_m, L, and $\eta\tau$ are larger. As the large inequality of land ownership under monarchy shortens the time for society to begin capital investment, monarchy facilitates economic development when land is the main source of wealth.

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.[31] The *endogenous* supply of physical capital marks its fundamental difference from land. 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 happens when γ is sufficiently small (see Proposition 4). The total physical capital stock is thus $K_t = B_{t-1}$ 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 τ proportion of their income to the monarch.[32]

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

[29] 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 (2008), for example, show that the crucial characteristics of capitalists, such as patience and work ethic, were initially cultivated in certain working families but not in the landed class.

[30] Though receiving the market wage w_t, workers still have to pay an exploitative tax τ that makes it essentially equivalent to receiving a forced wage $(1-\tau)w_t$.

[31] The results are similar if the occupational choices of capitalists are endogenous; see the working paper version for more details.

[32] An endogenous tax rate on capitalists is considered in the working paper version.

monarch's absolute power because the joint income of the elites (capitalists and landowners) grows faster than that of the monarch and so does their coercive power. When the burgeoning capitalists join force together with landowners in their fight against the monarch, the political transition may arrive faster than it would if they had acted alone; this is indeed true when N_l is small or when L/L_m is large enough.[33]

PROPOSITION 3. *After t_k, the elites' relative coercive power $x_t = \varphi(\frac{L+K_t}{L_m} - 1)$ goes up over time because K_t keeps increasing. In the political game between monarch and the elites, monarchy continues with no revolt before T_k, where T_k is determined by*

$$K_{T_k} = \omega_2 L_m - L \tag{5}$$

with $\omega_2 \equiv \frac{1-\eta+\omega_0/\varphi}{1+\eta\alpha/(1-\alpha)}$. Revolt occurs at $t \geq T_k$, which leads to compromise and a smooth transition to oligarchy when $\theta \geq \theta^*_{tk}$ holds, where

$$\theta^*_{tk} \equiv \frac{1-\tau}{1-\eta\tau(\chi/\varphi-\alpha)/(1-\alpha)},$$

and otherwise to an open fight that may result in either repression or revolution, where revolution (a violent transition to oligarchy) is more likely to happen as time goes by due to x_t increasing.

This proposition 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 at T_k, 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. Condition (5) also shows that when L_m is bigger, the political transition time T_k 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.

This proposition suggests that the smooth transition of political regime from monarchy to oligarchy tends to take place when the fighting cost is larger than the threshold θ^*_{tk}; in this case, it is not worthwhile for either group to resort to violent means, and thus mutually beneficial compromise is reached. The following analysis assumes that this smooth transition is 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. 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 τ^{h*}_t for public education.

[33] The coalition between capitalists and landowners seems more likely to happen than the co-optation 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-optation 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-optation. 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-optation of one group is, at least weakly, dominated by the coalition between capitalists and landowners in the compromise case. Co-optation may delay the open fight but cannot prevent it because the relative coercive power of the elites is increasing over time.

PROPOSITION 4. *Human capital investment does not start under monarchy if* $\gamma < \frac{N(\xi-\alpha)}{\alpha\omega_2 L_m}$, *where* $\xi \equiv [1 + (1-\alpha)(1/\eta\tau - 1)/\omega_2]^{-1}$. *It starts under oligarchy in period* t_h *that is determined by*

$$K_{t_h} = \frac{(1-\alpha)N}{\alpha\gamma} - L. \tag{6}$$

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

$$\alpha(L + K_t^*)h_t^{*\prime} - (1-\alpha)Nh_t^* = 0, \tag{7}$$

where $K_t^* = (1 - \tau_t^{h*})B_{t-1}$ *and* $h_t^* = f(\tau_t^{h*}B_{t-1}/N)$. *The public education expenditure* $M_t^{h*} = \tau_t^{h*}B_{t-1}$ *is strictly increasing in* B_{t-1}.

