LEADERSHIP, TRUST, AND CONSTITUTIONS by Roger B. Myerson
June 2006, `http://home.uchicago.edu/~rmyerson/research/prince.pdf`

*Hattusili was King... His family members and his troops were united... He kept the country subdued....
Each of his sons went to govern a region... But later, they began conspiring...
Whoever becomes king after me in the future, let his family members and his troops be united!...
When the King seeks evil for his brother or sister, his Council must tell him straight, "This is a matter of blood."
Remember the bloodshed that has cursed the royal family...
If anyone among the king's family does evil and lays eyes on the king's head, summon the assembly,
and if his testimony is dismissed then he shall pay with his head. They shall not kill him secretly.*
Proclamation of Telipinu, King of the Hittites. [edited excerpts] c. 1500 BCE.

*Xenophon made the following speech: "I have not come here, Seuthes, with the intention of asking you for anything, but to do my best to make it clear to you that... it was just as much in your interest to pay [the soldiers] as it was in theirs to be paid...
The people who have now become your subjects were not induced to accept your government out of any personal affection for you, but did so out of compulsion... Now suppose, first, that they see your relations with our soldiers are so good that the soldiers would stay here if you asked them... and that others, having heard all kinds of good reports of you from our men, would come quickly whenever you wished; or suppose that they get this unfavorable impression of you, that no more Greek troops are likely to come to you, because of their lack of confidence in you...
Which of these two alternatives, do you think, is better calculated to make your subjects fear you and look upon your government with a proper feeling of respect?..."
When Seuthes had listened to this speech, he cursed the man who was responsible for the money not having been paid... "As for me," Seuthes said, "I never meant to deprive your men of their pay and I shall give it to them now."*
Xenophon, Anabasis [Persian Expedition], chapter 7, c. 375 BCE.

...How art thou a king but by fair sequence and succession? Now, afore God... if you do wrongfully seize Hereford's rights... and deny his off'red homage, you pluck a thousand dangers on your head, you lose a thousand well-disposed hearts, and prick my tender patience to those thoughts which honor and allegiance cannot think.
William Shakespeare, Richard II, 1595 CE

Introduction. What are the fundamental forces that sustain the constitution of a political system? Constitutional rules can be enforced only by actions of individuals, who must have motivation to enforce these rules. So there must be specific agents who expect to be rewarded as long as they act to enforce constitutional rules, but who would lose these rewards and privileges if they did not fulfill their constitutional responsibilities.

Most important of these agents is, of course, the ruler or leader of the government (the prince). Histories tend to focus on these leaders to a great extent. What makes them so important? Next most important are high officials, including military commanders (captains) and civil administrators (governors). A political system can survive only if it solves some basic agency problems in motivating such officials, who are subject to moral hazard and imperfect observability. So agency problems are essential to the constitution of any political system.

Here we examine basic agency problems of government in the simplest political system: absolute monarchy. By asking how an individual leader can establish a state, we may gain insights into the nature of leadership.

High government agents will eschew temptations to abuse their power only if they expect loyal service to be rewarded. So the monarch, to be an effective leader, needs a reputation for reliably rewarding those who serve him in high office. Like a banker, the leader's promises of future credit must be trusted and valued as rewards for current service. Such a relationship of trust with active supporters is a leader's most important asset. Thus, even an absolute monarch may want to establish constitutional constraints on himself, so that he can more effectively solve agency problems of motivating his captains and governors.

We will show that such problems of agency and trust can cause the leader to govern through a closed aristocracy, not based on any innate-inequality assumption that aristocrats might be better than commoners, but based on an innate-equality assumption that commoners are not better than aristocrats. Entry into the ruling class must be regulated to assure officials that the leader will not cheat them and replace them.

Model 1: Motivating captains to support the prince's struggle for power [R, λ, c, δ, p() or s]

Suppose a principality yields income R that can be consumed or allocated by the ruler.
To become ruler, a prince must first defeat a rival army.
Then, to stay in power, the prince must defeat similar challenges from invaders that arrive at a Poisson rate λ.
To defeat any rival or challenger, the prince needs captains to form his army.
Let p(n) denote the prince's probability of winning when he is supported by n captains,
where $0 \le p(n) \le 1$, $p(0) = 0$, and p(n) increases as n increases ($p'(n) > 0$).
For each captain, the cost of supporting the prince against a rival or challenger is c.
The prince and the captains are assumed to be risk neutral and have discount rate δ.

To induce captains to support him, the prince must promise to pay them some part of his future revenue if they win.
(Past payments may inspire confidence but cannot be the direct motivation for captains to stay in the battle.)
Consider a captain who expects the prince to grant him some income y as long as the prince rules,
provided that the captain supports the prince against every challenger.
When there is no current challenger, a captain's expected discounted payoff is $U(n,y) = (y-\lambda c)/[\delta+\lambda(1-p(n))]$.
When a new challenge arrives, a captain's expected payoff before the battle is $pU-c$.
So for captains to rationally give support in battle, we need $p(n)U(n,y)-c \ge 0$.
The lowest income y that satisfies this participation constraint is $Y(n) = (\delta+\lambda)c/p(n)$.
Y defines a downward-sloping ($Y'<0$) supply curve for captains, who would accept a lower wage in a larger army.

If the prince has n captains who each get income y then, when no challenge is impending,
the expected discounted value of the prince's payoffs is $V(n,y) = [R - ny]/[\delta+\lambda(1-p(n))]$.
The prince's expected payoff on the eve of battle against a challenger is p(n)V(n,y).

The win probability p(n) may also depend on the anticipated size of rivals' armies, which we may denote by M.
Then for some function $p(\bullet|\bullet)$, we have $p(n) = p(n|M)$. May consider $p(n|M) = n^s/(n^s+M^s)$ for some s>1.

Absolutist systems, with no communication among the prince's supporters

We may say that a leader is absolute if his agents have no communication with each other, only with the leader.
So in absolutism, a captain does not observe or respond to any change in the prince's relationship with other captains.
We distinguish two cases: whether the prince can recruit from a bounded or unbounded set of potential captains.

