Autocracy, Devolution and Growth

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Abstract

Some autocracies have sustained high economic growth for many decades; others have stagnated at low levels of production. Paradoxically, the stagnating autocracies appear to possess more natural resources and be more resistant to political change than the growing autocracies. The paper proposes a new explanation for these observations. Consider an economy where an infinitely lived autocrat determines taxes and the political regime. As capital accumulates and growth rates decline, the autocrat faces an increasing temptation to expropriate the capitalists. Since expropriation eliminates growth, the autocrat may voluntarily refrain from expropriating if future growth is sufficiently large; otherwise, the temptation to expropriate can only be resisted through a credible commitment, that is, by devolving some political power. For autocrats with large benefits of control, for example valuable natural resource rents, devolution of power may always be unattractive. As a result, capitalists realize that they will eventually be expropriated, and capital accumulation therefore never starts. On the other hand, autocrats with small resource rents will eventually devolve power, since this commitment is necessary to sustain growth. Therefore, capitalists are willing to start accumulating despite the autocratic regime. In other words, autocracies are vulnerable to the resource curse.

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1 Introduction

Nowadays, most economists agree that economic and political changes are intertwined.[1] For example, it is commonly argued that both protection of property rights from governmental abuse creates economic growth, and that economic growth gives rise to political freedom, constraining the discretion of the executive.[2] Still, the relationship between limited government and economic outcomes is not very well understood. Notably, autocracies are found to be both the best and worst performers in terms of growth rates.[3] Moreover, the most economically successful autocracies tend to eventually be replaced by more democratic institutions, whereas poorly performing autocracies often prevail for a very long time.

In this paper, I argue that the scope for capital accumulation and growth in an autocracy is largely determined by the autocrat's incentive to cling to power. A main result of the model is that there can be private capital accumulation only if the autocrat's benefits from political control are not too large. The reason is that eventually, as capital accumulates and growth rates decline, an unfettered autocrat's temptation to expropriate capital becomes irresistible. Therefore, capital accumulation proceeds beyond this point only after the autocrat has relinquished some power. While autocrats with small benefits of political control are willing to relinquish power once it becomes necessary in order to sustain future capital accumulation, autocrats with large benefits of control are not. In the latter case, capitalists, looking ahead, realize that they will eventually be expropriated and never start accumulating.

Natural resource availability might be the most obvious determinant of an autocrat's incentive to cling to power. If a country is sufficiently rich in natural resources, an autocratic ruler will always resist political change, because of the lost stream of revenues. In a resource poor country, on the other hand, the autocrat may prefer sustaining capital accumulation to preserving resource rents. The model can therefore account both for the observed negative relationship between natural resource rents and economic growth and the great heterogeneity in economic outcomes under autocracy. It also suggests why resistance to political change may be greater in autocracies that never experienced capital accumulation than in the economically more successful autocracies.

The relationship between economic growth and the autocratic rule with its preda-

[1] E.g. "At some level, these rich dynamics of economic and political change have to be connected", (Persson and Tabellini (2006b)), or "...wealth, its distribution, and the institutions that allocate factors and distribute incomes are mutually interdependent and evolve together." (Przeworski (2004)).

[2] "The expansion of economic freedom will bring in train greater political freedoms."(Friedman (2002)).

[3] E.g. Almeida and Ferreira (2002).

tory potential has been (and still is) a topic of an extensive debate. While it is well recognized that expropriation or other property rights violations by political rulers are detrimental for investment and growth, there is no consensus on whether the respective protection of investors has to be institutionalized. According to one view, the abuse of political power can only be effectively prevented through explicit legal limitations on rulers' authority. Institutional checks and balances work as a commitment device against expropriation, which encourages investment and gets growth started. In the modern literature, this view is associated with works by North and Thomas (1970), North (1971), North and Weingast (1989) and has inspired a considerable amount of supportive empirical work.[4]

An alternative view is that sustained growth can be in the interest of an unconstrained dictator, who therefore rationally refrains from expropriation. As emphasized by Olson (1993), this argument does not require any benevolence on the part of the autocratic ruler; a "stationary bandit" will promote growth for selfish reasons. This view is also buttressed by the evidence – indeed, the most impressive growth episodes were almost always observed in autocratic regimes.[5] Furthermore, Glaeser et. al. (2004) stress that "initial levels of constraints on the executive do not predict subsequent economic growth" and "growth (...) may be feasible without immediate institutional improvement".

Nonetheless, the "stationary bandit" approach does not explain why most of the well-performing autocracies eventually limit the dictator's power, e.g. through partial or full democratization. The classical argument for devolution of power – the famous Lipset (1960) hypothesis – suggests that prosperity improves political institutions through better education and the increased importance of the middle class.

In this paper, we complement Lipset's demand-driven view of democratization and instead look at the supply side of political change. More precisely, we show that a self-interested dictator may choose to relinquish power in a phase of declining growth. We thus suggest a compromise between the view of North and Weingast (1989) and the "stationary bandits" argument of Olson (1993). Olson's argument implies that the interests of the dictator and the investors are aligned and no commitment device is needed at all. On the contrary, North and Weingast argue that the incentives of the ruler are always opposed to those of private investors, so in order to initiate investment and growth, the autocrat has to commit beforehand. In our model, the conflict of interests between the autocrat and the investors intensifies over time, thereby causing

[4] E.g. Knack and Keefer (1995), Goldsmith (1995), Hall and Jones (1999), Henisz (2000), Keefer (2004).

[5] E.g. Almeida and Ferreira (2002).

a potential delay in the devolution of power.

Specifically, we assume that a country is facing an exogenous opportunity for multi-period investment that is only exploitable by the private sector. This investment is characterized by decreasing returns to scale. An autocratic ruler can tax the private sector or expropriate it, but is unable to invest and thus support growth after expropriation. The ruler can also choose to relinquish some of her power, which reduces her payoff and deprives her of the right to expropriate. While being in power, the ruler enjoys private benefits of control, (part of) which are no longer available to the ruler after devolution. That is, the ruler cannot "fine tune" the devolution decision so as to keep every possible fraction of current economic privileges. The private sector has an option to avoid taxation and expropriation by diverting resources to a less efficient alternative use. Due to decreasing returns to scale, the growth rate in this economy declines over time. As a result, the degree of alignment of government's and private agents' interests also decreases: At the early stages of growth, when the growth rate is high, an autocrat has no incentive to seize assets, because delayed expropriation significantly increases the value at stake. As growth slows down, immediate expropriation ("getting the entire pie") becomes increasingly attractive, as compared to the option of postponing it to increase the size of the pie. The private sector recognizes these incentives of the ruler, and diverts resources once the ruler is tempted to expropriate. If the ruler's private benefit of control is relatively low, she commits to non-expropriation through devolution of power and thereby keeps the private sector investing. If the private benefits of control are high, the ruler does not want to ever lose them through devolution. Realizing that capital will eventually be expropriated, the private sector thus never starts to invest. Therefore, the model generates a variety of development trajectories: The country can face an early limitation of the ruler's power and grow in a non-autocratic regime. Alternatively, the country can grow under maintained autocracy and experience delayed devolution of power. Finally, the country can stagnate under an autocratic rule with neither devolution nor growth ever taking place.

The key feature of our model is that devolution of power is a commitment device against expropriation. A related strand of literature takes devolution of power as a commitment to redistribution. In Acemoglu and Robinson (2000, 2001), the rich elite relinquishes the power (by extending franchise) in case it cannot prevent social unrest through a temporary increase in taxes. Franchise extension transfers the taxation decision to the (poor) median voter, thereby working as a commitment device for more redistribution. Gradstein (2004) treats franchise extension as a commitment to private property rights. In his model, agents allocate their time between production and rent-seeking, with wealthier agents having a comparative advantage in the latter. With an income-based franchise, voting participation increases as the economy grows. The median voter becomes relatively more interested in curbing rent-seeking and protecting private property rights. Commitment to protect property rights in the future can thus be achieved by reduction in the franchise threshold. While these approaches provide an alternative explanation for devolution of power, they ignore the predatory nature of autocratic rulers, which is key to our argument.

Bates et. al. (2005) do consider predatory rulers. In their model, a government can be benevolent or opportunistic, but its type is unobservable to the citizens ex ante. The opportunistic government may decide to show restrains to pretend that it is benevolent in order to stimulate private investment and increase the appropriable assets in the future. In this model, the economy reaches full development under autocracy in case of a benevolent government and collapses in case of a predatory government. Robinson (2001) associates predatory behavior with inefficiently low public investment and suggests that the development-enhancing policies may facilitate the political power contest. Therefore, the party in power may refrain from promoting development. However, these models do not address the issue of the devolution of power, which is a fundamental aspect of our framework.

The model predicts that the economies stagnating under an autocratic rule are characterized by high private benefits of control, e.g. are abundant with appropriable natural resources. This finding parallels the "resource curse" literature, arguing that the natural resource wealth can be detrimental to countries' economic development. The early work on the "resource curse" attributes the underperformance of resource-rich countries to economic factors such as "Dutch disease" or deteriorating terms of trade for the primary commodities. Empirically, this effect is documented e.g. by Sachs and Warner (1995) and Gylfason (2000). More recent literature emphasizes the political and institutional determinants of the resource curse (see e.g. Robinson et al. (2006), Mehlum et al. (2006) and Ross (1999) for a review of both approaches), which again finds empirical support (Mehlum et al. (2006) and Boschini et al. (2003)). Finally, there are studies addressing the reverse effect – the impact of the resource curse on institutions. The effect is found to be negative and is attributed to reduced government accountability, a better ability to repressed opposition and increasing corruption and rent-seeking (see Ross (2001), Sala-i-Martin and Subramanian (2003) and Collier and Hoeffler (2005)). We propose an alternative link, suggesting that the abundant resources undermine the autocrat's incentives to relinquish power and hence, hamper capital accumulation.

Our model is consistent with a range of empirical findings. It predicts that autocratic economies would be characterized by either relatively high or relatively low growth rates, while the democratic regimes fall into an intermediate range, which is in line with Almeida and Ferreira (2002). It also provides a new insight into the relationship between income and democratization. While many cross-country studies find that richer countries devolve earlier, the more recent panel data analysis documents no effect of income on democracy (e.g. Acemoglu et. al. (2005)) or on the hazard rate out of autocracy (Persson and Tabellini (2006)) once the regressions include country fixed effects. The model suggests an explanation for this result, showing that there is no simple relation between country's income and democratization. Indeed, income in the model can be decomposed into the product of total factor productivity and some function of capital. These different components of income are predicted to have different effect on timing of devolution: Higher initial capital leads to earlier devolution, while higher total factor productivity delays devolution. Hence, if this effect of decomposition of income is not accounted for (which is the case in empirical studies), one would expect to find no clear relation between income and democratization. Furthermore, the model also suggests a new explanation to why many empirical studies (e.g. Barro (1999), Alvarez et al. (2000), Boix and Stokes (2003)) find that growth causes democratization. In our model, the devolution of power is preceded by a more or less extensive period of growth. Thus, if the data were to be generated according to our model, we would find that growth Granger causes democratization. Nevertheless, this conclusion is misleading: in the model, institutions of limited government and growth are determined simultaneously and endogenously. Indeed, in the absence of a possibility to relinquish power, growth would slow down if not completely stop. Similarly, in the absence of growth opportunities, the institutions of limited government would never be introduced. Therefore, by means of the model, we illustrate why the observed time pattern between growth and democratization does not reflect a causal relation. This is in line with the more recent literature (Acemoglu et al.(2004), Przeworski (2004)) that emphasizes the endogenous determination of institutions and growth.

The paper proceeds as follows. Section 2 describes the setup of the model and section 3 presents the model's solution. Section 4 addresses the assumptions of the model. The predictions of the model and its comparative statics are discussed in section 5. Section 6 discusses relevant case studies. Finally, Section 7 concludes and suggests some directions for further research.

2 The Model

An infinite horizon economy ruled by an autocrat is populated by identical atomistic citizens of mass one. At date $t = 0$, due to an exogenous shock, each citizen is being exposed to a technology allowing for growth based on capital accumulation. In each period t, output is produced from capital according to the Cobb-Douglas production function

$$y_t = A\left(K_t\right)^{\alpha},$$

were K_t denotes the capital stock and y_t denotes the output at time t. We assume that capital depreciates completely in each period; that is, the depreciation rate δ is 1.

Each period, a citizen can stay in the market or leave the market and divert the capital to an alternative activity. If some citizens stays, the Ruler has the power to tax the citizens through an economy-wide consumption tax τ_t. Taxation is costly for the Ruler. We assume the cost of tax collection $\Phi(\tau_t c_t)$ is proportional to the tax base:

$$\Phi(\tau_t c_t) = \phi(\tau_t) c_t,$$

where $\phi'(.) > 0, \phi"(.) > 0$, and $\phi(0) = \phi'(0) = 0$. The Ruler also has the option of expropriating the entire production process (we assume technological indivisibility of the capital stock) from each citizen. In the latter case, the Ruler can still employ the Cobb-Douglas production function but, unlike the citizens, she is unable to accumulate capital. Thus, due to complete depreciation, she can only use the expropriated capital stock in one period.[6] In case of expropriation, each citizen receives zero payoff from the moment of expropriation and onwards.[7]

If a citizen leaves, she receives a payoff with the net present value of L, which is non-taxable and non-expropriable. The decision to leave is irreversible: if diverted, capital cannot be returned to the market sector. We assume that

$$L < \sum_{i=0}^{\infty} \beta^i \ln \frac{(1-\alpha\beta)\, A K_0^{\alpha}}{(1+\tau_A)}, \qquad \text{A1}$$

[6]The introduction of a cost of expropriation does not affect the qualitative predictions of the model as long as the assumption of indivisibility of capital holds.

[7]The taxation scheme consisting of two instruments (consumption tax and complete expropriation of capital) was chosen to keep the analysis tractable. As will be shown below, in our setting, consumption tax does not influence the capital accumulation path. This, together with the cost of taxation, allows us to avoid the time inconsistency problem, standard in infinite-horizon taxation models. We believe that the argument of the model will not be destroyed by replacing the proposed tax scheme by one distortive (capital) tax and classifying expropriation as unappropriately high level of taxes. However, we are not able to solve for the resulting equilibrium.

where τ_A solves $1 - \phi'(\tau_i)(1 + \tau_i) + \phi(\tau_i) = 0$. As we shall see, assumption A1 implies that the alternative activity is less efficient than the market activity. That is, the citizen's payoff of leaving is less than the payoff she would get by staying in the market, were the Ruler able to commit to never expropriate from her. We also assume that the decision to leave is irreversible: if diverted, capital cannot be returned to the market sector.

The Ruler can also choose to devolve her power. We assume that this decision is equivalent to completely renouncing the right to expropriate and limiting the Ruler's power to set taxes; the Ruler cannot "fine tune" the devolution decision to keep all current economic privileges.[8] More precisely, we assume that after devolution of power, the Ruler cannot set a consumption tax above some upper bound τ_D, where

$$\tau_D < \tau_A. \qquad \text{A2}$$

We also assume that the devolution decision is irreversible, i.e., if the Ruler devolves she cannot return. Moreover, we assume that in this case no other dictatorial ruler can take over.