This proposition suggests that the tax rate for public education τ_t^{h*} is optimally chosen by the ruling elites to balance the marginal returns of investing in physical and human capital. Human capital investment starts later when the number of workers N is larger and when the return of initial investment γ is smaller. After t_h, public education begins, and its expenditure keeps increasing over time, which drives up the human capital level for workers and their coordination effectiveness. As a result, the collective coercive power of workers will eventually reach the threshold in some period and trigger a change of equilibrium outcome in the political game.

PROPOSITION 5. *After* t_h, *the relative coercive power of workers* $x_t = \frac{\alpha\psi(N,h_t)}{(1-\alpha)\psi(N_c+N_l,\bar{e})}$ *goes up over time because* h_t *is increasing. In the political game between elites and workers, oligarchy continues with no revolt before* T_h, *which is uniquely determined by*

$$\psi(N, h_{T_h}) = \omega_3\psi(N_c + N_l, \bar{e}), \tag{8}$$

where $\omega_3 \equiv \omega_0\left(1 + \frac{\eta\alpha}{1-\alpha}\right)^{-1}$. *Revolt occurs at* $t \geq T_h$, *which leads to compromise and full democracy when* $\theta \geq \theta_{th}^*$ *holds, where*

$$\theta_{th}^* = \frac{1-\tau}{1 - \frac{\alpha}{(1-\alpha)x_t}\eta\tau\chi}$$

and $\partial\theta_{th}^*/\partial x_t < 0$, *otherwise to an open fight that may result in either repression or revolution, where revolution (a violent transition to the rule of workers) is more likely to happen as time goes by due to* x_t *increasing.*

Similar to the transition from monarchy to oligarchy, mutual compromise is reached between the elites and workers when it is too costly to fight; 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 τ_t^{h*} for public education is also determined by Equation (7), because 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, although 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 differences in parameters related to tax collecting (η, τ), cost of fighting (θ), repressing capacity χ, and the effectiveness of groups in transforming incomes to coercive power ($\psi(N_j, e_t)$). If at both transition times T_k and T_h the cost of fighting is higher than the corresponding threshold, a smooth economic and political development path as illustrated

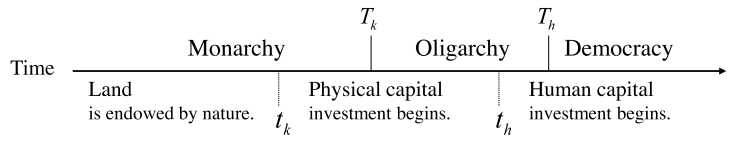

FIGURE 3

THE TIME LINE OF ECONOMIC AND POLITICAL DEVELOPMENT

TABLE 1
THE SMOOTH DEVELOPMENT PATH

The Political Transition				
Time	$t \le T_k$	$t \in [T_k, T_h]$		$t > T_h$
Political regime	Monarchy	Oligarchy		Democracy
The ruler	Dominant landowner	Landowners and capitalists		All factor owners
Exploitative tax	τ	τ on workers, 0 on others		0
Education tax	0	0 in $t \le t_h$, $\tau_t^{h*} > 0$ after t_h		$\tau_t^{h*} > 0$
The Economic Growth				
Time	$t \le t_k$	$[t_k, T_k]$	$[T_k, t_h]$	$[t_h, T_h]$	$t > T_h$
Physical capital K_t	0	B_{t-1}^{MK}	B_{t-1}^{OK}	$(1-\tau_t^{h*})B_{t-1}^{OH}$	$(1-\tau_t^{h*})B_{t-1}^{DH}$
Human capital H_t	$N+N_c$	N	N	$Nf(\frac{\tau_t^{h*}B_{t-1}^{OH}}{N})$	$Nf(\frac{\tau_t^{h*}B_{t-1}^{DH}}{N})$
Growth $\frac{Y_{t+1}/A_{t+1}}{Y_t/A_t}$	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 τ_t^{h*} are determined by (4), (6), (5), (8), and (7), respectively.

