The Bates Conjecture: A Compact Exposition with Dynamic Implications

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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, 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 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 insights 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 they are 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 when "control over violence as 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. 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 state of nature and identifies a logic for escaping their condition. In ar 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.

However, Bates' account differs from these treatments in multiple ways. I highlight three.

First, Bates pays considerable attention to decentralized solutions, that while possibly inefficient, are not brutish. Bates (1987), for instance, highlights sources of order that do not depend on the strategic use of sanctions. Religious beliefs present a form of sanctioning, though one not obviously in the control of a strategic actor. In Bates' account (p11), following Evans-Pritchard (1951), the leopard skin chief helps maintain order through arbitration and not because he has access to means of coercion punishment. Similarly, Bates, Greif, and

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

Singh (2002) describe multiple equilibria that could coexist, of which centralized coercion is one.

Second, Bates 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 does not permit optimal deviations by any player. 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.

Third, Bates is interested in explaining change and not simply in justifying current arrangements. Indeed, the focus on origins is explicit in many of the contributions. In Bates' treatments however *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. Bates documents change. To secure prosperity decentralized societies, for instance, European producers "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. But no catalyst for the transition is identified. 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)—yet his accounts of prosperity and violence rely 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, endogenizing shifts from equilibria with investments in violent technology to those without, and connecting 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

We 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). We let $a_{it} \in \{0,1\}$ denote the decision to invest in public goods at cost c_a a time t and let $v_{it} \in \{0,1\}$ denote the decision to invest in coercive technology (violence) 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.

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, let x_{it}^j denote the decision by i to target j for asset destruction. We then 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.

We 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.

We 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 we will assume that $A(1) = A(0)$ and $A(n) > A(n-1)$, meaning that solo contributions have no impact but solo deviations do.

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:

[2] In case where production is insufficient to cover costs we assume that contributions are nevertheless made but capital falls to zero.

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

Finally, we describe valuations for players conditional on capital stock and a set of strategy profiles, σ, over T periods:

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

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 we drop argument T in the usual case were $T = \infty$.

Before turning to solutions, we highlight a number of simplifying features of the model. Although the model allows 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). Although violence is at the heart of the logic, the model will 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 without incorporating the possibility of errors of some form, the framework cannot be used to shed light on historical patterns of violence. Last, the *uses* of violence are circumscribed. The model focuses less on the defense of property as on the generation of productive capacity.[3] 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

We consider the following strategy profiles.

- σ_A, *Anarchy*: No players invest in public goods or destructive technology in any period.
- σ_C, *Cooperation*: All players invest in public goods technology, none invest in destructive technology. If ever any player fails to invest in public goods technology in any period then all players stop investing in public goods in all future periods.
- σ_P, *Policing*: Players $1, 2, \dots, n-1$ ("citizens") invest in public goods in every period. Player n (the "enforcer") invests in destructive technology. If any citizens fail to invest in public goods technology, the enforcer destroys their capital (if multiple fail to contribute

[3]This, we note, is partly a matter of interpretation. We described the action a in the model as the decision to invest in a public good. Yet it could as easily be interpreted as refraining from appropriation. We can instead imagine that some share of each player's goods are owned insecurely. Individuals can take an action to appropriate amount c_a but in doing so impose a cost on others by adversely affecting their productivity: closing off a section of a stream provides private gains but downstream costs.

the enforcer destroys the capital of the citizen with the lowest index). If the enforcer fails to invest in destructive technology or fails to employ the technology when a citizen fails to invest in public goods then all players stop investing in public goods in all future periods.

