Political violence and endogenous growth

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Abstract

I provide an illustration of a dynamic version of Robert Bates' conjecture that technologies of coercion can be critical to generate prosperity. The model provides support for the conjecture under specified conditions, generates implications for growth paths, including transitions away from coercive strategies, and has implications for the evolution of inequality.

keywords: Political economy of development, conflict, violence, endogenous growth, folk theorem

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1 Introduction

In multiple contributions, Robert Bates has argued that violence and development are intimately connected. The core idea that societies accept violence as a price for prosperity can be found in Bates (1987) (Part I), Bates (2017) (Chapter 2), and Bates (2021) (Chapters 3 and 4). The most thorough formal development is perhaps that found in Bates, Greif, and Singh (2002), where it is shown that a threat of violence can strengthen incentives to engage in productive activity. A strong version of the conjecture places coercion at the heart of development processes. Referencing Weber, Bates (2015) conceives of coercion as the distinctive property of politics and Bates (2001) argues that the relationship between prosperity and violence is the key to understanding the political foundations of development (p 115).

Bates supports the argument that violence—especially when centralized—fosters development using historical evidence from a wide range of settings. The insight provides reinterpretations of the politics of 13th century Mediterranean city-states as well as of accounts of the Nuer in Sudan from Evans-Pritchard (1951), Tonga in Zambia from Colson (1974), and the Alur in Uganda from Southall (2004). And it is used to reinterpret political and economic developments in France and England, where, Bates argues, a "phase change" emerges when private power gives way to public power as "control over violence was vested in the center; and [...] violence was recast in hierarchical form" (Bates 2017, p23).

The argument is also supported by theory. Indeed, the account is primarily theoretical, with the empirics serving more to illustrate the logic than to establish a general regularity or to test a specific proposition. The theoretical accounts describe a state of nature in which in the absence of centralization of violence, economic production is under threat from decentralized violence. Producers either invest jointly in economic production and in the means of violence to protect their production, or they underproduce in order to avoid threats and ensure there is little worth stealing (Bates 2017 p 132).

The theoretical approach builds on a tradition that describes stateless societies as living in a low productivity state and identifies a logic for escaping their condition. In an early version, Mo Zi tells of how the absence of government induced a failure to take advantage of collective benefits and the presence of government induced cooperation through threat of sanctions (Zi 2020, 11.1 p34). The approach is perhaps most closely associated with Hobbes (1994) where the absolute centralization of violence is presented as the only solution to violence in a state of nature (Gauthier 1969).[1] Bates (2001) highlights the similarities between the World Bank's stated mission in Uganda and Hobbes' horror of disorder in the state of nature.

Bates' account builds on these classic treatments but insists that a satisfactory account should be an equilibrium account. An account in which order is simply supplied, as in Zi (2020) or Hobbes (1994) is not satisfactory unless the arrangement ensures that no player has an incentive to deviate. As Bates highlights, these constraints shape what outcomes are plausible: a shift to order might, for instance, require a concentration of benefits sufficient to compel the providers of order to play their part.

[1]More modern treatments are found in Taylor (1982) and Muthoo (2004).

Moreover, departing from some of these classic accounts, Bates' interest is in explaining development processes and not simply in giving an account of (or providing a normative justification for) current arrangements. In multiple contributions Bates documents change. To secure prosperity, decentralized European producers, for instance, moved to "contract for the services of more centralized systems." In this account there are gains from trade, and groups engage experts in violence to provide the security needed to obtain them. In other work, Bates focuses directly on growth—for instance in Nkurunziza and Bates (2003) and his project with the AERC on the political economy of economic growth in Africa (Ndulu et al. 2008).

Despite the interest in developmental processes however, in Bates' theoretical accounts *dynamic* considerations are not explicitly introduced. The equilibria that are identified explain different states of development but not development itself. Thus Bates (2017) (p 130) considers changes to the incentives to predate as income increases, but treats the increases as exogenous. Bates (2021) highlights how equilibria may break and things fall apart but does not include an account of the cause of collapse. The account of prosperity and violence in Bates, Greif, and Singh (2002) relies on comparative statics.

This leaves open historical questions: can the change in regimes be explained by the same logic, or do we require exogenous forces to make sense of development? Put differently: can the interplay of production and violence underpin an endogenous model of growth? It also leaves open questions about the future, such as that posed by Raffinot (2008): if violence explains why we are where we are, can we hope to escape violence at some point?

In the remainder of the paper I address these questions by introducing an endogenous growth model that illustrates Bates' conjecture in a dynamic setting. In this model there can be settings where, absent a technology of violence, citizens never accumulate capital sufficient to spur growth, but when such technology is available there can be growth paths that exhibit transitions from periods with little coercion, limited collective action, and low investment to periods with more coercion, effective collective action, and more investment and, possibly, to periods of prosperity with effective collective action and limited coercion. In this way the model connects violence not just to welfare but to growth. The model has implications for development dynamics and the evolution of inequality.

The next section presents the model. The following section presents two versions of the conjecture. The final section draws implications.

2 A model of public goods and economic growth

I consider a society N of n infinitely lived agents each endowed with initial capital k_0 and a unit of labor. In each period, individuals engage in production and divide production between consumption and savings.