in Figure 3 is to be taken, where the political regime adjusts smoothly to the evolving factor composition of land, physical capital, 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. *Compromise between the incumbent ruler and the challenging group is reached at both transition times T_k and T_h when it is too costly to fight ($\theta \ge \max\{\theta_{tk}^*, \theta_{th}^*\}$), and the political economy evolves as follows. Physical capital accumulation starts at period t_k and human capital investment starts at t_h. Monarchy continues before T_k, after which it is replaced by oligarchy of landowners and capitalists, and finally, after T_h, workers also gain political rights, and hence full suffrage is realized. The endogenous 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. The evolution of the total output $\{Y_t\}_{t=1}^{+\infty}$ is characterized by the increasing amount of total saving $\{B_{t-1}\}_{t=1}^{+\infty}$ in the economy, where $B_{t-1}^{MK} < B_{t-1}^{OK} < B_{t-1}^{OH} < B_{t-1}^{DH}$ in Table 1 holds and thus the economic growth rate keeps increasing due to knowledge accumulation, new capital investment, and expansion of political right.*

As shown in Table 1, the exploitative tax τ 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 thus increases incentives for more capital investment.

The efficiency gain is reflected in Figure 4 by the ever increasing economic growth rate along the path. Before t_k, the economy grows at an exogenous rate g that may be close to zero as is

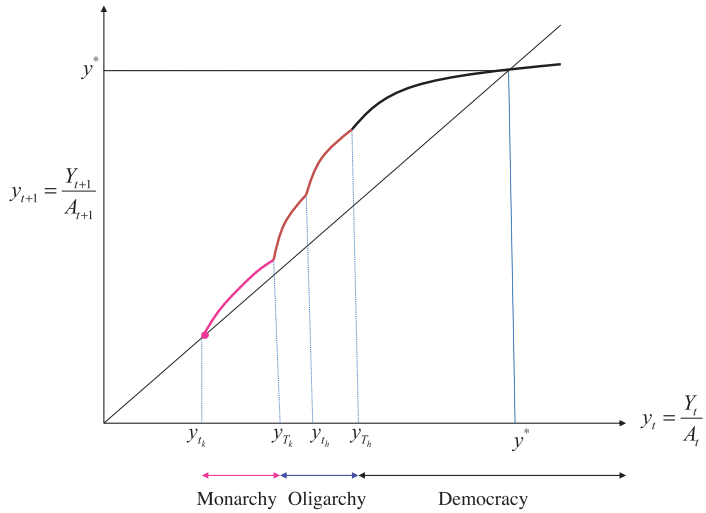

FIGURE 4

THE EVOLUTION OF DETRENDED OUTPUT ON THE SMOOTH DEVELOPMENT PATH

routine in the Malthusian era, which is represented by the first point in the graph at y_{t_k}. Once investment in physical capital starts, however, the economic growth rate $\frac{(L+K_{t+1})^{1-\alpha}}{(L+K_t)^{1-\alpha}}g$ becomes higher due to increasing capital accumulation. The political transition from monarchy to oligarchy at T_k further increases the growth rate because the total amount of capital investment increases from B_{t-1}^{MK} under monarchy to a higher level B_{t-1}^{OK} under oligarchy due to reduced tax-collecting cost. Starting from t_h, human capital investment pushes up the growth rate to $\frac{(L+K_{t+1})^{1-\alpha}H_{t+1}^{\alpha}}{(L+K_t)^{1-\alpha}H_t^{\alpha}}g$, which is then increased further by the larger total capital investment B_{t-1}^{DH} under democracy after T_h. As a result, the final steady-state output y^* is much higher than those that would have been achieved in any old economic and political regimes.

