The Coevolution of Economic and Political Development

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Abstract

This paper establishes a simple model of long run economic and political development, which is driven by the inherent technical features of different factors in production, 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 the respective factor 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.

In short, the process of growth is inherently destabilizing to a state. ... If however, growth is destabilizing, so is no growth, ... Relatively inefficient property rights threaten the survival of a state in the context of more efficient neighbors, and the ruler faces the choice of extinction or modifying the fundamental ownership structure to enable the society to ... raise the rate of growth.

North (1981, p. 29)

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, Hirshleifer (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 stock 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

Political Development Path

Monarchy T_k Elites Ruling T_h | Full Suffrage

Time 0

Land is the only capital. t_k Physical capital accumulation begins. t_h Human capital accumulation begins.
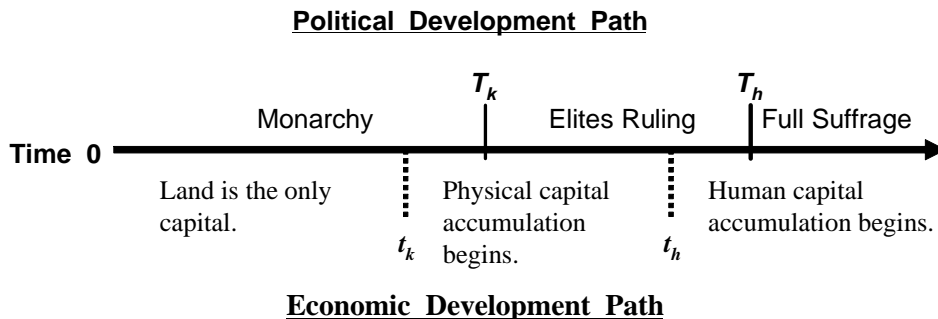
Economic Development Path

Figure 1: The Time Line of Economic and Political Development

under certain conditions characterized in the model.

The main results of the paper are in general consistent with historical evidence.[1] 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 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. Despite the fact that agrarian relationships were often conflictual, the feudal organization also accomplished the goal of providing peasants a safe and stable environment" (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

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[1] More details are presented in section 4.

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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.[2] 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 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). 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 (2003). Both views find support in historical evidence, as they should do, since they highlight two different

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[2] For a short survey of related literature, see Bertocchi (2006b) and studies cited there.

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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.[3] 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 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

Technology. There are overlapping generations in the economy. In every period the economy produces a single homogeneous good that can be used for consumption and investment. The good is produced using land, physical capital and human capital, which have different technical features: Land is exogenously given by nature and difficult to be destroyed. Physical capital can not be produced without material investment and endogenous effort, and it is easier to lose value if confiscated. Nature endows each individual with a basic unit of human capital in the form of physical strength and some basic intellectual skills even without any education expenditure, while further investment requires endogenous effort and cannot be easily forced. The complementarity among these three capital forms and their distinct technical features determine that the initial dominant capital form is land, followed by physical capital whose investment starts when there is enough surplus, and finally by human capital, which is invested only when physical capital stock is large enough. The exact timing, however, is also affected by institutional elements such as the political structure discussed

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[3]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.

later.

The production function at time t is

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

where A_{t+1} 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. 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.

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

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

where $K_1 > 0$, $K_2 \geq 0$, $K_3 < 0$, $K_{33} \leq 0$, $K_{13} \leq 0$, 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 $e_{t+1} \geq 0$ besides material resources m_t^h. The human capital production function is

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

where $h(0, A_{t+1}, e_{t+1}) = 1$, $h_1 \geq 0$, $h_2 \geq 0$, $h_3 \geq 0$, $h_{11} \leq 0$, $h_{23} \geq 0$, and $h_1(0, A_{t+1}, e_{t+1}) = \gamma < \infty$. The first condition means that even without any education expenditure, a worker is endowed with the basic human capital normalized to one unit. 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. Both physical and human capital depreciate completely after one period.

Individual Preferences. Individuals live 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

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

as in Galor and Moav (2006), 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 $Z > 0$. 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

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

The total bequest in society is denoted by B_t. 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 bequest B_t can be invested in either physical capital or human capital for the next generation, where $m_t^k + m_t^h \leq B_t$ holds.

