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**Fali Huang**  
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# The Coevolution of Economic and Political Development

Fali Huang<sup>1</sup>

School of Economics and Social Sciences  
Singapore Management University

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<sup>1</sup>School of Economics and Social Sciences, Singapore Management University, 90 Stamford Road, Singapore 178903. Email: flhuang@smu.edu.sg. Tel.: 65-68280859. Fax: 65-68280833. The author thanks seminar participants at SMU, City University of Hong Kong, Lessons from History International Conference at Hong Kong, North American Summer Meetings of Econometric Society at Minneapolis, DEGIT-XI at Jerusalem, and Far Eastern Summer Meetings of Econometric Society at Beijing for helpful comments. This research is supported by Wharton-SMU Research Center at SMU.

## **Abstract**

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

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

*Key Words:* *Economic Development, Political Development, Class Structure, Land, Physical Capital, Human Capital, Monarchy, Suffrage Extension.*

# 1 Introduction

At any time in human history, “[t]he efforts of men are utilized in two different ways: they are directed to the production or transformation of economic goods, or else to the appropriation of goods produced by others.” (Vilfredo Pareto, as quoted in James 1984, p. 63) Indeed, the main story line of human history, Hirschleifer (1994) argues, may be driven by the balance between cooperative economic activities leading to greater aggregate wealth, and political conflicts over its distribution. This dichotomy seems to be a good description of the relevant economics literature as well. One stream of studies emphasizes the effects of the former type of interactions on economic development. For example, Galor and Moav (2006) argue that the complementarity between physical and human capital would eventually eliminate the class distinction between capitalists and workers. The other stream of literature, in contrast, focuses on the political conflicts over income redistribution among owners of different factors (Acemoglu and Robinson, 2000, 2001, 2005).

Built on the new insights emerged from these two lines of research, the current paper tries to integrate them to capture the organic links in-between. And in doing so, it delineates a long run coevolution path of economic and political development as illustrated in figure 1. The accumulation of knowledge gradually changes the composition of capital stock and imposes “an evolutionary order upon the secular change of political and economic institutions” (North 1981, p. 208). As the main factor of production shifts from land (before  $t_k$ ) to physical capital (between  $t_k$  and  $t_h$ ) and then to human capital (after  $t_h$ ), the relative economic and hence coercive powers of landlords, capitalists, and workers shift accordingly, inducing the transition of political system from monarchy (before  $T_k$ ) to elite ruling (of landowners and capitalists between  $T_k$  and  $T_h$ ) and finally to democracy with full suffrage (after  $T_h$ ). Every new political regime, by extending political power to the owners of the new form of capital and thus increasing their future economic gains from investment, speeds up economic progress. Such a smooth reinforcing coevolution path between economic and political development may not always be realized; repression and economic stagnation could also happen under certain conditions characterized in the model.

The main results of the paper are in general consistent with historical evidence. After the shift from hunting and gathering to agriculture, the predominance of land in production lasted thousands of years. As Cipolla (1976, p. 183) observed, “until the nineteenth century the development of Europe, like that of any other preindustrial society, was ultimately constrained by the availability of land.” Gradually, industry and service sectors replaced agriculture to become dominant economic activities, leading to the industrial revolutions in the last half of eighteenth century (North 1981, p. 159). By the early twentieth century, the

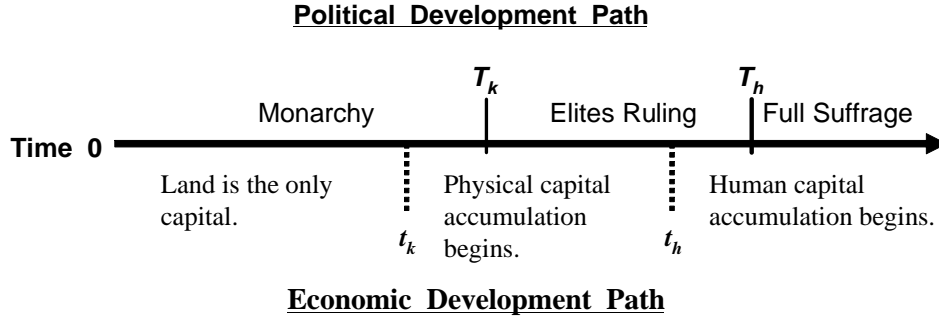


Figure 1: The Time Line of Economic and Political Development

modern concept of the wealth of nations emerged: “It was that capital embodied in the people – human capital – mattered.” (Goldin 2001)

The correlation between the evolving composition of capital stock in economy and the corresponding political regimes is also widely observed. “The agrarian basis of Europe’s political order dates back to the introduction of feudalism at the turn of the first millennium.” (Bertocchi 2006a). The ever growing economic strength of capitalists and landlords enables them to demand political power from the king. In Britain, for example, “Parliament became more sympathetic and accessible to the aspirations of merchants, masters and manufacturers, farmers and landowners” after the Glorious Revolution in 1688 (O’Brien 1994). The English experience, argued by Moore (1966, p. 429), “tempts one to say that getting rid of agriculture as a major social activity is one prerequisite for successful democracy.” In the second phase of the Industrial Revolution, the importance of human capital in the production process increased (Galor and Moav 2006). The rising human capital strengthened workers’ economic power, which eventually led to franchise expansion in several European countries (Acemoglu and Robinson 2000). The causal link between the level of economic development and political democracy is also confirmed by cross-national statistical analyses and comparative historical research (Huber, Rueschemeyer and Stephens 1993). Most democracies today have industrialized economies where human capital is the dominant capital form; in countries where natural resources are the main factors in production, authoritarian political regimes are more likely to happen than democracy (Lipset 1959, Moore 1966, Huber et al. 1993, among others).

The paper is related to studies on long-term growth.<sup>1</sup> North (1981) proposes a dynamic framework of political economy and substantiates it by rewriting the Western history in its light. He recognizes not only the influence of technology advancement on political institutions, but also the effects of political institutions on

<sup>1</sup>For a short survey of related literature, see Bertocchi (2006b) and studies cited there.

future technological and economic development. In some sense, the current paper is an attempt to formalize this dynamic framework in a simple model. It thus may shed light on the current debates on whether technology or institutions are more important in long-run growth. Acemoglu, Johnson, and Robinson (2005) argue that institutions are the fundamental cause of long-run growth, while Glaeser et al. (2004) demonstrate that human capital is more fundamental than institutions. Both claims can be true in the chain of dynamic interactions between economic fundamentals and political institutions, depending on which specific segment one chooses to investigate. For example, among countries with similar institutional backgrounds (e.g. colonies of the same mother country), the initial gap in economic fundamentals may become the ultimate cause of their later divergence since institutions are often endogenously adopted (Engerman and Sokoloff 1997, Rajan and Zingales 2006). On the other hand, between countries with similar initial human capital (e.g. North and South Korea), different institutions caused by exogenous factors may account for their later economic development gaps.

The paper also contributes to our understanding of suffrage extension. In the model, franchise expansion is driven by the increasing importance of human capital, which has two effects: it shifts the balance of political power in workers' favor, while on the other hand it also reduces the potential loss of elites since the total outputs are larger after suffrage extension. The conflict of income distribution between the elites and workers is the focus of Acemoglu and Robinson (2000), while the mutually beneficial aspect of franchise expansion is proposed by Lizzeri and Persico (2004) and Llavador and Oxoby (2005) among others. Both views find support in historical evidence, as they should do, since they highlight two different but necessarily interrelated aspects of the same process. Furthermore, our basic idea of linking human capital and suffrage extension is consistent with a range of related phenomena: The suffrage was usually first extended to skilled workers, then to unskilled ones, and finally to women, strictly following the ranking of their human capital levels;<sup>2</sup> in the U.S., the states with severe scarcity of labors extended suffrage earlier and more broadly (Engerman and Sokoloff 2005); the emergence of mass democracy often coincides historically with industrialization.