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. When the fighting cost is low during the political transition period (that is, if $\theta < \theta_{tk}^*$ at T_k or $\theta < \theta_{th}^*$ at T_h), the SPE outcome can be either repression or revolution. If repression occurs, the old political regime continues, and then the same political game is played in each following period t. Though this situation may continue for a long time, its probability gradually decreases as time goes on (due to $q'(x_t) < 0$ and x_t increasing), and sooner or later, either compromise or revolution will occur so that a transition to a new political regime is achieved.

When revolution happens in the transition process from monarchy to oligarchy, the result differs little from the compromise case because in both cases the political power is shared among landowners and capitalists, although only one landowner's treatment (namely, the monarch) is different. When it happens under elite rule, workers become the new ruler and impose tax τ on land and physical capital, which will last forever in this specific model context unless stochastic shocks are allowed to affect coercive capacities of different groups—if this happens, then the political regime may revert back to oligarchy, and then the same political game is to be repeated.

In both cases of repression and revolution, economic development lags behind that of the benchmark case because resources are wasted in tax collection and fighting. 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 3, which is the main insight of this article, holds for all scenarios.

5. HISTORICAL EVIDENCE

Roughly speaking, most Organization for Economic Co-operation and Development (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.

5.1. *A Brief Overview*. The key feature of economic development in the model, the main source of wealth evolving from land to physical capital and finally to human capital, 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 article, 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 (Blockmans, 1997). These are consistent with Proposition 2.

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 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 workplaces, which enhanced 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).

5.2. *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 (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 (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 an 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 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, 2004, 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 toward 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, although 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, 2004, 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.[34]

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 that remained unreformed between 1688 and 1815, the state retained 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, because 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. "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.

5.3. *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), although 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. 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. The practice of selling positions in the bureaucracy, for example, by converting the bourgeoisie into an aristocracy, diminished the bourgeois drive toward property and political independence. Commerce and manufacturing in France thus lagged behind that of England (Moore, 1966).

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

[34] 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.

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 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).

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 democracy entailing universal male suffrage.

5.4. *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.[35] The German experience illustrates that, the later that a country develops, the more complex its developmental path is, as 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 3 is also evident.

By the middle of the fourteenth century, Prussia still resembled Western Europe where peasants were prosperous and relatively free. Toward 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 and landed aristocracy.[36] The ruler's strong repressing capacity was perhaps the main reason why a labor repressive agrarian system was adopted in Germany, which seemed to be consistent with the observation that 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

[35] In this regard the experiences of Italy and Japan were similar.

[36] 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).

helped pave the way for the eventual achievement of its goals in a sequential matter. 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, although 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 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, p. 109).

6. CONCLUDING REMARKS

This article 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 source of wealth 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 economic progress is not interrupted; otherwise, political conflicts may lead to repression of some factor owners and economic stagnation.

A main insight to emerge from this article is the dynamic compatibility of economic and political development. On one hand, it brings a developmental perspective into the discussions of appropriate or growth-enhancing political institutions. For instance, the article suggests that when natural resources are the main form of wealth, monarchy or other authoritarian regimes are probably the political equilibrium that naturally arises; 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. On the other hand, it highlights the importance of a society's capacity for smooth political transitions in facilitating economic development. 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). In societies where institutions are rigid and difficult to change from within, economic stagnation often prevails, and ultimate changes may be forced upon them by costly domestic violence or outside threats.

The article'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, although 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 form of wealth, 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, because 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: PROOFS

A.1. *Proof of Proposition 1.* At the last node, the challenging group gets $(1-\tau)I_t^C$ if they refrain from revolting, and an expected income $q\Pi_{tR}^C + (1-q)\Pi_{tV}^C$ if they carry out the revolt, because with probability q the revolt is repressed and the group gets an income $\Pi_{tR}^C = (1-\tau)I_t^C/\theta$, whereas with probability $1-q$ the revolt is successful and the group gets an income $\Pi_{tV}^C = I_t^C + \eta\tau I_t^G + \eta\tau I_t^O$. So Not Revolt is chosen if

$$(1-\tau)I_t^C/\theta \geq q\Pi_{tR}^C + (1-q)\Pi_{tV}^C \tag{A.1}$$

holds. After some algebra this leads to $x_t \leq x_t^*(\theta)$, where

$$x_t^*(\theta) \equiv \omega_0 - \eta\left(1 + I_t^O/I_t^G\right)\psi_t^C/\psi_t^G,$$

with $\omega_0 = (1/\tau - 1)(1 - 1/\theta)\chi$, and $x_t^{*\prime}(\theta) > 0$ is easily obtained.