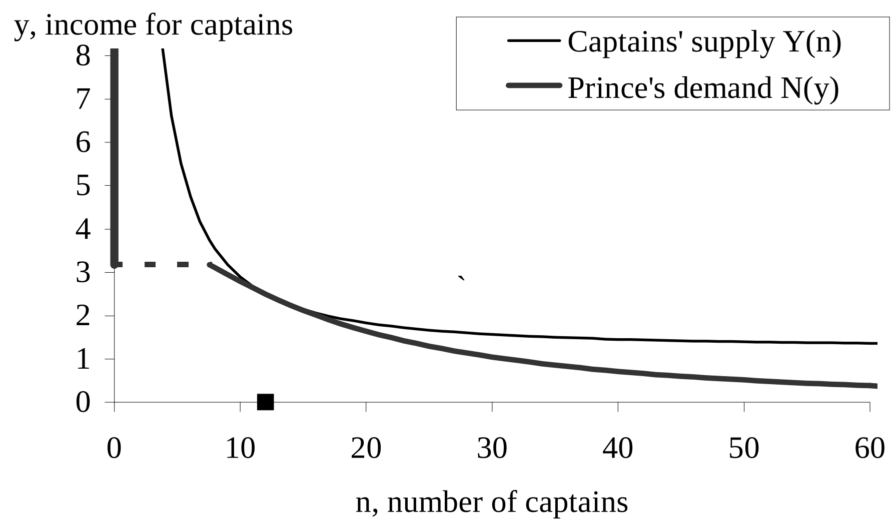
In the case of bounded recruiting, the prince is trusted only by captains in some given finite group or tribe.
Any captain in this group believes the prince will pay him y as long as he serves in battles and the prince retains power.
Individuals outside this group would expect never to be paid by the prince, and so would never support him in battle.
After winning, prince wants to pay y to the n members of his trusted group
only if (n,y) satisfies the demand constraint $V(n,y) = \max_{k\leq n} V(k,y)$.
So we can define the prince's demand curve by $N(y) = \operatorname{argmax}_{n\geq 0} V(n,y)$.
The demand constraint is satisfied on this curve and at some (n,y) such that $n\leq N(y)$.
A local equilibrium (n,y) must satisfy the demand constraint and supply constraint $y\geq Y(n)$.
There always exists a local equilibrium at $n=0$, $y=\infty$, which represents distrust.

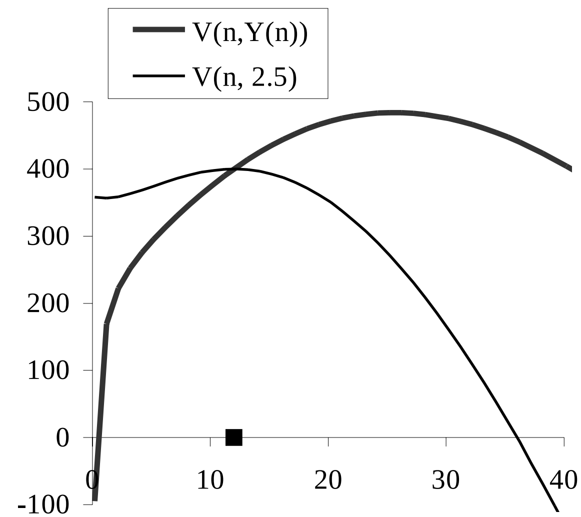
In the case of unbounded recruiting, an unbounded supply of potential captains are equally ready to trust the prince.
But the prince would not pay captains for past service if he could freely recruit new captains before next battle.
Any n which maximizes $p(n)V(n,y)-n(y/\lambda)$ for the prince before battle also maximizes V(n,y) after battle,
because $V(n,y) = [R - \lambda n(y/\lambda) + \lambda p(n)V(n,y)]/(\lambda+\delta)$.
So an absolute prince with unbounded recruiting can sustain an eqm (n,y) with $n=N(y)$ and $y\geq Y(n)$
if earning trust of a new recruit requires an advance payment of y/λ or more.
Advance pay y/λ is a costly signal that the prince has not hired more captains than he will want to retain after battle.

If (n,y) is an equilibrium, then (n,Y(n)) is also an equilibrium and is better for the absolute prince.
Fact. If (n,Y(n)) is an equilibrium for an absolute prince and $n > 0$, then $\operatorname{argmax}_{k\geq 0} V(k,Y(k)) > n$.
So an absolute prince could always gain from relaxing absolutism and commiting himself to retain more captains.

With a win-probability function p(n) = p(n|M) that depends on the anticipated size of challengers' armies, we may assume that challengers will resemble our prince. So a local eqm is also a <u>global equilibrium</u> iff n = M. To see how intense competition for power can become, we may consider global equilibria with maximal M.

A numerical example Consider R=90, λ=0.2, δ=0.05, c=5, s=1.5, so $p(n|M) = n^{1.5}/(n^{1.5}+M^{1.5})$.
For this example, the maximal global absolutist eqm is at n=M=12 and y=2.5. A new recruit would cost y/λ=12.5.





Calculations at `http://home.uchicago.edu/~rmyerson/research/prince.xls`

In this eqm, the captains' portion of the principality's income is ny/R = 0.333.
With M=12: Y(12)=2.5, N(2.5) = $\text{argmax}_{n\geq 0}$ V(n,2.5) = 12, yielding p=0.5, V=400.
But $\text{argmax}_{n\geq 0}$ V(n,Y(n)) = 25.5, which would yield p=0.756, Y=1.65, V=484.
Before battle, $\text{argmax}_{n\geq 0}$ p(n)V(n,Y(n)) = 31.1, yielding p=0.807, Y=1.55, pV=380.

Introducing the prince's court

In the context of a global absolutist equilibrium, a prince would do better if he could credibly recruit more captains.
The prince can make this commitment credible by creating a court where the captains meet regularly
and share any complaints that they may have against him.

In a weak court, complaints could shift the expected equilibrium to one where nobody trusts the leader,
so that his expected value would drop to $V_0 = R/(\delta+\lambda)$.
Captains who have not been cheated by the prince get expected payoff $U(n,y) > 0$ in equilibrium,
so they have no incentive to complain unless the prince actually deviated.
So with a weak court, a local equilibrium for the prince and his captains can be
any (n,y) satisfying $y \geq Y(n)$ and $V(n,y) \geq V_0$.

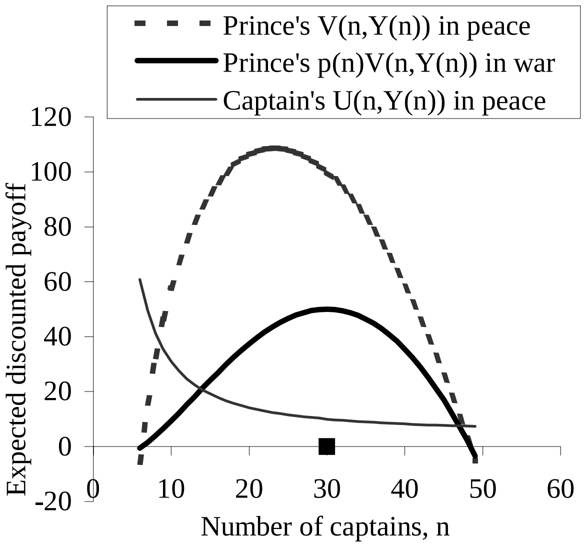
It may be strange to assume that challengers only arrive at rate λ when all captains know that nobody trusts the prince.
So we define a strong court to be one where complaints could shift the expected equilibrium to distrust ($n=0$, $y=\infty$)
and cause a new challenger to emerge from the court, so that the incumbent's expected value would drop to 0.
With a strong court, a local equilibrium for the prince can be any (n,y) satisfying $y \geq Y(n)$ and $V(n,y) \geq 0$.
Before battle, the prince would want to negotiate an optimal local equilibrium that
maximizes $p(n)V(n,y)$ subject to these constraints.
Because $p(n)$ is increasing in n, $\text{argmax}_{n\geq 0}\, p(n)V(n,Y(n)) \geq \text{argmax}_{n\geq 0}\, V(n,Y(n))$.