To the extent that the cooperative and conflicting sides of human interactions are treated simultaneously, the paper is connected with Grossman and Kim (1995) and Grossman (2002) among others. Our results suggest that the cooperative side dominates history progress in the long run, though the conflicting side may change history paths for some time and often into the stagnant directions.

The paper proceeds as follows. In section 2 the basic elements of the political economy model are

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<sup>2</sup>In Britain, for example, the suffrage extension was to the middle class in 1832, to the urban working class in 1867, to the agricultural labourer in 1884, and finally to women in 1919 and 1928.

introduced. Section 3 presents the analysis of the model. Further discussions and related historical evidence are collected in section 4. Some concluding remarks are offered in the final section.

## 2 The Political Economy Model

### 2.1 The Economy

**Preferences.** There are overlapping generations in the economy. Each individual lives for two periods, childhood and adulthood, where generation  $t$  achieves adulthood in period  $t$ . They accumulate human capital in childhood and participate in the production process in adulthood. Individuals are identical in preferences, which are represented by a log-linear utility function

$$u_t^i = (1 - \beta) \log c_t^i + \beta \log(Z + b_t^i),$$

where  $c_t^i$  is the adulthood consumption of individual  $i$  of generation  $t$ ,  $b_t^i$  is the transfer to his offspring,  $\beta \in (0, 1)$  and  $Z > 0$ .<sup>3</sup> The budget constraint is  $c_t^i + b_t^i \leq I_t^i$ , where  $I_t^i$  is his income at adulthood. As a result of utility maximization, the optimal bequest of individual  $i$  of generation  $t$  is

$$b_t^i = \max\{\beta(I_t^i - Z), 0\}.$$

Only when the productivity of an economy increases to the extent that someone's income is higher than  $Z$ , would there be any resources left as bequest. The total bequest in society is denoted by  $B_t$ , which can be invested in either physical capital or human capital for the next generation.

**Technology.** 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

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

where  $A_t$  is the knowledge stock,  $L$  the quantity of land that is fixed overtime,  $K_t$  the quantity of physical capital, and  $H_t$  the efficient units of human capital. Both physical and human capital depreciate completely after one period. The knowledge in society is accumulated through idle curiosity and learning-by-doing at a speed of  $g > 0$  so that  $A_{t+1} = A_t(1 + g)$ . This knowledge accumulation process would be the ultimate growth engine in the economy.

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<sup>3</sup>This type of utility function is used by Galor and Moav (2006) among others; the exact specifications are not essential for the qualitative results.

The physical capital  $K_{t+1}$  is produced by capitalists combining material resources  $m_t^k$  and knowledge  $A_{t+1}$ . Its amount is also affected by tax rate  $\tau_{k,t+1}$  on capital returns. In specific, the physical capital production function is

$$K_{t+1} = K(m_t^k, A_{t+1}, \tau_{k,t+1}), \quad (1)$$

where  $K_3 < 0$ ,  $K_{33} \leq 0$ ,  $K_{13} \leq 0$ , and  $K(0, A_{t+1}, \tau_{k,t+1}) = 0$  meaning that a positive amount of material  $m_t^k > 0$  is needed to produce any physical capital.

To acquire human capital above the basic level, workers have to make costly effort which decreases in the tax rate  $\tau_{h,t+1}$  imposed on wages. The amount of material resource devoted to public education is  $m_t^h$ , where  $m_t^k + m_t^h \leq B_t$  holds. The human capital production function is

$$h_{t+1} = h(m_t^h, A_{t+1}, \tau_{h,t+1}), \quad (2)$$

where  $h_3 \leq 0$ ,  $h_{23} \leq 0$ ,  $h_{33} \leq 0$ ,  $h_1(0, A_{t+1}, \tau_{h,t+1}) = \gamma < \infty$ , and  $h(0, A_{t+1}, \tau_{h,t+1}) = 1$ . The last condition means that even without any education expenditure, a worker is endowed with the basic human capital (normalized to one unit) in the form of basic intellectual abilities and physical strength, as long as the wage is not below the subsistence level  $w_0$ . The aggregate amount of human capital at time  $t$  is  $H_t \equiv N_t h_t$  where  $N_t$  is the number of workers and  $h_t$  the units of human capital per worker.

Note the three factors of production have different technical features: Land is exogenously given by nature and difficult to be created or destroyed. Physical capital, in contrast, has to be produced with endogenous effort and material investment, and it is easier to lose value if confiscated. These features also apply to human capital investment beyond the basic level that is endowed by nature. As the analysis will show, the complementarity among these three capital forms in production and their distinct technical features co-determine the sequence of the economic development path in figure 1, while the exact timing is also affected by institutional elements such as the political structure discussed below.

**Demographic Structure.** There are  $N_L$  landowners and  $N_C$  capitalists, which are few in the population and fixed over generations. The initial endowment of land among landowners is exogenously given and then passed on to their children, so is the ability of capitalists to generate physical capital. Landowners and capitalists participate in production using their assets rather than direct producing skills. The majority are workers who supply only human capital. Following Hansen and Prescott (2002), the worker population  $N_t$  is set to be consistent with the broad demographic trends in history, where the supply of raw labors keeps the real wage at the subsistence level  $w_0$ , while the worker population becomes constant once costly education



starts at  $t_h$ .<sup>4</sup> That is,

$$N_t = \begin{cases} \left(\frac{\alpha}{w_0} A_t\right)^{\frac{1}{1-\alpha}} (\sigma L + K_t) & \text{if } h_t = 1, \\ \left(\frac{\alpha}{w_0} A_{t_h}\right)^{\frac{1}{1-\alpha}} (\sigma L + K_{t_h}), & \text{if } h_t > 1. \end{cases} \quad (3)$$

## 2.2 The Political Structure

The division of products among the three groups of factor owners (landowners, capitalists, and workers) is determined by the political system, where the ruling group may exploit ruled agents through taxes and confiscation. The political structure of the society is ultimately shaped by the relative economic and bargaining powers of the agents.

We make two assumptions on the establishment and transition of political regimes. The first assumption is essentially *might-is-right*: the ruler group is composed of agents who have dominant violence potential than the ruled agents. This is in line with North's (1981, p. 21-22) theory of state where "the key to understanding the state involves the potential use of violence to gain control over resources. (...) The contract theory assumes an equal distribution of violence potential amongst the principals. The predatory theory assumes an unequal distribution." We take a more general approach, assuming the coercive ability of a group is determined by its collective economic power and organizing efficiency.

In specific, suppose the violence ability  $v_{ti}$  of an individual  $i$  at period  $t$  is proportional to his income  $I_t^i$  where  $v_{ti} = \varpi I_t^i$  with  $\varpi \in (0, 1)$ . The collective coercive power of a group  $G$  of individuals is  $v_G = \psi(G) \sum_{i \in G} \varpi I_t^i$ , where  $\psi(G) \in [0, 1]$  denotes the organizing efficiency of the coalition. It is reasonable to assume  $\psi(G)$  decreases in the group size  $G$  due to free-riding and information problems, where  $\psi(1) = 1$  is a special case for a single member group. When two groups fight, the one with a higher coercive power can always defeat the other, where the cost is equal to the violence level of the defeated group; if they have equal coercive power, each wins with a probability one half.

The initial political regime is established based purely on might-is-right, where the dominant group becomes the first ruler. The dynamic economic development, however, would constantly shift the relative economic and hence coercive powers of groups, and eventually pose threatening challenges to the old political order. There are three possible actions for the incumbent ruler, namely, Not Repress, Repress, and Compromise. If the incumbent ruler does nothing (i.e., choosing *Not Repress*), the challenging group would become the new ruler by might-is-right. To preserve its political dominance, the incumbent ruler may thwart the economic progress to curb the growing economic/coercive power of ruled agents (i.e., choosing *Repress*). This leads to our second assumption, namely, *the incumbent's advantage*, since the ability to repress (or,

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<sup>4</sup>An endogenous account for such demographic changes is in Galor and Weil (2000).

in general, to modify the economic development course) increases the incumbent’s bargaining power in the political game. Such an advantage is not without limit, however, since repression does not come cheap: the ruler’s incomes are reduced because the economy would not produce at its full potential, and extra costs are to be incurred to maintain its ruling since an underdeveloped economy would induce domestic unrest and invite outside invasions from strong neighbors. The repression cost  $\theta_t > 0$  is determined at each period  $t$  by the degree of political competition from both within and outside the country, where  $\theta_t \sim F(\cdot)$  with support  $[\underline{\theta}, \bar{\theta}]$ . When *Compromise* is chosen, political power is shared between the incumbent ruler and the challenging group, assuming the challenging group can make credible commitment to share political power even after they gain dominant economic power in the future.