Beyond decisions regarding production, consumption, and savings, individuals can choose to invest in public goods or to invest in destructive technology (or neither). I let $a_{it} \in \{0, 1\}$ denote the decision to invest in public goods at cost c_a at time t and let $v_{it} \in \{0, 1\}$ denote the decision to invest in coercive technology at cost c_v. These costs are taken from production before production is split between consumption and savings.[2]

Contributions to productive technology augment total factor productivity for all individuals. Related ideas are found elsewhere in the literature on endogenous growth. In Alesina and Rodrik (1994), for instance, government expenditure on productive services affects factor productivity (via g in their model); in that model, however, the institutions are exogenous and the question is over the authoritative choice of taxes that will determine g. In Aghion et al. (2016) government taxation, minus graft, generates infrastructure (F) which in turn helps foster innovation (α) again in a context with exogenous institutions. Here the institutions—understood as norms of cooperation and sanctioning—are endogenous.

Substantively we might think of the model as operating at a more micro or more macro level. At a micro level we might think of contributions to the public good corresponding, for instance, to participation in community security against external threats, or contributing to the upkeep of wells or the maintenance of common land. We might also think of contributions as actors *refraining* from extracting assets from others. At a macro level we might think of actors as being political communities that contribute to public goods that are shared across communities, such as a system of justice or the maintenance and protection of trade routes.

I will assume that contributions to destructive technology in a given period make it possible to destroy the assets of one other player in a period, prior to consumption. An agent that has invested in destructive technology can elect to use this against one or no other player. Formally, let x_{it}^j denote the decision by i to target j for asset destruction and let $x_{it} := \max(x_{jt}^i)_{j \in N} \in \{0, 1\}$ indicate whether i's assets have been destroyed in period t by any other player. This destructive capacity is similar to an idea represented in Figure 1.3 in Bates (1987): the destruction is timed so that any attempt at defection is *instantly* punished. To simplify equilibrium conditions I also assume that a citizen whose capital is destroyed following a failure to produce public goods can be costlessly compelled to contribute to public goods alongside others.[3]

Let σ denote a profile of behavioral strategies, indicating which actions each player will choose at any point in time given the history of play to date.

I now embed these decisions regarding production, public goods production, and targeted destruction in a Solow type growth model. Per period production is given by:

$$y_t(m_t, k_t) = A(m_t) f(k_t)$$

where total factor productivity, $A(m_t)$, is a weakly increasing function of the numbers contributing to public goods, $m_t := \sum a_t^i$ and f satisfies Inada conditions. For the analyses below I will assume that $A(1) = A(0)$ and $A(n) > A(n-1)$, meaning that solo contributions have no impact but solo deviations do.

[2]If ever production is insufficient to cover costs I assume that contributions are nevertheless made but capital falls to zero.

[3]Without this, quantities 4 and 5 below need to be adjusted to ensure that an enforcer is willing to punish given that non-contributing deviators reduce the value of remaining in a cooperative state.

Private capital evolves according to:

$$k_{i,t+1} = \begin{cases} \max(0, (1-d)k_{it} + s(y_t(m_t, k_{it}) - a_{it}c_a - v_{it}c_v)) & \text{if} \quad x_{it} = 0 \\ 0 & \text{if} \quad x_{it} = 1 \end{cases} \tag{1}$$

where d is depreciation and s is the (fixed) savings rate.

Instantaneous utility is then given by:

$$u_{it}(k_{it}, m_t, a_{it}, v_{it}, x_{it}) = \begin{cases} (1-s)(y_t(m_t, k_t) - a_{it}c_a - v_{it}c_v) & \text{if} \quad x_{it} = 0 \\ 0 & \text{if} \quad x_{it} = 1 \end{cases} \tag{2}$$

Valuations for players conditional on capital stock and a set of strategy profiles, σ, over T periods is given by:

$$w_i(k|\sigma, T) = \sum_{t=1}^{T} \delta^{t-1} u_{it}(k_{it}, m_t, a_{it}, v_{it}, x_{it})$$

where δ is a common discount factor, $k_{i1} = k$ and k_{it}, $t > 1$ is determined according to the law of capital in (1) and $m_t, a_{it}, v_{it}, x_{it}$ are determined by strategy profile σ. To avoid clutter I drop argument T in the case where $T = \infty$.

Before turning to solutions, I highlight a number of simplifying features of the model. Although the model allows for a form of centralization of coercive power, there are no institutions or centralization of collective decision making authority of the form described for instance in Bates (1987) (Chapter 2). The model is noise-free in the sense that there is no uncertainty and no errors. An effect of this assumption is that the model does not predict violence at any stage. As in Bates, Greif, and Singh (2002)—and unlike in Schumpeter (2013) for instance—growth derives from the *threat* of destruction not destruction itself. Thus the framework cannot be used to shed light on historical patterns of violence except insofar as these are thought of as byproducts of threats. Last, the *uses* of violence are circumscribed. The model focuses less on the defense of property as on the generation of productive capacity. The setup does not allow bilateral, targeted violence and transfers and so does not capture two features prominent in Bates (1987) and Bates (2017): the scope for bilateral dispute resolution or the increased incentives of enforcers to abuse authority as incomes rise.