Capital Ownership and Demographic Structure. Individuals differ in asset holding. Workers own no land nor physical capital, who supply only human capital. Landowners and capitalists participate in production using their assets rather than direct producing skills, where 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. There are N_L landowners and N_C capitalists, which are few in the population and fixed over generations. The majority are workers, the number of which is N_t in generation t. Consistent with the demographic trends in history, the supply of raw labors is endogenously determined such that the real wage is maintained at the subsistence level w_0, while the worker population is assumed fixed once costly education starts at t_h (Galor and Weil 2000).[4] The precise level of N_t, similar as in Hansen and Prescott (2002), is described later.

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 shaped by the relative political and bargaining powers of the agents.

In specific, 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

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[4]Alternative assumptions of population growth would not affect the qualitative results.

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 $\varpi > 0$. 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 behavior and imperfect information problems, where $\psi(1) = 1$ is a special case for a single member group. A group with a higher coercive power can always defeat others, where the cost is equal to the violence level of the defeated group; when two groups have the same coercive power, each wins with a probability one half. The initial political regime is established based 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. If the incumbent ruler does nothing, the challenging group would become the new ruler based on 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. This leads to our second assumption, namely, *the incumbent's advantage,* since the ability to repress (or, 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 exogenously 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 $[\underline{\theta}, \overline{\theta}]$.

An alternative to repression is political compromise, where political power is shared between the incumbent and the challenging group, given that the challenging group can make credible commitment to share political power even after they gain dominant economic power in the future. If mutual compromise is reached, a smooth economic progress and political transition is not blocked; if not, repression, economic stagnation, and invasion may happen, which are not uncommon in the history and even in current times.

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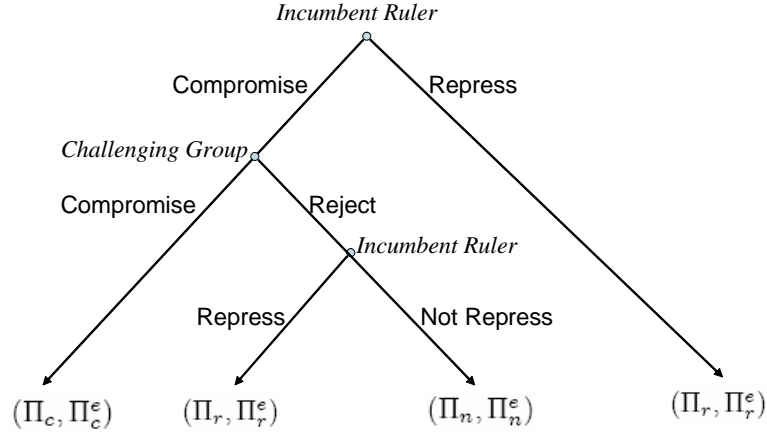
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Figure 2: The Political Game between Incumbent Ruler and Challenging Group

the horizon for political decisions.[5] 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.[6] In crucial periods 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 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 payoffs and subgame perfect Nash equilibrium are discussed in the next section.

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 the time when the total amount of land is fixed, agriculture is the dominant production method, and people were not ed-

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[5] 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."

[6] Allowing preemptive repression may alter the timing but not the qualitative results of the transition process.

ucated. The initial physical capital stock K_0 is zero and the initial human capital per worker is $h_0 = 1$. In any period $t \in [0, t_k]$, the productivity is so low that $B_t = 0$ and no saving is available for capital accumulation; the capitalists were thus not distinguishable from the worker group.

In any period $t \in [0, t_k]$, there are

$$N_t = (\frac{\alpha}{w_0} A_t)^{\frac{1}{1-\alpha}} \sigma L \tag{3}$$

workers, each paid a fixed reservation wage w_0 which clears the labor market. A landlord i owns land L_i and employs N_{ti} workers, where $\sum_{i=1}^{N_L} L_i = L$. The revenue of a landlord i is $\pi_{ti} \equiv \max_{N_{ti}} A_t (\sigma L_i)^{1-\alpha} N_{ti}^{\alpha} - w_0 N_{ti}$. The optimal labor demand is $N_{ti}^* = (\frac{\alpha}{w_0} A_t)^{\frac{1}{1-\alpha}} \sigma L_i$, which increases in the knowledge stock A_t and land size L_i. The aggregate labor demand from all landlords $\sum_{i=1}^{N_L} N_{ti}^* = N_t^D$ is indeed equal to the labor supply N_t in (3). So the optimal revenue of a landlord i with land L_i is

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

where $\lambda \equiv (1-\alpha)(\frac{\alpha}{w_0})^{\frac{\alpha}{1-\alpha}}$. The profit is linear in land size L_i and increases in the knowledge stock A_t over time. When $\pi_{ti} < Z$ the landowner i does not have positive bequests. Since the growth rate of A_t is g, the population of workers grows at a rate $g^{\frac{1}{1-\alpha}}$ in each generation, so does the total profit. That is, the per capita output remains roughly constant.