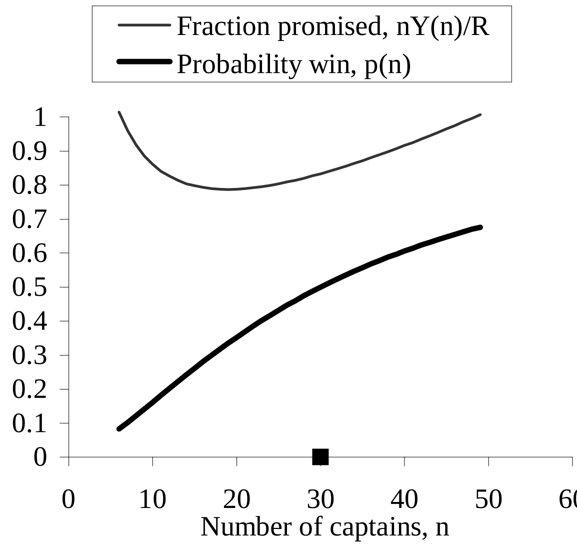
As before, a local equilibrium is global when $n = M$.

Fact Suppose $p(n|M)=n^s/(n^s+M^s)$ where $s > 1$.
If $(M,Y(M))$ is a global eqm with weak courts, then $\text{argmax}_{n\geq 0}\, V(n,Y(n)) > M$.

Consider again our **numerical example** with R=90, δ=0.05, c=5, s=1.5, λ=0.2.
The maximal global eqm with weak courts has M=14.4=n, y=Y=2.5, ny/R=0.4, V=360.
But with M=14.4: $\text{argmax}_{n\geq 0}$ V(n,Y(n)) = 25.7, yielding p=0.705, Y=1.77, V=407;
before battle, $\text{argmax}_{n\geq 0}$ p(n)V(n,Y(n)) = 32.1, yielding p=0.769, Y=1.63, pV=302.

With strong courts, $\exists$ global eqm such that even before battle the prince would not want to commit to a larger army.
In this eqm, M = 30 = n, y = Y(n|M)=2.5, ny/R=0.833, V(n,y) = 100, p(n)V(n,y) = 50.





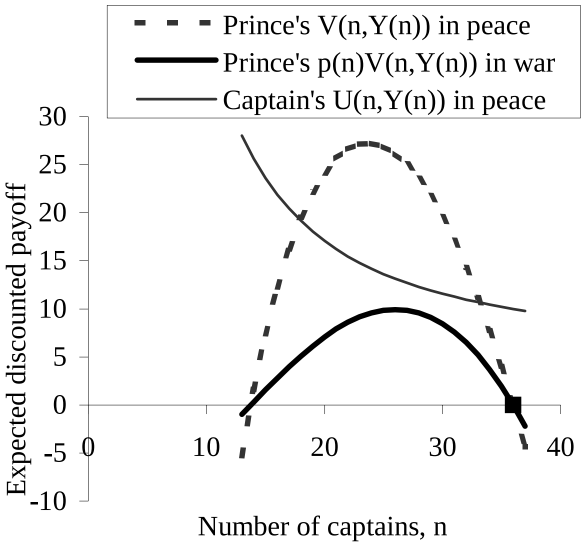
Consider alternative local equilibria that are feasible for a prince against M=30.
As we vary n, prince's total wage bill nY(n) = n(δ+λ)c/p(n) is u-shaped, going above R when n<6.24 or n>48.4.
When n < 6.24, the small p(n) makes Y(n) so large that nY(n) > R.
So a captain will not support a leader who is considered unlikely to get support from many other captains.
The captains are in a coordination game, where nobody wants to support a leader whom nobody else is supporting.
Xenophon's Cyrus the Great recruited the largest army in Asia by an equilibrium like the high end (n$\approx$48,V$\approx$0),
invoking the possibility of a behavioral type (Persian virtue) to make this eqm focal.

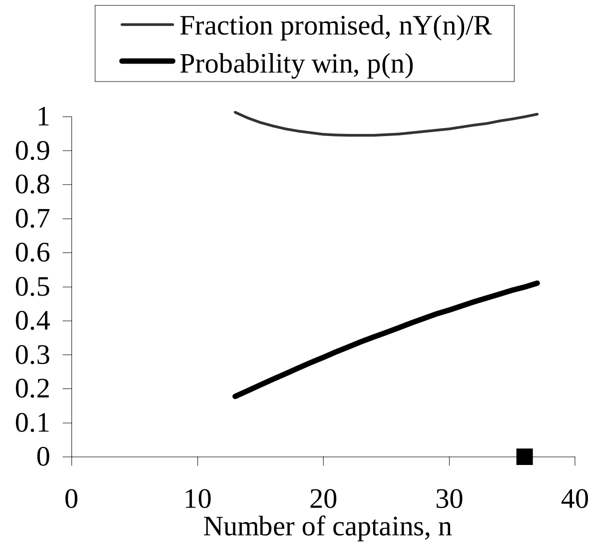
For our numerical example with R=90, δ=0.05, c=5, s=1.5, λ=0.2,

the **maximal global equilibrium with strong courts** has M=36=n, y=Y=2.5, ny/R=1, V=0.

Against armies of size M=36, an army of size n=23.7 would maximize V(n,y).

Princes could be deterred from such profit-taking by fear that deviation from the virtuous high-n low-V strategy would cause the members of their court to distrust and desert them.





Multiplicity of equilibria as the basis for constitutions

We have found two reasons why captains might not support a prince in equilibrium:

Unreliability A captain should not support when he fears that he would not be rewarded, which would be rational for the prince if it would not adversely affect the prince's ability to recruit other supporters in the future.

So there can always be an eqm where people outside any given group would not trust or support the prince.

Weakness A captain should not support when he fears that other captains are also unlikely to support the prince, making prince's probability of success so small that even credible promises to share R would not be worth the cost c.

So this coordination game always has equilibria where the prince gets no support.

A reliable reputation with many active supporters is the rare asset that defines a leader.
Factors that focus eqm-coordination on one leader may be called legitimacy (extrinsic) or charisma (intrinsic).
The charisma to gather a confident army may be bestowed on individuals by random (Poisson λ) events.