2.1 Strategy Profiles

I consider three types of strategy profiles. In each period the state is considered either "normal" or "failed". Each strategy profile specifies actions in a given period for all players conditional on the current state, which in turn determines the classification of future states.

- σ_A, *Anarchy*: No players invest in public goods or destructive technology, regardless of the state.

- σ_C, *Cooperation*: In a normal state all players invest in public goods technology, none invest in destructive technology. In a failed state no player invests in public goods.
- σ_P, *Policing*: In a normal state, players $1, 2, \ldots, n-1$ ("citizens") invest in public goods. Player n (the "enforcer") invests in destructive technology. If any citizens fail to invest in public goods during a cooperative period, the enforcer destroys their capital (if multiple fail to contribute, the enforcer destroys the capital of the citizen with the lowest index). In a failed state no players invest in public goods.

Periods are normal unless (a) some player failed to invest in public goods in a period in which σ_C was specified, or (b) the enforcer failed to invest in destructive technology or failed to employ the technology when a citizen failed to invest in public goods in a period in which σ_P was specified.

Each profile has an associated steady state capital stock for each player type that arises when the strategy is played repeatedly. I denote these steady states by k_A^*, k_C^* and $k_{P_e}^*$ and $k_{P_c}^*$ for the enforcer and citizens respectively. These steady states are characterized below.

In addition, I consider a set of complex profiles, each characterized by threshold values (to be specified later when I examine equilibrium strategies):

- σ_{AC}: If $k_i < \underline{k}_{AC}$ players play σ_A. If $k_i \geq \underline{k}_{AC}$ they play σ_C.
- σ_{AP}: If $k_i < \underline{k}_{AP}$ players play σ_A. If $k_i \geq \underline{k}_{AP}$ all players play σ_P.
- σ_{APC}: If $k_i < \underline{k}_{APC_1}$ players play σ_A. If $\underline{k}_{APC_1} \leq k_i < \underline{k}_{APC_2}$ then all players play σ_P. If $k_1 \geq \underline{k}_{APC_2}$ then all players play profile σ_C.

Note that the threshold for switching out of policing strategies depends on the capital of citizens (index 1), which may be different to those of the enforcer (index n). Note also that the switch from A to C in strategy APC may be instantaneous, if for example, $\underline{k}_{APC_2} < \underline{k}_{APC_1}$.

Note that these strategy profiles simply describe behaviors for different levels of capital stock. In the next sections I examine whether these profiles are in equilibrium. If a complex profile is an equilibrium this means that *in equilibrium* players will be willing to use different stage game strategies depending on current conditions. It does not mean that the equilibrium changes but, more simply, that changes themselves are in equilibrium.

To characterize equilibria I make use of the following sets:

$$K_C = \{k : w_i(k|\sigma_C) \geq D(k)\} \tag{3}$$
$$K_P = \{k : w_n(k|\sigma_P) \geq D(k)\} \tag{4}$$

where $D(k)$ is the defector's payoff given capital stock k when m other players invest in public goods:

$$D(k) := (1-s)A(n-1)f(k) + \delta w_i(f((1-d)k + sA(n-1)f(k))|\sigma_A)$$

These correspond, respectively, to the value of the capital stock for which (a) players do better cooperating in all periods than taking the defector's payoff and (b) the enforcer does better by investing in destructive technology in all periods than by taking the defector's payoff. Note that the defector's payoff is the same in both cases since in both cases the defector pays no costs while $n-1$ others contribute.

Let $T_C(k)$ denote the number of periods it takes for a citizen's capital to reach at least $\min(K_C)$ when all players are playing σ_P, in a subgame starting with capital k and let $k_C(k)$ denote the capital attained by the enforcer at that point. We say that $T_C(k)=\infty$ if capital never exceeds $\min(K_C)$. Now define:

$$K_{PC} := \left\{k : w_n(k|\sigma_P, T_C(k)) + \delta^{T_C(k)} w_n(k_C(k)|\sigma_C, \infty) \geq D(k)\right\} \tag{5}$$

This corresponds to values of capital such that the enforcer does better by investing in destructive technology—and punishing if needs be—in periods up to $T_C(k)$ and cooperating thereafter—with all others cooperating—than by failing to invest (or punish) and taking the defector's payoff.

Finally define:

$$K'_P = \{k : w_n(k|\sigma_P) \geq D'(k)\} \tag{6}$$

where

$$D'(k) := (1-s)(A(n)f(k)-c_a) + \delta w_i(f((1-d)k + s(A(n)f(k)-c_a)|\sigma_A)$$

In this set, the enforcer prefers the payoffs from remaining in the policing equilibrium to a deviation to one shot *public good investment* followed by a return to the anarchic equilibrium.

2.2 Comparisons

Conditions for some of the equilibria described in the next section depend on the steady states that would obtain under the simple strategies. I characterize these next.