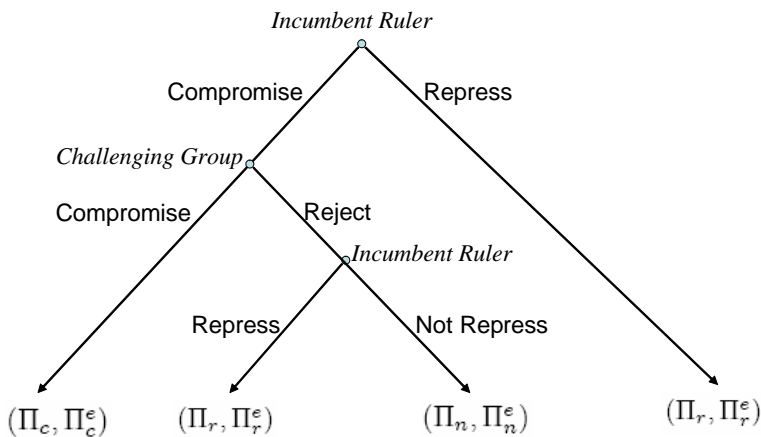


Figure 2: The Political Game between Incumbent Ruler and Challenging Group

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. This implies the ruler would not take any preemptive repressing actions in peaceful time when the balance of coercive power is in its favor, and the ruled group has no alternative but to obey the current political order.<sup>5</sup> In a crucial period when the political regime would have changed based on might-is-right, the incumbent ruler and the challenging group play a political game illustrated in Figure 2. Faced with the potential challenge, the incumbent ruler moves first by choosing *Compromise* or *Repress*. The game

<sup>5</sup>Due to the extremely long period (often in the magnitude of hundreds of years) the model covers, it is not realistic to assume agents can take into consideration of all 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.” Allowing longer horizons and strategic options such as preemptive repression may alter the timing but not the qualitative results of the transition process.

ends if the ruler selects *Repress* since in the beginning of this period it still has dominant power. When *Compromise* is chosen, the challenging group moves next, choosing to accept the proposed compromise or reject it. When compromise is accepted, the game ends; if *Reject* is selected, the incumbent ruler moves in the last step deciding between *Repress* and *Not Repress*. The exact payoffs and subgame perfect Nash equilibria are discussed in the next section. If mutual compromise is reached in equilibrium, the economic progress and political transition will proceed as in Figure 1; if not, repression, economic stagnation, and invasion may happen, which are not uncommon in history.

### 3 The Economic and Political Development

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

**The Economy.** The initial state of our model economy corresponds to a time when agriculture is the dominant production method, and people are not educated. The productivity is so low that no saving is available for capital accumulation; the capitalists are thus not distinguishable from the worker group. Such a situation will continue until period  $t_k$  (determined below in (5)), which means  $h_t = 1$  and  $K_t = 0$  in any period  $t \in [0, t_k]$ .

A landlord  $i$  owns land  $L_i$  and employs  $N_{ti}$  workers at wage  $w_t$ , where  $\sum_{i=1}^{N_L} L_i = L$ . His revenue is  $\pi_{ti} \equiv \max_{N_{ti}} A_t(\sigma L_i)^{1-\alpha} N_{ti}^\alpha - w_t N_{ti}$ , where the optimal labor demand is  $N_{ti}^* = (\frac{\alpha}{w_t} A_t)^{\frac{1}{1-\alpha}} \sigma L_i$ . Given the labor supply  $N_t$  in (3), the subsistence wage level  $w_0$  clears the labor market. So a landlord with land  $L_i$  earns a profit

$$\pi_{ti} = \lambda A_t^{\frac{1}{1-\alpha}} \sigma L_i, \tag{4}$$

where  $\lambda \equiv (1 - \alpha)(\frac{\alpha}{w_0})^{\frac{\alpha}{1-\alpha}}$ . The aggregate profit  $\pi = \sum_{i=1}^{N_L} \pi_{ti} = \lambda A_t^{\frac{1}{1-\alpha}} \sigma L$  grows at the same rate  $g^{\frac{1}{1-\alpha}}$  as the worker population  $N_t = (\frac{\alpha}{w_0} A_t)^{\frac{1}{1-\alpha}} \sigma L$ , while the wage is fixed at  $w_0$ . So the per capita output remains roughly constant over time, around  $\frac{\pi}{N_t} + w_0 = \frac{w_0}{\alpha}$ .

**The Political Game among Landowners.** Initially there is no incumbent ruler, so the political game is determined completely by the rule of might-is-right, where landlords decide whether or not to grab the land of others by violence. Since by assumption the land is not destroyable, a landlord  $i$  by defeating another landlord  $j$  in the beginning of period  $t$  would get the latter's land that yields profit  $\pi_{tj}$ , while incurring a cost of  $\varpi \pi_{tj}$  equal to the violence level of  $j$ ; so the net gain is  $(1 - \varpi)\pi_{tj} > 0$ .

Let  $\Omega$  be the set of all possible coalition that can be formed among landowners, and  $G \in \Omega$  a generic element of the set. The following proposition shows that monarchy emerges as the political regime in

equilibrium where the king owns the largest piece of land.<sup>6</sup>

**Proposition 1** (i) *When land is the only capital, a monarchy is a political equilibrium immune to coalition: The king is the biggest landowner who owns land  $L_M$ , where  $L_M > \max_{G \in \Omega} \{\psi(G) \sum_{i \in G} L_i\}$ , and imposes a tax rate of at least  $1 - \varpi$  on the other landlords' profits; the distribution of land ownership is stable. (ii) The first period the society starts to have surplus is*

$$t_k = \frac{(1 - \alpha)}{\ln(1 + g)} (\ln Z(\lambda A_0 \sigma)^{-1} - \ln \bar{L}), \quad (5)$$

where  $\bar{L} \equiv L_M + (1 - \varpi)(L - L_M)$ ;  $t_k$  arrives earlier when  $L_M$  and  $1 - \varpi$  are higher.

**Proof.** The monarchy is indeed an equilibrium since there are no profitable deviations. No coalition is able to challenge the king given the land distribution, since the coercive power is proportional to one's profit and hence to land size. The king would not grab other landlords' lands since the tax rate  $1 - \varpi$  yields the same amount of revenue as doing so. The landlords would accept the tax because they get no benefit from fighting either as an individual or as a group. The landlords would not fight each other because the net benefit of doing so is at most zero: By grabbing another landlord  $j$ 's land, one can get an after-tax profit not higher than  $\varpi \pi_j$ , which equals the fighting cost he has to incur.