At the second node, when $x_t \leq x_t^*(\theta)$ holds, given that the challenging group will stop revolting at the last node, the ruler's payoff is $\Pi_t^G = I_t^G + \eta\tau I_t^C + \eta\tau I_t^O$ if choosing Repress, and $\Pi_{tP}^G = I_t^G + \eta\tau I_t^O \frac{I_t^G}{I_t^C + I_t^G}$ if choosing Compromise. So the best choice is Repress. When $x_t > x_t^*(\theta)$ holds instead, given that the challenging group will still revolt, choosing Repress brings two possible outcomes to the ruler: It wins the fight with probability q and then gets an income $\Pi_{tR}^G = \Pi_t^G$, whereas if it loses, revolution occurs and it gets $(1-\tau)I_t^G/\theta$. So the expected income of the incumbent ruler choosing to repress is $q\Pi_t^G + (1-q)(1-\tau)I_t^G/\theta$. If the ruler chooses to compromise instead, its income is Π_{tP}^G. So Repress is the optimal choice when

$$q\Pi_t^G + (1-q)(1-\tau)I_t^G/\theta > I_t^G + \eta\tau I_t^O \frac{I_t^G}{I_t^C + I_t^G} \tag{A.2}$$

holds. After some algebra this leads to $\theta < \theta_t^*(\eta, \tau, \chi)$, where

$$\theta_t^*(\eta, \tau, \chi) = \frac{1-\tau}{1 - \eta\tau - \eta\tau(\chi\psi_t^G/\psi_t^C - 1)/(1 - I_t^O/Y_t)}.$$

So Repress is more likely to be chosen when $\theta_t^*(\eta, \tau, \chi)$ is higher, which is true when $\eta\tau$ and χ are higher. That is, the ruler's best strategy is Repress if $\theta < \theta_t^*(\eta, \tau, \chi)$, and Compromise if otherwise.

At the first node, when $x_t \leq x_t^*(\theta)$, given that the ruler will repress, it is best for the challenging group to choose Not Revolt, whereas when $x_t > x_t^*(\theta)$, it is best to choose Revolt, which will leads to compromise if $\theta \geq \theta_t^*(\eta, \tau, \chi)$, otherwise to Repress and conflict.

If $\theta \geq \theta_t^*(\eta, \tau, \chi)$ holds, given the ruler's optimal choice of compromise, the challenging group will choose to compromise instead of revolt if

$$q\Pi_{tR}^C + (1-q)\Pi_{tV}^C \leq I_t^C + \eta\tau I_t^O \frac{I_t^C}{I_t^C + I_t^G}$$

holds, which is indeed true given $\theta \geq \theta_t^*(\eta, \tau, \chi)$. ■

A.2. *Proof of Lemma 1.* 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, $\sum_{i=1}^{N_l} N_{ti}^* = N + N_c$ 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 $I_{ti}^* = (1-\alpha)(\frac{N+N_c}{L})^{\alpha} A_t L_i \equiv \lambda A_t L_i$. The size of a landlord's land L_i satisfies $L_i > \frac{L}{N+N_c}\frac{\alpha}{1-\alpha}$, which guarantees that a landlord's profit is higher than worker wage w_t^*. The monarch's total income at any period $t \in [0, t_k]$ is

$$I_{mt} = \lambda A_t L_m + \eta\tau\lambda A_t \left[L - L_m + \frac{\alpha}{1-\alpha} L \right] = \lambda A_t \left[(1-\eta\tau) L_m + \frac{\eta\tau}{1-\alpha} L \right],$$

which includes his land profit and tax revenues from other landlords and workers. ■