Let k^*_A, k^*_C denote the steady state associated with σ_A, and σ_C respectively. Let $k^*_{P_c}$ and $k^*_{P_e}$ denote the steady state associated with σ_P for citizens and enforcers respectively—since these may accumulate capital at different rates within the same regime. Each of these steady states is defined implicitly via:

$$\begin{aligned}
k^*_A &= \{k : k = \frac{s}{d} y_t(0,k)\} && (7)\\
k^*_C &= \{k : k = \frac{s}{d}(y_t(n,k)-c)\} && (8)\\
k^*_{P_e} &= \{k : k = \frac{s}{d}(y_t(n-1,k)-v)\} && (9)\\
k^*_{P_c} &= \{k : k = \frac{s}{d}(y_t(n-1,k)-c)\} && (10)
\end{aligned}$$

Steady state $k^*_A > 0$ is guaranteed to exist from Inada conditions. For the other cases, steady states with positive capital are not guaranteed to exist by Inada conditions alone but do exist if c is sufficiently low.

To illustrate, for the case in which $f(x) = \sqrt{x}$ we can calculate the steady state explicitly given productivity A and per period investment costs c as:

$$k^* = \frac{As\left(As + \sqrt{(As)^2 - 4cds}\right)}{2d^2} - \frac{cs}{d}$$

In this case, existence of the steady state requires all terms are real and so $c \leq \frac{s}{4d}A^2$.

The steady states associated with the complex strategies depends on which strategy profiles are reached in the long run. For instance behavior under σ_{APC} may never transition out of σ_A, may transition to σ_P and remain there, or may transition through to σ_C. In each case the long run steady state is given by the long run strategy profile independent of the path it took to get there.

How do these steady states compare in terms of welfare? Instantaneous utility is increasing with steady state capital; in particular, at a steady state with k^*, $u = \frac{d(1-s)}{s}k^*$.[4] This makes it possible to rank the values of the steady states for different players in terms of instantaneous (and so also in terms of future discounted) utility. I focus on such "long run" welfare in the analysis, though highlight that a strategy profile that produces a more highly valued long run outcome may not itself be more highly valued by a player before that outcome is attained.

Clearly citizens prefer a cooperative steady steady to a policing steady state in the long run since the former entails greater returns to capital at the same cost.

However a cooperative steady state may not Pareto dominate a policing equilibrium if the enforcer prefers the latter. In the long run the enforcer might prefer either the cooperative equilibrium or the policing equilibrium depending on the productivity gains from $A(n)$ relative to $A(n-1)$ and the difference in costs, c_a compared with c_v. In the simple case above, for instance, an enforcer is indifferent between the two steady states if $A(n-1) = 5, A(n) = 6, c_a = 5, c_v = 0$. In either case her steady state capital would be $k^* = 25$.

For citizens to prefer a policing steady state to an anarchic steady state we require that c_a not be too high and $A(n-1)$ not be too low. In the example above, for instance, a citizen is indifferent if $c_a = 1$, $A(0) = 1$ and $A(n-1) = 2$. In this case the steady state capital is 1 in both situations with the costs of contributing to the public good exactly equal to the productivity gains. Marginally higher or lower values for $A(n-1)$ would break the indifference. By the same logic, an enforcer's preferences over a policing or anarchic steady state depend on relative costs of c_v relative to the gains from $A(n-1)$.

[4] At the steady state $k^* = (1-d)k^* + s(y-c)$ and so $y - c = \frac{dk^*}{s}$ and so $u = (1-s)(y-c) = \frac{d(1-s)}{s}k^*$.

2.3 Equilibria

Proposition 1 identifies conditions for a variety of equilibria. For the proposition I will take the minimum of an empty set to be infinity.

Proposition 1

1. *Profile σ_A is subgame perfect for all k.*
2. *Profile σ_C is subgame perfect for any subgame with $k \in K_C$.*
3. *If $k^*_{P_e} \leq \min(K'_P)$ profile σ_P is subgame perfect for any subgame with $k \in K_P$.*
4. *Profile σ_{AC} with threshold $\underline{k}_{AC} = \min(K_C)$ is subgame perfect.*
5. *If $k^*_{P_e} \leq \min(K'_P)$ then profile σ_{AP} with threshold $\underline{k}_{AP} = \min(K_P)$ is subgame perfect.*
6. *If $k^*_{P_e} \leq \min(K'_P)$ then profile σ_{APC} with thresholds $\underline{k}_{APC_1} = \min(K_{PC})$ and $\underline{k}_{APC_2} = \min(K_C)$ is subgame perfect.*

Proof: The assumptions that $A(1) = A(0)$ and $c_a > 0$ yield part (1) as these imply unilateral deviations from all defect is always costly. Part (2) follows from part (1) and the definition of K_C. For part (3), the enforcer is willing to enforce from the definition of K_P—the condition on (3) ensures that the enforcer does not have an incentive to deviate to cooperative play. The behavior of citizens is sustained because unilateral defection is never tempting if the enforcer indeed enforces as any gains from defection are destroyed in equilibrium. The equilibrium is subgame perfect in the anarchic subgame from part (1). Parts (4) and (5) follow from parts (1) and (2) and from parts (1) and (3) respectively. The condition on Part (5) is required since absent this the enforcer has an incentive to deviate by switching to cooperation instead of policing. Part (6) follows from the definition of K_{PC} and from part (4). □

Note that the assumption that $A(1) = A(0)$ is important for the proof. If instead $A(1) > A(0)$ then a player would not only have a private incentive to contribute to the public good but could also have incentives to contribute with an instantaneous loss in order to benefit indirectly from benefits to others players that may lead them to contribute in future rounds.