While being in power, the Ruler receives private benefits of control of b units each period. In the later point in the paper I will interpret these benefits as natural resource rents. After devolution of power, these benefits are no longer available to the Ruler. Note that we do not argue that the devolution deprives the Ruler of all benefits. Instead, b reflects those benefits of control that are lost upon devolution. We also assume that if the economy reaches full development, the industrial sector is sufficiently more productive than the natural resource sector, so the steady-state post-devolution payoff of the Ruler exceeds the value of the flow of private benefits.

The citizen's instantaneous utility is logarithmic, so she maximizes the flow of her future utilities

$$V_t = \sum_{j=1}^{\infty} \beta^j v(c_{t+j}) = \sum_{j=1}^{\infty} \beta^j \ln c_{t+j},$$

where c_t is consumption and β is the discount factor. The Ruler's utility is linear and her payoff function is denoted

$$U_t = \sum_{j=1}^{\infty} \beta^j d_{t+j},$$

where d_{t+j} is the payoff received by the Ruler in period $t + j$.

The timing of the game is as follows: The citizens and the Ruler meet at discrete time periods $t = 0, 1, ..., \infty$. Each period has three stages. If there was no devolution of power in the past, at stage 1 of period t, the Ruler decides whether to devolve (D)

[8] In Section 4, we discuss the implications of relaxing this assumption.

or abstain from devolution (ND). At stage 2, each citizen decides whether to stay in the market sector (S) or leave (L). At stage 3 of period t, in case some citizens stay in the market sector, the Ruler chooses whether or not to expropriate (E) the capital of some citizens. Expropriated capital is used for production only in period t and then it depreciates completely, as the Ruler cannot invest. If no expropriation (NE) occurs, production, consumption and investment take place and taxes are paid. Then, the game proceeds to the period $t+1$.

As in any other multi-stage game, the history of the game is a collection of all actions played up to stage t. A (behavior) pure strategy of the ruler/citizen is a function $\sigma(h^t)/\rho(h^t)$ prescribing an action in each of the ruler's/citizens' controlled game tree nodes for a given history of the game h^t. For example, conditional on the history h^t, at the first stage of each period, a pure strategy of the ruler determines a choice between D_t and ND_t. At the second stage, the strategy of each citizen determines S_t or L_t taking into account all the past actions including those just played at stage 1 of period t. At the third stage, the ruler's strategy defines a choice of whether and whom to expropriate, again, conditional on all actions played up to stage 3 of period t and, if some capital is not expropriated, τ_t; the non-expropriated citizen's strategy prescribes the investment choice for the next period.

In what follows we seek a symmetric (as regards the citizens) pure-strategy subgame-perfect Nash equilibrium of this game. In addition, we assume that the equilibrium actions of the player are constant on the histories that only differ in the behavior of the sets of agents of measure zero (like in Gul, Sonnenschein and Wilson (1986)).[9] This implies that the strategies of Ruler and each citizen cannot be conditioned on the actions of any single citizen, or in other words, that unilateral deviation of a single citizen does not affect choices of the Ruler and the other citizens. With this assumption, each citizen takes taxes and the timing of devolution as given. One can also show that in the symmetric equilibrium the Ruler would not have incentive to behave differently with respect to different groups of citizens. These consideration allow us to take a shortcut and discuss this game as a game between a Ruler and the representative tax-taking Citizen.

3 Analysis of the Game

In this section we solve for symmetric subgame-perfect equilibria of the game. We start by analyzing the development path of this economy in the absence of Ruler's

[9] This assumption may require some technical restrictions, e.g. to insure that the set of citizens taking each given action is measurable. We assume them to hold.

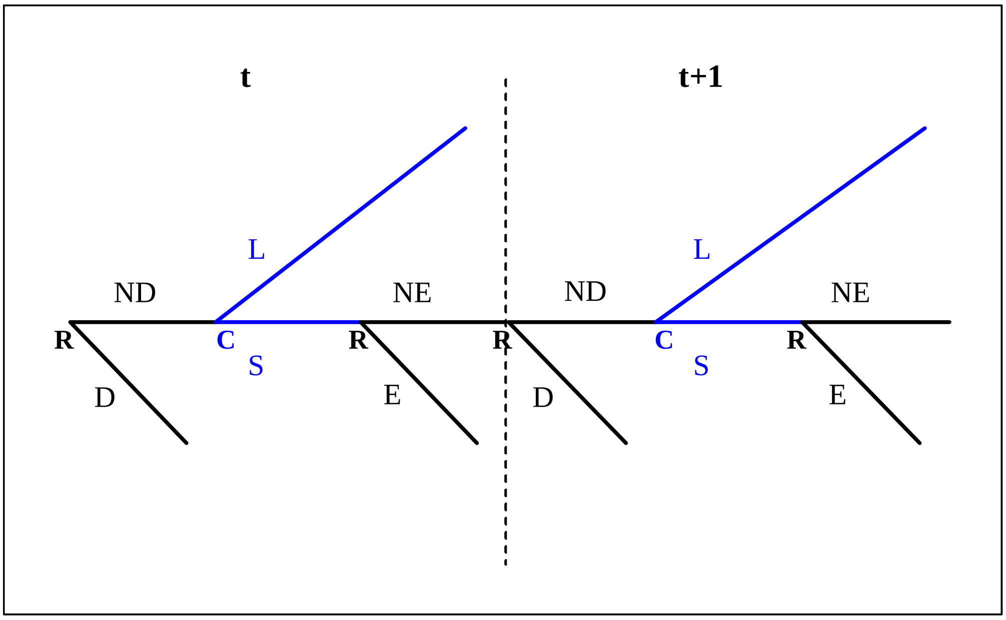

Figure 1. Timing of the game

intervention, that is, without taxation, expropriation or devolution. We continue by describing the optimal taxation choice of the Ruler, were she not able to expropriate, and the choices of the Ruler and the Citizen along the non-expropriation path. Then we proceed to show that for sufficiently high capital level the Ruler always prefers expropriation to any other continuation strategy which allows us to treat this game as a finite-horizon one and solve it backwards. Finally we discuss equilibria that arise for different sets of parameter values.

3.1 The benchmark case: no government intervention

Let us start by describing the evolution of this economy in the absence of any governmental intervention. As staying in the market sector is more productive than leaving it, the efficient outcome is for production to occur in the market sector and for the citizen to maximize her utility

$$\max \sum_{j=1}^{\infty} \beta^j \ln c_{t+j},$$

subject to the dynamic budget constraint

$$K_{t+1} = A\left(K_t\right)^{\alpha} - c_t.$$

This problem is identical to the standard Ramsey growth model and the solution is[10]

$$
\begin{aligned}
c_t &= (1-\alpha\beta)\,AK_t^{\alpha}, \qquad (1)\\
K_{t+1} &= \alpha\beta AK_t^{\alpha}.
\end{aligned}
$$

The dynamic equilibrium of this economy is characterized by the capital and the output monotonically converging to the steady state values K^* and y^*, respectively:[11]

$$
\begin{aligned}
K^* &= (\alpha\beta A)^{\frac{1}{1-\alpha}},\\
y^* &= A^{\frac{1}{1-\alpha}}(\alpha\beta)^{\frac{\alpha}{1-\alpha}}.
\end{aligned}
$$

Note that along the transition path, both capital and output are approaching the steady state at a decreasing rate. The growth rate of capital

$$\gamma_k(t) \equiv \frac{K_{t+1}-K_t}{K_t} = \alpha\beta AK_t^{\alpha-1}-1,$$

and the growth rate of output

$$\gamma_y(t) \equiv \frac{y_{t+1}-y_t}{y_t} = [\gamma_k(t)+1]^{\alpha}-1,$$

are both decreasing in t.

3.2 Subgame-perfect Nash equilibrium

We turn to the analysis of the game between the Ruler and the Citizen and characterize the pure-strategy subgame-perfect Nash equilibria of this game.

We start by examining the Ruler's taxation incentives.

Lemma 1 *If the Ruler were not able to expropriate and the Citizen were not able to leave the market, the Ruler would choose the same tax rate τ_A each period, such that*

$$1-\phi'(\tau_A)(1+\tau_A)+\phi(\tau_A)=0.$$

Proof. First, note that in our setting, consumption taxation does not influence the capital accumulation path (and thus the output path). Indeed, assume that the Citizen is facing a flow of taxes $\{\tau_t\}, t=1,...,\infty$. As was discussed above, in the equilibrium in consideration each citizen takes taxes as given - indeed, her unilateral deviation has no impact on the choices of the Ruler and thus her investment decision could not affect taxes. Citizen's problem then becomes

$$
\begin{aligned}
&\max \sum_{t=0}^{\infty}\beta^t \ln c_t\\
&\text{s.t.}\quad K_{t+1} = AK_t^{\alpha}-(1+\tau_t)c_t,
\end{aligned}
$$

[10] It can be confirmed by the usual guess-and-verify method.

[11] We concentrate on studying the increasing branch of the saddle path.

and the solution is

$$\begin{aligned} c_t &= \frac{(1-\alpha\beta)\, AK_t^{\alpha}}{(1+\tau_t)}, \\ K_{t+1} &= \alpha\beta AK_t^{\alpha}. \end{aligned} \tag{2}$$

Thus, it is only the consumption profile $\{c_t\}$ that changes as compared to the benchmark case (1), while capital accumulation is unaffected by τ_t.

As a result, at each point in time t, the Ruler solves the problem

$$\begin{aligned} &\max_{\{\tau_i\}} \sum_{i=t}^{\infty} \beta^{i-t} \left(\tau_i c_i - \Phi(\tau_i c_i)\right) = \\ &\max_{\{\tau_i\}} \sum_{i=t}^{\infty} \beta^{i-t} \left(\tau_i - \phi(\tau_i)\right) \left(\frac{(1-\alpha\beta)\, AK_i^{\alpha}}{(1+\tau_i)}\right). \end{aligned}$$

In the absence of the Citizen's diversion opportunity, the solution of this maximization problem does not depend on past taxes. In other words, the Ruler can decide on each period's tax separately. The respective first-order condition can be rewritten as

$$1 - \phi'(\tau_i)(1+\tau_i) + \phi(\tau_i) = 0.$$

As $\phi' > 0$, the right-hand side of this equality is decreasing in τ_i. Moreover, it is positive at $\tau_i = 0$ and negative at $\tau_i \to \infty$. Thus, there is a unique $\tau_i \equiv \tau_A$ satisfying first-order conditions and, as second-order conditions are satisfied, it indeed determines the maximum point. ∎

Lemma (1) explains why we imposed assumption A1. The assumption ensures that, if the Citizen leaves the market, she receives less than she would under Ruler's full discretion to tax (but not to expropriate). The Ruler in this case does not receive any payoff in addition to the private benefit of control, hence, overall efficiency falls. In turn, our assumption on post-devolutionary taxation A2 simply reflects the idea that devolution imposes some restrictions on the Ruler, so that she is no longer able to choose her preferred tax rate.

We proceed to characterize the equilibria.

Lemma 2 *In any SPNE in all subgames following the devolution of power, the Ruler sets the highest possible tax rate τ_D in each period and the Citizen stays in the market.*

Proof. As shown above, a consumption tax does not influence the capital accumulation path. Indeed, the citizens ignore the effect of their decisions to stay or leave on the Ruler's choice of the tax rates and the timing of devolution, and take them as given. Hence, in each period after the devolution of power, the Ruler and the Citizen "share a pie" of a predetermined size, unless the Citizen diverts the capital to the non-market sector. Let us describe the symmetric subgame-perfect Nash equilibrium of this subgame. First, note that given the restrictions on the post-devolution maximum tax rate, the Citizen chooses to stay in the market for any tax schedule.. Indeed, after devolution, the Ruler cannot not set the tax rate above τ_D. So, at any point in time t, the Citizen's payoff from staying in the market is at least as high as her payoff when the Ruler taxes at the rate τ_D:

$$V^S(\tau_t, \tau_{t+1}, \tau_{t+2}, ...) \geq \sum_{i=t}^{\infty} \beta^{i-t} \ln \frac{(1-\alpha\beta) AK_i^{\alpha}}{(1+\tau_D)},$$

while her payoff from leaving the market is

$$V^L = L.$$

Note that the Citizen's payoff from leaving the market is below the post-devolutionary payoff. Indeed, as $\tau_A > \tau_D$ and the capital stock increases over time,

$$\sum_{i=0}^{\infty} \beta^{i} \ln \frac{(1-\alpha\beta) AK_i^{\alpha}}{(1+\tau_A)} \leq \sum_{i=0}^{\infty} \beta^{i} \ln \frac{(1-\alpha\beta) AK_i^{\alpha}}{(1+\tau_D)} \leq \sum_{i=t}^{\infty} \beta^{i-t} \ln \frac{(1-\alpha\beta) AK_i^{\alpha}}{(1+\tau_D)}. \quad (3)$$

From our assumption (A1) and inequality (3), it follows that once devolution occurs, it is never optimal for the Citizen to leave the market

$$L < \sum_{i=t}^{\infty} \beta^{i-t} \ln \frac{(1-\alpha\beta) AK_i^{\alpha}}{(1+\tau_D)}.$$ [12]

That is, after devolution of power, the Citizen always prefers staying in the market to leaving for the alternative sector:

$$V^S(\tau_t, \tau_{t+1}, \tau_{t+2}, ...) > V^L.$$

Thus, in any SPNE, the Ruler is free to choose the tax schedule that brings her the maximal payoff given the post-devolutionary tax restrictions. As $\tau_D < \tau_A$, the Ruler's payoff increases with the increase in each period's tax. So in every period t, she sets the tax rate τ_t equal to the maximum post-devolutionary tax τ_D. ■

Before proceeding we need to establish one important property of any (symmetric) subgame-perfect equilibrium of this game. No SPNE can have expropriation on the game path. Indeed, expropriation cannot occur in equilibrium, as the Citizen would gain by deviating to the shadow sector just before the Ruler expropriates. It implies

[12] Here we assume that the capital level at which the Ruler chooses to devolve is at least as high as K_0. We will see below that this assumption will always hold along the game path of the SPNE.

that along the game path of any subgame-perfect Nash equilibrium each citizen, being a tax-taker, invests a fixed share $\alpha\beta$ of current output and this choice is independent of actual tax rates (see Lemma 1). That is, the capital accumulation path always follows rule (2). Therefore, in seeking the game path of SPNE we can limit ourselves to analyzing capital accumulation trajectories that correspond to this rule. This observation together with Lemma (2) yields a useful corollary.