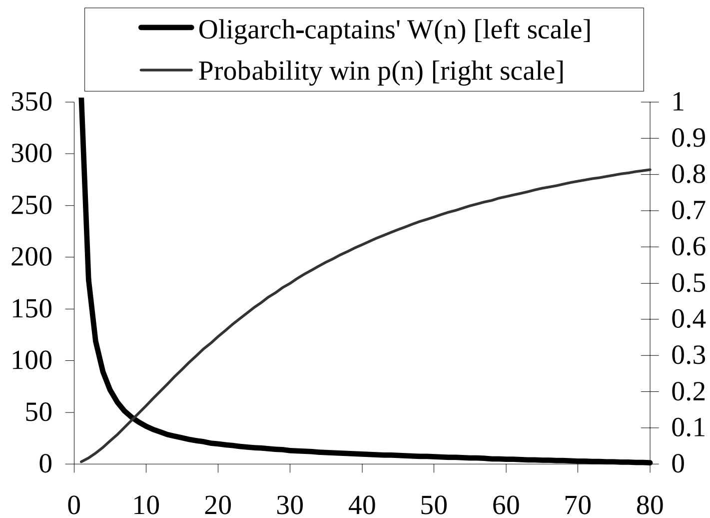
To maintain reliability, we have seen that a prince's supporters need a court or forum to communicate grievances, and they need a shared sense of group identity so that they will all react to a breach of trust against any one captain.
There can be new recruiting, but any new captain must be accepted into this group, to be assured that his mistreatment by the prince would cause them all to distrust the prince.
Participation in the prince's court can be required for good relationship with prince (feudal oath of aid and counsel).

When a political leader has a reputation for adhering to some set of behavioral norms, he may fear that his violating any of these norms could also destroy his supporters' trust (decrease n, or increase λ).
A political leader may fear to violate an established constitution when his relationships with supporters were developed in the context of it, so that violating the constitution would seem to his supporters like cheating one of them.
Thus constitutional democracy may be based on captains' fragile trust of their leader.
(On multiple equilibria as basis of constitutions, see Hardin 1989, Myerson 2004.)
(The need for supporters' trust is a critical constraint on challengers in the selectorate model of BdM-S-S-M.)

Monarchy and oligarchy.

Starting with an assumption of absolute monarchy, we showed that, to credibly motivate his captains into battle, a prince can gain by establishing a court where his captains can remove him from power if he breaks promises to them. But the prince's court can yield other equilibria that are worse for the prince.

When succession disputes are resolved in such a court, rival heirs may compete by promising more than the minimal $y = (\delta+\lambda)c/p(n)$ that motivates captains into battle. With Bertrand price-competition among heirs, the court could eventually convert the monarchy into an oligarchy where each of n captains gets income $Y = R/n$. Each captain's utility is then $W(n) = (R/n-\lambda c)/[\delta+\lambda(1-p(n))]$. In our example with $R=90$, $\delta=0.05$, $c=5$, $\lambda=0.2$, $s=1.5$ and $M=30$, this W(n) is a monotone decreasing function of n.



$\lim_{n\to 0} W(n) = +\infty$. So oligarchs prefer to reduce the size n of their oligarchy, even though $p(n) \to 0$ as $n\to 0$. In the oligarchy, any captain must become an equal partner who gets R/n; but a monarch can hire captains at the wage Y(n) that motivates them in battle. Transformation of monarchies into contracting oligarchies could be one explanation of dynastic decline.

From captains to governors

Among high agents of the state, one primary distinction is between military captains who help the prince get power, and administrative governors who help the prince use power profitably.
Separating captains from revenue sources by a central treasury reduces any one agent's expected profit from rebelling.
But we should also recognize basic differences in the agency problems of captains and governors.
Captains work to win power for the prince, who may be tempted by the short-term benefits of not rewarding them.
The prince delegates power to governors, who then may be tempted to use their power for private benefits.
A captain's most serious temptation is to avoid danger in battles that occur as rare discrete events, but administrative governors may have continuous temptations to divert wealth from provinces that are hard for the prince to monitor.
We ignored problems of monitoring in our simple model of the captains, but imperfect monitoring is essential to the agency problems of governors, because the prince's power to replace governors would enable him to costlessly control them if he could perfectly observe their costs and their actions.

The different problems of motivating governors may further explain why a prince might recruit his high officials only from some small subset of society, the "aristocracy".
Model 1 has equilibria in which only "aristocrats" trust that the prince would reward them, but Model 1 also admits equivalent equilibria in which the prince would recruit a whole new set of captains at each challenge.
The prince could replace captains when new challenges arise, because captains' expected payoffs go to 0 before battle.
The right to fight in future battles is not part of the captains' rewards, and so they can be retired.
It is only necessary that new captains should know about the prince's past history so that the new captains' trust of the prince can be conditioned on his having paid all promised incomes to past supporters.
But the continuous problem of controlling powerful hard-to-monitor governors
forces the prince to allow them valuable privileges on a continous basis.
These privileges are too valuable to be just given away to newcomers,
although they may be used to pay retiring captains. The result may create to an aristocracy.

Model 2: Incentives for governors whom the prince needs to control provinces [D, α, β, γ, K, H, δ]

Suppose a governor always has three options: to be a good governor, or to be corrupt, or to openly rebel against the prince (flee abroad with local treasures).

Let D denote the expected payoff to a governor when he rebels.

The prince cannot directly observe whether a governor is good or corrupt, but he can observe any costly crises that may occur under a governor's rule.

When the governor is good, crises will occur in his province at a Poisson rate α.

When the governor is corrupt, crises occur at a Poisson rate β, where $\beta > \alpha$, and the corrupt governor also gains an additional secret income worth γ per unit time.

The governor observes any crisis in his province shortly before the prince does.

Crises are very costly for the prince (may yield challengers of model 1), and so he wants to induce his governors to be good (as well as nonrebellious themselves).

The position of governor may be quite valuable, but candidates have only some limited wealth K, and so they cannot pay more than K for the job. Suppose $K < D$.

The prince may derive some advantage from deferring payments to a governor, but the prince's temptation to sack a governor increases with the debt owed to him.

So let H denote the largest credit owed to a governor that the prince can be trusted to pay.

Again, we assume that each individual is risk neutral and has discount rate δ.

We now characterize **an optimal incentive plan** that minimizes the prince's expected cost subject to the constraints that a governor should never want to be corrupt or rebel.