Note also that many of these equilibria will be observationally equivalent if their respective thresholds are not met. Thus if K_C is empty then σ_{AC} is behaviorally equivalent to σ_A; if K_P is empty then σ_{AP} is behaviorally equivalent to σ_A—we never achieve full or partial cooperation.

3 The conjecture

We are now ready to state the conjecture[5] as:

Conjecture 1 *There are parameter values such that steady state payoffs under σ_{AP} Pareto dominate payoffs under σ_A and σ_{AC}.*

[5]Strictly the result that follows is a proposition not a conjecture since it is accompanied by a proof; I refer to it as a conjecture because the empirical analogue of the proposition is a conjecture regarding the role of violence in the history of development.

Proof: I first establish that there are cases in which (i) σ_{AC} does not transition to σ_C for $k \leq k^*_A$ (ii) the enforcer is indeed willing to play σ_P at k^*_A and (iii) $k^*_{P_e} > k^*_A$ and $k^*_{P_c} > k^*_A$.

I establish the possibility with an extreme case.

Let:

a. $c_a \geq (A(n) - A(n-1))f(k^*_A)$
b. $\delta = 0$
c. $c_v = 0$
d. $f(k^*_{P_c}) - c_a \geq f(k^*_A)$
e. $c_a \geq (A(n) - A(n-1))f(k^*_{P_e})$

Condition (a) ensures that $A(n)f(k^*_A) - c_a \leq A(n-1)f(k^*_A)$ and so there is a short term incentive to defect from a cooperative equilibrium at all points up to and including k^*_A. Together with (b) this is enough to ensure that σ_{AC} will not involve a transition to σ_C behavior, establishing (i).

Condition (c), together with (b) ensures that the enforcer has no incentive to deviate from σ_P, and as noted above, citizens in general have no incentive to deviate from σ_P. This establishes (ii). Condition (d) ensures that σ_P Pareto dominates σ_A in the long run (we focus on the citizens since these have higher costs). Condition (e) ensures that in the policing equilibrium the enforcer does not have an incentive to start producing public goods in the case in which $c_v = 0$ and $\delta = 0$.

Condition (a) requires that c_a is not too small but (d) requires that it not be too large. For an example in which both conditions are satisfied let $f(k) = k^{0.5}$, $d = s = 0.5$, $A(0) = A(1) = 1, A(n-1) = 3, A(n) = 3.2$ and $c_A = 2$. Then steady state capital, given A and c is $k^*(A, c) = \frac{1}{2}A\left(A + \sqrt{A^2 - 4c}\right) - c$ and so $k^*_A = k^*(1, 0) = 1$, $k^*_C = k^*(3.2, 2) = 5.5$, $k^*_{P_c} = k^*(3, 2) = 4$, and $k^*_{P_e} = k^*(3, 0) = 9$.

Condition (e) is satisfied by the same parameter values. $\square$

In the example used in the proof of Conjecture 1, the enforcer has steady state capital of 9 in the policing steady state which is more than she could achieve in the steady state when all cooperate. If instead we had $A(n) = 4$ then we would have $f(k^*_A) = 1$ and $f(k^*_{P_c}) = 4$ the enforcer would have steady state capital of 9 in the policing steady state but would achieve 12 in the steady state where all cooperate, and of course the citizens also have a lower payoff from σ_P than from σ_{PC}. In this case, strategy profile σ_P would still be in equilibrium but it would be an equilibrium under pressure in the sense that both the citizens and the enforcer have an incentive to have the enforcer shift from destruction to production. This consideration motivates the second version of the proposition.

Conjecture 2 *There are parameter values such that σ_{APC} is a subgame perfect Nash equilibrium and steady state payoffs Pareto dominate payoffs under σ_A, σ_{AC} and σ_{AP}.*

This second version of the conjecture shifts focus from the centralization of violence to its re-decentralization.
The next section provides examples of cases that establish this second conjecture.

4 Discussion

The main result is that paths exist in which, absent a destructive technology, players will not succeed in endogenously switching from noncooperative to cooperative behavior as capital grows, but that the ability to make inefficient investments in destructive technology can render these transitions possible, in equilibrium. Substantively, the invention of a destructive technology—or the social arrangement that allows it to be used—makes growth trajectories possible that would otherwise be unobtainable.

The negative result, that first best solutions cannot (always) be obtained, is consistent with the skepticism in Bates, Greif, and Singh (2002) regarding the claim that efficient equilibria can be sustained simply through the threat of decentralized sanctions and high discount factors, but it does so in a dynamic setting. The problem here is not simply that discount rates are too low but rather that growth rates under anarchy are not able to generate the capital that is needed to sustain decentralized cooperation. The positive result is consistent with policing solutions in Bates, Greif, and Singh (2002).

Investment in destructive capacity, though inefficient (as resources are diverted from production), improves outcomes by stemming incentives to free ride. Remarkably in the dynamic context I consider here, the need for destructive capacity is not necessarily permanent: destructive capacity can induce growth in capital that removes the need for threats of destruction in the long run. In this sense we see an endogenous process of institutional change intertwined with endogenous economic growth.