Corollary 1 *Along the non-expropriation (sub)game path, the Citizen never leaves the market. The Ruler chooses τ_A while in power and τ_D after devolution.*

Proof. If there is no expropriation along the game path, the maximum tax the Ruler would set is τ_A. Thus, the Citizen's payoff from staying will never be below

$$\underline{V} = \sum_{i=t}^{\infty} \beta^{i-t} \ln \frac{(1-\alpha\beta)\, AK_i^{\alpha}}{(1+\tau_A)}.$$

But, as capital accumulates, the payoff from leaving is always below the payoff from staying:

$$L < \sum_{i=0}^{\infty} \beta^{i} \ln \frac{(1-\alpha\beta)\, AK_i^{\alpha}}{(1+\tau_A)} \leq \sum_{i=t}^{\infty} \beta^{i-t} \ln \frac{(1-\alpha\beta)\, AK_i^{\alpha}}{(1+\tau_A)} = \underline{V} \leq V^S\left(\tau_t, \tau_{t+1}, \tau_{t+2}, \ldots\right).$$

As a result, along the non-expropriation game path, the Ruler can always choose his preferred tax levels, that is τ_A while in power and τ_D after devolution. ■

Denote the share of output the Ruler receives while being in power by

$$\varepsilon_A = \frac{\tau_A - \phi(\tau_A)}{(1+\tau_A)}(1-\alpha\beta),$$

and the one she gets after devolution by

$$\varepsilon_D = \frac{\tau_D - \phi(\tau_D)}{(1+\tau_D)}(1-\alpha\beta).$$

Note that as the tax in autocracy is higher than after devolution, $\tau_A > \tau_D$, the same is true about the Ruler's output shares:

$$\varepsilon_A > \varepsilon_D.$$

We are now ready to study how the Ruler's incentive to expropriate evolves over time.

Lemma 3 *If $\frac{\varepsilon_A}{(1-\beta)} < 1$, then in any SPNE along all the paths where the Citizen invests a fixed share $\alpha\beta$ of current output, there exists a finite time period T such that the Ruler prefers expropriation at stage 3 of period T over any other continuation strategy.*

Proof. We start with some introductory observations. There are three types of "exits" in this game. First, the Ruler can expropriate the capital from the Citizen. If this occurs, the Citizen is left with zero capital and cannot restart production, so that the continuation of the game is fully predetermined. Second, the Citizen can divert the capital to the shadow sector, which makes the continuation game independent of the players' actions. Finally, the Ruler can devolve power. Since this decision is irreversible, and after devolution the continuation game has a unique subgame-perfect Nash Equilibrium, the value of the remaining game is also clear at the time of devolution.

Observe that after the capital has reached a sufficiently high level, no SPNE can have exits of the first two types along the game path. Indeed, in case of expropriation, the Citizen gets zero, while if she diverts the capital at the preceding stage, she is guaranteed a positive payoff. Similarly, if the Citizen diverts the capital, the Ruler is left with the private benefits of control only. As we assume that the steady-state post-devolution payoff of the Ruler is higher than the value of the flow of private benefits, by continuity, the same holds if devolution occurs sufficiently close to the steady state. Thus, the Ruler prefers devolving power at the preceding stage rather than clinging to power and only receiving the benefits of control.

This implies that in the subgame starting at stage 3 of some period t the Ruler is choosing between immediate expropriation, set of continuation paths where the game "ends" by the devolution of power at some future period $t + \widetilde{t}$ and a path where the game "continues" forever. The assumption of the Lemma ensures that in the steady state the net present value of tax returns is not high enough to prevent the Ruler from expropriating. By continuity, the same result holds around the steady state. ■

This Lemma states that if the agents are not very patient, the non-market activity is not very inefficient, and/or the share of capital in production α is high, expropriation always takes place if the economy is sufficiently close to the steady state. Note that if the Ruler's value of expropriating at T is higher than the value of any alternative continuation strategy at time T, the same is true for any $t > T$, as output monotonically converges to the steady-state value y^*.

Corollary 2 *If* $\frac{\varepsilon_A}{1-\beta} < 1$, *and* T *is the time period found in Lemma 3, then any SPNE is characterized by the Ruler choosing to expropriate at stage 3 of every period* $T, T+1, T+2, ...$*along all the paths where the Citizen invests a fixed share* $\alpha\beta$, *and the Citizen leaving the market to avoid expropriation.*

Throughout the paper, we assume that the conditions of Lemma 3 hold; that is, the parameters of the model are such that in the steady state, the Ruler always prefers expropriation over any other strategy. Corollary 2 thus allows us to treat period T as a "final" period and solve the game backwards from there.

Period T As shown in Corollary 2, at stage 3 of period T, the Ruler expropriates. At stage 2 of period T, the Citizen leaves the market sector to get a positive payoff, as compared to the zero payoff in case of staying and being expropriated at the next stage. As a result, at stage 1 of period T, the Ruler has to choose between devolution, in which case she receives a payoff

$$U(D_T) \equiv \tau_D \sum_{i=0}^{\infty} \beta^i c_{T+i} = \varepsilon_D \sum_{i=0}^{\infty} \beta^i y_{T+i},$$

and no devolution, which gives her a flow of future benefits of control

$$U(ND_T) \equiv \sum_{i=0}^{\infty} \beta^i b = \frac{b}{1-\beta},$$

as the Citizen leaves the market at the next stage.

Period T-1 At stage 3 of period $T-1$, the Ruler compares the option of expropriating and getting

$$U(E_{T-1}) = y_{T-1} + \frac{b}{1-\beta}$$

to the option of non-expropriating, taxing and proceeding to stage 1 of period T (where she either devolves or stays and receives a flow of benefits of control only).

If already in period T, the devolution payoff is lower than the flow of the benefits of control

$$U(D_T) < U(ND_T), \tag{4}$$

the Ruler has to decide whether to expropriate at stage 3 of period $T-1$ and receive $U(E_{T-1})$, or proceed to stage 1 of period T to get the flow of the benefits of control and receive

$$U(NE_{T-1}, \tau_A, ND_T) = \varepsilon_A y_{T-1} + b + \beta U(ND_T) = \varepsilon_A y_{T-1} + \frac{b}{1-\beta}.$$

Since

$$U(NE_{T-1}, \tau_A, ND_T) = \varepsilon_A y_{T-1} + \frac{b}{1-\beta} < y_{T-1} + \frac{b}{1-\beta} = U(E_{T-1}),$$

the Ruler prefers to expropriate at $T-1$ as well. Note that the devolution payoff $U(D_t)$ is increasing over time, while the payoff of sustaining the autocratic regime with no market production $U(ND_t)$ is constant. Thus, if inequality (4) holds, that is, the devolution payoff is lower than the accumulated private benefit in period T, the same is true for all periods $t < T$. As a result, the backward induction argument repeats itself until period $t = 0$, where at stage 3 the Ruler again chooses to expropriate, at stage 2 the Citizen leaves the market and at stage 1, the Ruler stays to enjoy the flow of private benefits of control. The Ruler's incentive to keep the private benefits of control is so strong that she never wants to devolve and lose them. Therefore, the Ruler cannot commit not to expropriate and, as a result, no investment ever takes place.

Proposition 1 *An economy with sufficiently high private benefits of control b is stuck in an "underdevelopment trap": the autocratic ruler never relinquishes power and the efficient production technologies never get implemented.*

Assume now that the private benefits of control are not too high, so that devolution is chosen at stage 1 of period T,

$$U(D_T) > U(ND_T).$$

Then, the Ruler compares the payoff of expropriation $U(E_{T-1})$ to the devolution payoff in period T

$$\begin{aligned} U(NE_{T-1}, \tau_A, D_T) &= \varepsilon_A y_{T-1} + b + \beta U(D_T) \\ &= \varepsilon_A y_{T-1} + b + \beta \left[\varepsilon_D \sum_{i=0}^{\infty} \beta^i y_{i+T} \right]. \end{aligned}$$

She prefers expropriation iff

$$U(NE_{T-1}, \tau_A, D_T) < U(E_T). \tag{5}$$

Suppose that condition (5) is met so that the ruler chooses to expropriate. Similarly to above, at stage 2 of period $T-1$, the citizen prefers to leave the market. At stage 1, the ruler once more either devolves to prevent the citizen from leaving, and gets the payoff

$$U(D_{T-1}) = \varepsilon_D \sum_{i=0}^{\infty} \beta^i y_{i+T-1},$$

or does not devolve and receives the benefit of control

$$U(ND_{T-1}) \equiv \sum_{i=0}^{\infty} \beta^i b = \frac{b}{1-\beta}.$$

As we have already discussed what happens in the case when the latter exceeds the former, assume now that

$$U(D_{T-1}) > U(ND_{T-1}).$$

Period T-2 At stage 3, the Ruler again faces the choice of expropriating the Citizen and getting

$$U(E_{T-2}) = y_{T-2} + \frac{b}{1-\beta},$$

vs. proceeding to stage 1 of period $T-1$ where she devolves, which yields

$$\begin{aligned} U(NE_{T-2}, \tau_A, D_{T-1}) &= \varepsilon_A y_{T-2} + b + \beta U(D_{T-1}) \\ &= \varepsilon_A y_{T-2} + b + \varepsilon_D \sum_{i=0}^{\infty} \beta^{i+1} y_{i+T-1}. \end{aligned}$$

As above, the Ruler expropriates iff

$$U(NE_{T-2}, \tau_A, D_{T-1}) < U(E_{T-2}). \tag{6}$$

The backward induction proceeds to stage 2 of period $T-2$, where the argument repeats.

Before we proceed, we need to establish a useful result.

Lemma 4 *For a given set of parameters, the difference $U(NE_t, \tau_A, D_{t+1}) - U(E_t)$ is single-peaked with a peak at some finite $\widetilde{t}$.*

Proof. See the Appendix. ■

As shown above, the Ruler's devolution decision is determined by the difference between her payoff from expropriation in period t and her payoff from devolution in period $t+1$. This Lemma establishes that there is a unique period of time $\widetilde{t}$ where the respective difference reaches its maximum and that it monotonously declines for $t > \widetilde{t}$.

Continuing to solve the model backwards, there are two possible scenarios: (i) either in period $\widetilde{t}$, the expropriation payoff falls below the non-expropriation payoff

$$U(E_{\widetilde{t}}) < U\left(NE_{\widetilde{t}}, \tau_A, D_{\widetilde{t}+1}\right)$$

or (ii) in each period $t \geq 0$, expropriation is preferred over non-expropriation. Denote the set of parameters supporting case (i) by Ω_{DD}, (for the reasons that will be clear below) and the set of parameters supporting case (ii) by Ω_2. It is easy to see that neither of these cases is degenerate, that is, that both sets Ω_{PD} and Ω_2 are non-empty.

Indeed, assume that $b = 0$, and consider the difference between the payoffs from expropriation and non-expropriation (followed by devolution) in the initial period $t = 0$. As output is increasing over time,

$$\begin{aligned} U(NE_0, \tau_A, D_1) - U(E_0) &= \varepsilon_D \sum_{t=1}^{\infty} \beta^t y_t - (1-\varepsilon_A) y_0 > \varepsilon_D \sum_{t=1}^{\infty} \beta^t y_1 - (1-\varepsilon_A) y_0 \\ &= y_0 \left[\frac{\varepsilon_D \beta}{1-\beta} \frac{y_1}{y_0} - (1-\varepsilon_A) \right]. \end{aligned} \tag{7}$$

For given values of $(\varepsilon_A,\ \varepsilon_D, \beta, A)$, if the initial capital is sufficiently low, the growth rate in the first period

$$\frac{y_1}{y_0} = \left(\alpha\beta A K_0^{(\alpha-1)}\right)^{\alpha}$$

is sufficiently high for expression (7) to be positive. Continuity ensures that the same holds for small positive b. By Lemma 4

$$U\left(NE_{\widetilde{t}}, \tau_A, D_{\widetilde{t}+1}\right) - U\left(E_{\widetilde{t}}\right) \geq U\left(NE_0, \tau_A, D_1\right) - U\left(E_0\right) > 0,$$

which proves the nonemptiness of the set Ω_{PD}.

Alternatively, consider the peak period $\widetilde{t}$. As output increases towards the steady-state value y^*,

$$\begin{aligned} U\left(NE_{\widetilde{t}}, \tau_A, D_{\widetilde{t}+1}\right) - U\left(E_{\widetilde{t}}\right) &= \varepsilon_D \sum_{i=1}^{\infty} \beta^i y_{\widetilde{t}+i} - (1-\varepsilon_A) y_{\widetilde{t}} - \frac{\beta b}{1-\beta} \\ &< \varepsilon_D \sum_{i=1}^{\infty} \beta^i y^* - (1-\varepsilon_A) y_{\widetilde{t}} - \frac{\beta b}{1-\beta}. \end{aligned} \tag{8}$$

Note that due to the separability of the payoff function, $\widetilde{t}$ is independent of b. Given $(\varepsilon_A,\ \varepsilon_D, \beta, A, K_0)$, one can choose a sufficiently high b so that

$$0 < \varepsilon_D \sum_{i=1}^{\infty} \beta^i y^* - \frac{\beta b}{1-\beta} < (1-\varepsilon_A) y_{\widetilde{t}}.$$

Hence, expression (8) is negative, i.e., the considered parameters belong to the set Ω_2. We proceed by analyzing these two cases separately.

Case i

By construction, the payoff of expropriation in $\widetilde{t}$ is less than the payoff of devolution in $\widetilde{t}+1$. Moreover, we know that the Ruler prefers expropriation to devolution at the steady state, i.e., when $t \to \infty$. By Lemma 4, there exist $\widehat{t} \geq \widetilde{t}$ such that the Ruler prefers to expropriate at stage 3 of any period $t > \widehat{t}$, but not to expropriate at stage 3 of period $\widehat{t}$. It implies that the Ruler devolves at stage 1 of period $\widehat{t}+1$. The reason is simple: if the Ruler were to stay in power at stage 1 of period $\widehat{t}+1$, by non-expropriating at stage stage 3 of period $\widehat{t}$, she would receive a flow of private benefits of control as well as tax revenue in period $\widehat{t}$. Thus, her payoff from not expropriating in $\widehat{t}$ falls short of the expropriation payoff as the latter includes both the private benefits and the entire output in period $\widehat{t}$. That is,

$$U\left(NE_{\widehat{t}}, \tau_A, D_{\widehat{t}+1}\right) > U\left(E_{\widehat{t}}\right). \tag{9}$$

By backward induction, the Citizen stays in the market at stage 2 of period $\widehat{t}$. Indeed, no expropriation takes place at stage 3 and the devolution occurs at stage 1 of period $\widehat{t}+1$. Hence, there is no expropriation along this (sub)game path and, by Corollary 1, the Ruler sets $\tau_{\widehat{t}} = \tau_A$, and the Citizen chooses to stay. At stage 1 of period $\widehat{t}$, the Ruler compares the option of devolving to the option of proceeding to the next stage. Devolution yields the Ruler's payoff

$$U\left(D_{\widehat{t}}\right) = \varepsilon_D \sum_{i=0}^{\infty} \beta^i A K_{i+\widehat{t}}^{\alpha}. \tag{10}$$

Non-devolution followed by taxation entails a positive tax revenue in this period and the devolution payoff from the next period on

$$U\left(ND_{\widehat{t}}, NE_{\widehat{t}}, \tau_A, D_{\widehat{t}+1}\right) = \varepsilon_A A K_{\widehat{t}}^{\alpha} + b + \varepsilon_D \sum_{i=1}^{\infty} \beta^i A K_{i+\widehat{t}}^{\alpha}. \tag{11}$$

As taxes under autocracy are higher than after devolution, $\varepsilon_A > \varepsilon_D$ and $b \geq 0$, the Ruler does not devolve at stage 1 of period $\widehat{t}$.