The king's total income  $\pi_{tM}^T$  includes land profit  $\pi_{tM}$  and tax revenue  $(1 - \varpi) \sum_{i \neq M} \pi_{ti}$ :

$$\pi_{tM}^T = \pi_{tM} + (1 - \varpi) \sum_{i \neq M} \pi_{ti} = \lambda A_t^{\frac{1}{1-\alpha}} \sigma \bar{L},$$

where the second equality follows (4). Since  $t_k$  is the earliest possible period that a society starts to have positive bequests and the king is the richest person,  $\pi_{t_k, M}^T = Z$  must be true, which leads to (5). It is obvious that  $t_k$  decreases in  $L_M$ ,  $L$ , and  $1 - \varpi$ . ■

This proposition implies that the property rights of land are secure in the monarchy system, thanks to the overwhelming power of the king who protects the petty landowners for taxes. The aggregate outputs are also the highest since no resources are wasted in fighting each other over land ownership, and the taxes are not distorting given that the total land size is fixed and no investment is feasible yet. The monarchy also facilitates economic development, since the high inequality of land ownership often shortens the time for a

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<sup>6</sup>The violent potential of workers is not important now for three reasons. First, there is nothing to grab from a worker who already accepts the subsistence wage  $w_0$ . Second, there is no gain for workers to help any landlords in fighting since they always get the same wage  $w_0$  no matter which landlord they are working for, given the aggregate labor supply. Third, workers are unable to challenge landowners as an individual and as a group due to their low income and low coalition efficiency associated with the large number of them. Even if workers succeeded in getting all the lands, the equilibrium land distribution would not change from that described in the proposition. So workers would stay out of political games until after  $t_h$  when human capital investment starts.

society to start investment in other forms of capital. As Cipolla (1976, p. 32) observed, “In a predominantly poor society lacking corrective means (...), a high concentration of wealth is an indispensable condition to the formation of saving.” From these aspects, the monarchy is an appropriate or efficient political regime when land is the only capital. This may explain why throughout history, “individuals given a choice between a state – however exploitative it might be – and anarchy, have decided for the former.” (North 1981, p. 24)

### 3.2 Physical Capital and Elite Ruling: $(t_k, T_k]$

With surplus available in society after  $t_k$ , capitalists start to produce physical capital instead of working as raw labors.<sup>7</sup> Since producing physical capital requires special skills of capitalists, the king cannot get much value by confiscating their factories if the capitalists do not operate them; and physical capital is much easier to be hidden or destroyed by their owners, the capitalists, than land. To capture these insights, we assume confiscation brings less value to the king than imposing taxes on capital returns. The endogenous supply of physical capital marks its fundamental difference from land; it reinforces the cooperative aspect and down plays the conflicting side of the relationship among factor owners. Such a change in economic arena will induce corresponding adjustments in the political system, where the political power is to be shared.

#### 3.2.1 Physical Capital Accumulation

Capitalists borrow material resources from the king and rent the physical capital back to him at a market rate  $r_t$ , while paying the king at a tax rate  $\tau_{kt}$  on capital returns. When the borrowing cost is positive, the return rate  $r_t$  can be interpreted as the *net* rate earned by capitalists; without loss of generality, we normalize the borrowing cost at zero.

The choice sequence in each period  $t$  is as follows. The king first announces  $\tau_{kt}$ ; then capitalists produce physical capital  $K_t = K(m_{t-1}^k, A_t, \tau_{kt})$ , taking as given  $r_t$ ,  $\tau_{kt}$  and  $m_{t-1}^k = B_{t-1} = \beta(\pi_{t-1, M}^T - Z)$ ;<sup>8</sup> and finally the king decides his demand for capital and labor. The capital return rate  $r_t$  and wage  $w_0$  clear the capital and labor markets in equilibrium. The optimal choices are summarized in the following lemma.

**Lemma 1** *The optimal tax rate  $\tau_{k,t}^*$  on capital returns is uniquely determined by  $K_t + \tau_{k,t}^* K_3 = 0$  for  $t \in (t_k, T_k)$  under monarchy. It maximizes the king’s total revenue  $\pi_{tM}^T = \lambda A_t^{\frac{1}{1-\alpha}} (\sigma \bar{L} + \tau_{kt} K_t)$ . The physical capital stock  $K_t = K(B_{t-1}, A_t, \tau_{kt}^*)$  increases over time.*

<sup>7</sup>The assumption that capitalists do not emerge from landowners is consistent with historical evidence; see Doepke and Zilibotti (2005) for a plausible explanation.

<sup>8</sup>For simplicity we model the aggregate supply of physical capital in a reduced form rather than deriving it from individual behaviors. The king would find it optimal to invest only in physical capital at this time period; see proposition 3 for the formal proof.

**Proof.** In the appendix. ■

The ever increasing physical capital stock induces faster growth in the total output  $\lambda A_t^{\frac{1}{1-\alpha}}(\sigma L + K_t)$  and worker population, while the per-capita output is still roughly constant at  $\frac{w_0}{\alpha}$  as before. The king benefits from the process of capital accumulation through increased tax revenues. The economic development, however, would gradually build up pressure to challenge the absolute power of the king. Measured by before-tax revenues, the total economic power of the elites (the capitalists and landlords),  $\lambda A_t^{\frac{1}{1-\alpha}}(\sigma(L - L_M) + K_t)$ , grows faster than the king's  $\lambda A_t^{\frac{1}{1-\alpha}}\sigma L_M$ ; and so does their coercive power.

### 3.2.2 The Political Game Between the King and Elites at $T_k$

Suppose period  $T_k$  is the first time when the elites would have the same coercive power as the king. Then  $T_k$  is uniquely determined by  $\psi(N_C + N_L - 1)\lambda A_{T_k}^{\frac{1}{1-\alpha}}(\sigma(L - L_M) + K_{T_k}) = \lambda A_{T_k}^{\frac{1}{1-\alpha}}\sigma L_M$ , which boils down to

$$K_{T_k} = \left(\frac{1}{\psi(N_C + N_L - 1)} + 1\right)\sigma L_M - \sigma L. \quad (6)$$

At the beginning of period  $T_k$  when the king still has slightly dominant coercive power, the elites and the king play the political game in Figure 2. The king can use his incumbent advantage to repress the challenge by stagnating the economic and hence the coercive power of the elites. For example, he can freeze the physical capital stock at certain level  $\bar{K} < K_{T_k}$  by directly confiscating their assets or spending his savings in non-productive ways (say in religion, arts, or jewelry) than lending them to capitalists. The king's income with Repress is

$$\Pi_r \equiv \lambda A_{T_k}^{\frac{1}{(1-\alpha)}}(\sigma\bar{L} + \tau_{k,T_k}^*\bar{K}) - \theta_{T_k},$$

where  $\tau_{k,T_k}^*$  is the optimal tax rate, and  $\theta_{T_k}$  is the repression cost at period  $T_k$ .

If a compromise is reached where the king and the elites share political power and impose zero tax on land and physical capital, the king's income shrinks to his land profit

$$\Pi_c \equiv \lambda A_{T_k}^{\frac{1}{(1-\alpha)}}\sigma L_M.$$

If the king chooses Not Repress, the elites would gain the ruling power at the end of period  $T_k$  based on might-is-right and confiscate the king's land or impose a tax rate  $1 - \varpi$  on it (by proposition 1). The net income of the king with Not Repress is

$$\Pi_n \equiv \varpi \lambda A_{T_k}^{\frac{1}{(1-\alpha)}}\sigma L_M = \varpi \Pi_c.$$

Note the king is always better off choosing Compromise than Not Repress since  $\Pi_c > \Pi_n$  holds due to  $\varpi < 1$ , and both are independent of the repression cost  $\theta_{T_k}$ . Whether Repress is a better choice for the king

depends on how costly the repression is, since  $\Pi_r$  strictly decreases in  $\theta_{T_k}$ . The comparison between the three outcomes  $\Pi_n$ ,  $\Pi_c$  and  $\Pi_r$  is illustrated in figure 3.