Each of these three profiles have an associated steady state for each player type. We 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, we consider a set of complex profiles, each characterized by threshold values (to be specified later when we consider equilibrium strategies):

- σ_{AC}: Players play σ_A. If at any point k_i reaches $\underline{k}_{AC}$ they switch to σ_C.
- σ_{AP}: Players play σ_A. If at any point k_i reaches $\underline{k}_{AP}$ without prior strategy deviations, then all players switch to σ_P.
- σ_{APC}: Players play σ_A. If at any point k_i reaches $\underline{k}_{APC_1}$ then all players switch to σ_P; if at that point or any subsequent point k_1 reaches $\underline{k}_{APC_2}$ without prior strategy deviations, then all players switch to profile σ_C.

Note that the threshold for switching out of policing strategies depends on the capital of a 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 maybe be instantaneous, if for example, $\underline{k}_{APC_2} < \underline{k}_{APC_1}$.

To characterize equilibria we 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:

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

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 $\min(K_C)$. We now define:

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

This corresponds to values of capital such that the enforcer does better by investing in destructive technology 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 *cooperation* followed by a return to the anarchic equilibrium.

2.2 Equilibria

Proposition 1 identifies conditions for a variety of equilibria. For the proposition we 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 enforcers 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). $\square$

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.

2.3 Comparisons

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.

To help characterize equilibria we identify the steady states associated with different strategy profiles.

We let k^*_A, k^*_C denote the steady state associated with σ_A, and σ_C respectively. We 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 equilibrium. 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 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^*, $u = \frac{d(1-s)}{s}k^*$. 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. We 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 $A(n-1)$.

3 The conjecture

We are now ready to state the conjecture[4] as:

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

Proof: We 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 $k^*_{P_c} > k^*_A$.

We 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. $c_a \geq (A(n) - A(n-1))f(k^*_{P_e})$

Then (a) ensures that 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 transition to σ_C, establishing (i). Then (c), together with (b) ensures that the enforcer has no incentive to deviate from σ_P, and as shown above, citizens also 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).

[4]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.

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 are satisfied let $f(k) = k^{0.5}$, $d = s = 0.5, A(1) = 1, A(n-1) = 3.5, A(n) = 3.2$ and $c_A = 2$ then $f(k_A^*) = 1$ and $f(k_C^*) = 5.5$, $f(k_{P_c}^*) = 4$, and $f(k_{P_e}^*) = 9$.

Condition (e) is satisfied by the same parameter values and 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 $\delta = 0$. $\square$

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}.*

The next section provides examples of cases that establish this conjecture.

4 Discussion

The main result is that paths exist in which 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 always it to be used—make 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 propositions 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 that simply that discount rates are too low but 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 we 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).