Before proceeding backwards to period $\widehat{t}-1$, we need to establish an intermediate result. Consider the Ruler's net payoff

Lemma 5 *As time passes, the Ruler's payoff from expropriation net of private benefits of control becomes more attractive relative to the payoff from devolution net of private benefits of control.*

Proof. See the Appendix. ■

Intuitively, the further away is the economy from the steady state, the longer is the growth horizon and the more appealing it is to get a share of future increasing profits (through devolution of power), as compared to grabbing the entire pie today.

Now, we are ready to discuss the choice of Ruler in the period $\widehat{t}-1$.

Lemma 6 *At stage* 3 *of period* $\widehat{t}-1$*, the Ruler prefers non-expropriation over expropriation.*

Proof. See the Appendix. ■

By definition, at stage 3 of period $\widehat{t}$, the Ruler prefers non-expropriation, followed by devolution, to expropriation. The Ruler's choice between non-expropriation and expropriation is determined by two factors: the growth rate of output and the private benefits of control that are lost upon devolution. Now turn to period $\widehat{t}-1$. By choosing not to expropriate in period $\widehat{t}-1$, the Ruler retains the benefits of control for period $\widehat{t}$, as she does not devolve in that period. Therefore, as compared to period

$\widehat{t}$, expropriation at $\widehat{t}-1$ is associated with a smaller gain in the private benefits of control. In addition, the growth rate of output in period $\widehat{t}-1$ is higher than at $\widehat{t}$, thereby providing the Ruler with additional incentive to refrain from expropriation. Hence, the Ruler chooses not to expropriate at stage 3 of period $\widehat{t}-1$,

$$U\left(NE_{\widehat{t}-1}, \tau_A, ND_{\widehat{t}}, NE_{\widehat{t}}, \tau_A, D_{\widehat{t}+1}\right) > U\left(E_{\widehat{t}-1}\right).$$

As above, at stage 2 of period $\widehat{t}-1$, the Citizen decides to stay. At stage 1 of period $\widehat{t}-1$ the Ruler again chooses whether to devolve. If she does not devolve, her payoff is

$$\begin{aligned} U\left(ND_{\widehat{t}-1}, NE_{\widehat{t}-1}, \tau_A, ND_{\widehat{t}}, NE_{\widehat{t}}, \tau_A, D_{\widehat{t}+1}\right) &= \varepsilon_A AK^{\alpha}_{\widehat{t}-1} + b + \beta\left(\varepsilon_A AK^{\alpha}_{\widehat{t}} + b\right) \\ &\quad + \sum_{i=1}^{\infty}\beta^i \varepsilon_D AK^{\alpha}_{i+\widehat{t}}. \end{aligned}$$

An immediate devolution yields the same flow of payments from period $\widehat{t}+1$ onwards, but lower payoffs in periods $\widehat{t}-1$ and $\widehat{t}$

$$U\left(D_{\widehat{t}}\right) = \varepsilon_D AK^{\alpha}_{\widehat{t}-1} + \beta\varepsilon_D AK^{\alpha}_{\widehat{t}} + \sum_{i=1}^{\infty}\beta^i \varepsilon_D AK^{\alpha}_{i+\widehat{t}}.$$

Therefore, the Ruler chooses not to devolve at stage 1 of period $\widehat{t}-1$. At stage 3 of period $\widehat{t}-2$, we repeat the argument of Lemma 6 to conclude that the Ruler again prefers not to expropriate.

We continue solving the model backwards along the same lines until we reach period $t=0$. In all these steps, the optimal strategy for the Ruler is to tax the citizen without devolution or expropriation. The optimal strategy for the Citizen is to stay in the market sector. The tax rate chosen by the Ruler is set to $\tau_t = \tau_A$ in each period $t = 1, 2, ...\widehat{t}-1$.

Thus, we can conclude that there is a unique symmetric pure strategy SPNE where along the game path the Ruler taxes the Citizen while retaining autocratic power and not expropriating up to period $\widehat{t}$, and devolves in period $\widehat{t}$; that is

$$\sigma(h^t) = \begin{pmatrix} \left(ND_t, NE_t\right), \ t = 0, ..., \widehat{t}, \quad D_{\widehat{t}+1}; \\ \tau_t = \begin{cases} \tau_A, \ t = 0, ..., \widehat{t}; \\ \tau_D, \ i = \widehat{t}+1, ..., \infty \end{cases} \end{pmatrix}.$$

The citizen always stays in the market along the game path:

$$\rho(h^t) = \left(S_t, \ t = 0, ..\infty\right).$$

That is, for each set of parameters in Ω_{DD} the Ruler chooses to delay devolution. We summarize our findings in the following proposition:

Proposition 2 *There exists a non-empty set of model parameters Ω_{DD}, such that the Ruler prefers to devolve rather than expropriate in at least one period $\widetilde{t}$. If the parameters belong to the set Ω_{DD}, then along the game path of the unique symmetric pure strategy SPNE, the Ruler delays devolution until period $\widehat{t}$, where $\widehat{t}$ is the latest period in which the Ruler prefers devolution over expropriation.*

Case ii

In this case, in each period $t \geq 0$ expropriation is preferred over non-expropriation followed by devolution in the next period. The resulting equilibrium depends on the relation between the Ruler's payoff to devolution in the initial period and the value of the future flow of private benefits of control.

More precisely, suppose that the parameter values are such that in period $t = 0$, the Rulers's valuation of immediate devolution exceeds the valuation of the flow of control benefits:

$$U\left(D_0\right) > \frac{b}{1-\beta}. \tag{12}$$

As the payoff to devolution increases over time, the same holds for every subsequent period $t > 0$:

$$U\left(D_t\right) > \frac{b}{1-\beta}.$$

Thus, when we solve the game backwards, at stage 3 of every period the Ruler prefers to expropriate, at stage 2 the Citizen leaves the market and at stage 1 the Ruler chooses to devolve. This also holds for the very first period $t = 0$, which means that the devolution occurs immediately, before any growth in this economy takes place. Here, the Ruler values growth after devolution more than stagnation in an autocratic regime. To achieve any growth, she must relinquish her power in the very first period, otherwise the citizen immediately switches to a non-market activity.

In this case, in the unique symmetric pure strategy SPNE, the ruler devolves in the initial period $t = 0$, that is

$$\sigma(h^t) = \left(\begin{array}{c} D_0; \\ \tau_t = \tau_D, t = 0, ..\infty \end{array} \right).$$

The citizen again never leaves the market sector along the game path:

$$\rho(h^t) = \left(S_t,\ t = 0, ..\infty\right).$$

Conditions (10) and (12) suggest that such an equilibrium can take place in economies where e.g. the initial capital is relatively high, the private benefits of control are moderate, or the Ruler's power to tax after devolution is relatively large. By construction, the set of parameters supporting this equilibrium is a subset of Ω_2. Denote this set by

Ω_{ID}, where ID stays for immediate devolution. This set is non-empty. For example, this outcome can be observed in economies that start up very close to the steady state. As shown above, the Ruler always prefers to expropriate; the efficiency assumption ensures that the flow of private benefits of control falls short of the devolution payoff in the steady state which, by continuity, also holds in a neighborhood of the steady state.

Proposition 3 *There exists a non-empty set of model parameters Ω_{ID}, such that the Ruler's payoff from expropriation is always higher than the payoff from the devolution in the next period, but the payoff from devolution in $t = 0$ exceeds the value of the flow of private benefits of control. If the parameters belong to the set Ω_{ID}, devolution occurs in the very first period and the economy fully realizes its growth potential.*

Finally, consider the situation where, in period $t = 0$, the Ruler's payoff of immediate devolution is lower than the net present value of the flow of control benefits:

$$U(D_0) < \frac{b}{1-\beta}. \tag{13}$$

Here, when we solve the game backward, the Ruler still expropriates at stage 3 of each period t. This holds in period T by Lemma 3. It also holds in all earlier periods irrespective of the Ruler's choice at stage 1 of period $t+1$. Therefore, the Citizen again leaves at stage 2. But now the Ruler prefers not to devolve at stage 1 of early periods, as devolution is not sufficiently attractive. In particular, there is no devolution in the initial period $t = 0$ where inequality (13) holds. Therefore, such an economy also becomes locked in an underdevelopment trap: at the beginning of growth, the post-devolutionary future does not look sufficiently tempting to the Ruler. Thus, she prefers to retain all her political power to receive the private benefits of control, even though the Citizen immediately leaves the market to avoid expropriation. As a result, growth in this economy never occurs.

Formally, in the unique symmetric pure strategy SPNE along the game path, the ruler does not devolve in period $t = 0$:

$$\sigma(h^t) = (ND_0),$$

and the citizen leaves the market sector in the very initial period:

$$\rho(h^t) = (L_0).$$

Similarly to the above, conditions (10) and (12) suggest that this equilibrium outcome is observed in economies with low initial capital, high benefits of control and relatively limited Ruler's power to tax after devolution. Denote the respective set of parameters by $\Omega_U \subset \Omega_2$.

Proposition 4 *There exists a non-empty set of model parameters Ω_U such that the Ruler's payoff from expropriation is always higher than the payoff from the devolution in the next period, and the value of the flow of private benefits of control exceeds the payoff from devolution at $t = 0$. If the parameters belong to the set Ω_U, the economy is caught in an underdevelopment trap: no growth or devolution of power ever occurs.*

4 Discussion

In this section, we discuss the key assumptions of our model and their implication for the results. In the model, we abstract from open conflict. That is, the only threat that the Citizen can make to the Ruler is that of exit. Introducing the possibility of conflict into the model would not change the nature of its predictions, but might bring some additional insights. Assume that the Citizen can struggle with the Ruler in order to force her to relinquish the power. Then, as growth declines and the Ruler is prepared to give up power in the near future, we may expect both the Ruler and the Citizen to fight less intensively. Thus, unlike in a stationary setting where the intensity of struggle would typically be constant, we may find that as growth slows down, uproars become less violent. This extension could be helpful in relating the model to the evidence, which suggests that even peaceful devolutions of power are normally preceded by some pressure on the ruler.

Another key assumption is that the ruler can commit to relinquish the power. In other words, the institutional structure in the economy allows for the devolution of power. The formation of these institutions is beyond the scope of our analysis. Clearly, if such institutions are lacking, the Ruler cannot credibly commit not to expropriate. Similarly, we assume that the citizens can, in turn, guarantee the ruler a "safe haven" after she devolves. If such an institution is missing, the autocrat has no incentive to devolve. Therefore, in the absence of either of these institutions, the model would predict any economy to be locked in an underdevelopment trap.

What happens if we allow the Ruler to "fine tune" the devolution decision? That is, suppose the Ruler may choose the post-devolutionary tax level (while keeping the assumption that devolution is associated with the absence of expropriation). Under this relaxed assumption, the Ruler does not impose any restrictions on the post-devolutionary tax return. The devolution of power occurs in any period between $t = 0$ and the period when the payoff of expropriation is just below the payoff of eternal taxation. Indeed, the Ruler can now make devolution as profitable as taxation and is thus indifferent concerning the timing of the devolution, as long as the Citizen does not leave the market. For example, if the Citizen has a weak preference for devolution, the Ruler is ready to devolve in the very initial period. That is, such "fine tuning" prevents us from predicting the precise timing of devolution. However, as long as the "fine tuning" implies post-devolutionary loss in private benefits of control, the inefficient "underdevelopment trap" equilibrium outcome continues to exist.

Some of the less realistic predictions of the model are artifacts of simplification. For example, along the equilibrium path, no expropriation occurs in the model, while we do observe examples of the government's predative behavior in real life. Lack of expropriation in the model is due to the fact that we have assumed perfect information and no uncertainty. If we instead assume that the Citizen is imperfectly informed, or there are random shocks to the production function, we extend the set of SPNE by including equilibria involving expropriation of capital along the equilibrium path. Similarly, uncertainty can yield "revolutionary" equilibria, that is, equilibria with conflict-driven devolution of power.

In our pure-strategy SPNE, no autocracy can survive in the long run, while we do observe non-collapsing autocracies in the real world (e.g. consider China). However, this does not imply that the model contradicts the evidence. The growth prospects might be sufficiently good, so that the devolution stage has not yet been reached. Also, we have deliberately confined the attention to a set of parameters under which expropriation is preferred in the steady state. Relaxing this assumption can produce equilibria with an eternal growing autocracy.

Finally, the model predicts that the growth rate declines after the devolution of power. Note that in our model, the devolution of power is, in fact, represented by an improvement in property rights protection. Most empirical studies record the opposite effect – better property right protection spurs growth. This effect can easily be incorporated in the basic framework. For example, we might extend the model to allow for more sectors. If some sectors do not have a diversion opportunity, these sectors will start to accumulate only in the absence of the expropriation threat. That is, the devolution of power will give rise to an additional wave of investment and growth, not attainable under autocracy.

5 Predictions of the model

Now we are ready to discuss the model's predictions and comparative statics, as well as the importance of our modelling assumptions.

Proposition 5 *In an economy that is growing under autocratic rule, a higher level of initial capital entails earlier devolution of power. In an economy locked in an under-*

development trap, an increase in initial capital may entail early devolution of power and growth.

The formal proof can be found in the Appendix. Informally, consider two economies, one starting with the initial capital K_0 and another - with the capital that the first economy would reach in period $t = 1$,

$$K_0^{'} = K_1 > K_0.$$

The backward induction procedure described above implies that the choices made by the agents in the first economy in period t are identical to the choices made by the agents in the second economy in period $t-1$. Thus, if in the former economy the devolution of power occurs at date $\widehat{t}$, in the latter economy it occurs at date $\widehat{t}-1$. Intuitively, an increase in the initial capital, other things equal, implies that the economy starts closer to the steady state and experiences lower growth rates throughout its development path. As a result, the future does not look that tempting for the Ruler and her incentive to grab at each point in time increases. Thus, in order to persuade the citizens to remain in the market, the Ruler needs to devolve power earlier.

Alternatively, assume that the former economy is in the "underdevelopment trap". That is, in any period $t > 0$, the Ruler prefers expropriation at stage 3 of period t to devolution at stage 1 of period $t+1$ and her devolution payoff in period $t = 0$ is less than the flow of private benefits of control. Then, an increase in initial capital to $K_0^{'} = K_1$ does not influence the relative attractiveness of expropriation, as compared to the devolution in the next period. Indeed, as mentioned above, the decisions made in the latter economy at time t replicate the decisions made in the former at time $t+1$, so the Ruler of the economy starting with $K_0^{'}$ still prefers expropriation at any $t' > 0$. Therefore, the institutions are fully determined by the Ruler's devolution decision in period $t = 0$. Note that the Ruler's devolution payoff is increasing in the level of the initial capital, while the flow of private benefits of control is constant. As $K_0^{'} = K_1 > K_0$, the devolution of power in period $t = 0$ in the latter economy brings the Ruler as much as the devolution in period $t = 1$ in the former economy, which is higher than the payoff to devolution in the initial period in the former economy:

$$U\left(D_0|K_0'\right) = U\left(D_1|K_0\right) > U\left(D_0|K_0\right).$$

Hence, it may be the case that the devolution payoff at $K_0^{'}$ exceeds the flow of private benefits of control and thus, in the latter economy, the devolution of power occurs in the very initial period $t' = 0$.