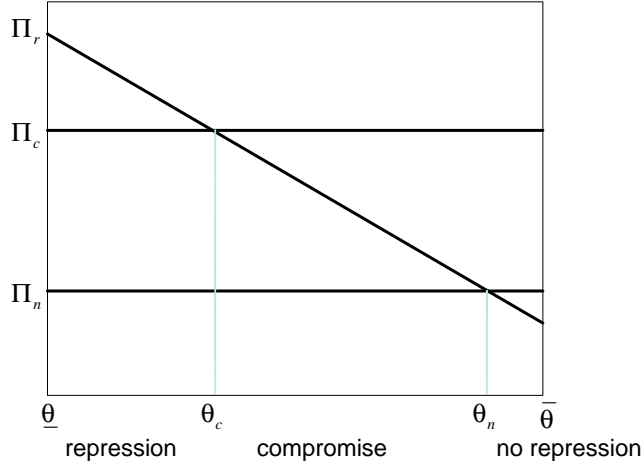


Figure 3: The Incumbent Ruler's Incomes and Repression Cost  $\theta$

**Lemma 2** *There exist two unique levels of repression costs  $\theta_c$  and  $\theta_n$ , where  $\theta_c < \theta_n$ , such that  $\Pi_r > \Pi_c > \Pi_n$  for  $\theta_{T_k} \in [\underline{\theta}, \theta_c)$ ,  $\Pi_c > \Pi_r \geq \Pi_n$  for  $\theta_{T_k} \in (\theta_c, \theta_n]$ , and  $\Pi_c > \Pi_n > \Pi_r$  for  $\theta_{T_k} \in (\theta_n, \bar{\theta}]$ .*

**Proof.** In the appendix. ■

For the elites, compromise is better than repression since under compromise the economic progress is not blocked and they pay no tax; and the case of no repression is even better since they get extra tax revenues from the King's land.

**Proposition 2** *The Subgame Perfect Nash Equilibrium in the political game between the king and elites at period  $T_k$  is (Repress, Repress; Compromise) when  $\theta_{T_k} \in [\underline{\theta}, \theta_c)$ , (Compromise, Repress; Compromise) when  $\theta_{T_k} \in [\theta_c, \theta_n]$ , and (Compromise, Not Repress; Reject) when  $\theta_{T_k} \in (\theta_n, \bar{\theta}]$ .*

**Proof.** When  $\theta_{T_k} < \theta_c$ , the king would repress capitalists since  $\Pi_r > \Pi_c > \Pi_n$  holds by lemma 2. When  $\theta_{T_k} \in (\theta_c, \theta_n]$ , the king would choose to repress if his proposed compromise is rejected since  $\Pi_r \geq \Pi_n$ ; given the king's strategy, the elites would accept the compromise; then the king would choose to compromise in the first place due to  $\Pi_c \geq \Pi_r \geq \Pi_n$ . So (Compromise, Repress; Compromise) is the SPE for  $\theta_{T_k} \in [\theta_c, \theta_n]$ . When  $\theta_{T_k} > \theta_n$  the king would choose 'Not Repress' after the compromise is rejected since  $\Pi_r < \Pi_n$ ; knowing this the capitalists would reject the compromise proposed by the king, and the SPE is (Compromise, Not Repress; Reject). ■

The proposition suggests mutually beneficial compromise can be reached only when the repression cost is in the middle range; when the repression cost is low, repression and economic stagnation are more likely to happen, and when it is very high, no-repression happens and the king loses his political power to the challenging group. All three cases have historical examples.

In Europe the contest for power is the routine : “an appropriate degree of rivalry among states may put pressure on the sovereign to decentralize power and provide political foundations for secure markets in order to enlarge the tax base and the future military capabilities of the system.” (Alston et al. 1996, p. 129) So in general their repression costs are in the middle range. Among European countries, the heavy reliance on navy for military power and hence less capacity for domestic repression may be one reason that the king and elites in England achieved compromise, compared with repression in the continental countries such as France and Spain (Skocpol 1973).

Where there are no strong rivals from competing states or potential rulers within his own state, the repression cost tends to be quite low and hence “the existing ruler characteristically is a despot, a dictator, or an absolute monarchy.” (North 1981, p. 27) This is likely to happen when a kingdom is isolated geographically from others, or the neighbors are much weaker, such as in China or Egypt: “Ecumenical empires did not fear flight, especially when, like China, they defined themselves as the center of the universe, the hearth and home of civilization, and everything outside as barbarian darkness. There was no other places to go.” (Landes 1998, p. 36) Similarly, “Egypt was isolated by desert and water from invaders and was not overrun until (...) at the end of the twelfth dynasty.” (North 1981, p. 95) The repression may continue for a long time until outside threats dramatically increase the repression costs and turn it into the no-repression case, where the incumbent is forced to yield political power to the challenging group. As globalization increases and the international political environment becomes more competitive, the possibility of repression is likely to go down.

Since the main interest of this paper is the long run coevolution path of economic and political development, we focus on the smooth case of  $\theta_{T_k} \in [\theta_c, \theta_n]$ , where the landlords and capitalists would share the political power and there is no income tax on them from period  $T_k$  onwards.

### **3.3 Human Capital Investment and Full Suffrage: $[T_k, T_h]$**

During the initial periods under elite ruling, workers are still raw labors and paid the subsistence level of wage  $w_0$ . Only when the physical capital stock is large enough would public education starts; the first period when this happens is  $t_h$ , from then on human capital investment starts. The worker wages, however, still



remain at  $w_0$  until period  $t'_h > t_h$  when the disincentive of low wages on human capital accumulation is big enough, and they may never rise to the competitive levels under elite ruling due to concerns of political stability. But eventually, the elites will have to face the political challenge of workers as their human capital and wages continue to increase.

### 3.3.1 Wage Tax and Education Expenditure

Since human capital investment involves costly inputs and worker effort, the supply of educated workers becomes limited. In specific, it is assumed constant at the level of  $N_h \equiv N_{t_h}$  as in (3), where  $t_h$  denotes the first period when human capital investment starts under the elite ruling. Given the labor supply  $N_h$ , the competitive wage level

$$w_{t+1}^* = \alpha A_{t+1} (\sigma L + K_{t+1})^{1-\alpha} (N_h h_{t+1})^{\alpha-1}$$

would clear the labor market. The actual wage for workers at period  $t + 1$  is

$$w_{t+1} \equiv (1 - \tau_{h,t+1}) w_{t+1}^*,$$

where  $\tau_{h,t+1} \in [\underline{\tau}, \bar{\tau}_{t+1}]$  is the implicit wage tax rate set by the ruling elites. The upper bound  $\bar{\tau}_{t+1} \equiv 1 - \frac{w_0}{w_{t+1}^*}$  guarantees the lowest wage  $w_0$ , which allows workers to maintain living at the subsistence level. The lower bound

$$\underline{\tau} \equiv 1 - \frac{\psi(N_L + N_C)}{\psi(N_L + N_C) + \psi(N_h)} \frac{1}{\alpha} \quad (7)$$

arises from the political concern: The aggregate income of workers is  $(1 - \tau_{h,t+1}) w_{t+1}^* N_h h_{t+1} = \alpha(1 - \tau_{h,t+1}) Y_{t+1}$ , while the income of elites is  $(1 - \alpha + \alpha \tau_{h,t+1}) Y_{t+1}$ . To prevent the workers' coercive power from being high enough to challenge the ruling of elites,  $\psi(N_h) \alpha (1 - \tau_{h,t+1}) Y_{t+1} \leq \psi(N_L + N_C) (1 - \alpha + \alpha \tau_{h,t+1}) Y_{t+1}$  must hold, which is equivalent to  $\tau_{h,t+1} \geq \underline{\tau}$ .

Note  $\underline{\tau} > 0$  must be true if workers earning competitive wages can ever become dominant; but this implies  $\tau_{h,t+1} \geq \underline{\tau} > 0$  so that workers under elite ruling cannot get the full competitive wage  $w_{t+1}^*$ . On the other hand,  $\tau_{h,t+1}$  cannot be too high, otherwise workers are less willing to make effort in accumulating desirable skills and hence their productivity would be low.

Suppose the elites first choose public education expenditure  $m_t^h$  and then the wage tax  $\tau_{h,t+1}$ . To capture the idea that the disincentive of tax on wages increases over time,  $h_2 + (1 - \alpha + \alpha \underline{\tau}) h_{23} < 0$  is assumed. The optimal solutions are described in the following proposition.