We learn in addition that the investment in destructive capacity has both an aggregate and a distributive effect: enforcers do better than citizens when policing strategies are played. Indeed they need to since we require $c_v < c_a$ so that policing strategies can be incentivized even though cooperative strategies cannot be. On the growth path then we see a boost in production and an increase in inequality.

Figure 1 illustrates using an example in which along the equilibrium path players shift from playing σ_A to playing σ_P to playing σ_C. This results in endogenous changes in productivity, endogenous growth, and transitional inequality, similar to that described by Kuznets (1955). It illustrates how the same logic that explains the centralization of power along development paths can also explain subsequent decentralization. The same logic that makes sense of Henry II centralizing power in England as described by Bates (2017) can provide an explanation for subsequent weakening of monarchs as citizens' dependence on them declines.

This type of development path is not the only type that can emerge from this structure however. In Figure 2 I show a rich variety of growth paths as c_v and c_a vary. We see:

1. When costs of collective action are sufficiently low, the cooperative equilibrium can be reached via σ_{AC}, without a need to pass through a policing phase first—examples of this can be seen in the first row. In these cases, policing may speed up convergence but may have no impact on long run outcomes.

2. When costs of collective action are higher—but not too high— σ_{APC} can eventually transition to σ_C even though σ_C would not be reached by σ_{AC} alone. In this case the

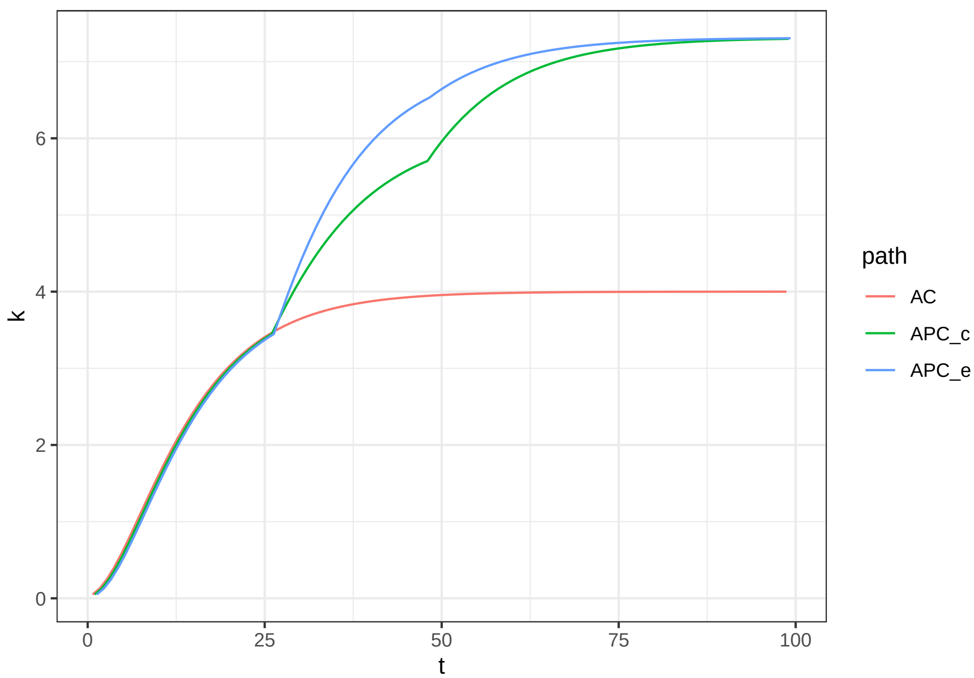

Figure 1: Welfare from two equilibria. Upper curves show capital returns to the enforcer and citizens in an σ_{APC} equilibrium. Lower curve shows returns to all citizens from an σ_A or σ_{AC} equilibrium. Assumptions: $\delta = 0.4$, $c_a = 0.4$, $v = 0.2$, $d = 0.2$, $s = 0.4$, $f(k) = k^{.5}$, $A(n) = 1.5$, $A(0) = 1$, $A(m-1) = 1.4$. We see endogeneous transitions between strategy types and transitional inequality.