The above discussion implies the following corollary.

Corollary 3 *Economies with lower level of initial capital are more likely to be locked in an underdevelopment trap.*

An underdevelopment trap equilibrium outcome can only arise in an economy where the set parameters $(\alpha, A, \beta, \tau_D, \tau_A, b) \in \Omega_U$, so that the Ruler never prefers devolution over expropriation. As shown above, among these economies, higher initial capital leads to early devolution and growth, while lower capital blocks the economic and institutional development.

Now consider a technological change – an increase in the total factor productivity parameter A. Intuitively, a country with a higher total factor productivity has a higher growth rate in each period and steady-state capital. So, at each point in time, this country's future growth potential weakens the incentives to expropriate. As a result, we expect the devolution of power to be delayed. On the other hand, the value of devolution relative to the value of expropriation increases with TFP (e.g. due to a higher growth rate in each period). Thus, higher total factor productivity may improve the chances for eventual devolution in economies in an underdevelopment trap.

Proposition 6 *If an economy is in the underdevelopment trap, higher total factor productivity may create the devolution of power and growth. For two growing economies, an economy with higher total factor productivity, other things equal, experiences later devolution of power.*

Proof. See the Appendix. ∎

Other things equal, higher total factor productivity translates into a higher growth rate. Hence, we have an immediate Corollary:

Corollary 4 *Among growing economies, autocracies are more likely to experience higher growth rates than are less autocratic regimes.*

An increase in labor intensity α or in discount factor β has an ambiguous effect.

Comparing the results of Propositions 5 and 6 we see that different components of initial income have opposite effects on the timing of the devolution of power - higher initial capital causes earlier devolution while higher total factor productivity delays it. This may explain why recent panel-data studies find no effect of income on democracy (e.g. Acemoglu et. al (2005)) or on the hazard rate out of autocracy (Persson and Tabellini (2006)) once they control for country fixed effects. Indeed, the model predicts a non-linear effect of the two components of income, to capture which one would need to include an interaction term between income and an indicator for high TFP into a democracy regression. This interaction term would have a negative predicted sign.

On the other hand, a long-run effect between the income and growth that arises in the Acemoglu et. al (2005)'s regression (and produces the well-known cross-country correlation between income and democracy) reflects different development paths for different countries. In our model it would be captured by the set of the exogenous (including institutional) factors, such as the existence of the devolution mechanism, private benefits of control etc.

Next, let us address the impact of private benefits of control on the devolution of power. The Ruler retains the benefits of control only while being in power, whereas these benefits are no longer available to her after devolution. Thus, private benefits do not influence the Ruler's trade-off between early and late expropriation. Instead, they only have an impact on the Ruler's incentive to devolve. If the benefits are low, the Ruler can delay devolution for a long time, because the Citizen realizes that the Ruler will not cling to power the day she needs to commit not to expropriate to avoid losing investment. On the contrary, if private benefits of control are very high, the Ruler will not be willing to ever give up power, no matter how much capital accumulation is lost. Recognizing this, the Citizen never invests in the market sector and there is neither devolution nor growth. Thus, an abundance of natural resources has a detrimental effect on growth. In the intermediate range, as the private benefit of control increases, the Ruler's relative incentive to expropriate, as opposed to devolution, increases too. As a result, in order to keep capital accumulation going, the Ruler needs to devolve earlier since, at later stages, she always prefers to stay in power, and no commitment is possible. Thus, in this range, an increase in private benefits speeds up the devolution of power. Therefore, the model predicts a non-linear effect of the private benefits of control on the devolution of power. This prediction of the model parallels the arguments of the resource curse literature – that abundant natural resources may hinder growth[13] and capital accumulation.[14] Moreover, it suggests that the resource curse should also be non-linear: an increase in resource size does not have any impact on growth, until the resource rents become sufficiently large to completely kill growth.[15] We summarize our findings in the following Proposition.

Proposition 7 *If the Ruler's private benefits of control are sufficiently small, an increase in the private benefits causes earlier devolution of power. Eventually, a further increase in the private benefits of control locks an economy in an underdevelopment trap with neither growth nor devolution.*

[13] E.g. see Sachs and Warner(1995) and Gylfason (2001)

[14] See Gylfason and Zoega (2001)

[15] A non-linear (negative) effect of the resource curse on growth is found by e.g. Sala-i-Martin and Subramanian (2003)

Proof. See the Appendix. ■

Note that the maximum post-devolutionary tax τ_D available to the Ruler and the private benefits of control are two sides of the same coin. That is, both of them reflect the Ruler's loss associated with giving up power. Thus, the effect of τ_D should be similar to that of the benefit of control. Indeed, a higher post-devolutionary tax rate makes the devolution option more attractive relative to the expropriation. Thus, the Ruler can credibly postpone devolution without jeopardizing industrialization. On the other hand, if the Ruler's payoff after devolution is very low (or very uncertain), she has no incentive to devolve and the economy is in the underdevelopment trap.[16] For such an economy, a sufficient increase in τ_D will cause an eventual devolution of power.

Proposition 8 *If the post-devolutionary tax rate τ_D is sufficiently low, the economy is locked in the underdevelopment trap. An increase in the post-devolutionary tax rate first causes devolution to occur and then delays it.*

Proof. See the Appendix. ■

Similarly, a change in the cost of taxation $\phi(.)$ inducing an increase in τ_A and Ruler's tax revenues received under autocracy has the same impact on the timing of devolution as an increase in τ_D. (Here we only consider an increase in τ_A which does not change the Ruler's incentive to expropriate in the steady state, and the incentive of the citizen to stay in the market as long as there is no expropriation, so that the assumption of Lemma 3 and condition (7) continue to hold). This result has a very simple explanation. When the Ruler decides whether or not to expropriate, she weights the expropriation payoff against the payoff from non-expropriation today and devolution next period. If she chooses to devolve, she retains the today's autocratic tax revenue and receives the devolution payoff from tomorrow onwards. Therefore, by expropriating at period t, she foregoes the tax revenue $\varepsilon_A y_t$. The higher is this revenue, the weaker are her incentives to expropriate and the longer she can stay in power without using the commitment device. On the other hand, if the economy is locked in an underdevelopment trap, the tax revenues from capital accumulation under autocratic regime are too low to persuade the Ruler to forgo the private benefits of control. In this case an increase in τ_A may bring about an eventual devolution.

Proposition 9 *If the autocratic tax rate τ_A is sufficiently low, the economy is locked in the underdevelopment trap. In this case a change in the cost of taxation $\phi(.)$ inducing an increase in τ_A causes eventual devolution of power. In a growing economy an increase in τ_A delays devolution..*

[16]E.g. consider an extreme case when the Ruler cannot be credibly guaranteed any post-devolutionary payment from the citizen.

Proof. See the Appendix. ■

To illustrate our findings, we consider numerical simulations with parameters $A = 1$, $\alpha = 0.36$, $\tau_D = 0.35$, $\tau_A = 0.4$ and $\beta = 0.7$.[17] In figure 2, we graph the set of

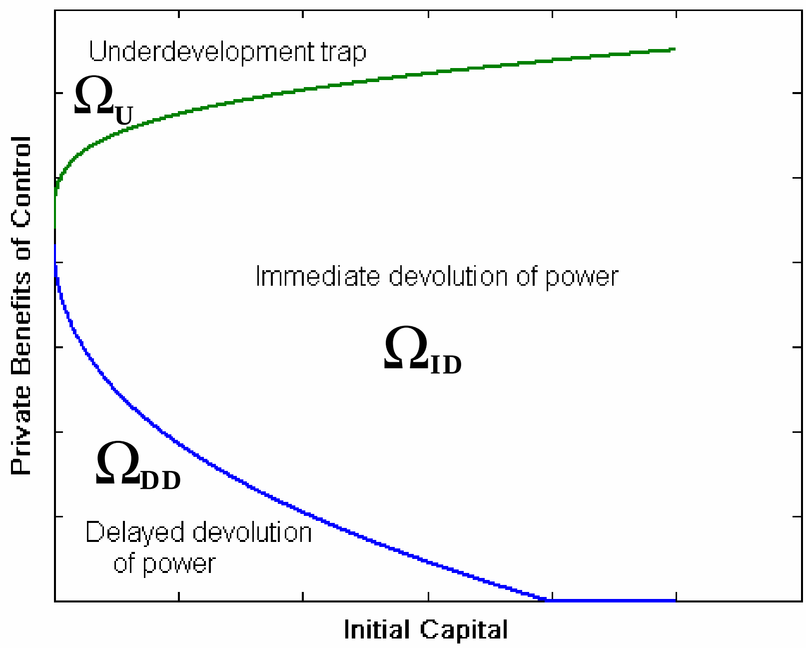

Figure 2. Development trajectories

equilibria in our economy as a function of the initial capital and the private benefits of control. We see that low values of initial capital and private benefits of control result in an equilibrium with delayed devolution of power. An increase in either initial capital or the benefit of control brings the economy into the area of immediate devolution of power. A further increase in the private benefit of control leads to the "underdevelopment trap" equilibria with neither growth nor devolution of power.

What are the predictions on the relationship between growth and the political regime? In our model, depending on the parameter values, there are two possible regimes: Either an economy is locked in the underdevelopment trap and neither growth nor devolution occurs, or the economy sustains an autocratic regime at higher growth rates and devolves as growth slows down. Thus, we see that the dictatorships are characterized either by no growth or by high growth rates, while less autocratic regimes fall in an intermediate range. The source of this cross-sectional variation may be different

[17]The values of A and a are standard for numerical simulations of the Ramsey model. The value of the time discount β captures the fact that in our model we have complete depreciation over one period.

initial conditions, different stages of development (that is, the time of acquiring the technology) or a difference in technology per se. This prediction is consistent with the finding of Almeida and Ferreira (2002), who show that the cross-country variability of growth rates is higher among autocracies, and that autocracies are likely to be the best and the worst performers in terms of growth.

Second, according to the model, devolution of power is often preceded by several periods of growth. Therefore, it may look as if, in line with the results of Barro (1999) and others, the model establishes a causal relationship from growth to democratization, at least in the Granger-sense. But this conclusion is misleading: in the model, institutions of limited government and growth are determined simultaneously and endogenously. Indeed, if the institutions facilitating the devolution of power are missing in an economy, so that the power cannot be credibly relinquished, growth will not occur. On the other hand, in the absence of growth opportunities, the government would never self-impose any checks and balances. Therefore, the observed time pattern between growth and democratization does not necessarily reflect a causal relation.

6 Some cross-country and case studies

In this section, while not aiming at systematic empirical analysis, we relate the predictions of the model to a few observed patterns. As a preliminary step, we try to replicate the pattern of Figure 2, which links the initial capital and private benefits of control to the institutional transformation. For a set of countries, we plot the proxy of the initial capital against the proxy of the private benefits, grouping the countries by the time of their first institutional improvement after 1820. We approximate initial capital by the logarithm of a country's GDP per capita in 1820, taken from "Historical Statistics for the World Economy" by Madisson (2006), where year 1820 is chosen as the earliest year for which the GDP data is available for a decent number of countries. Private benefits of control are approximated by the country's abundance of natural resources, which is in turn proxied by the share of natural resources in total export in 1970 taken from Sachs and Warner (1995). We define institutional improvement as the increase by a minimum of 3 units in the Constraints on Executive variable from Polity IV data set. The result is presented in Figure 3.

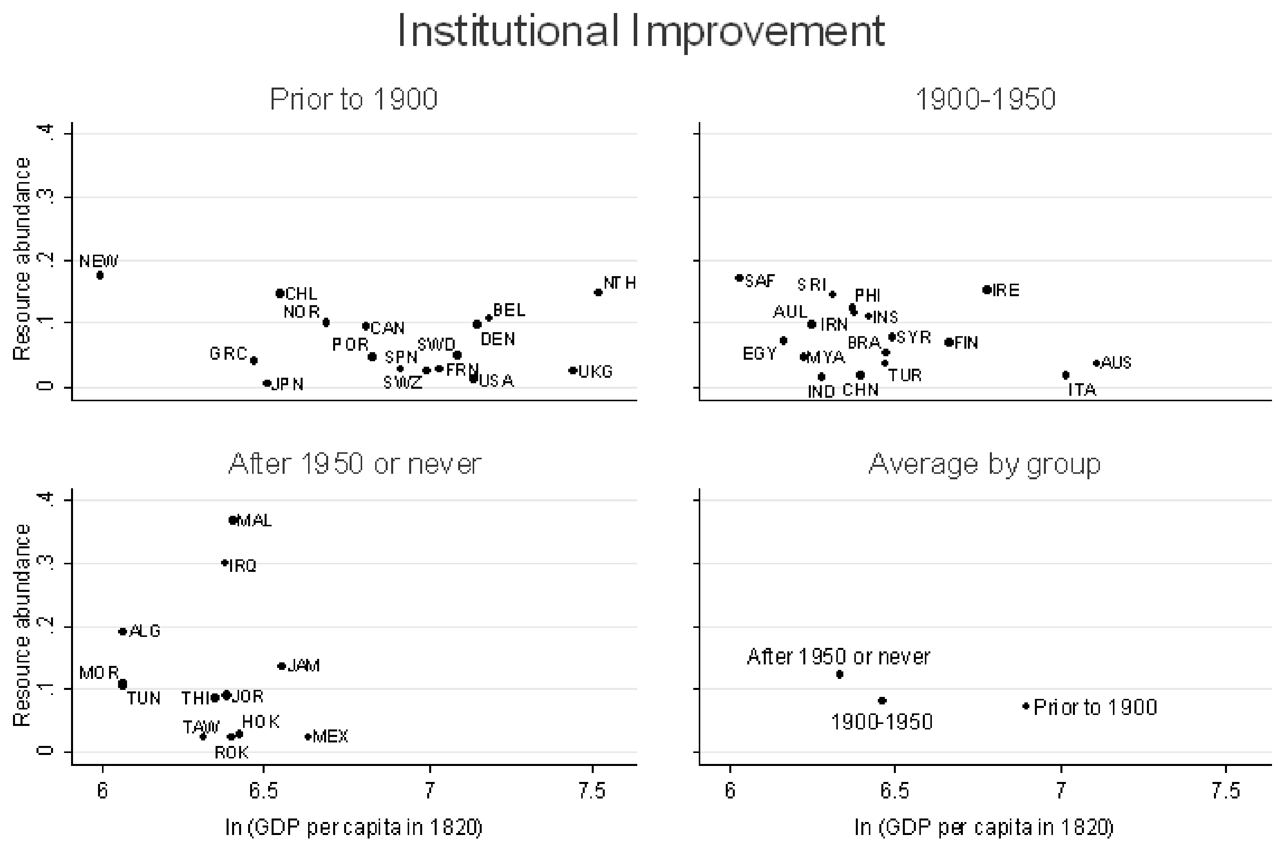

Figure 3.
– Institutional improvement is measured as an increase by a minimum of 3 units in the Constraints on executive (XCONST) variable from Polity IV data set. It ranges from 1 to 7, with higher values corresponding to more constrained executive. Countries that had XCONST$\geq$4 by the initial time of entry into the Polity IV database are classified as having their first institutional improvement at the moment of entry.
– Initial capital is proxied by the log of a country's GDP per capita in 1820 (Maddison (2006))
– Private benefits of control are measured by the country's abundance of natural resources (which is proxied by the share of natural resources in total export in 1970).