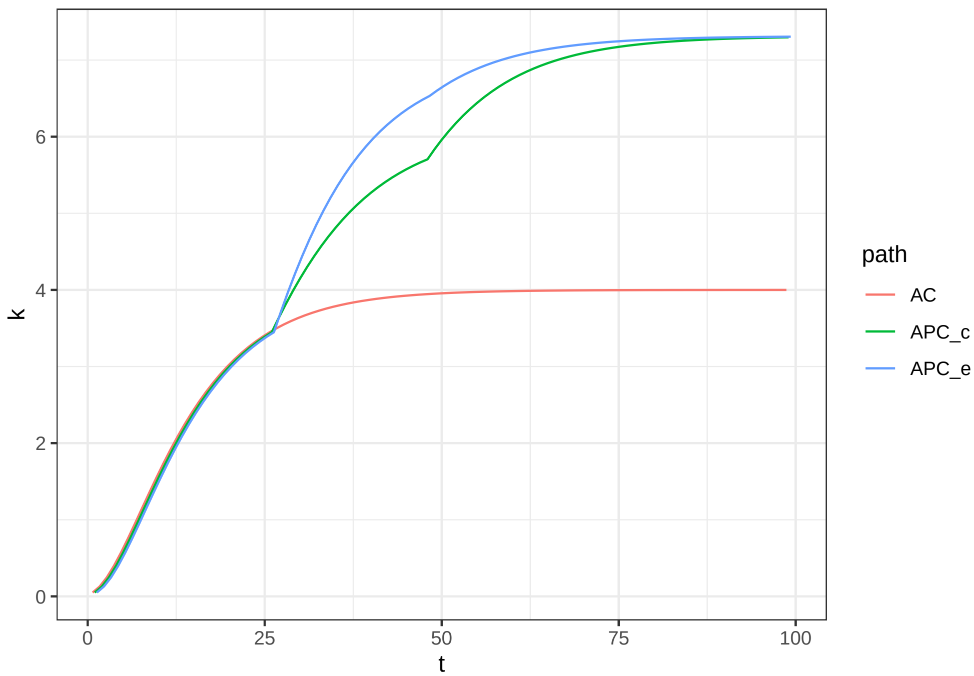

Figure 1: Welfare from two equilibria. Upper curves show capital returns to the enforcer and citizens in an σ_{APC} equilibrium. Lower curve shows returns to all citizens from an σ_A or σ_{AC} equilibrium. Assumptions: $\delta = 0.4$, $c_a = 0.4$, $v = 0.2$, $d = 0.2$, $s = 0.4$, $f(k) = k^{.5}$, $A(n)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

This type of development path is not the only type that can emerge from this structure however. In Figure 2 we 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 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