**Proposition 3**  $m_t^{h*}$  and  $\tau_{e,t+1}^*$  are uniquely determined under the elite ruling:

$$m_t^{h*} \begin{cases} = 0 & \text{for } t < t_h, \\ > 0 & \text{for } t \geq t_h, \text{ where } \frac{\partial m_t^{h*}}{\partial B_t} > 0; \end{cases}$$

$$\tau_{h,t+1}^* \begin{cases} = \bar{\tau}_{t+1} & \text{for } t+1 < t'_h \text{ so that } w_{t+1} = w_0, \\ \in (\underline{\tau}, \bar{\tau}_{t+1}) & \text{for } t+1 \geq t'_h, \text{ where } \frac{\partial \tau_{h,t+1}^*}{\partial A_t} < 0, \\ = \underline{\tau} & \text{for } t+1 = T_h; \end{cases}$$

where  $T_k < t_h < t'_h < T_h$ , all of which are uniquely determined.

**Proof.** In the appendix. ■

This lemma suggests that only when the surplus  $B_t$  becomes large enough would investment in human capital starts at period  $t_h$ ; before then only physical capital is accumulated.<sup>9</sup> And when the stock of knowledge is not high enough, the human capital is not very responsive to workers' effort so that workers are still paid the subsistence wage  $w_0$  in  $t \in [t_h, t'_h]$  as before, even after human capital investment starts. A direct implication is that when human capital is not important in production or when worker effort is not essential for human capital investment, the elites will set the optimal wage at  $w_0$ . This is consistent with  $w_0$  being the wage level under monarchy.

### 3.3.2 The Political Game Between Elites and Workers at $T_h$

As the human capital stock goes up and wages continue to increase, the collective coercive power of workers also grows. It will eventually match that of the elites in period  $T_h$ , when the optimal tax rate  $\tau_{h,T_h}^*$  reaches the lower bound  $\underline{\tau}$ . The political game between the elites and workers at period  $T_h$  is the same as that between the king and the elites, where full suffrage obtains and workers earn competitive wages  $w_{t+1}^*$  if compromise is reached. With similar arguments as in section 3.2.2, we get the following results.

**Proposition 4** *There exist two unique levels  $\theta'_c$  and  $\theta'_n$ , where  $\theta'_c < \theta'_n$ , such that the subgame perfect Nash equilibrium in the political game between elites and workers at period  $T_h$  is (Repress, Repress; Compromise) when  $\theta_{T_h} \in [\underline{\theta}, \theta'_c)$ , (Compromise, Repress; Compromise) when  $\theta_{T_h} \in [\theta'_c, \theta'_n]$ , and (Compromise, Not Repress; Reject) when  $\theta_{T_h} \in (\theta'_n, \bar{\theta}]$ .*

**Proof.** In the appendix. ■

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<sup>9</sup>This justifies our earlier assumption that only physical capital was invested under monarchy when the total surplus was even smaller.

### 3.4 A Smooth Development Path: Summary

If the repression costs remain in the middle ranges at both transition times  $T_k$  and  $T_h$ , a smooth economic and political development path is likely to be taken, where new production potentials are realized by adjusting political institutions accordingly. England seems to be such a case, where political compromises were reached in these crucial moments. The smooth evolving path of this type of political economy is summarized by the following proposition.

**Proposition 5** *When the repression costs are in the middle range where  $\theta_{T_k} \in [\theta_c, \theta_n]$  and  $\theta_{T_h} \in [\theta'_c, \theta'_n]$  such that compromises between the incumbent ruler and the challenging group are reached, the political economy would evolve as follows. Physical capital accumulation starts at period  $t_k$  while human capital investment starts at  $t_h$ ; the per capita output stays constant before  $t_h$  and starts to increase afterwards. Monarchy is the political equilibrium before period  $T_k$ , then it's replaced by elite ruling of landlords and capitalists, and finally, workers are also granted political rights and hence full suffrage is realized after period  $T_h$ . The time path  $t_k < T_k < t_h < T_h$  suggests that economic development leads to political transition, which in turn facilitates future economic development.*

This fast-track economic and political development is the one illustrated in figure 1. During this process, the population of workers grew at the same rate as the total output (with faster growth rates when physical capital accumulation started after  $t_k$ ) so that the per capita output was constant before human capital investment started at  $t_h$ , after which the per capita output began to increase while the population stayed the same. After  $T_h$ , all factor owners gain political power and earn competitive returns, which enables the economy to produce at its full capacity.

Roughly speaking, most OECD countries have experienced all the developmental stages and are now beyond  $T_h$ . Many countries, however, are not so lucky as this benchmark path shows; when mutually beneficial political compromise is not reached, the economic progress is often stagnated by political repressions. On the other hand, not every country has to go through every developmental stage described in the model, due to various elements such as wars, colonization, and transnational economic activities. So our simple model paints only a broad brush picture of the long run development path, which is driven mainly by the technical features of different factors in production and political conflicts among self-interested factor owners on dividing the outputs. That said, the model is actually less restrictive than it appears, since many elements (such as cultures, religions, ideologies, racial concerns, and international environment), though not explicitly modeled, may implicitly affect production functions and repression costs.

## 4 Historical Perspective and Further Discussions

This section gathers some historical evidence trying to convince the reader that the simple model analyzed above is relevant and useful in organizing our thoughts on long run economic and political development. Our discussions below mainly focus on the history of Western Europe (esp. Britain) where the full time line suggested in the model has been realized, and political compromises were reached timely enough to avoid economic stagnation.

**Land, Anarchy, and Monarchy.** From the beginning of settled agriculture, about eight thousand years past before the peak of the Roman Empire. After the fall of the Roman Empire in the fifth century up to the year 1000, Europe was stagnate in income and population. The introduction of feudalism in the 9th century enabled Europe to gradually emerge from the anarchy and develop “a political-economic structure which produced sufficient order and stability to in turn induce changes leading to its breakdown (...).” (North 1981, p. 124)

Since land is difficult to destroy in fighting, it has been the main target of endless fights and wars in centuries. The property rights of land are better protected in a monarchy system where the king uses his dominant coercive power to provide security for petty landlords in exchange of taxes. “While the ten millennia since the creation of settled agriculture appear in historical retrospect as an endless saga of war and of butchery, exploitation (however defined), enslavement, and mass murder, most often done by the state ruler or his agents, it is still essential to stress the necessity of a state for economic progress. Throughout history, individuals given a choice between a state – however exploitative it might be – and anarchy, have decided for the former.” (North 1981, p. 24)

The link between land size and coercive power is observed by Smith ([1776] 1976, p. 408): “The security of a landed estate (...) depended upon its greatness. To divide it was to ruin it, and to expose every part of it to be oppressed and swallowed up by the incursions of its neighbors.” Later, the growth of a money economy made the link between economic power and coercive power even more close: “The size of a king’s army now depended on his purse.” (North 1981, p. 136)

**Physical Capital and Elite Ruling.** When income and population started growing, it is possible to accumulate wealth and invest in physical capital. As a result, industry and service sectors gradually replaced agriculture and became the dominant economic activities. During this transition process, the aristocracy as a group did not contribute to industrialization, and remained attached to the landed estates as its only source of wealth (Bertocchi 2006a, Doepke and Zilibotti 2005).

The ever growing wealth of capitalists made it possible to gain political power from the king. “A very important instance of convergent interests between major segments of the landed aristocracy and the upper ranks of the town dwellers occurred in Tudor and Stuart England.” (Moore 1966, p. 424) This is an important condition leading to the compromise between the king and elites, which “caused an early removal of feudal rights but at the same time allowed the aristocracy to retain economic and political control” (Bertocchi 2006a). After the Glorious Revolution in 1688, “a succession of ministries (...) managed to create political conditions which turned out over time to be conducive to British dominance of world trade in manufactures and international services,” although these actions “should in no sense be interpreted as a ‘strategy’ for the long-term development of the British economy.” (O’Brien 1994)

**Wages, Human Capital, and Suffrage Extension.** In the same time, however, workers still received very low wages as before. Under Elizabeth and Stuart statutes (which remained unreformed between 1688 and 1815) “the state retained very considerable powers (...) to determine wages and conditions of employment. (...) Such statutes and the common law (...) strengthened the authority of employers and depressed wages.” (O’Brien 1994) Indeed, “workers’ living standards showed no clear progress before 1820.” (Lindert 1994) The value of human capital in the production process 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. Its importance increased in the second phase, when workers’ effort also became a crucial element affecting firms’ productivity; this prompted a sequence of education reforms in England since the 1830s, designed primarily to satisfy the increasing skill requirements (Galor and Moav 2006).