We see that, indeed, countries that have higher initial capital and moderate levels of natural resources experience earlier institutional change. In particular, countries that improved their institutions before 1900 are concentrated in the south-east corner of the figure. Countries that experienced institutional improvement between 1900 and 1950, tend to have lower capital, concentrating in the south and south-west part of the figure. Finally, countries that had their first increase in Polity after 1950 and countries that did not ever face an increase in Polity occupy the south-west and the north-west part of the picture with low initial capital and/or higher natural resources. Therefore, the data roughly corresponds to the model-generated Figure 2. However, we must mention that data on natural resources in 1820 (which is taken to be the basis year) is not available. With the use of resource data from 1970, we are likely to end up with a notably noisy diagram.

Therefore, we proceed by discussing a few cases providing support to the patterns predicted by the model. The model generates two general classes of development trajectories: either the economy stagnates under an autocratic rule, or it starts growing. In the latter case, the economy may experience early or late devolution of power.

There are numerous examples of countries stagnating under a kleptocratic autocracy. Consider, for example, the Democratic Republic of the Congo (former Zaire). This country, abundant in natural resources such as diamonds, uranium, copper and cobalt, until very recently was suffering from extreme inequality and poverty, having an average per capita GDP growth of –2.8% over the last 30 years (see Figure 4). For 32 years (1965-1997), it was under the dictatorship of Joseph Mobutu-Sese Seko. He started his rule by nationalizing foreign-owned firms and handing their management to relatives and close associates who stole the companies' assets. He captured the control over the resource sector and heavily exploited it. By the early 1980s, his personal wealth was estimated at $5 billion (Leslie 1987), while the rest of the country was basically a subsistence economy (only five per cent of the population were estimated to work in the formal sector during the 1990's). Why was this stagnant path chosen? We propose a two-fold answer: The private benefits of being in control of such a resource-rich economy were high. In addition, there was no institutional way in Congo to guarantee Mobutu a sufficient part of the returns (including the natural sector rents) in case he were to limit his expropriative power.[18] Therefore, Mobutu was willing to forgo the potential future gains from capital accumulation for the immediate benefits of the resource extraction.

Let us turn to the examples of devolution. Given the model's somewhat Marxian

[18] In this sense, Congo differed markedly from Botswana where, as argued by Acemoglu et al. (2003), the institutional reforms were not challenging the stability of the elite.

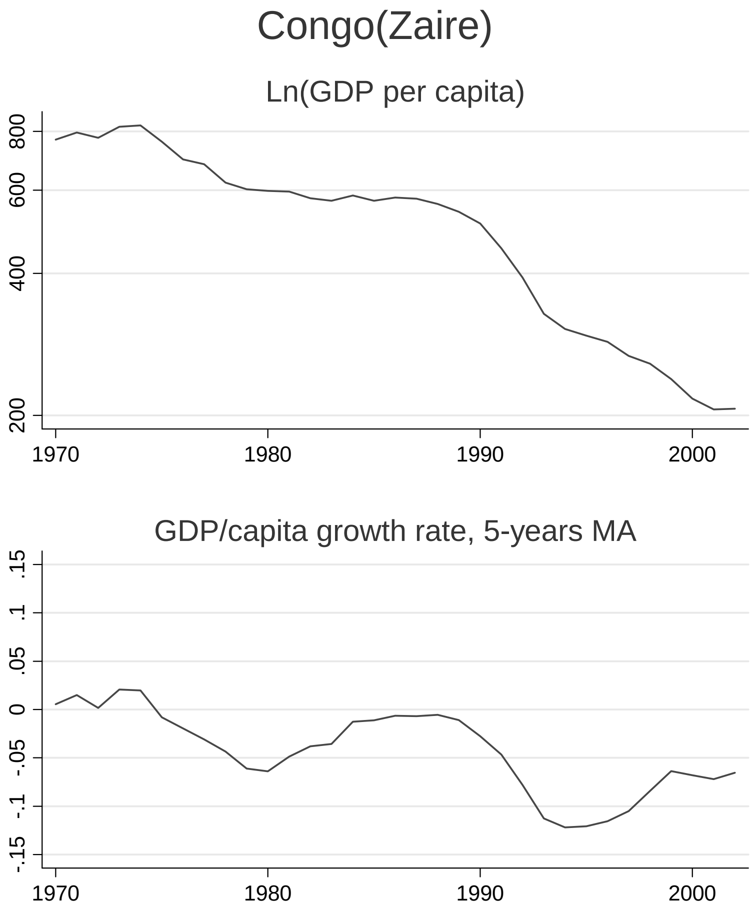

Figure 4.

spirit, notably that the change of regime is caused by capital accumulation, it is natural to look for supportive evidence in the historical examples of bourgeois state transformations. Consider the Glorious Revolution of 1688 in Britain. As argued in the seminal paper of North and Weingast (1989), the Glorious Revolution established the institutions of limited autocracy, allowing the government to credibly commit to secure property rights and eventually leading to economic growth. However, the historical data on economic growth in Britain (see Figure 5) suggests that not only did the economy start to grow well before the end of the 17th century but, more interestingly, the growth rates were declining towards the time of the Glorious Revolution and not accelerating until another 50 years after it. That is, the constraints on autocratic power brought by the Glorious Revolution were imposed in the declining growth phase of development, which supports the proposed mechanism.[19]

[19] Obviously, the reality is much more complex than the model. We cannot claim that it was

From Clark (2005), ch. 10 fig. 4.
Dotted line corresponds to the growth rate of real output per year from the previous decade.
Solid line corresponds to a 50-year moving average

Figure 5.

There are, however, more recent examples allowing us to observe the devolution mechanism in practice. Singapore, being a one-party state with Prime Minister Lee Kuan Yew holding his position from 1959 to 1990, is believed to be quite authoritarian. (The Polity IV database measures the constraints on executive power by 3 out of 7). However, as documented by Yap (2003), there are several episodes in the recent history of Singapore when the government creates commitment mechanisms to avoid private sector divestment. Consider, in particular, the period 1985-1986. As can be seen

(only) the slowdown in growth that caused the institutional transformation. Many other factors and shocks were probably involved. In addition, while the confiscatory power of the Crown clearly existed (and was exercised in the first half of the 17th century through forced loans, enclosure fines etc.), it is not clear what is the empirical counterpart of the model's expropriation and accumulation of assets. One potential candidate would be investments in the quality of land (such as enclosures and the development of new agricultural techniques), being hampered by heavy and unpredictable taxation. Alternatively, it could be argued that the expansion of the East India Company, and its close association with the Crown (see, e.g., Pincus (2002), had put at risk established trade and trade-related capital.

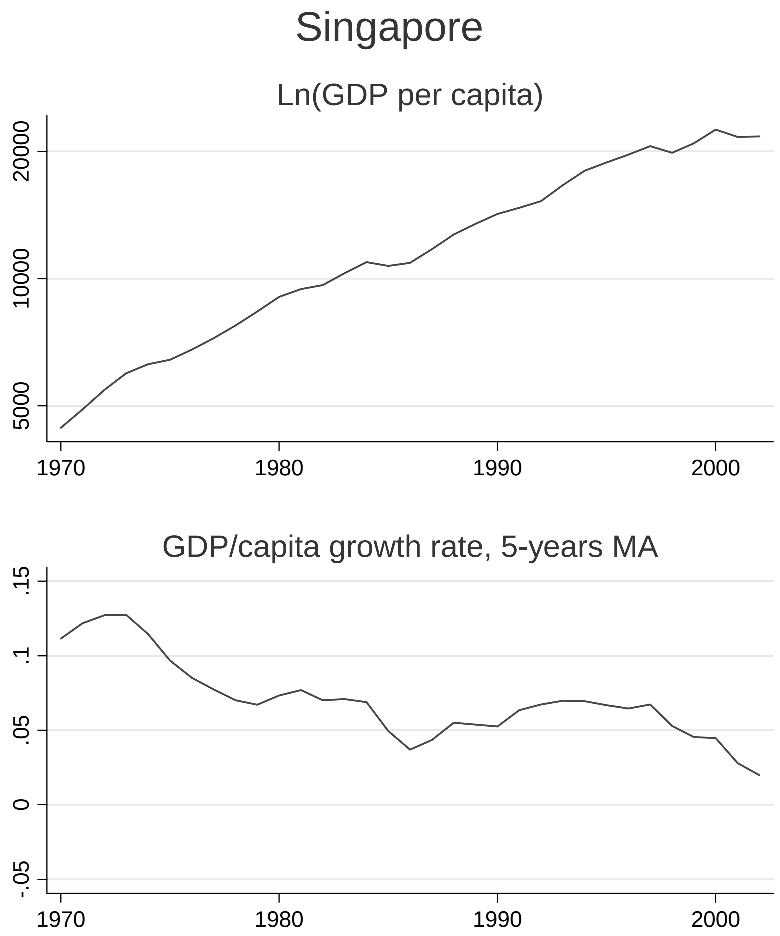

Figure 6.

from Figure 6, the per capita GDP growth rates in Singapore were declining from the early 1970 towards the mid-1980s. In 1985, after a period of growth rate decline, the government introduced several policy changes aimed at increasing the private sector's monitoring of and participation in policy setting. To name just a few, the government replaced the Finance Minister with a former private sector leader, while returning budgetary policy-making to the Finance Ministry. It pursued a policy of divestment of state ownership in the public-private joint-ownership enterprises. It created an Economic Review Committee, comprising six business representatives and six government representatives to reexamine the government's ten-year Economic Development Plan. While these measures did not change the actual political regime in Singapore, they clearly imposed additional constraints on the government's authority, demonstrating its commitment to non-expropriative policies. Moreover, the attempts to improve the credibility were not a regular practice of the Singaporean government (Yap (2003)), but rather a peculiar characteristic of some historical episodes. This piece of evidence, and especially its timing, illustrates the delayed devolution trajectory.

7 Conclusions and Extensions

We have built a model that addresses the interplay between devolution of political power and economic growth. The model suggests that if there are decreasing returns to capital accumulation, the ruler will be tempted to expropriate at high levels of capital and lower levels of growth. Foreseeing this, the investors cease to invest unless the ruler credibly commits not to expropriate. If being in power is not associated with high private benefits, the ruler self-imposes institutional checks and balances to protect entrepreneurs' property rights. In this case, the devolution of power occurs after a period of sustained growth, unless the initial capital is so high that the ruler is tempted to expropriate even before growth starts. In the latter case, devolution of power precedes growth. If instead the benefits of control are high, the autocrat sacrifices capital accumulation to keep these benefits. Such an economy never develops.

The model can be extended in several directions. One extension is to study how competition between rulers influences the incentives to cling to power. The threat of being overthrown tomorrow increases the relative value of current payoff and strengthens the incentive to expropriate which, in turn, is recognized by the private sector. This leads to earlier devolution. At the same time, the prospects of future devolution weaken the incentives to cling to power. Therefore, in our setting, competition for power is expected to yield earlier devolution in growing economies. The intensity of the power struggle would also depend on the development path – stagnating economies are expected to face more violent power conflicts, while growing economies would experience less violent conflicts as the time of devolution approaches. Alternatively, one can study oscillating regimes, allowing for a conflict technology so that citizens can replace the ruler and the ruler can mount a coup to return to power.

Another extension is to consider different types of growth. If growth is driven by improvement in the quality of products, each of the products is on the market only for a limited period of time. Thus, the incentive to grab for a ruler increases as the product may not be around tomorrow. This would lead to earlier devolution of power. One important prediction of this extension would be as follows: Acemoglu, Aghion and Zilibotti (2003) suggest the growth strategy of less developed countries is investment-based, while more developed economies switch to innovation-based growth. Thus, we may expect earlier devolution of power in more technologically advanced countries.

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A Appendix

A.1 Proof of Lemma 3

We analyze the subgame starting at stage 3 of some period t. At this stage, the Ruler is choosing between immediate expropriation and possible continuation options. For the reasons we mentioned in informal proof, the continuation games to be taken into consideration are those where the game "ends" by the devolution of power at some future period $t+\widetilde{t}$ or continues forever. More precisely, all continuation strategies consistent with SPNE belong to the set:

$$S_t \equiv \left\{ \left\{ s_t^{D_{t+\tilde{t}}} \right\}_{\widetilde{t}=1,2,..}, s_t^{ND} \right\} \tag{14}$$

where

$$s_t^{D_{t+\tilde{t}}} \equiv \left(\tau_t, ND_{t+i}, NE_{t+i}, \tau_{t+i}\ i=1,..\widetilde{t}-1\ ,\ D_{t+\widetilde{t}}\right), \widetilde{t}=1,2,...;$$

are all continuation strategies where taxation is followed by the devolution of power in period $\widetilde{t}$, and

$$s_t^{ND} \equiv (\tau_t, ND_{t+i}, NE_{t+i}, \tau_{t+i},\ i=1,..\infty)$$

denotes a strategy, where devolution never occurs and taxation is continued forever.

We start by finding the maximum payoff the Ruler can get if she taxes forever. As the Citizen has the option of leaving the market, the Ruler's payoff cannot exceed the payoff characterized in Lemma 1.[20] That is, the maximum utility of the Ruler in the case of eternal taxation cannot be higher than

$$U\left(s_t^{ND}\right) \le \sum_{i=t}^{\infty} \beta^{i-t} \varepsilon_A A K_i^{\alpha} + \frac{b}{1-\beta} \equiv \overline{U}_t.$$

Consider now instead the continuation games where the Ruler eventually devolves. Once more, we are interested in the maximum payoff the Ruler can achieve in such a continuation game. Note that this problem differs from the problem faced by the Ruler under eternal taxation by an additional constraint on post-devolutionary taxes; after the devolution, the tax rate is determined by the SPNE and is equal to τ_D. Thus, we can conclude that the maximum payoff achieved by the Ruler in such a continuation game cannot be greater than that under eternal taxation

$$U\left(s_t^{D_{t+\tilde{t}}}\right) \le \overline{U}_t \qquad \widetilde{t}=1,2,...$$

Now, we are ready to discuss the choice of the Ruler at stage 3 of some period t. Let us show that for sufficiently large t, the Ruler prefers expropriation over any other

[20] Including Citizen's participation constraints into the Ruler's optimization problem can only add some additional restrictions and decrease the Ruler's maximum utility.

continuation strategy. We have just seen that the best continuation strategy for the Ruler brings her no more than $\overline{U}_t$.