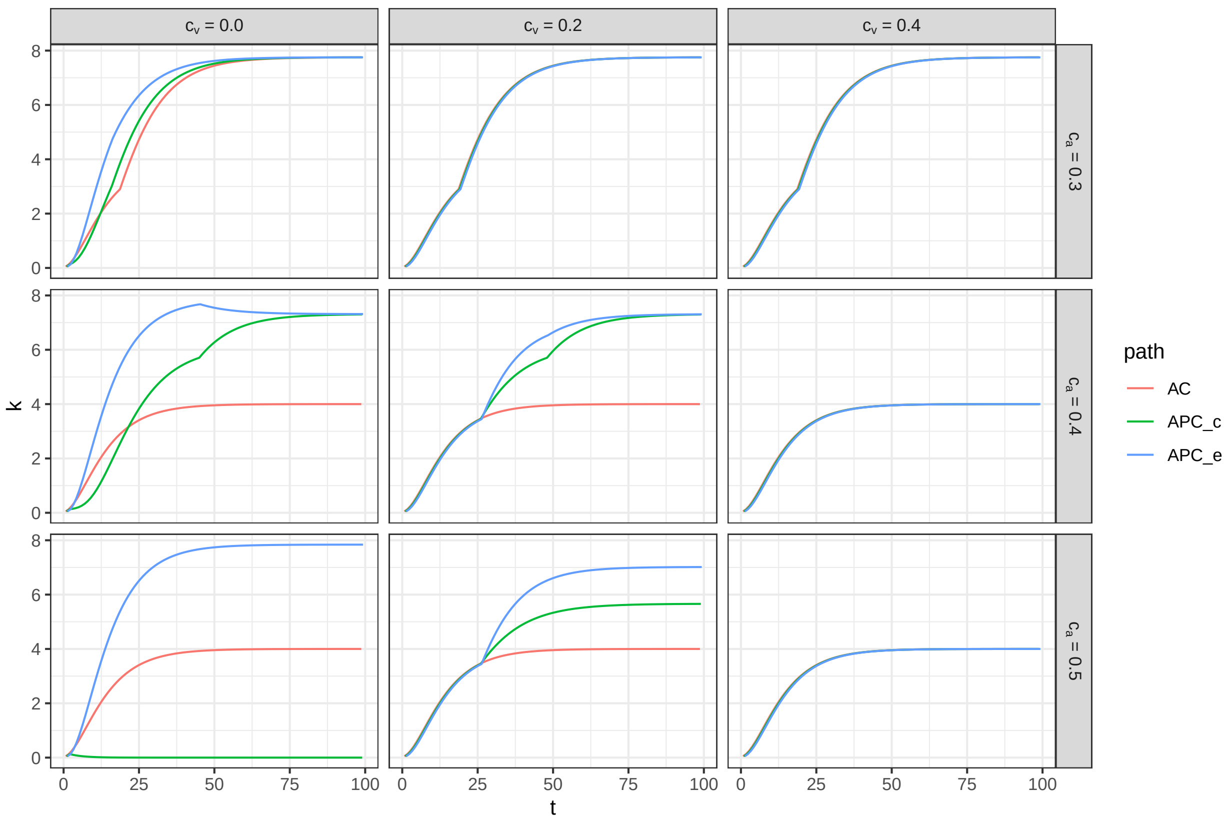

Figure 2: Capital accumulation for σ_{AC} and σ_{APC} for values of δ and c_a when $v = 0.2$, $d = 0.2$, $s = 0.4$, $f(k) = k^{.5}$, $A(n) = 1.5$, $A(0) = 1$, $A(m-1) = 1.4$.

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.

Three 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 we 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 we 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 tun 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.

One could impose that transitions between strategy profiles arise only when these are both enforceable and Pareto optimal and so eliminate these unfavorable outcomes. An example is given in Figure 3. In this example we show paths arising from the APC equilibrium similar to that in the lower left of Figure 2 alongside the path arising from an alternative equilibrium, APC', in which the threshold 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. 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.

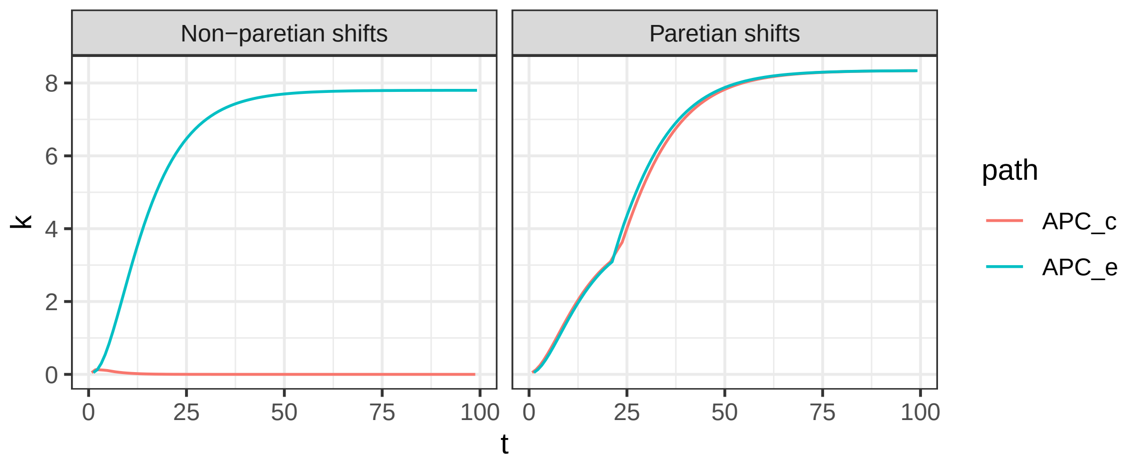

Figure 3: Equilibrium growth paths for enforcers and citizens when equilibria require Pareto improvements (right) and when they do not (left). In the left path a too early transition to σ_P prevents capital accumulation by citizens which in turn precludes a later shift to σ_C.

The example highlights a requirement of subgame perfect behavior by rational actors is not sufficient to characterize development processes, even when choice sets and motivations are well understood. We need, in addition, a theory of equilibrium selection, a theory that can tell us under what conditions a pretender can convince a population of their place and how things will play out.

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 that clarifies a possibly essential role of violence. A byproduct is a new explanation for transitional inequality along paths of development. Should we believe the account? Of course not. Bates (2015) rightly describes the basic model as a fable—an attitude to models advocated by Cartwright (2010) and Johnson (2017)—one that 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 might explain our past and highlight conditions that account for variation in our histories of prosperity and violence.

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