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 π_{tj}, while incurring a cost of $\varpi \pi_{tj}$; so the net gain is $(1 - \varpi)\pi_{tj}$, which is positive when $\varpi < 1$. The following proposition shows that monarchy emerges as the political regime in equilibrium where the king owns the largest piece of land.[7]

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 $L_M > \psi(N_L - 1)\sum_{i \neq M} L_i$,*

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[7] The violent potential of a worker is similarly determined; but it 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.

and imposes a tax rate of at least $\tau_{lt} = 1 - \varpi$ on the other landlords' profits; the distribution of land ownership is stable. (ii) The first period the society starts to have surplus is

$$t_k = \frac{(1-\alpha)}{\ln(1+g)}[\ln Z(\lambda A_0 \sigma)^{-1} - \ln(\varpi L_M + (1-\varpi)L)]. \tag{5}$$

t_k arrives faster when the king's land size L_M and the tax rate $1 - \varpi$ are higher.

Proof. The monarchy is indeed an equilibrium since they are no profitable deviations. No coalition is able to challenge the king given the land distribution $L_M > \psi(N_L - 1)\sum_{i \neq M} L_i$ since the coercive power is proportional to one's profit and hence to the land size. The king would not grab other landlords' lands since the tax rate $\tau_{l,t+1} = 1 - \varpi$ yields the same amount of revenue as doing so. The landlords would accept the tax because by fighting they would get nothing both as an individual and 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 after-tax profit not higher than $\varpi \pi_j$, which equals the fighting cost he has to incur.

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

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

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 right of land is 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 on 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. In this sense, the monarchy is an efficient political regime when land is the only productive 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) It also facilitates economic development, since the high inequality of land ownership often shortens the time for a 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."

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

After t_k is reached, the king has a positive bequest $b_t = \pi_{tM}^T - Z$ at time t, though other landlords are not yet ready to save. With surplus available in society, capitalists can implement their ideas of combining material resources and knowledge to produce physical capital, and start to focus on capital investment instead of working as raw labors. Given the technical features of physical and human capital production functions, the king would find it optimal to invest only in physical capital at this time period.[8]

Since producing physical capital requires special knowledge and skills of capitalists, the king cannot get much value by confiscating the machines or factories if the capitalists do not operate them. To capture this insight, 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.

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 τ_{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 population of workers during $(t_k, T_k]$ is

$$N_t^k = (\frac{\alpha}{w_0} A_t)^{\frac{1}{(1-\alpha)}} (\sigma L + K_t),$$

where the subsistent level wage w_0 still clears the labor market.

The choice sequence in each period t is as follows. The king first announces τ_{kt}; then capitalists produce physical capital $K_t = K(m_{t-1}^k, A_t, \tau_{kt})$, taking as given r_t, τ_{kt} and $m_{t-1}^k = B_{t-1} = \beta(\pi_{t-1,M}^T - Z)$;[9] and finally, given the market rate r_t and wage w_0, the king decides his demand for capital and labor. The optimal choices are summarized in the following lemma.

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[8] See proposition 3 for the formal proof of this result.

[9] For simplicity we model the aggregate supply of physical capital in a reduced form rather than deriving it from individual behaviors.

Lemma 1 *In period $t \in (t_k, T_k)$ under monarchy, the optimal tax rate $\tau_{k,t}^*$ on capital returns maximizes the total income of the king*

$$\tau_{k,t}^* = \arg\max_{\tau_{k,t}} \lambda A_t^{\frac{1}{1-\alpha}} (\sigma \overline{L} + \tau_{kt} K_t), \tag{6}$$

where $\overline{L} \equiv L_M + (1 - \varpi)(L - L_M)$. The physical capital stock $K_t = K(B_{t-1}, A_t, \tau_{kt}^*)$ increases over time.