A.3. *Proof of Proposition 2.* The $N_l - 1$ landlords constitute the challenging group. Their coercive power is $v_t^C = \psi_t^C I_t^C = \psi(N_l - 1, \bar{e})\lambda A_t (L - L_M)$, the monarch's coercive power is $v_t^G = \psi_t^G I_t^G = \psi(N, 1)\lambda A_t L_M = \lambda A_t L_M$ given that $\psi(1, \bar{e}) = 1$, and the joint before-tax income of the neutral group (workers) is $I_t^O = \lambda A_t \frac{\alpha}{1-\alpha} L$. According to Proposition 1, in the equilibrium landlords will not challenge the monarch if $x_t \leq x_t^*(\theta)$ holds, where $x_t = v_t^C / v_t^G = \psi(N_l - 1, \bar{e})(L - L_M)/L_M$ does not change over time, and

$$\begin{aligned} x_t^*(\theta) &= \omega_0 - \eta \left(1 + I_t^O / I_t^G\right) \psi_t^C / \psi_t^G \\ &= \omega_0 - \eta\psi(N_l - 1, \bar{e})(1 + \alpha L/(1-\alpha)L_M) \end{aligned}$$

is also constant. Then $x_t \leq x_t^*(\theta)$ boils down to $L_M \geq \omega_1 L$, where

$$\omega_1 \equiv \frac{1 + \eta\alpha/(1-\alpha)}{1 - \eta + \omega_0/\psi(N_l - 1, \bar{e})}.$$

So as long as $L_M \geq \omega_1 L$, the relative coercive power of land owners is not higher than the threshold $x_t^*(\theta)$ to challenge the monarch. Note that if after-tax incomes are used instead to calculate coercive powers, the result is the same qualitatively. ■

A.4. *Proof of Proposition 3.* 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 $N_{ti}^* = N\frac{L_i + k_{ti}^*}{L + K_t}$. Plugging 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 π_{ti}^* is proportional to his land size L_i: $\pi_{ti}^* = (1-\alpha)A_t(\frac{N}{L+K_t})^{\alpha}L_i$. A landlord's income is thus $I_{tl} = \pi_{ti}^*$. The joint income of capitalists is $I_{tc} = r_t^* K_t$, whereas that of workers is $w_t^* N_t^* = \alpha Y_t$. The after-tax income of the monarch is

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

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)

$$I_t^C = (1-\alpha)A_t\left(\frac{N}{L+K_t}\right)^{\alpha}(L - L_m + K_t) \tag{A.3}$$

grows faster than the monarch's, and so does their coercive power φI_t^C compared with the monarch's $I_t^G = (1-\alpha)A_t(\frac{N}{L+K_t})^{\alpha}L_m$. The relative power of the elites is thus $x_t = \frac{\varphi(L+K_t-L_m)}{L_m}$, whereas the threshold is $x_t^*(\theta) = \omega_0 - \eta\varphi(1 + I_t^O/I_t^G)$, where $I_t^O = \alpha Y_t = \alpha A_t(L+K_t)^{1-\alpha}N^{\alpha}$. Then $x_t = x_t^*(\theta)$ will be reached in a certain period denoted by T_k when $K_{T_k} = \omega_2 L_m - L$ holds, where

$$\omega_2 = \frac{\omega_0/\varphi + 1 - \eta}{1 + \eta\alpha/(1-\alpha)}.$$

Note that $K_{T_k} > 0$ is implied by $L_M \geq \omega_1 L$ in Proposition 2. As 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.