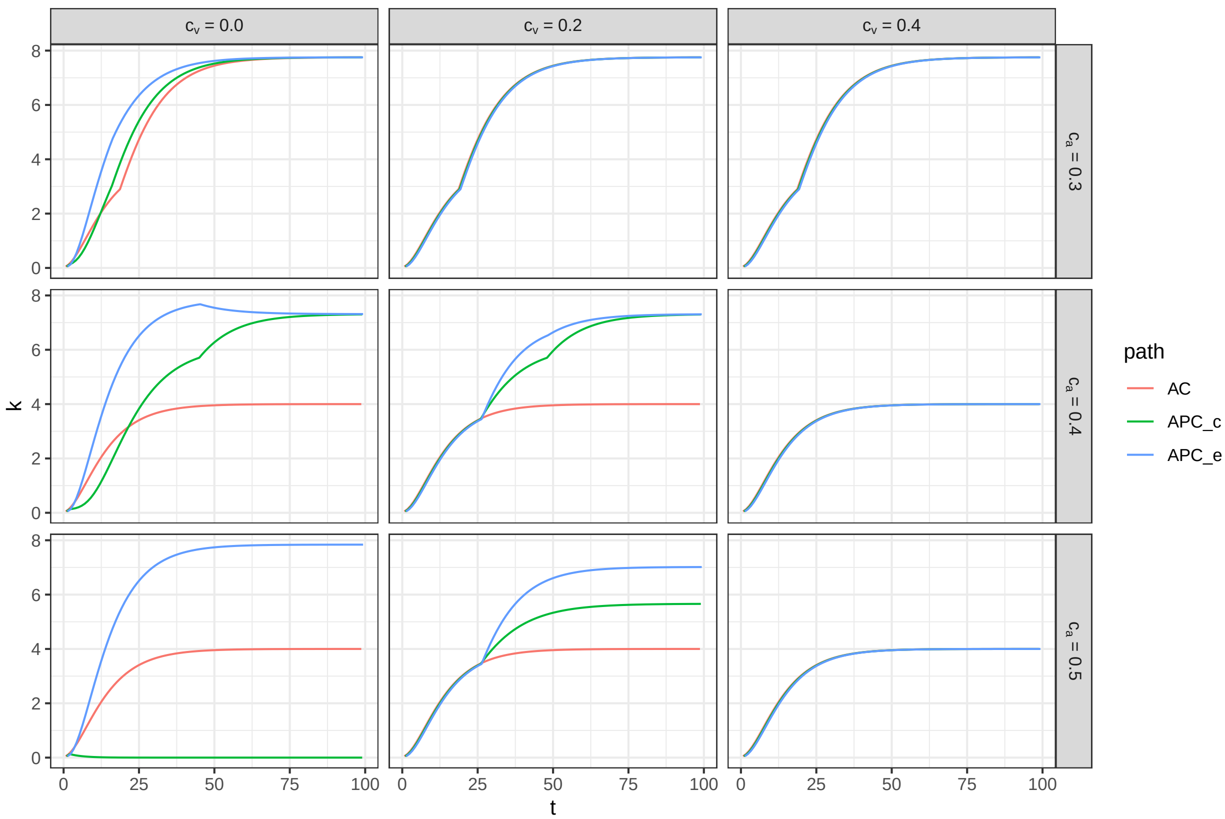

Figure 2: Capital accumulation for σ_{AC} and σ_{APC} for values of δ and c_a when $v = 0.2$, $d = 0.2$, $s = 0.4$, $f(k) = k^{.5}$, $A(n) = 1.5$, $A(0) = 1$, $A(m-1) = 1.4$.

destructive technology can make it possible to get to a collective action equilibrium that would otherwise be out of reach—provided the cost of destruction is not too high. The first two panels of the center row illustrate. In these cases we see transitional inequality. We may even see a two sided reduction in equality when equilibria transitions to σ_C. The first panel of the middle row illustrates.

3. When costs of collective action are higher still, σ_{APC} might never transition to σ_C. In such cases σ_{APC} may or may not be a Pareto improvement over σ_{AC} and may induce permanent inequality.

4. For destructive technology to make a difference it must be cheap. This can be seen in a comparison of the third column to other columns. If destructive technology is as expensive or more expensive that productive technology, then the conditions to ensure compliance by the enforcer are more difficult to satisfy than the conditions to secure cooperation by citizens.

Four features of these results are worth highlighting.

Variation. As should be clear from Figure 2, the conjecture establishes the *possibility* that investment in destructive capacity fosters growth. But it does not suggest that destruction is in general either necessary or sufficient. A society may be willing to invest in violence, should it be sustainable, but not develop the capital needed to sustain it. Conversely, a society might grow through threats of destruction but would also have, perhaps with some delay, without it. More generally, formal analysis speaks strongly against singular narratives. Even in this simple model there is marked variation both across contexts—that is, across settings with different parameters, and within contexts—that is, across equilibria. Moreover, many other equilibria exist in addition to those identified here. For instance, although I focused on cases where there is a monopolist investing in violence rather than public goods, there could be equilibria in which the role rotates through membership, producing a more equal growth in capital and shortening the path to a transition to a cooperative equilibrium. Although I focused on equilibria in which all citizens contribute, there may be equilibria in which some subgroups do and some do not.

Rationality and Myopia. The transitions to cooperative equilibria do not depend on player farsightedness. Bates (2015) notes that the possibility of order from violence can depend on the fact that players interact over time, yet in this setting if violence is sufficiently cheap—and destructive—the shadow of the future is not important either for ensuring the specialist maintains violence or that citizens produce. When there is a threat of immediate and complete capital destruction, as here, citizens have an incentive to cooperate even if myopic. Moreover, it is possible that policing equilibria could raise capital of citizens to the point where they are willing to contribute without any threat of sanction.

Forced development and exploitation. The fact that destructive technology can give rise to long run Pareto optimal outcomes does not mean that citizens will welcome policing equilibria. Although long run payoffs of a policing equilibrium may be higher, the costs to achieving them may be too great for a collective to be willing to accept rationally—absent coercion. Rather, the *short* term incentive to avoid destruction is what makes players willing to contribute to investments that might in fact render them better off in the long run. In addition to forced development, it is also possible that the strategic use of violence results in a wipe out of the productive assets of citizens. If enforcers can compel compliance before citizens have developed capital, the extracted contributions may prevent them from ever accumulating capital. An instance of such dynamics is seen in the lower left panel of Figure 2.[6]

Restrained Leviathans. Transitions from from σ_P to σ_C behavior in a σ_{APC} equilibrium can result in utility losses for enforcers. One might wonder how can citizens achieve this shift: why would the enforcer give up their privileged position simply because their services are no longer needed to maintain order? The answer, akin to logics in Bates (2021), is that the enforcers are themselves subject to relations of dependence on citizens: if citizens shift to strategies that punish elites when they militarize instead of contributing directly to the common good, the incentives of enforcers are to give up their position. The theory of revolution given here is thin: revolution is in equilibrium, but it is not explained beyond that.