Proof. In the appendix. ∎

The economy in period (t_k, T_k) has an ever increasing physical capital stock $K(B_{t-1}, A_t, \tau_{kt}^*)$, which also induces faster growth in the population of workers than before. The market rate of capital return $r_t = \lambda A_t^{\frac{1}{1-\alpha}}$ clears the physical capital market. The king benefits from the process of capital accumulation through increased tax revenues. The economic development, however, would gradually build up the 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 $\lambda A_t^{\frac{1}{1-\alpha}} \sigma L_M$, so does their coercive power. Suppose period T_k is the first time when the elites have the same coercive power as the king. Then T_k is uniquely determined by

$$K_{T_k} = (\frac{1}{\psi(N_E)} + 1)\sigma L_M - \sigma L, \tag{7}$$

where $N_E \equiv N_C + N_L - 1$ denotes the group size of the elites.

3.2.2 The Political Game Between the King and Elites at T_k

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 $\overline{K} < K_{T_k}$ by directly confiscating their assets or spending his savings in non-productive ways (say in religion, arts, or jewelry) than lending them to capitalists. Based on (6), the king's income with Repress is

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

where τ_{k,T_k}^* is the optimal tax rate with $K_t = \overline{K}$, and θ_{T_k} is the repression cost at period T_k.

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

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1). There would be zero tax rate on the assets of the ruling elites. The income of the king choosing Not Repress at period T_k is

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

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 is

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

Note $\Pi_c > \Pi_n$ always holds due to $\varpi < 1$, and both are independent of θ_{T_k}. In contrast, Π_r strictly decreases in θ_{T_k}. The comparison between Π_n, Π_c and Π_r is illustrated in figure 3.
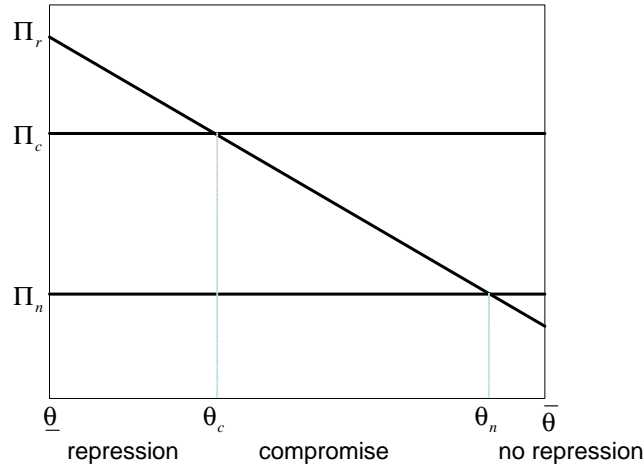

Figure 3: The Incumbent Ruler's Incomes and Repression Cost θ

Lemma 2 *There exist two unique levels of repression costs θ_c and θ_n, where $\theta_c < \theta_n$, such that $\Pi_r > \Pi_c > \Pi_n$ for $\theta \in [0, \theta_c)$, $\Pi_c > \Pi_r \geq \Pi_n$ for $\theta \in (\theta_c, \theta_n]$, and $\Pi_c > \Pi_n > \Pi_r$ for $\theta \in (\theta_n, 1]$.*

Proof. In the appendix. ∎

The expected income levels of elites under repression, compromise, and no repression are denoted by Π_r^e, Π_c^e, and Π_n^e respectively. It is straightforward to see $\Pi_r^e < \Pi_c^e < \Pi_n^e$ always holds: Compromise is better than repression for the elites since under compromise the economic progress is not blocked and they pay no tax; the case of no repression is even better since they get extra tax revenues from the King's land. The equilibrium of this political game is described in the following proposition.

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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 $\theta_{T_k} \in (\theta_n, \overline{\theta}]$.*

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 since $\Pi_r^e < \Pi_c^e$; 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) Typically repression would continue for a long time until outside threats dra-

matically increase the repression costs and turn it into the a no-repression case, where the incumbent is forced to yield political power to the challenging group. One example is foreign intervention as currently happening to Iraq. 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 of economic and political development, we focus on the 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 and Full Suffrage: $[T_k, T_h]$

3.3.1 Investment in Physical and Human Capital: $[T_k, t_h]$

Under the elite ruling, the allocation of investment between physical and human capital is chosen to maximize the combined total profit of landlords and capitalists. Now we prove the priority of physical capital investment.

Proposition 3 *Only when the surplus B_t becomes large enough would investment in human capital starts; before then only physical capital is accumulated. The first period after which human capital investment starts under the elite ruling is t_h, which is uniquely determined by*

$$\alpha\gamma(\sigma L + K(B_{t_h-1}, A_{t_h}, 0)) - (1-\alpha)K_1(B_{t_h-1}, A_{t_h}, 0) = 0. \tag{8}$$

Proof. Recall m_t^h denotes the inputs invested in human capital. Since the tax rate on physical capital is zero, the next period physical capital is $K_{t+1} = K(B_t - m_t^h, A_{t+1}, 0)$; the workers are still paid w_0 and the next period human capital is $h_{t+1} = h(m_t^h, A_{t+1}, e_{t+1})$.[10] The elites' objective function is to maximize their joint returns by choosing m_t^h first and then N_{t+1}.