The value of expropriating at t is

$$U(E_t) = AK_t^\alpha + \sum_{i=t}^{\infty} \beta^{i-t} b = y_t + \frac{b}{1-\beta}.$$

Denote by σ a positive constant

$$\sigma \equiv 1 - \frac{\varepsilon_A}{(1-\beta)} > 0.$$

As long as y_{t+1} is sufficiently close to y^*, so that $\Delta y_{t+1} = y^* - y_{t+1}$ is sufficiently small, we see that the maximum of the Ruler's payoff in any continuation game is always less than her payoff of expropriating at t. Indeed, the difference between the Ruler's expropriation payoff and the maximal Ruler's payoff in any continuation game is

$$\begin{aligned}
& U(E_t) - \overline{U}_t \\
= \; & y_t - \sum_{i=t}^{\infty} \beta^{i-t} \varepsilon_A A K_i^\alpha \\
> \; & y_t - \sum_{i=t}^{\infty} \beta^{i-t} \varepsilon_A y^* \\
= \; & y_t - \frac{\varepsilon_A}{1-\beta} y^* \\
= \; & y_t - y^* + \left(1 - \frac{\varepsilon_A}{1-\beta}\right) y^* \\
= \; & \sigma y^* - \Delta y_{t+1} > 0,
\end{aligned} \tag{15}$$

where the inequality in (15) follows from the fact that $y_i = AK_i^\alpha$ increases towards y^*, and thus for any i

$$y_{t+1} < y_{t+1+i} < y^*.$$

That is, there exists such a time period T that in any SPNE, the Ruler chooses to expropriate at date T.

A.2 Proof of Lemma 4

The difference between the payoff from non-expropriation and the payoff from expropriation in period t is given by

$$U\left(NE_t, \tau_A, D_{t+1}\right) - U\left(E_t\right) = \varepsilon_D \sum_{i=1}^{\infty} \beta^i y_{t+i} - \left(1 - \varepsilon_A\right) y_t - B, \tag{16}$$

where B denotes the flow of the private benefits of control as of tomorrow, $B = b\beta/(1-\beta)$.

As the taxation in our model does not influence the capital development path, a capital level in each time period $t+i$ is

$$K_{t+i} = (\alpha\beta A)^{\frac{1-\alpha^i}{1-\alpha}} (K_t)^{\alpha^i} \tag{17}$$

and the output is

$$y_{t+i} = AK_{t+i}^{\alpha} = A(\alpha\beta A)^{\alpha\frac{1-\alpha^i}{1-\alpha}} (K_t)^{\alpha^{i+1}}. \tag{18}$$

Thus, equation (16) is equivalent to

$$U(NE_t, \tau_A, D_{t+1}) - U(E_t) = \varepsilon_D A \sum_{i=1}^{\infty} \beta^i (\alpha\beta A)^{\alpha\frac{1-\alpha^i}{1-\alpha}} (K_t)^{\alpha^{i+1}} - (1-\varepsilon_A) AK_t^{\alpha} - B.$$

Let us introduce an auxiliary continuous function of the capital

$$F(k) = \varepsilon_D A \sum_{i=1}^{\infty} \beta^i (\alpha\beta A)^{\alpha\frac{1-\alpha^i}{1-\alpha}} k^{\alpha^{i+1}} - (1-\varepsilon_A) Ak^{\alpha} - B.$$

Note that $F(K_t)$ represents the difference between the Ruler's value of non-expropriation in period t, followed by devolution at stage 1 of period $t+1$, and expropriation at stage 3 of period t as a function of the capital K_t. We study how this function changes with k. The derivative of $F(k)$ declines over time, being positive around zero and negative at the steady state capital K^*. Indeed,

$$\begin{aligned} \frac{\partial F(k)}{\partial k} &= \frac{\alpha}{k}\left[\varepsilon_D A \sum_{i=1}^{\infty} \beta^i \alpha^i (\alpha\beta A)^{\alpha\frac{1-\alpha^i}{1-\alpha}} (k)^{\alpha^{i+1}} - (1-\varepsilon_A) Ak^{\alpha}\right] \\ &= \frac{\alpha A}{k^{1-\alpha}}\left[\varepsilon_D \sum_{i=1}^{\infty} \beta^i \alpha^i (\alpha\beta A)^{\alpha\frac{1-\alpha^i}{1-\alpha}} (k)^{\alpha(\alpha^i-1)} - (1-\varepsilon_A)\right]. \end{aligned}$$

As $k \to 0$, the expression in square brackets becomes infinitely large. On the other hand, at $k = K^*$, the expression in brackets equals

$$\varepsilon_D \frac{\alpha\beta}{1-\alpha\beta} - (1-\varepsilon_A) < \varepsilon_A \frac{1}{1-\alpha\beta} - 1 = \frac{\tau_A - \phi(\tau_A)}{1+\tau_A} - 1 < 0.$$

As $F'(k)$ is also continuous, there exists a threshold value $\tilde{k}$, such that

$$\begin{aligned} \frac{\partial F(k)}{\partial k} &\geq 0, k \leq \tilde{k} \\ \frac{\partial F(k)}{\partial k} &\leq 0, k > \tilde{k} \end{aligned}$$

and, consequently, $F(k)$ increases for $k \leq \tilde{k}$, reaches its maximum at $\tilde{k}$ and decreases for $k > \tilde{k}$. Note that $F(0) = -B \leq 0$ and

$$F(K^*) = A\,(K^*)^{\alpha}\left(\frac{\varepsilon_D}{(1-\beta)} - 1\right) - B < 0.$$

Therefore, if in the economy in consideration $K_0 > \tilde{k}$, the peak of the expression $U\left(NE_t, \tau_A, D_{t+1}\right) - U\left(E_t\right)$ corresponds to period $\widetilde{t} = 0$. If instead $K_0 < \tilde{k}$, the maximum of $U\left(NE_t, \tau_A, D_{t+1}\right) - U\left(E_t\right)$ is achieved in period $\widetilde{t}$, such that

$$\left|K_{\widetilde{t}} - \widetilde{k}\right| = \min_t \left|K_t - \widetilde{k}\right|.$$ [21]

A.3 Proof of Lemma 5

Consider the difference between the ratio of devolution payoff to the payoff to expropriation, both net of private benefits of control, for two subsequent periods

$$\frac{U\left(NE_{t-1}, \tau_A, D_t\right) - b}{y_{t-1}} - \frac{U\left(NE_{t-2}, \tau_A, D_{t-1}\right) - b}{y_{t-2}} = \varepsilon_D \sum_{i=0}^{\infty} \beta^{i+1}\left[\frac{y_{i+t}}{y_{t-1}} - \frac{y_{i+t-1}}{y_{t-2}}\right].$$

As the growth rate of output is decreasing,

$$\frac{y_t}{y_{t-1}} > \frac{y_{i+t}}{y_{i+t-1}}$$

if and only if

$$\frac{y_{i+t}}{y_t} - \frac{y_{i+t-1}}{y_{t-1}} < 0.$$

The latter condition is equivalent to

$$\frac{U\left(NE_{t-1}, \tau_A, D_t\right) - b}{y_{t-1}} - \frac{U\left(NE_{t-2}, \tau_A, D_{t-1}\right) - b}{y_{t-2}} < 0.$$

A.4 Proof of Lemma 6

The Ruler's expropriation payoff is

$$U\left(E_{\widehat{t}-1}\right) = y_{\widehat{t}-1} + \frac{b}{1-\beta}.$$

If she does not expropriate, she sets tax τ_A and receives private benefits for periods $\widehat{t}-1$ and $\widehat{t}$, and devolves at stage 1 of period $\widehat{t}+1$

$$U\left(NE_{\widehat{t}-1}, \tau_A, ND_{\widehat{t}}, NE_{\widehat{t}}, \tau_A, D_{\widehat{t}+1}\right) = \varepsilon_A y_{\widehat{t}-1} + b + \beta\left[U\left(NE_{\widehat{t}}, \tau_A, D_{\widehat{t}+1}\right)\right]. \quad (19)$$

Using inequality (9), we see that the payoff from taxing at $\widehat{t}-1$ and $\widehat{t}$ and devolving at $\widehat{t}+1$ is higher than that from taxing at $\widehat{t}-1$ and expropriating at $\widehat{t}$

$$\begin{aligned} U\left(NE_{\widehat{t}-1},\tau_A,ND_{\widehat{t}},NE_{\widehat{t}},\tau_A,D_{\widehat{t}+1}\right) &> \varepsilon_A y_{\widehat{t}-1}+b+\beta U\left(E_{\widehat{t}}\right) \\ &= \varepsilon_A y_{\widehat{t}-1}+b+\beta\left[y_{\widehat{t}}+\frac{b}{1-\beta}\right] \\ &= \varepsilon_A y_{\widehat{t}-1}+\beta y_{\widehat{t}}+\frac{b}{1-\beta}. \end{aligned}$$

If we can now show that in period $\widehat{t}-1$, the growth rate is sufficiently high, so that the Ruler gains by taxing and postponing expropriation by one period

$$\varepsilon_A y_{\widehat{t}-1}+\beta y_{\widehat{t}} > y_{\widehat{t}-1}, \tag{20}$$

we can conclude that

$$U\left(NE_{\widehat{t}-1},\tau_A,ND_{\widehat{t}},NE_{\widehat{t}},\tau_A,D_{\widehat{t}+1}\right) > U\left(E_{\widehat{t}-1}\right).$$

We prove that inequality (20) holds by contradiction. Inequality (20) is equivalent to

$$\frac{y_{\widehat{t}+1}}{y_{\widehat{t}}} > \frac{1-\varepsilon_A}{\beta}. \tag{21}$$

Suppose that inequality (21) does not hold, that is

$$\frac{y_{\widehat{t}+1}}{y_{\widehat{t}}} < \frac{1-\varepsilon_A}{\beta}. \tag{22}$$

As we know, at stage 3 of period $\widehat{t}$, the Ruler prefers non-expropriation followed by devolution of power to the expropriation:

$$U\left(NE_{\widehat{t}},\tau_A,D_{\widehat{t}+1}\right) > U\left(E_{\widehat{t}}\right) = y_{\widehat{t}}+\frac{b}{1-\beta}.$$

This implies that her devolution payoff net of the private benefits is higher than the value of the expropriated output

$$U\left(NE_{\widehat{t}},\tau_A,D_{\widehat{t}+1}\right)-b > y_{\widehat{t}},$$

or, equivalently,

$$\varepsilon_A y_{\widehat{t}}+\varepsilon_D\sum_{i=0}^{\infty}\beta^{i+1}y_{i+\widehat{t}} > y_{\widehat{t}}.$$

From Lemma 5, it immediately follows that the same holds at stage 3 of period $\widehat{t}-1$,

$$\varepsilon_A y_{\widehat{t}-1}+\varepsilon_D\sum_{i=0}^{\infty}\beta^{i+1}y_{i+\widehat{t}} > y_{\widehat{t}-1},$$

or equivalently,

$$\sum_{i=0}^{\infty}\beta^{i}\varepsilon_{D}\frac{y_{i+\widehat{t}}}{y_{\widehat{t}-1}}>1-\varepsilon_{A}. \tag{23}$$

Remember that output in our model is growing at a decreasing rate. Using inequality (22), we have

$$\frac{y_{\widehat{t}+i}}{y_{\widehat{t}-1}}=\frac{y_{\widehat{t}+i}}{y_{\widehat{t}+i-1}}\frac{y_{\widehat{t}+i-1}}{y_{\widehat{t}+i-2}}..\frac{y_{\widehat{t}}}{y_{\widehat{t}-1}}<\left(\frac{1-\varepsilon_{A}}{\beta}\right)^{i+1}.$$

As a result, at stage 3 of period $\widehat{t}-1$, the ratio of tomorrow's devolution payoff net private benefits of control to the expropriated output must be below $1-\varepsilon_{A}$. Indeed,

$$\begin{aligned}\sum_{i=0}^{\infty}\beta^{i+1}\varepsilon_{D}\frac{y_{i+\widehat{t}}}{y_{\widehat{t}-1}} &< \sum_{i=0}^{\infty}\beta^{i+1}\varepsilon_{D}\left(\frac{1-\varepsilon_{A}}{\beta}\right)^{i+1}= \\ &= (1-\varepsilon_{A})\frac{\varepsilon_{D}}{\varepsilon_{A}}.\end{aligned}$$

As $\varepsilon_{D}<\varepsilon_{A}$, we conclude that

$$\sum_{i=0}^{\infty}\beta^{i}\varepsilon_{D}\frac{y_{i+\widehat{t}}}{y_{\widehat{t}}}<1-\varepsilon_{A},$$

contradicting inequality (23).

A.5 Proof of Proposition 5

Consider an economy with the initial capital K_0 where the devolution of power occurs at date $\widehat{t}>0$. The fact that devolution occurs in period $\widehat{t}$ means that

$$\begin{aligned}U\left(NE_{\widehat{t}-1},\tau_{A},D_{\widehat{t}}\right)(K_0)-U\left(E_{\widehat{t}-1}\right)(K_0) &> 0,\\ U\left(NE_{\widehat{t}+j-1},\tau_{A},D_{\widehat{t}+j}\right)(K_0)-U\left(E_{\widehat{t}+j-1}\right)(K_0) &< 0, j=1,...,\infty,\end{aligned}$$

or, equivalently,

$$\varepsilon_{D}\sum_{i=0}^{\infty}\beta^{i}y_{\widehat{t}+i}(K_0)-(1-\varepsilon_{A})\,y_{\widehat{t}-1}(K_0)-B > 0, \tag{24}$$

$$\varepsilon_{D}\sum_{i=j}^{\infty}\beta^{i-j}y_{\widehat{t}+i}(K_0)-(1-\varepsilon_{A})\,y_{\widehat{t}+j-1}(K_0)-B < 0, j=1,...,\infty, \tag{25}$$

where B denotes the flow of the private benefits of control as of tomorrow, $B=b\beta/(1-\beta)$

Applying expressions (17) and (18) to conditions (24) and (25) yields

$$\varepsilon_{D}A\sum_{i=0}^{\infty}\beta^{i}(\alpha\beta A)^{\alpha\frac{1-\alpha^{i}}{1-\alpha}}(K_{\hat{t}})^{\alpha^{i+1}}-(1-\varepsilon_{A})\,AK_{\hat{t}-1}^{\alpha}-B > 0, \tag{26}$$

$$\varepsilon_{D}A\sum_{i=j}^{\infty}\beta^{i}(\alpha\beta A)^{\alpha\frac{1-\alpha^{i}}{1-\alpha}}\left(K_{\hat{t}+j}\right)^{\alpha^{i+1}}-(1-\varepsilon_{A})\,AK_{\hat{t}+j-1}^{\alpha}-B < 0, j=1,...,\infty. \tag{27}$$

With the use of the auxiliary function $F(k)$ introduced in the proof of Lemma 4, that set of inequalities (26-27) is equivalent to

$$F(K_{\widehat{t}-1}) > 0, \tag{28}$$
$$F(K_{\widehat{t}+j}) < 0, j = 0, ..., \infty. \tag{29}$$

There are two possibilities:

Case A. If the set of parameters is such that $F(\tilde{k}) > 0$, there exist $\underline{k}$, $\overline{k}$, such that

$$\underline{k} \leq \tilde{k} \leq \overline{k},$$

and

$$F(\underline{k}) = F(\overline{k}) = 0.$$

In such an economy, if the initial capital is sufficiently low ($K_0 < \overline{k}$), the devolution of power occurs in period t such that

$$F(K_{t-1}) > 0,$$
$$K_{t-1} \leq \overline{k},$$
$$K_{t+j} > \overline{k}, j = 0, ..., \infty,$$

which is equivalent to inequalities (28-29).