The mechanism of the game is the same as in Proposition 1. Revolt is chosen when $\theta < \theta_{tk}^*$ holds, where

$$\theta_{tk}^* = \frac{1-\tau}{1-\eta\tau-\eta\tau(\chi\psi_t^G/\psi_t^C - 1)/(1 - I_t^O/Y_t)} = \frac{1-\tau}{1-\eta\tau(\chi/\varphi-\alpha)/(1-\alpha)}$$

for any period $t \geq T_k$ given that $\psi_t^G = 1$, $\psi_t^C = \varphi$, and $I_t^O/Y_t = \alpha$. ■

A.5. *Proof of Proposition 4.* 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 $M_{t-1}^h = \tau_t^h B_{t-1}$, $h_t = f\left(\frac{M_{t-1}^h}{N}\right)$, and $K_t = B_{t-1} - M_{t-1}^h = \left(1-\tau_t^h\right)B_{t-1}$. The FOC for τ_t^{h*} is

$$\alpha[L + (1-\tau_t^{h*})B_{t-1}]f'\left(\tau_t^{h*}B_{t-1}/N\right) - (1-\alpha)f\left(\tau_t^{h*}B_{t-1}/N\right)N = 0 \text{ if } \tau_t^{h*} > 0, \tag{A.4}$$

(A.5) $$\alpha(L + B_{t-1})\gamma - (1-\alpha)N \le 0 \quad \text{if } \tau_t^{h*} = 0,$$

where $f'(0) = \gamma$ and $f(0) = 1$ are substituted in (A.5). It is obvious to see that the left-hand side in (A.5) strictly increases in the total surplus B_{t-1}, and thus it would eventually arise to zero at certain period t_h, after which human capital investment starts. t_h is thus defined by (A.5) at equality.

Given $M_{t-1}^{h*} = \tau_t^{h*} B_{t-1}$, for interior solutions based on (A.4) we have

$$\begin{aligned}\frac{\partial M_{t-1}^{h*}}{\partial B_{t-1}} &= \frac{\partial \tau_t^{h*} B_{t-1}}{\partial B_{t-1}} = \frac{\partial \tau_t^{h*}}{\partial B_{t-1}} B_{t-1} + \tau_t^{h*} \\ &= \frac{\alpha f'}{-\alpha(L + (1-\tau_t^{h*})B_{t-1})f''/N + f'} > 0.\end{aligned}$$

When γ 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

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

where $\widehat{L} \equiv (1-\eta\tau)L_m + \frac{\eta\tau}{1-\alpha}L$. The FOC is $\alpha(L+K_t)f_t' - (\xi_t - \alpha)Nh_t \le 0$, where $\xi_t \equiv [1 + \frac{(1-\alpha)(1-\eta\tau)}{\eta\tau}\frac{L_m}{L+K_t}]^{-1}$, and thus $\xi \equiv \xi_{T_k} = [1 + (1-\alpha)(1/\eta\tau - 1)/\omega_2]^{-1}$ given that $K_{T_k} = \omega_2 L_m - L$. So human capital investment will not start under monarchy when the FOC holds strictly at T_k: $\alpha(L + K_{T_k})\gamma - (\xi_{T_k} - \alpha)N < 0$, which leads to $\gamma < \frac{N(\xi-\alpha)}{\alpha\omega_2 L_m}$. ■

A.6. *Proof of Proposition 5.* The mechanism of the game is the same as in Proposition 1, although the detailed incomes are $I_t^G = (1-\alpha)Y_t$, $I_t^C = \alpha Y_t$, and $I_t^O = 0$. 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, although the main results still hold.