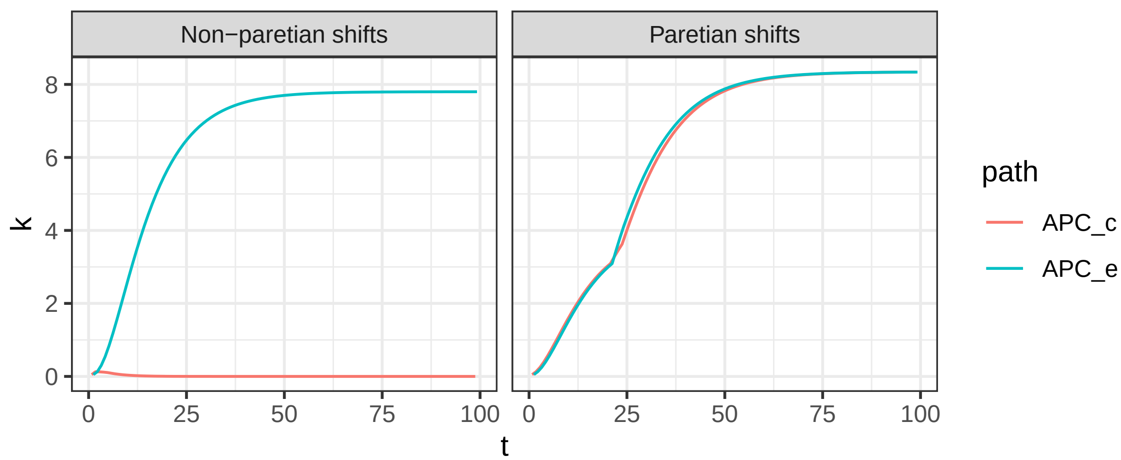

Figure 3: Equilibrium growth paths for enforcers and citizens when equilibria require Pareto improvements (right) and when they do not (left). In the left path a too early transition to σ_P prevents capital accumulation by citizens which in turn precludes a later shift to σ_C.

These last two considerations highlight an unsatisfactory aspect of this model. As seen here the requirement of subgame perfect behavior by rational actors is not sufficient to characterize development processes, even when choice sets and motivations are well understood. Oftentimes many different paths are possible. We need, in addition, a theory of equilibrium selection. A theory of political entrepreneurship is needed to explain under what conditions σ_{AP} is played when σ_A is available. A theory of revolution is needed to explain under what conditions σ_{APC} is played when σ_{AP} is available.

One simple approach to addressing some of these concerns within the current framework is to impose a requirement that transitions between strategy profiles arise only when these are

[6]As pointed out by a reviewer, this pattern is reminiscent of colonial (and post colonial) states imposing taxes on capital strapped citizens that leave them unable to accumulate capital and benefit from whatever production enhancing public goods have been provided.

Pareto improvements over strategy profiles that do not involve the transitions. An example of how this refinement can have bite is given in Figure 3. In this example I show paths arising from a σ_{APC} equilibrium similar to that in the lower left of Figure 2 alongside the path arising from an alternative equilibrium, σ'_{APC}, in which the threshold for transition to P is selected to be the lowest value of k for which both (a) enforcers have an incentive not to deviate from the policing equilibrium—as in APC, *and* (b) the change to σ_P from σ_A induces a Pareto improvement evaluated in terms of discounted utility. Note that the difference between the paths lies in the *timing* of the shift to policing. σ'_{APC} postpones the shift to a point when citizens have sufficient capital to be able to both contribute and prosper, resulting, ultimately, in improved outcomes for both the enforcer and the citizens. Such a condition could similarly remove transitions to C when these are not improvements for the enforcer.

5 Conclusion

Bates' conjecture is rich in implications. In the dynamic form described here, it has the merit of connecting collective action problems to endogenous growth theory in a form that both demonstrates the ways that growth can depend on political innovations and clarifies a possibly essential role of violence. The results presented here confirm the idea that in some settings access to technologies of coercion can produce growth paths that produce levels of development that would otherwise not be attainable. But they do not support the idea that coercion is always necessary for prosperity. A byproduct of this formalization is a new explanation for transitional (political and economic) inequality along paths of development.

Should we believe the account? Of course not. Bates (2015), echoing Rubinstein (2012), rightly describes the basic model as a fable—an attitude to models advocated by Cartwright (2010) and Johnson (2017). The model here is intended not to justify the *status quo*, as did Hobbes or Locke, or to claim that processes are unique, determined, and predictable, as did Marx. The goal, rather, is to point to possible logics that, coupled with data, might help explain our past and highlight conditions that account for variation in our histories of prosperity and violence.

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