Not surprisingly, after 1800, employers in Lancashire soon found that “they need more than a labor force that was available. They needed a labor force that was loyal, reliable, and motivated. To insure this they paid wages that soon became institutionalized as ‘fair wages’ (...).” (Huberman 1986, 1991, 1992, as cited in Mokyr 1993, p. 91) Consistent with our assumption of the link between wage and worker effort, Lazonic (1994) argued that “the contribution of workers to superior economic performance depends on their attitudes. Workers will only expend high levels of effort in the production process if they expect to receive what they consider to be a ‘fair share’ in the consequent returns.” However, due to intense competitive pressures, employers are often unable to make credible promises to workers that their shares would be ‘fair’. “By giving workers the assurance that their expectations for rewards would be met, collective organization made workers more willing to contribute high levels of effort to production.” “Eager to generate output for sale while there were profits to be made, employers became receptive to sharing power with workers’ organizations” rather than fighting unionization.

The increasing value of human capital shifted the power balance more favorable to workers, making their threat of violence a significant factor in shaping the franchise expansion. In Britain, the motive to pass the First Reform Act in 1832 for suffrage extension was to avoid social disturbances, which seems to be the consensus amongst historians. For example, Lang (1999, p. 36) concludes that “the level of unrest reinforced the case for immediate reform now, rather than later: it was simply too dangerous to delay any longer. Just as Wellington and Peel had granted emancipation to avoid a rising in Ireland, so the Whigs (...) should grant reform as the lesser of two evils.”

On the other hand, the increasing importance of human capital also brought benefits to elites and hence made compromise more appealing than before. “The employers’ acceptance of collective bargaining in turn opened the way for political transformations (...). In the eyes of the British political elite of the 1860s and 1870s the advent of cooperative industrial relations under the aegis of business-minded union leaders transformed craft workers from uncontrollable subversive into responsible citizens. One result was the 1867 extension of the right to vote to the better-paid of the workers” (Lazonick 1994). After several further extensions of suffrage, full democracy was finally realized in Britain in 1884 for men and in 1928 including women.

## 5 Concluding Remarks

This paper establishes a simple model on the coevolution path of economic and political system, which is driven by the inherent technical features of different factors in production and the political conflicts among factor owners in output distribution. The dynamic economic progress transforms the main capital form in economy from land to physical capital and then to human capital, which enables their respective owners (landlords, capitalists, and workers) to gain political powers in the same sequence. When it is too costly for any group of factor owners to repress others, political compromise is reached and the economic progress is not blocked; otherwise, political conflicts may lead to repression of some factor owners and hence economic stagnation.

A main insight emerging from the paper is about the compatibility of economic and political development, which brings a developmental perspective into the discussions of appropriate or growth-enhancing political institutions. For instance, the paper suggests when natural resources are the main factor in production, imposing democracy may induce anarchy and stagnation; an alternative way is to help accumulate physical and human capital. Only when human capital becomes the dominant production factor 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 and to facilitate further economic development.

On the other hand, many elements in society such as religions, cultures, geography, and history may influence development by affecting the costs of political transition. For example, the willingness to make political compromise may greatly facilitate economic progress. As Mokyr (2005) argues, by the middle of the eighteenth century Britain 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. Britain’s great asset was (...) that its political institutions were nimbler, and that they could be changed at low social cost (...)” In contrast, one can imagine that in societies where people are conditioned to blindly obey authority, the institutions are more rigid and difficult to change from within. In this aspect, the intense global competition in both political and economic terms, by increasing the outside threats to inefficient economies, may lower the feasibility of repressive political regimes and hasten the development process.

The framework of the current paper may prove useful in understanding related long run development issues. For example, the changing motivation, formats, and frequency of wars over time may also reflect the shifts of capital stock composition. If democratic countries are necessarily highly invested in human capital, which is often true, it is not surprising that they seldom wage wars at 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 evolution of education system, in terms of both contents and financing methods, may also be shaped by similar driving forces.

# APPENDIX

**Lemma 1.**

**Proof.** We solve the king's decision problem from the last step, where his objective function is

$$\pi_{tM}(\tau_{kt}) = \max_{N_{tM}, K_t} A_t(\sigma L_M + K_t)^{1-\alpha} N_{tM}^\alpha - w_t N_{tM} - r_t K_t.$$

The king's demand for labor is  $N_{tM}^* = (\frac{\alpha}{w_t} A_t)^{\frac{1}{(1-\alpha)}} (\sigma L_M + K_t^*)$ , while the other landlords' demand is still the same as before:  $N_{ti}^* = (\frac{\alpha}{w_t} A_t)^{\frac{1}{(1-\alpha)}} \sigma L_i$  for landlord  $i$ . So the total labor demand equals the labor supply  $N_t = (\frac{\alpha}{w_0} A_t)^{\frac{1}{(1-\alpha)}} (\sigma L + K_t^*)$  when  $w_t = w_0$ .

The optimal solution for physical capital is  $r_t = (1 - \alpha) A_t (\sigma L_M + K_t)^{-\alpha} (N_{tM}^*)^\alpha = \lambda A_t^{\frac{1}{1-\alpha}}$ , where  $\lambda \equiv (1 - \alpha) (\frac{\alpha}{w_0})^{\frac{\alpha}{1-\alpha}}$ . Note the market rate of capital return  $r_t$  is independent of land size and physical capital stock. The king's profit from his land, after plugging  $N_{tM}^*$  and  $r_t$ , is  $\pi_{tM} = \lambda A_t^{\frac{1}{1-\alpha}} \sigma L_M$ , which depends only on his land size and not on the physical capital used. This would also be true for the other landlords when they have positive bequests. That is, any landlord's profit is independent of the physical capital used and hence independent of the tax rate  $\tau_{k,t}$  imposed on capitalists. Without loss of generality, we assume the demand for physical capital is equal to its supply.

The total income of the king  $\pi_{tM}^T = \lambda A_t^{\frac{1}{1-\alpha}} (\sigma \bar{L} + \tau_{kt}^* K_t)$  includes land profit plus tax revenues from land and physical capital. It depends only on the aggregate amount, not on the distribution, of either land or physical capital. So it would remain the same after the other landlords and the capitalists start to have positive bequests some periods later. The FOC  $K_t + \tau_{kt}^* K_\tau = 0$  yields the unique optimal tax rate  $\tau_{k,t}^*$  since the SOC  $2K_\tau + \tau_{kt}^* K_{\tau\tau} < 0$  is satisfied.