To minimize the prince's expected cost of paying governors, the optimal incentive plan can be characterized by a stochastic process $\tilde{U}(t)$ = (the expected present discounted value of pay owed to the governor at time t).
Let $\tau = \gamma/(\beta-\alpha)$. To deter corruption, at each crisis the governor's expected value must drop by τ.
(So $(\beta-\alpha)\tau=\gamma$. In any short time interval ε, corruption yields benefits $\gamma\varepsilon$ but increases Pr(crisis) by $(\beta-\alpha)\varepsilon$.)
Backloading pay is better whenever possible. So when $\tilde{U}(t) < H$, the governor gets no pay.
Credit u grows between crises at rate $\tilde{U}'(t)=\delta u(t)+\alpha\tau$, but u drops at a crisis by $\tilde{U}(t_+)=\tilde{U}(t_-)-\tau$. [So $E\tilde{U}'=\delta u$.]
When $\tilde{U}(t)=H$, the governor is paid at rate $\delta H+\alpha\tau$ and has $\tilde{U}'(t)=0$ until the next crisis, when $\tilde{U}$ drops to $H-\tau$.
To deter rebellion, $\tilde{U}(t)$ must never go below D after any crisis. (Governor sees the crisis first and could rebel then.)
Let $G = D+\tau = D+\gamma/(\beta-\alpha)$ = (lowest possible credit u such that $u-\tau \geq D$ after a crisis).
So a new governor must start with $\tilde{U}(0) = G = D+\gamma/(\beta-\alpha)$, but should pay K to the prince for this status.
After a crisis, if $\tilde{U}(t_-)-\tau < G$, the governor should be called to court (where he can't rebel) for a trial where, with probability $(\tilde{U}(t_-)-\tau)/G$ he is reinstated at $\tilde{U}(t_+)=G$, but otherwise he is dismissed (to U=0).

Let V(u) be the prince's total expected discounted cost of paying governors, when the current governor's credit is u.
Given any u in [G,H], the prince chooses y = (pay rate), u' = (credit growth rate between crises),
q = Pr(gov'r dismissed if crisis), $\hat{u}$ = (credit after crisis if not dismissed)
Optimality conditions: $\delta V(u) = \min\,[y + V'(u)u' + \alpha q(V(G)-K) + \alpha(1-q)V(\hat{u}) - \alpha V(u))]$ over $(y,u',q,\hat{u})$
subject to $\delta u = y+u'-\alpha(u-(1-q)\hat{u})$, $(1-q)\hat{u} \geq D$, $u-(1-q)\hat{u} \geq \tau$, $0 \leq q \leq 1$, $y \geq 0$, $u' \leq 0$ when u=H, $\hat{u}\in[G,H]$.
(Promise-keeping requires that, for any small $\varepsilon>0$, $u \approx y\varepsilon+(1-\delta\varepsilon)[(1-\alpha\varepsilon)(u+\varepsilon u')+\alpha\varepsilon(u-\tau)] \approx u+\varepsilon(y+u'-\delta u-\alpha\tau)$.)
The solution has, $\forall u\in[G,H]$: $y+u'=\delta u+\alpha\tau$, y=0 if u<H, $u'=0$ if u=H, $\hat{u}=\max\{u-\tau, G\}$, $1-q=(u-\tau)/\hat{u}$.
The prince's value function V(•) is a convex function with $0 \leq V'(u) < 1$ for all u<H.
Convexity of V implies that the prince could never decrease expected cost by extraneous randomization.

Computing the prince's value function. If $G \leq u < H$ then over the next short time interval ε we get
$V(u) \approx (1-\delta\varepsilon)[(1-\alpha\varepsilon)V(u+\varepsilon u')+\alpha\varepsilon V(u-\tau)] \approx V(u)+\varepsilon[V'(u)u'-(\delta+\alpha)V(u)+\alpha V(u-\tau)]$.
Thus, with $u'=\delta u+\alpha\tau$, we get $V'(u) = [(\delta+\alpha)V(u)-\alpha V(u-\tau)]/(\delta u+\alpha\tau)$.
When $u<G$, a trial either restores the governor to credit G, with probability u/G, or disimisses him and gets a new governor who pays K for the same G status. So for any $u < G$, $V(u) = V(G)-(1-u/G)K$.
V' is discontinuous at G: If $u<G$ then $V'(u) = K/G$, but the right derivative at G is
$V'(G) = [(\delta+\alpha)V(G)-V(G-\tau)]/(\delta G+\alpha\tau) = \delta(V(G)-K)/(\delta G+\alpha\tau) + K/G$.

Lemma: The left derivative of V at H satisfies the boundary condition $V'(H) = 1$. (See proofs at end.)
Lemma: V can be computed from: $V(G)-K = (G-K)/\Psi(H)$ and $V'(u) = (1-K/G)\Psi(u)/\Psi(H)-K/G$,
where $\forall u<G$, $\Psi(u) = 0$; $\Psi(G) = \delta G/(\delta G+\alpha\tau)$; $\forall u \geq G$, $\Psi'(u) = \alpha[\Psi(u)-\Psi(u-\tau)]/(\delta u+\alpha\tau)$.
Lemma: V is a convex increasing function with $0 \leq V'(u)<1$ for all $u < H$.

Convexity of V on [G,H] implies that the prince could never decrease expected cost by extraneous randomization.
Randomization happens only within the interval [0,G], and V is linear on [0,G].
Paying ε to reduce the debt by ε would change the prince's expected cost to $\varepsilon+V(u-\varepsilon) \approx V(u)+\varepsilon(1-V'(u)) < V(u)$,
because $V'(u) < 1$ when $u<H$, and so the prince cannot gain by paying the governor when $u < H$.

<u>Fact:</u> The prince's ex ante expected cost $V(G)-K = (G-K)/\Psi(H)$ is a strictly decreasing function of the bound H.
So greater trust is good for the prince.

If H were less than G then it would be impossible for the prince to design an incentive plan
such that governors are always deterred from corruption and rebellion in this problem.

The prince must randomize between dismissal and reinstatement after crises when the governor's credit is below $G+\tau$.
But with $K>0$, the prince would actually prefer to dismiss than to reinstate ($V(G)-K < V(G)$).
If the prince could not be trusted to randomize appropriately, then he could not always deter corruption and rebellion.

Long-run analysis

In the long-run stationary distribution of the governor's credit $\tilde{u}$, let $F(u) = P(\tilde{u}<u)$.

Lemmas: $F(u) = P(\tilde{u}<u)$ satisfies $-F'(u) = \alpha(F(u)-F(u+\tau))/(\delta u+\alpha\tau)$, $F(G) = 0$, $1-F(H) = P(\tilde{u}=H) > 0$.

(Computing F: $F(u) = 1-\Omega(u)/\Omega(G)$ where $\Omega(u)=0\ \forall u>H$; $\Omega(H)=1$; $\forall u<H$, $-\Omega'(u) = \alpha(\Omega(u)-\Omega(u+\tau))/(\delta u+\alpha\tau)$.)

If $u \leq H-m\tau$, then $F(u) \leq [\alpha\tau/(\delta G+\alpha\tau)]^{m+1}$. $E(\tilde{u}) \geq H-\alpha\tau^2/(\delta G)$.

<u>Facts:</u> $P(\tilde{u}=H) \geq (\delta H-\alpha\tau^2/G)/(\delta H+\alpha\tau)$, which goes to 1 as H becomes large.

So if H is high then, in the long run, the prince will usually pay high wages $\delta H+\alpha\tau$ to governors.

The rate of turnover for governors $\int_{u=G}^{G+\tau} \alpha(1-(u-\tau)/G)\,dF(u) \leq \alpha F(G+\tau)$ goes to 0 as H becomes large.