The problem is solved backwards. Taking m_t^h as given, the optimization problem is

$$\max_{N_{t+1}} A_{t+1}(\sigma L + K_{t+1})^{1-\alpha} N_{t+1}^\alpha h_{t+1}^\alpha - w_0 N_{t+1}. \tag{9a}$$

The optimal labor demand $N_{t+1}^* = [\frac{\alpha A_{t+1}}{w_0}]^{\frac{1}{1-\alpha}}(\sigma L + K_{t+1})h_{t+1}^{\frac{\alpha}{1-\alpha}}$ is then plugged into problem (9a) to get

$$\max_{m_t^h} \lambda A_{t+1}^{\frac{1}{1-\alpha}}(\sigma L + K_{t+1})h_{t+1}^{\frac{\alpha}{1-\alpha}}.$$

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[10] This result still holds when the effort level is endogenized below (see lemma 3).

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The FOC w.r.t. m_t^h is

$$\alpha(\sigma L + K_{t+1})h_1 - (1-\alpha)h_{t+1}K_1 \;=\; 0 \text{ if } m_t^h > 0, \tag{10}$$

$$\alpha(\sigma L + K_{t+1})\gamma - (1-\alpha)K_1 \;\leq\; 0 \text{ if } m_t^h = 0, \tag{11}$$

where $h_1(0, A_{t+1}, e_{t+1}) = \gamma$ and $h(0, A_{t+1}, e_{t+1}) = 1$ are substituted in (11). The LHS in (11) strictly increases in the total surplus B_t given $K_1 > 0$ and $-K_{11} \geq 0$. It would eventually arise to zero at certain period t_h, after which human capital investment starts. t_h is thus defined by (8), which is (11) 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 (7), is still small.[11] ∎

This lemma justifies our earlier assumption that only physical capital is invested under monarchy when the total surplus is small (or when the return rate of investing in physical capital is high). During the initial period $[T_k, t_h]$ under elite ruling, workers are still raw labors with the basic unit of human capital, and their population N_t^k also grows at the same rate as before so that the subsistent level of wage w_0 is maintained. After t_h, however, things start to change.

3.3.2 Public Education and Human Capital Investment: $[t_h, T_h]$

Since human capital investment involves costly inputs and effort of workers, the supply of educated workers becomes limited from period t_h. For simplicity, it is assumed fixed at $N_h \equiv [\frac{\alpha A_{t_h}}{w_0}]^{\frac{1}{1-\alpha}}(\sigma L + K_{t_h})$.[12] A related issue is that the wage rate of workers may also have to be adjusted in order to induce effort from them. The wage is still set by the ruling class as before, though w_0 coincides with the market clearing wage given the (endogenously adjusted) worker population.

Suppose the wage at period $t+1$ is set at

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

where $w_{t+1}^* = \alpha A_{t+1}(\sigma L + K_{t+1})^{1-\alpha}(N_h h_{t+1})^{\alpha-1}$ is the competitive wage level, and $\tau_{e,t+1} \in [0, 1)$ is an implicit tax rate on a worker's competitive wage. So $1 - \tau_{e,t+1}$ indicates the *fairness of wage* and thus would affect worker effort e_t in accumulating human capital. Suppose

$$e_{t+1} = \begin{cases} 1 - \tau_{e,t+1} - \varepsilon & \text{if } w_{t+1} > w_0 \\ 0 & \text{if } w_{t+1} = w_0 \end{cases},$$

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[11] The king's problem of allocating resources between physical and human capital is similar and hence omitted.

[12] The main results hold as long as the supply of educated workers is limited. A similar assumption is made for the Solow growth period in Hansen and Prescott (2002), while an endogenous account for such demographic changes is in Galor and Weil (2000).

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where ε is some baseline fairness to induce worker effort. $\tau_{e,t+1}$ also determines the relative economic power of workers versus elites since the aggregate income of workers is $(1 - \tau_{e,t+1})w^*_{t+1}N_h h_{t+1} = \alpha(1 - \tau_{e,t+1})Y_{t+1}$, while the income of elites is $(1 - \alpha + \alpha\tau_{e,t+1})Y_{t+1}$.