If the initial capital exceeds $\overline{k}$, the ruler devolves in period $t = 0$.

Case B. Alternatively, if $F(\tilde{k}) < 0$ (or, more weakly, $F(K_t) < 0$ for any $t = 0, ..., \infty$), the Ruler always prefers expropriation over devolution of power. In this case, there is a threshold level of capital k_{UD}, such that the value of devolution at k_{UD} is exactly equal to the value of the flow of private benefits:

$$U(D_0|k_{UD}) = \varepsilon_D A \sum_{i=0}^{\infty} \beta^i (\alpha\beta A)^{\alpha \frac{1-\alpha^i}{1-\alpha}} (k_{UD})^{\alpha^{i+1}} = B.$$

As the devolution payoff increases with capital at the point of devolution, for any levels of initial capital below k_{UD}, the economy is in the "underdevelopment trap" – the capital is not accumulated and the power is never devolved. If initial capital is above k_{UD}, the devolution occurs in the initial period $t = 0$.

Now consider two economies, one starting with the initial capital K_0, and another with the initial capital $K_0' > K_0$, all other things equal. As $K_0' > K_0$, at each point in time, the capital stock (on or off market) of the second country will exceed that of the first country:

$$K_j^{'} > K_j, j = 1, ..., \infty. \tag{30}$$

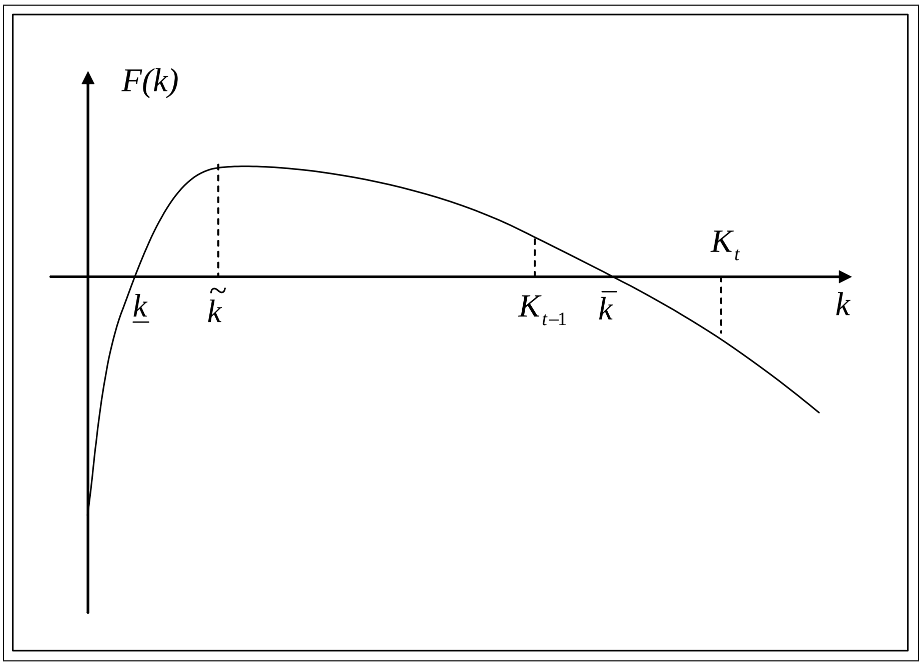

Figure 7. Case A

Start with the analysis of Case A. First assume that the initial capital K_0 is sufficiently high

$$K_0 > \overline{k},$$

so that the devolution of power in this economy occurs in the initial period $t = 0$. It immediately follows that in the economy with the initial capital K_0', satisfying

$$K_0' > K_0 > \overline{k},$$

the devolution of power also occurs at $t = 0$.

Now assume that the initial capital K_0 is not very high so that devolution in the economy with the initial capital K_0 occurs at date $t > 0$, which is equivalent to

$$F(K_{t-1}) > 0,$$
$$K_{t-1} \leq \overline{k},$$
$$K_{t+j} > \overline{k}, \ 0 = 1, ..., \infty.$$

From (30) we conclude that in the economy with the initial capital K_0' devolution cannot occur after period t, as

$$K_{t+j}' > K_{t+j} > \overline{k}, \ j = 0, ..., \infty.$$

Moreover, if the distance between K_0' and K_0 is sufficiently large, it may be the case that $K_t' > \overline{k}$, or, equivalently, that $F(K_t') < 0$, which implies that the devolution in the economy starting with K_0' occurs strictly before period t.

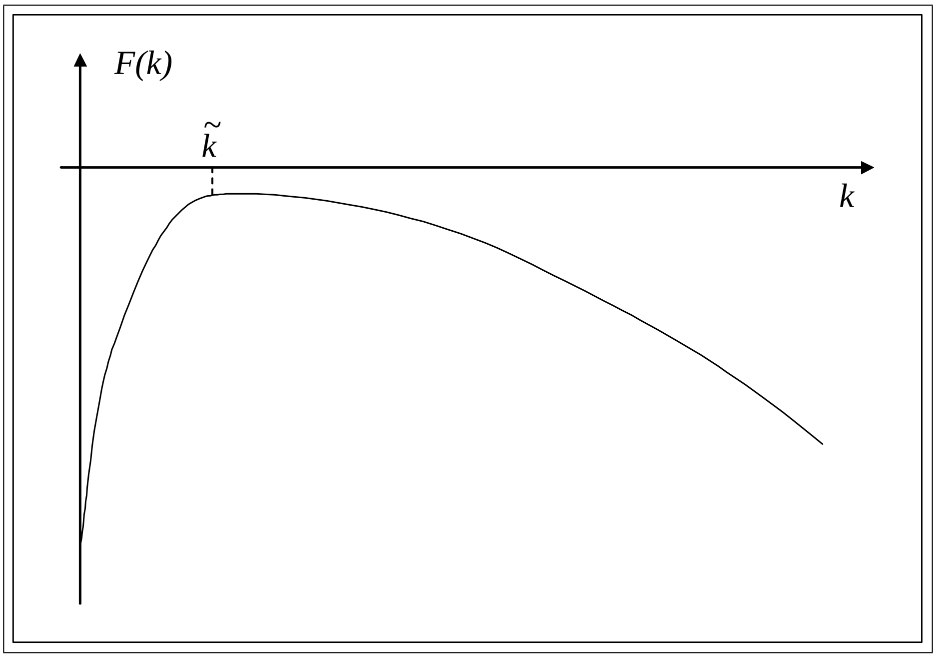

Figure 8. Case B

There is a subtle point in this argument: if the set of parameter values is such that the segment $\left[\underline{k}, \overline{k}\right]$ where $F(k)$ is positive (i.e. the Ruler prefers devolution over expropriation), is too small, it may be the case that a particular capital accumulation path $(K_0', K_1', ...K_t'...)$ " misses" it. That is, there exists a t', such that the capital in period t' is below the "devolution segment" and the capital in period $t'+1$ is above it:

$$K_0' < K_1' < ... < K_{t'}' < \underline{k} \leq \overline{k} < K_{t'+1}' < ...$$

As a result, in such an economy, devolution of power either occurs in the very initial period (if K_0' is sufficiently high) or never takes place. In this case, an increase in initial capital is not necessarily associated with the (weakly) earlier devolution of power. For example, it may be the case that in the economy with the initial capital K_0, the devolution of power occurs at some period $t > 0$ where

$$\underline{k} \leq K_{t-1} \leq \overline{k} < K_t,$$

while in the economy with the initial capital $K_0' > K_0$, no devolution ever occurs. Such a situation is purely an artefact of the discrete nature of our game. One simple way of avoiding it is to assume that the adoption of technology requires a minimum initial capital/savings, this minimum being $K_{0\,\min} = \tilde{k}$ - the point of maximum of $F(k)$.[22]

[22]To make this restriction only depend on the technological parameters, we assume there is a maximum tax $\overline{\tau}_d$ that the Ruler can charge after the devolution of power. As $\tilde{k}(\tau_d)$ decreases in τ_d, we set $K_{0\,\min} = \tilde{k}(\overline{\tau}_d)$.

With this restriction for any initial capital below $K_{0\min}$, the country cannot accumulate capital and get growth going (and thus, no devolution of power ever occurs). If the initial capital is above $K_{0\min}$, $F(k)$ declines for any k and an increase in initial capital always results in a (weakly) earlier devolution of power. In our analysis, we will only consider economies with initial capital above $K_{0\min}$.[23]

In Case B, an increase in initial capital can affect the timing of devolution in only one situation: if K_0 is below the threshold k_{UD} and K_0' is above it. In this case, an increase in initial capital from K_0 to $K_0' > K_0$ entails a change in the timing of devolution: in the economy with K_0, devolution of power never occurs, while the economy with K_0' faces an immediate devolution. If both K_0 and K_0' are below (or above) the "underdevelopment" threshold, a increase from K_0 to K_0' does not have any impact on devolution.

So we conclude that an increase in initial capital leads to a (weakly) earlier devolution of power.

A.6 Proof of Proposition 6

The Ruler devolves at the last point in time such that the devolution payoff exceeds the expropriation payoff (see conditions (24)-(25)). This can be rewritten as

$$\begin{aligned}
\varepsilon_D \sum_{i=0}^{\infty} \beta^i \frac{(\alpha\beta A)^{\frac{1-\alpha^{\hat{t}+i+1}}{1-\alpha}}}{\alpha\beta} (K_0)^{\alpha^{\hat{t}+i+1}} &> \frac{(\alpha\beta A)^{\frac{1-\alpha^{\hat{t}+1}}{1-\alpha}}}{\alpha\beta} (K_0)^{\alpha^{\hat{t}+1}} + B, \\
\varepsilon_D \sum_{i=j}^{\infty} \beta^{i-j} \frac{(\alpha\beta A)^{\frac{1-\alpha^{\hat{t}+i+1}}{1-\alpha}}}{\alpha\beta} (K_0)^{\alpha^{\hat{t}+i+1}} &< \frac{(\alpha\beta A)^{\alpha\frac{1-\alpha^{\hat{t}+j+1}}{1-\alpha}}}{\alpha\beta} (K_0)^{\alpha^{\hat{t}+j+1}} + B \\
& \quad j = 1..\infty,
\end{aligned}$$

where K_0 is initial capital.

Consider the ratio of the Ruler's devolution payoff less the private benefit of control to the value of expropriated output in period t:

$$\frac{U\left(NE_{t-1}, \tau_A, D_t\right)(K_0) - B}{y_t\left(K_0\right)} = \frac{\varepsilon_D \sum_{i=0}^{\infty} \beta^i \frac{(\alpha\beta A)^{\frac{1-\alpha^{t+i+1}}{1-\alpha}}}{\alpha\beta} (K_0)^{\alpha^{t+i+1}} - B}{\frac{(\alpha\beta A)^{\frac{1-\alpha^{t+1}}{1-\alpha}}}{\alpha\beta} (K_0)^{\alpha^{t+1}}}. \tag{31}$$

[23] We believe that this assumption is very restrictive. For example, the numerical simulation for an economy with parameters $A = 1$, $\alpha = 0.36$, $\tau_d = 0.35$, $\tau_a = 0.4$, $\beta = 0.7$ shows that output at $\tilde{k}$ is app. 1.4% of the steady state output and that it takes app. 12 periods to (almost) reach the steady state capital $0.9999K^*$, if the economy starts from $\tilde{k}$. Note that in our model, we have complete depreciation over one period, so a period should be at least 10-15 years, which is also reflected in the value of the discount factor used in simulations.

The devolution of power occurs at the very last moment when this ratio is above 1. Note that the ratio is increasing in the productivity parameter A :

$$\frac{\partial}{\partial A}\left(\frac{U\left(NE_{t-1},\tau_A,D_t\right)\left(K_0\right)-B}{y_t\left(K_0\right)}\right)>0. \tag{32}$$

Consider two economies facing technologies with total factor productivity A and $A'>A$, respectively, and assume that the devolution of power in the former economy occurs at some period $\hat{t}$. Inequality (32) implies that in all time periods when the devolution of power is preferred under productivity A, it is also preferred under productivity A'. Thus, the devolution of power in the economy with A' cannot occur earlier than in $\hat{t}$.

On the other hand, assume that an economy with productivity A is in an underdevelopment trap, so that the ratio (31) is always below 1. By (32), higher productivity A' implies higher ratios (31) for all periods t and may, in fact, result in some of these ratios increasing above 1. Thus, in this case, higher productivity may cause devolution of power and growth.

A.7 Proof of Proposition 7

The higher is B, the lower is $F(k)$ for each level of capital k. Thus, with an increase in B the graph of $F(k)$ shifts downwards and the upper bound of the "devolution segment" $\overline{k}$ declines. Therefore, as the capital accumulation path is not affected by B, the devolution of power occurs at (weakly) lower levels of capital or, equivalently, at earlier periods in time.

If B increases even more, $F(k)$ becomes negative for any k, the "devolution segment" disappears and the economy falls into the "underdevelopment trap".

A.8 Proof of Proposition 8

If τ_D (and thus ε_D) is very low, $F(k)$ is negative for any k, and the economy falls into the "underdevelopment trap".

The higher is τ_D, the higher is $F(k)$ for each capital k. Thus, with an increase in τ_D, the graph of $F(k)$ shifts upwards and the upper bound of the "devolution segment" $\overline{k}$ increases. Therefore, as the capital accumulation path is not affected by τ_D, the devolution of power occurs at (weakly) higher levels of capital or, equivalently, at later periods in time.

A.9 Proof of Proposition 9

If τ_A (and thus ε_A) is very low, there is a parameter range so that $F(k)$ is negative for any k, and the economy falls into the "underdevelopment trap". The higher is τ_A, the higher is $F(k)$ for each capital k. Thus, with increase in τ_A the graph of $F(k)$ shifts upwards. Hence, an increase in τ_A may cause an economy to get out of an underdevelopment trap. In addition with an increase in τ_A. the upper bound of the "devolution segment" $\overline{k}$ increases. Therefore, as the capital accumulation path is not affected by τ_A, for higher τ_A devolution of power occurs at (weakly) higher levels of capital or, equivalently, at later periods in time.