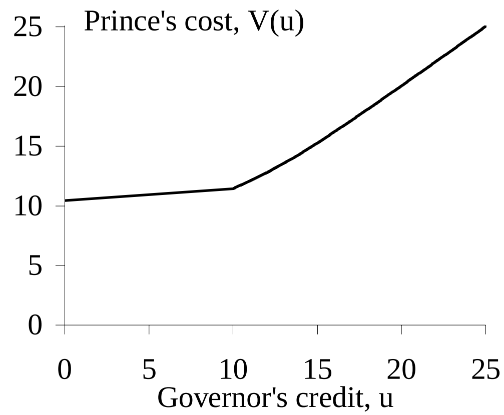
So with high H, successful governors tend to become entrenched in office.

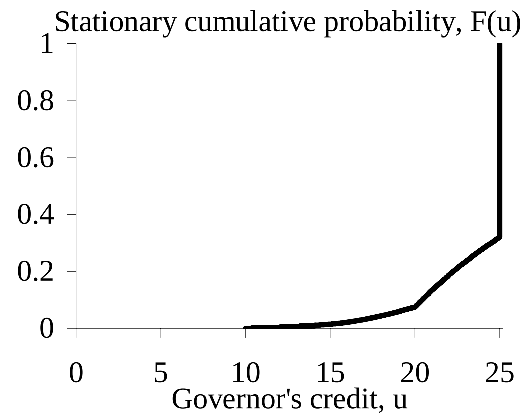
Thus, even when the prince is secure in power and is as patient as his agents (same discount factor),
agency costs give the prince an incentive to accumulate large expensive debts to his governors.
This effect may also explain dynastic decline.
The general equilibrium analysis in Model 1 was made tractable by assuming stationarity.
But this partial-equilibrium Model 2 suggests an intrinsic nonstationarity: increasing wealth of high officials.

Example: Let $\delta = 0.05$, $\alpha = 0.1$, $\beta = 0.3$, $\gamma = 1$, $D = 5$, $K = 1$, $H=25$.

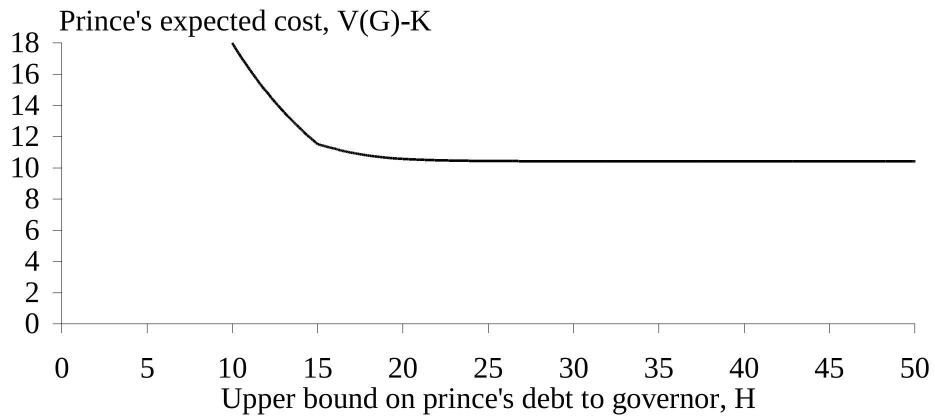
Then $\tau = \gamma/(\beta-\alpha) = 5$, $G = D+\tau = 10$, $V(G)-K = 10.44$, $1-F(H) = 0.68$,

E(pay rate) = $(\delta H+\alpha\tau)(1-F(H)) = 1.19$, E(dismissal rate) = $\int_{u=G}^{G+\tau} \alpha(1-(u-\tau)/G)\,dF(u) = 0.00030$.





Changing H (from 10 to ∞) could change $V(G)-K = (G-K)/\Psi(H)$ from 18 to 10.42.



(With H=10=G, we would get: pay $y=\delta G+\alpha\tau=1$, dismissal rate $\alpha(1-(G-\tau)/G)=0.05$, $V(G)-K = 18$.)

Selling offices and guaranteeing fair trials of officials

This model of high government officials is just a modest elaboration of Becker-Stigler (1974), Shapiro-Stiglitz (1984). As Becker-Stigler emphasized, powerful officials who are hard to monitor should get great rewards for a good record, and the leader who raises them to such great expectations should charge them ex ante for the privilege.
They may pay with money, or with underpaid prior service, or with the discharge of a debt owed to an ancestor.
What I want to emphasize here is that this backloading of rewards makes the leader a debtor to his high officials, and so an effective leader must create institutions that give his officials some power to enforce these debts.

The prospect of high payoffs makes the governor's office a valuable asset that a prince should not waste on a talented person who cannot pay for the office (unless there are big inequalities among people's ability).
The prince's ideal would be to sell the office for K=G, so that capital from new governors would cover their cost.
When $G=D+\gamma/(\beta-\alpha)$ is large, candidates who can pay so much may not exist.
In some societies, people without political connections may be unable to protect large private wealth, but any prince needs a reputation for protecting his supporters' assets.
This effect also may tend to make the prince's supporters into a self-perpetuating aristocracy.

The threat of dismissal must be moderated by randomization, or else it would incite governors to rebel after crises.
Such randomization can be achieved by a "fair trial" in the prince's court.
But there is a tension between selling office and randomizing dismissal: with K>0, the prince prefers to dismiss.
For credibility, "fairness" of trials of governors must be actively monitored by others in the prince's court, because the correct outcome cannot be simply predicted from the facts of the case (governor must be uncertain).
(Septimus Severus began recruiting lower-class generals. The Senate could guarantee fair trials only for upper class.)

The prince cannot gain by punishing ex-governors, because governors' expected payoffs cannot be less than G (to avoid rebellions), and so any plan to unproductively punish an ex-governor must be offset by increasing the probability of reinstating the governor after a crisis, instead of reselling his office for K.

Perspectives on constitutional government

We have examined the need for trust between a political leader and his supporters.
Many of our insights about a monarch and his active supporters can be extended to
the politicians and high officials in more complex constitutional governments.

To fully characterize a constitution as a self-enforcing dynamic system, one must specify not only
(1) a set of political offices, (2) the powers, privileges, and responsibilities of these offices,
and (3) the procedures for selecting future holders of these offices;
but also (4) the privileged individuals who actually hold these offices at some initial time.

Under any political system, a leader can win power and hold power only with the help of active supporters,
a core group small enough to monitor, who trust that their leader will reward them after his victory.
The rules which define what a leader must do to maintain his supporters' trust are a personal constitution for the leader.

The first officials of a new constitution need supporters to win this privilege.
In negotiating a new political system, established leaders cannot begin by abandoning the source of their power:
those who supported them in expectation of future rewards.
So the fate of a new constitution may depend critically on the pre-existing personal constitutions
that bind its first political leaders with their primary supporters.
We should not assume that the rules of a new regime are written on a blank slate.
A democratic constitution would be imperiled if its most powerful office were won by a politician who could be
confident that his active supporters would still trust him after he openly violated the constraints of the constitution.
(See also my paper on "Federalism and incentives for success of democracy.")