The relative coercive power of workers is $x_t = \frac{\psi(N,h_t)\alpha}{\psi(N_c+N_l,\bar{e})(1-\alpha)}$, whereas the threshold level is

$$x_t^*(\theta) = \omega_0 - \eta\psi(N,h_t)/\psi(N_c+N_l,\bar{e}).$$

Then $x_t \le x_t^*(\theta)$ boils down to $\psi(N,h_t) \le \omega_3\psi(N_c+N_l,\bar{e})$, where

$$\omega_3 \equiv \omega_0/[1 + \eta\alpha/(1-\alpha)].$$

So T_h is determined by $\psi(N,h_{T_h}) = \omega_3\psi(N_c+N_l,\bar{e})$. Revolt is chosen when $\theta < \theta_{th}^*$ holds, where

$$\begin{aligned}\theta_{th}^* &= \frac{1-\tau}{1-\eta\tau-\eta\tau(\chi\psi_t^G/\psi_t^C - 1)/(1 - I_t^O/Y_t)} \\ &= \frac{1-\tau}{1-\eta\tau\chi\psi(N_c+N_l,\bar{e})/\psi(N,h_t)} = \frac{1-\tau}{1-\eta\tau\chi\alpha[(1-\alpha)x_t]^{-1}}.\end{aligned}$$

It is obvious to see that $\partial\theta_{th}^*/\partial x_t < 0$. Then at $t = T_h$ we get $\theta_{T_h}^* = \frac{1-\tau}{1-\eta\tau\chi/\omega_3}$. ■

A.7. *Proof of Proposition 6.* The evolution of the total output $\{Y_t\}_{t=1}^{+\infty}$ is characterized by the total bequest $\{B_t\}_{t=1}^{+\infty}$ in the economy, which is affected by the political schemes and their associated tax rates. In any period $t \le t_k$ 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 $(t_k, T_k]$, the economy is productive enough to have savings to invest in physical capital $K_{t+1} = B_t^{MK}$, where

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

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 at $[t_k, T_k]$ is

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

During $(T_k, t_h]$, 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

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

at $(T_k, t_h]$, where the total saving is

$$B_t^{OK} = (1 - \alpha + \alpha\eta\tau)Y_t - (N_l + N_c)Z.$$

It is easy to see that $B_t^{OK} > B_t^{MK}$ holds, and hence $\Psi_t(B_t^{OK}) > \Psi_t(B_t^{MK})$ is true. 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

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

where the total saving is

$$B_t^{OH} = (1 - \alpha + \alpha\eta\tau)Y_t - (N_l + N_c)Z + \max\{\alpha(1 - \tau)Y_t - NZ, 0\}.$$

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 τ_t^{h*} for public education again maximizes the total output as

before. The total output is now

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

where the total saving is

$$B_t^{DH} = Y_t - (N_l + N_c + N)Z = A_t y_t - (N_l + N_c + N)Z.$$

It is easy to see that the amount of total saving is increasing over time, $B_t^{MK} < B_t^{OK} < B_t^{OH} < B_t^{DH}$, due to political regime changing and investment in new capital forms.

Similar as before, $y_{t+1} = Y_{t+1}/A_{t+1}$ is strictly increasing and concave in $y_t = Y_t/A_t$:

$$\frac{dy_{t+1}}{dy_t} = (L + K_{t+1})^{-\alpha} N^{\alpha} h_{t+1}^{\alpha} A_t \left[(1-\alpha)(1-\tau_t^{h*}) + \alpha(L + K_{t+1})(h_{t+1})^{-1} \frac{\tau_t^{h*}}{N} h'_{t+1}\right] > 0,$$

$$\frac{d^2 y_{t+1}}{d^2 y_t} = (L + K_{t+1})^{-\alpha} N^{\alpha} h_{t+1}^{\alpha} (A_t)^2 \left[\alpha(L + K_{t+1})(h_{t+1})^{-1} \left(\frac{\tau_t^{h*}}{N}\right)^2 h''_{t+1}\right.$$

$$\left. - \alpha(1-\alpha)(L + K_{t+1})^{-1}(1-\tau_t^{h*})^2 - \alpha(1-\alpha)(L + K_{t+1})(h_{t+1})^{-2}\left(\frac{\tau_t^{h*}}{N} h'_{t+1}\right)^2\right] < 0,$$

and in the limit it converges to the steady state $y^* = (L + N_c k^*)^{1-\alpha} N^{\alpha} h^*$. ■

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