The physical capital stock  $K_t = K(B_{t-1}, A_t, \tau_{kt}^*)$  increases over time since

$$\frac{\partial K_t}{\partial B_{t-1}} = K_1 + K_\tau \frac{\partial \tau_{kt}^*}{\partial B_{t-1}} \geq K_1 - \frac{1}{2} (K_1 + \tau K_{\tau 1}) = \frac{1}{2} K_1 - \tau K_{\tau 1} > 0,$$

where the first inequality obtains from  $K_\tau \frac{\partial \tau_{kt}^*}{\partial B_{t-1}} = \frac{K_\tau (K_1 + \tau K_{\tau 1})}{-2K_\tau - \tau K_{\tau\tau}} = \frac{K_1 + \tau K_{\tau 1}}{-2 - \tau K_{\tau\tau}/K_\tau} \geq \frac{(K_1 + \tau K_{\tau 1})}{-2}$  given that  $-\tau K_{\tau\tau}/K_\tau \leq 0$ . ■

**Lemma 2.**

**Proof.** Conditions  $\Pi_c \geq \Pi_r$  and  $\Pi_r \geq \Pi_n$  can be simplified to, respectively,

$$\begin{aligned} \theta_{T_k} &\geq \lambda A_{T_k}^{\frac{1}{(1-\alpha)}} (\sigma \bar{L} + \tau_{k,T_k}^* \bar{K} - \sigma L_M) \equiv \theta_c, \\ \theta_{T_k} &\leq \lambda A_{T_k}^{\frac{1}{(1-\alpha)}} (\sigma \bar{L} + \tau_{k,T_k}^* \bar{K} - \sigma \varpi L_M) \equiv \theta_n. \end{aligned}$$

It is straightforward to see that  $\theta_c < \theta_n$ . ■



**Proposition 3.**

**Proof.** The objective function of the elites is

$$\Pi_{e,t+1} = \max_{\tau_{h,t+1}} (1 - \alpha + \alpha\tau_{h,t+1})A_{t+1}(\sigma L + K_{t+1})^{1-\alpha}(N_h h_{t+1})^\alpha,$$

taking as given  $m_t^h$ ,  $h_{t+1} = h(m_t^h, A_{t+1}, \tau_{h,t+1})$ , and  $K_{t+1} = K(B_t - m_t^h, A_{t+1}, 0)$ . The FOC w.r.t.  $\tau_{h,t+1}$  is

$$h_{t+1} + (1 - \alpha + \alpha\tau_{h,t+1}) \frac{\partial h_{t+1}}{\partial \tau_{h,t+1}} = 0 \text{ if } \tau_{h,t+1} \in [\underline{\tau}, \bar{\tau}_{t+1}], \quad (8)$$

$$h(m_t^{h*}, A_{t+1}, \underline{\tau}) + (1 - \alpha + \alpha\underline{\tau}) \frac{\partial h(m_t^{h*}, A_{t+1}, \underline{\tau})}{\partial \tau_{h,t+1}} < 0 \text{ if } \tau_{h,t+1} = \underline{\tau}, \quad (9)$$

$$h(m_t^{h*}, A_{t+1}, \bar{\tau}_{t+1}) + (1 - \alpha + \alpha\bar{\tau}_{t+1}) \frac{\partial h(m_t^{h*}, A_{t+1}, \bar{\tau}_{t+1})}{\partial \tau_{h,t+1}} > 0 \text{ if } \tau_{h,t+1} = \bar{\tau}_{t+1}. \quad (10)$$

The assumption  $h_2 + (1 - \alpha + \alpha\underline{\tau})h_{23} < 0$  implies the LHS of the above three expressions all decrease in  $A_t$  since  $\tau_{h,t+1} \geq \underline{\tau}$ . The inequality in (10) holds until period  $t'_h$  when (8) holds at equality,  $\tau_{h,t'_h}^* = \bar{\tau}_{t'_h}$ , which uniquely determines  $t'_h$ . For the interior solutions,

$$\frac{\partial \tau_{h,t+1}^*}{\partial A_{t+1}} = \frac{h_2 + (1 - \alpha + \alpha\tau_{h,t+1}^*)h_{23}}{-SOC} < 0$$

holds based on (8); so the optimal wage tax  $\tau_{h,t+1}^*$  decreases in  $A_{t+1}$ , until it drops to the lower bound  $\underline{\tau}$  at period  $T_h$ , which is uniquely determined by  $\tau_{h,T_h}^* = \underline{\tau}$ .

Taking as given  $\tau_{h,t+1}(m_t^h)$ , the FOC for  $m_t^h$  is

$$\alpha(\sigma L + K_{t+1})h_1 - (1 - \alpha)h_{t+1}K_1 = 0 \text{ if } m_t^h > 0, \quad (11)$$

$$\alpha(\sigma L + K_{t+1})\gamma - (1 - \alpha)K_1 \leq 0 \text{ if } m_t^h = 0, \quad (12)$$

where  $h_1(0, A_{t+1}, \tau_{h,t+1}) = \gamma$  and  $h(0, A_{t+1}, \tau_{h,t+1}) = 1$  are substituted in (12). For interior solutions we have

$$\frac{\partial m_t^{h*}}{\partial B_t} = \frac{\alpha K_1 h_1 - (1 - \alpha)h_{t+1}K_{11}}{-SOC} > 0$$

based on (11). So the *LHS* in (12) also strictly increases in the total surplus  $B_t$ , and it would eventually arise to zero at certain period  $t_h$ , after which human capital investment starts.  $t_h$  is thus defined by (12) at the equality. When  $t_h \geq T_k$ , human capital investment starts under elite ruling; this is indeed the case when the capital stock at  $T_k$ ,  $K_{T_k}$  in (6), is still small. ■

**Proposition 4.**

**Proof.** At the beginning of period  $T_h$ , if the elites freeze the economic power of workers at a level  $\bar{Y} \equiv Y_{T_h-1}$ , they get an income

$$\Pi'_r \equiv (1 - \alpha + \alpha\tau_{h,t+1})\bar{Y} - \theta_{T_h},$$

where  $\theta_{T_h}$  denotes the repression cost. If a compromise is reached where workers are allowed to share political power, each group gets its competitive returns with  $\tau_{h,t+1}^* = 0$  afterwards. The elites then get

$$\Pi'_c \equiv (1 - \alpha)Y(m_{T_h-1}^h, A_{T_h}, 0).$$

In this case the total output is maximized at the social optimal level.<sup>10</sup>

If the elites do not repress, workers would get exclusive political power after period  $T_h$ . For simplicity suppose workers impose a uniform tax rate  $\tau_{T_h}^*$  on both landowners and capitalists to maximize their income  $(\alpha + \tau_{T_h}(1 - \alpha))Y(m_{T_h-1}^h, A_{T_h}, 0)$ , where  $\tau_{T_h}^*$  is uniquely determined by  $\sigma L + K_t + (\alpha + \tau_{T_h}^*(1 - \alpha))K_\tau = 0$ . Then the elites would get

$$\Pi'_n \equiv (1 - \tau_{T_h}^*)(1 - \alpha)Y(m_{T_h-1}^h, A_{T_h}, 0) = (1 - \tau_{T_h}^*)\Pi'_c,$$

which is smaller than  $\Pi'_c$  (note the education expenditure is not affected by  $\tau_{T_h}^*$ ).

Conditions  $\Pi'_c \geq \Pi'_r$  and  $\Pi'_r \geq \Pi'_n$  can be simplified to, respectively,

$$\begin{aligned} \theta_{T_h} &\geq (1 - \alpha + \alpha\tau_{h,t+1})\bar{Y} - (1 - \alpha)Y(m_{T_h-1}^h, A_{T_h}, 0) \equiv \theta'_c, \\ \theta_{T_h} &\leq (1 - \alpha + \alpha\tau_{h,t+1})\bar{Y} - (1 - \tau_{T_h}^*)(1 - \alpha)Y(m_{T_h-1}^h, A_{T_h}, 0) \equiv \theta'_n. \end{aligned}$$

$\theta'_n > \theta'_c$  is due to  $\Pi'_n < \Pi'_c$ , or equivalently  $\tau_{T_h}^* > 0$ . Similar to Lemma 2, there exist two unique levels  $\theta'_c$  and  $\theta'_n$ , where  $\theta'_c < \theta'_n$ , such that  $\Pi'_r > \Pi'_c > \Pi'_n$  holds for  $\theta_{T_h} \in [\underline{\theta}, \theta'_c)$ ,  $\Pi'_c \geq \Pi'_r \geq \Pi'_n$  for  $\theta_{T_h} \in [\theta'_c, \theta'_n]$ , and  $\Pi'_c > \Pi'_n > \Pi'_r$  for  $\theta_{T_h} \in (\theta'_n, \bar{\theta}]$ .

The challenging group, workers in this case, always prefer no repression to compromise, and compromise to repression. The fundamental features of this game are similar to that between the king and elites. The equilibrium results follow directly from the proof of proposition 2.

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<sup>10</sup>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 bequest at least from period  $T_h$ . When this is not true, the elites have more incentives to repress workers and hence may delay the transition, while the main results still hold.

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