Conclusions We have applied basic models of agency theory to probe the essential problems of rewarding the agents who maintain a political leader in power.
Under any system, a political leader can win and hold power only with the costly efforts of many supporters who must expect rewards from his success.
Powerful officials who cannot be perfectly monitored must also expect great rewards, so that a threat of dismissal can deter them from abuse of power.
Costs of rewarding high officials can be recouped by selling offices (for money or service), but then the leader gets a positive incentive to dismiss and resell an office.
So a successful leader always needs to credibly reassure his supporters and agents that rewards will be allocated according to some mutually understood rules.

These rules, which define what a leader must do to maintain his supporters' trust, may be considered as a kind of personal constitution for the leader, even if he is a monarch who is not formally constrained by any other constitution.
In this personal constitution, the leader is constrained to share benefits of power with a privileged group of agents and supporters, and new recruiting into this group may be restricted to protect the privileges of its current members.
There must be some court or forum where the leader's compliance with these rules can be monitored by his supporters.
To them at least he must give a kind of justice.

We have not asked why he should give justice to others who are not active supporters. (Henry II, 1st Song emperors.)
But his personal constitution could also commit the leader to comply with other norms and promises, if his violation of them would be treated like his cheating a supporter.

In democracy, leaders should extend their base of support to include voting masses.
But a core of active supporters, small enough to monitor, is essential for any leader.
So the performance of democracy may depend critically on the personal constitutions that bind its political leaders with their active supporters.

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All calculations in this paper can be done in a spreadsheet available at
`http://home.uchicago.edu/~rmyerson/research/prince.xls`

Appendix: Proofs for Model 1.

Fact. If (n,Y(n)) is an eqm for the absolute prince with n>0 then $\text{argmax}_{k\geq 0} V(k,Y(k)) > n$.

Proof The demand constraint gives us

$V(n,Y(n)) = \max_{k\in[0,n]} V(k,Y(n)) \geq \max_{k\in[0,n]} V(k,Y(k))$, so $\text{argmax}_{k\in[0,n]} V(k,Y(k)) = n$.

The demand constraint for n>0 also implies that the first partial derivative of V satisfies $V_1(n,y) \geq 0$, because otherwise the absolute prince would prefer to drop at least some of his n captains.

The second partial derivative is $V_2(n,y) = -n/(\delta+\lambda(1-p(n))) < 0$.

Furthermore, $Y'(n) = -c(\delta+\lambda)p'(n)/p(n)^2 < 0$.

Now let $\bar{V}(n)= V(n,Y(n))$. By the chain rule, the derivative of $\bar{V}$ is

$\bar{V}'(n) = V_1(n,Y(n)) + V_2(n,Y(n))Y'(n) > 0$.

So there must exist some k>n such that $\bar{V}(k) > \bar{V}(n)$. Q.E.D.

Fact Suppose $p(n|M)=n^s/(n^s+M^s)$ where s > 1. Given M,
if $V(M,Y(M)) \geq R/(\delta+\lambda)$, so that (M,Y(M)) is a global eqm with weak courts,
then $M \leq R\lambda/[4c(\delta+\lambda)^2]$ and $\text{argmax}_{n\geq 0} V(n,Y(n)) > M$.

Proof Given $V(M,Y(M|M)|M) \geq R/(\delta+\lambda)$, the definitions of V and Y with $p(M|M)=0.5$ imply $(R-Mc(\delta+\lambda)2)/(\delta+\lambda/2) \geq R/(\delta+\lambda)$. The inequality $M \leq R\lambda/[4c(\delta+\lambda)^2]$ follows by algebra.

Again let $\bar{V}(n) = V(n,Y(n|M)|M) = [R-n(\delta+\lambda)c/p(n|M)]/[\delta+\lambda-\lambda p(n|M)]$.

Abbreviating p for p(n|M), we have

$\bar{V}'(n) = \bar{V}(n)\lambda p'/(\delta+\lambda-\lambda p) - (\delta+\lambda)c[1/p - np'/p^2]/(\delta+\lambda-\lambda p)$
$\quad = \{\bar{V}(n)\lambda p' + (\delta+\lambda)c[np'/p^2 - 1/p]\}/(\delta+\lambda-\lambda p)$.

Find the highest n that maximizes V(n,Y(n|M)|M) over the interval $n\in[0,M]$.

The given inequality for M implies that $\bar{V}(n)\geq R/(\delta+\lambda)$, which (with the definition of V) also implies $R\lambda/(\delta+\lambda) \geq nc(\delta+\lambda)/p^2$. Then

$\bar{V}'(n) \geq \{[R/(\delta+\lambda)]\lambda p' + (\delta+\lambda)c[np'/p^2 - 1/p]\}/(\delta+\lambda-\lambda p)$
$\quad \geq \{p'nc(\delta+\lambda)/p^2 + (\delta+\lambda)c[np'/p^2 - 1/p]\}/(\delta+\lambda-\lambda p)$
$\quad \geq [2np'/p - 1](\delta+\lambda)c/[p(\delta+\lambda-\lambda p)]$.

Our formula for p(n) = p(n|M) implies $p'(n) = p(n)[1-p(n)]s/n$.

So with $n \leq M$, $p(n|M)\leq 1/2$, and s>1, we get

$\bar{V}'(n) \geq [2(1-p)s - 1](\delta+\lambda)c/[p(\delta+\lambda-\lambda p)] > 0$.

So $\bar{V}'(n)>0$. This implies that n is not an interior maximum for $\bar{V}$ in [0,M], and n≠0.

Thus, we have n = M, that is, $\bar{V}(M) = \max_{n\in[0,M]} V(n)$.

Then $\bar{V}'(M) > 0$ implies that there exists $\hat{n} > M$ such that $\bar{V}(\hat{n}) > \bar{V}(M)$. Q.E.D.

Fact. Suppose $p(n|M) = n^s/(n^s+M^s)$ with $s \leq 2$. Then $W'(n) < 0$ for all $n \leq M$.

Proof With $p=p(n)= n^s/(n^s+M^s)$, we have $p' = p(1-p]s/n$.

From the definition $W(n) = (R/n-\lambda c)/(\delta+\lambda-\lambda p(n))$, we get

$W'(n) = [(R-n\lambda c)\lambda(1-p)ps - R(\delta+\lambda(1-p))]/[n(\delta+\lambda-\lambda p)]^2$.

Since $R-n\lambda c < R$ and $\lambda(1-p) < \delta+\lambda(1-p)$, this derivative is always negative when $ps \leq 1$, which holds when $s\leq 2$ and $n\leq M$ (so that $p(n)\leq 0.5$). Q.E.D.