The elites are faced with a trade-off in setting wages: if it is too low, workers are not willing to make effort in accumulating desirable skills and hence their productivity would be low; if the wage is higher, the total outputs are also higher, but the income share of the elites is lower. The political concern of high wage is that the workers' coercive power to challenge the ruling of elites would also be high. Note that when $\psi(N_h)\alpha(1 - \tau_{e,t+1})Y_{t+1} \geq \psi(N_L + N_C)(1 - \alpha + \alpha\tau_{e,t+1})Y_{t+1}$ holds, the coercive power of workers is higher than the elites and a new political equilibrium may emerge due to might-is-right. To prevent this from happening, the tax rate must be high enough where

$$\tau_{e,t+1} \geq 1 - \frac{\psi(N_L + N_C)}{\psi(N_L + N_C) + \psi(N_h)}\frac{1}{\alpha}. \tag{12}$$

This implies workers would not get the full competitive wages under elites ruling since $\tau_{e,t+1} > 0$ is always true under condition $\psi(N_h)\alpha > (1 - \alpha)\psi(N_L + N_C)$, which is assumed true. The following lemma summarizes the optimal choices of the elites.

Lemma 3 *In each period $t \in [t_h, T_h]$, the optimal public education expenditure m^{h*}_t and $\tau^*_{e,t+1}$ are uniquely determined, where $\frac{\partial m^{h*}_t}{\partial B_t} > 0$, $\frac{\partial \tau^*_{e,t+1}}{\partial A_t} \leq 0$, $\frac{\partial e^*_{t+1}}{\partial A_t} \geq 0$. The optimal wage remains at w_0 and $e^*_t = 0$ until A_t is large enough in period t'_h, which is defined by $h_3(m^h_{t'_h}, A_{t'_h}, 0) = (1 - \alpha\varepsilon)^{-1}$.*

Proof. In the appendix. ∎

This lemma suggests when the stock of knowledge is not high enough in $t \in [t_h, t'_h]$, the human capital is not very responsive to workers' effort so that the desired worker effort is zero and hence workers are still paid the subsistence wage w_0 as before, even after human capital investment starts with $m^{h*}_t > 0$. A direct implication is that when human capital is not important in production or when work effort is not essential for human capital investment, the elites will set the optimal wage at w_0 for workers. Only when the total surplus builds up and there is enough physical capital, would the elites find beneficial to increase workers' wages in order to induce their endogenous effort. Some relevant historical evidence is in section 4.

As the human capital stock goes up and wages continue to increase, the collective coercive power of the workers also grows. When it matches that of the elites in period T_h, the equality in (12) must

hold at the optimal tax rate τ^*_{e,T_h}. The condition can be rewritten as

$$e^*_{T_h} = \frac{\psi(N_L + N_C)}{\psi(N_L + N_C) + \psi(N_h)} \frac{1}{\alpha} - \varepsilon,$$

which uniquely determines T_h since $\frac{\partial e^*_t}{\partial A_t} > 0$ for $e^*_t > 0$ while the RHS is a constant.

3.3.3 The Political Game between Elites and Workers at Period T_h

The political game between the elites and workers at period T_h is the same as that between the king and the elites. With similar arguments as in section 3.2.2, we get the following results.

Proposition 4 *There exist two unique levels θ'_c and θ'_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 $\theta_{T_h} \in (\theta'_n, \overline{\theta}]$.*

Proof. In the appendix. ∎

The full suffrage enables workers to earn competitive wages and increases workers' effort in human capital accumulation. As a result, the production is more efficient than before. If the repression costs remain similar at the two transition times T_k and T_h, it is plausible that countries which reached compromise at T_k are also likely to do so at T_h. 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; 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 real wage of workers was maintained at the subsistent level w_0, even after human

capital investment started at t_h; only after t_h' did it slowly increase towards the competitive wage level. 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 capital output was constant before human capital investment started at t_h, after which the per capital 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.

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. Roughly speaking, most OECD countries have experienced all the developmental stages and are now beyond T_h, while many developing countries are still working towards it; some underdeveloped countries may still live in the stage before T_k, or at least before t_h. 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 a political game 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 cultural, religious, ideological, and racial concerns and international environment), though not explicitly modeled, may implicitly affect the production functions and the 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.[13] 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

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[13]Since it is far beyond the scope of the paper to discuss in details the exact paths taken by history, the interested reader is referred to the related studies cited in this paper.

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] 1937): "When land was considered as the means, not of subsistence merely, but of power and protection, it was thought better that it should descend undivided to one... 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 (North 1981, p. 159). During this transition process, there is a widely-shared perception that the aristocracy as a group did not contribute to industrialization, and remained attached to the landed estates as its only source of wealth: "in 1500 land was still the only form of investment, and in fact it was forbidden for a nobleman to become engaged in commerce or industry," though progressively this was relaxed (Bertocchi 2006a).

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).[14] 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 ... Throughout the industrial revolution, when the law remained firmly on the side of employers, Parliament also rejected most petitions it received to protect the traditional rights of skilled workers." (O'Brien 1994) Indeed, "workers' living standards showed no clear progress before 1820." (Lindert 1994) This is consistent with our model, since the value of human capital in the production process is still limited in the first phase of the Industrial Revolution: workers developed skills primarily through on-the-job training, and child labor was highly valuable. Its importance increased in the second phase, which prompted a sequence of education reforms in England since the 1830s, designed primarily to satisfy the increasing skill requirements (Galor and Moav 2006). Accordingly, workers' effort also became a crucial element affecting firms' productivity.

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 fairness of wage and worker effort, Lazonick (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

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[14]In France, a delayed but more abrupt defeat of feudal power happened, "guided by the capitalistic bourgeoisie that at the end of the 18th century ended the ancient regime."

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 shifts 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 brings benefits to elites and hence makes 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.

Accompanied with the franchise expansion was the increased provision of public goods. It was made possible in Britain by the progressive reform of local government initiated by the Municipal Corporations Act of 1835 (Lizzeri and Persico 2003). The expenditure on public education also went up. By the Education Act of 1870 the British government provided universal education for the first time and made it free in 1891, after major suffrage extension in 1867 and 1884; the reform act of 1902 led to a further expansion in the resources for schools (Acemoglu and Robinson 2000).

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 to facilitate economic development is to increase the repression costs the monarchy or the elites are faced and 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 facilitate further economic development.

On the other hand, many elements in a 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 the 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

$$\pi_{tM}(\tau_{kt}) = \max_{N_{tM}, K_t} A_t(\sigma L_M + K_t)^{1-\alpha} N_{tM}^\alpha - w_0 N_{tM} - r_t K_t.$$

The optimal solutions for labor and capital are respectively

$$N_{tM}^* = (\frac{\alpha}{w_0} A_t)^{\frac{1}{(1-\alpha)}} (\sigma L_M + K_t^*),$$

$$r_t = (1-\alpha) A_t (\sigma L_M + K_t)^{-\alpha} N_{tM}^\alpha = \lambda A_t^{\frac{1}{1-\alpha}}, \tag{13}$$

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. So the king is indifferent about the exact physical capital they demand. Without loss of generality, we assume the demand for physical capital is equal to its supply; when the other landlords start to have positive bequests, their demand for physical capital is proportional to their land sizes so that $K_{ti}^* = \frac{L_i}{L} K_t^*$ for $i = 1, 2, ..., N_L$. Given this, their demand for labor is $N_{ti}^{k*} = (\frac{\alpha}{w_0} A_t)^{\frac{1}{(1-\alpha)}} (\sigma L_i + \frac{L_i}{L} K_t^*)$ and hence the population of workers $N_t^k = \sum_{i=1}^{N_L} N_{ti}^{k*}$ clears the labor market at the subsistence wage level w_0.

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.

The total income of the king $\pi_{t,M}^T = \lambda A_t^{\frac{1}{1-\alpha}} (\sigma \overline{L} + \tau_{kt}^* K_t)$ would remain the same after the other landlords and the capitalists start to have positive bequests some periods later. The FOC yields the unique optimal tax rate $\tau_{k,t}^*$ since the SOC $2K_\tau + \tau K_{\tau\tau} < 0$ 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. Condition $\Pi_c \geq \Pi_r$ can be simplified to

$$\theta_{T_k} \geq \lambda A_{T_k}^{\frac{1}{(1-\alpha)}}(\sigma\overline{L} + \tau_{k,T_k}^*\overline{K} - \sigma L_M) \equiv \theta_c.$$

So $\Pi_c \geq \Pi_r$ holds for $\theta_{T_k} \geq \theta_c$. Similarly, the condition $\Pi_r \geq \Pi_n$ holds if

$$\theta_{T_k} \leq \lambda A_{T_k}^{\frac{1}{(1-\alpha)}}(\sigma\overline{L} + \tau_{k,T_k}^*\overline{K} - \sigma\varpi L_M) \equiv \theta_n.$$

So $\Pi_r \geq \Pi_n$ for any $\theta_{T_k} \leq \theta_n$. It is straightforward to see that $\theta_c < \theta_n$. ∎

Lemma 3.

Proof. The public education decision of the elites is made to maximize their total income:

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

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

$$\alpha(\sigma L + K_{t+1})\frac{\partial h_{t+1}}{\partial m_t^h} - (1-\alpha)h_{t+1}\frac{\partial K_{t+1}}{\partial m_t^h} = 0,$$

which is exactly the same as condition (10), where $\frac{\partial m_t^{h*}}{\partial B_t} = \frac{\alpha K_1 h_1 - (1-\alpha)h_{t+1}K_{11}}{-SOC} > 0$.

The FOC w.r.t. e_{t+1} is

$$(1 - \alpha\varepsilon - \alpha e_t)\frac{\partial h_{t+1}}{\partial e_{t+1}} - h_{t+1} \quad = \quad 0 \text{ if } e_{t+1} > 0, \tag{14}$$

$$(1 - \alpha\varepsilon)\frac{\partial h(m_t^h, A_t, 0)}{\partial e_{t+1}} - 1 \quad < \quad 0 \text{ if } e_{t+1} = 0. \tag{15}$$

Note the LHS of (15) increases in A_t given $h_{23} > 0$. The equality holds in period t_h' when $e_{t+1}^* = 0$. In periods when $e_{t+1}^* > 0$, it strictly increases in A_{t+1} since $\frac{\partial e_{t+1}^*}{\partial A_{t+1}} = \frac{(1-\alpha\varepsilon-\alpha e_t)h_{23}}{-SOC} > 0$ holds based on (14); and the optimal implicit wage tax is $\tau_{e,t+1}^* = 1 - e_{T_h}^* - \varepsilon$, which decreases in A_{t+1}. ∎

Proposition 4.

Proof. At the beginning of period T_h, if the elites freeze the economic power of workers at the level of $T_h - 1$, they get an income

$$\Pi_r' \equiv (1 - \alpha\varepsilon - \alpha e_{T_h-1})Y_{T_h-1} - \theta_{T_h},$$

where $Y_{T_h-1} = Y(e_{T_h-1}, m_{T_h-2}^h, A_{T_h-1})$ denotes the repressed aggregate output at time T_h, and θ_{T_h} the repression cost. If a compromise is reached where workers are allowed to share political power, each group gets their competitive returns with $\tau_{e,t+1}^* = 0$ afterwards. The elites then get

$$\Pi_c' \equiv (1 - \alpha)Y(e_d, m_{T_h-1}^h, A_{T_h}),$$

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where $e_d = 1 - \varepsilon$. In this case the total output is maximized at the social optimal level.[15]

If the elites do not repress, the 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 $(\alpha + \tau_{T_h}(1 - \alpha))Y(e_d, m^h_{T_h-1}, A_{T_h})$, 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

$$\Pi'_n \equiv (1 - \tau^*_{T_h})(1 - \alpha)Y(e_d, m^h_{T_h-1}(\tau^*_{T_h}), A_{T_h}),$$

which is smaller than Π'_c.

The challenging group, the 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 results follow directly from the following lemma and the proof of proposition 2.

Lemma 4 *There exist two unique levels θ'_c and θ'_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 $\theta_{T_h} \in (\theta'_n, \overline{\theta}]$.*

    Proof. Compromise is better than repression for elites if $\Pi'_c > \Pi'_r$, which boils down to

$$\theta_{T_h} \geq (1 - \alpha(\varepsilon + e_{T_h-1}))Y_{T_h-1} - (1 - \alpha)Y(e_d, m^h_{T_h}, A_{T_h}) \equiv \theta'_c.$$

Repress is better than Not Repress for elites if $\Pi'_r \geq \Pi'_n$, that is

$$\theta_{T_h} \leq (1 - \alpha(\varepsilon + e_{T_h-1}))Y_{T_h-1} - (1 - \tau^*_{T_h})(1 - \alpha)Y(e_d, m^h_{T_h}(\tau^*_{T_h}), A_{T_h}) \equiv \theta'_n.$$

$\theta'_n > \theta'_c$ is due to $\Pi'_n < \Pi'_c$. ∎

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[15] 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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