Appendix: Proofs for Model 2.

To prove that $V'(H)=1$, compare the prince's cost when $u=H$ to when $u=H-\varepsilon$.

If there is no crisis during the next short time interval of length $\varepsilon/u' = \varepsilon/(\delta H+\alpha\tau)$, then $u=H-\varepsilon$ case will come to look exactly like the $u=H$ case.

During this short time interval, the prince pay at rate $\delta H+\alpha\tau$ in the $u=H$ case but will pay 0 in the $u=H-\varepsilon$ case, so the expected difference of payments by the prince during this short interval is $(\delta H+\alpha\tau - 0)\varepsilon/(\delta H+\alpha\tau) = \varepsilon$.

So if there is no crisis in this short time interval, then the prince's future discounted costs with $u=H$ will be just ε more than with $u=H-\varepsilon$.

The probability of a crisis in this short interval is $\alpha\varepsilon/(\delta H+\alpha\tau)$, and the prince's expected discounted costs after such a crisis would differ in these two cases by only $\varepsilon V'(H-\tau)$.

So $V'(H) = \lim_{\varepsilon\to 0} (V(H)-V(H-\varepsilon))/\varepsilon = (\varepsilon + \varepsilon V'(H-\tau)\alpha\varepsilon/(\delta H+\alpha\tau))/\varepsilon = 1$.

Computing V.

For any u in [G,H], we have $V'(u) = [(\delta+\alpha)V(u)-\alpha V(u-\tau)]/(\delta u+\alpha\tau)$.

Differentiation implies that, $\forall u\in[G,H]$, $V''(u) = \alpha[V'(u)-V'(u-\tau)]/(\delta u+\alpha\tau)$.

We also have $V'(u) = K/G$ for $u<G$, but $V'(G) = \delta(V(G)-K)/(\delta G+\alpha\tau) + K/G$.

Now let $\Psi(u) = (GV'(u)-K)/(V(G)-K)$.

$\forall u<G$: $\Psi(u) = 0$. We have the initial condition $\Psi(G) = \delta G/(\delta G+\alpha\tau)$.

$\forall u\geq G$: $\Psi'(u) = \alpha[\Psi(u)-\Psi(u-\tau)]/(\delta u+\alpha\tau)$.

The unique solution to this differential equation for $\Psi(u)$ can be numerically computed for all $u\geq G$.

From the lemma $V'(H)=1$. So $\Psi(H) = (G-K)/(V(G)-K)$, and so $V(G) = K+(G-K)/\Psi(H)$.

V(u) for other u can be solved from $V'(u) = [\Psi(u)(V(G)-K)-K]/G = (1-K/G)\Psi(u)/\Psi(H)-K/G$.

Convexity of V, with $0\leq V'(u)<1$ for all $u\leq H$. $V'(u)=K/G\geq 0$ is constant for all $u\in[0,G]$.

Then V' has a discontinuous increase at G to $V'(G) = \delta(V(G)-K)/(\delta G+\alpha\tau) + K/G > 0$.

Then from $V''(u) = \alpha[V'(u)-V'(u-\tau)]/(\delta u+\alpha\tau)$ $\forall u\in[G,H]$, we recursively derive $V''>0$ $\forall u\in[G,H]$.

The bounds on V' follow immediately from $0\leq V'(0)$, $V''(u)>0$, and $V'(H)=1$.

Computing the stationary distribution.

Let F denote the stationary cumulative distribution $F(u) = P(\text{Governor'sCredit} < u)$.

To equalize the rate of transitions upwards across u and downwards across u, we must have $(\delta u+\alpha\tau)F'(u) = \alpha(F(u+\tau)-F(u))$, and so $-F'(u) = \alpha(F(u)-F(u+\tau))/(\delta u+\alpha\tau)$.

We know $F(G)=0$, $F(u)=1$ for any $u>H$, but we need to find $F(H)$.

$1-F(H)$ is the discrete probability mass at the upper bound H (where the governor gets paid).

So let $\Omega(u) = (1-F(u))/(1-F(H))$.

So $\Omega(u)=0$ for any $u>H$. $\Omega(H)=1$. For any $u<H$, $-\Omega'(u) = \alpha(\Omega(u)-\Omega(u+\tau))/(\delta u+\alpha\tau)$.

So we can numerically solve for $\Omega(u)$ for all $u \in [G,H]$.

Notice $\Omega(G) = (1-0)/(1-F(H))$ and $1-F(u) = \Omega(u)(1-F(H))$.

Thus, we can compute F by $F(u) = 1-\Omega(u)/\Omega(G)$.

Let $\tilde{u}$ denote the governor's random credit with the stationary cumulative-probability $F(u)=P(\tilde{u}<u)$.

Lemma. $\forall w\in[G,H]$, $0 = \int_G^w \delta u\, dF(u) + \int_G^{G+\tau} \alpha(G+\tau-u)\, dF(u) + \int_w^{w+\tau} \alpha(u-w-\tau)\, dF(u)$.
Proof. Consider $E(\max\{0,\tilde{u}-w\}) = \int_G^w (u-w)\, dF(u)$.
With the stationary distribution, this expected value is constant over time.
The right-hand side of the equation in the lemma is the rate at which this expected value would increase over time starting with the distribution F.
The first integral is $P(\tilde{u}<w)\, E(\delta\tilde{u} \mid \tilde{u}<w)$, which is the expected rate of increase of the current governor's credit $\tilde{u}$ when starting from a state with $\tilde{u}<w$.
When a crisis makes governor's credit go below G, the prince raises the credit back up to G by reinstatement or replacement, and the rate of this raise is $\alpha E(\max\{G+\tau-\tilde{u},0\})$, the second integral.
The third integral is the rate at which newly nonzero (negative) values of $\max\{0,\tilde{u}-w\}$ are created from a governor with credit above w having a crisis that brings his credit below w.

In the above lemma, the first and second integrals are positive, and the third integral is negative.
Notice also that $\int_w^{w+\tau} \alpha(w+\tau-u)\, dF(u) \leq \alpha\tau[F(w+\tau)-F(w)]$. So the lemma implies:
Corollary. $\forall w\in[G,H]$, $F(w)\, E(\delta\tilde{u} \mid \tilde{u}<w) - \alpha\tau[F(w+\tau)-F(w)] \leq 0$.

Lemma $\forall w\in[G,H]$, $F(w) \leq F(w+\tau)[\alpha\tau/(\delta G+\alpha\tau)]$.
Proof. From the previous corollary, we get $\alpha\tau[F(w+\tau)-F(w)] \geq F(w)\, E(\delta\tilde{u} \mid \tilde{u}<w) \geq F(w)\, \delta G$.

Fact. $F(H) \leq [\alpha\tau/(\delta G+\alpha\tau)]$. For any integer $m>0$, if $u \leq H-m\tau$, then $F(u) \leq [\alpha\tau/(\delta G+\alpha\tau)]^{m+1}$.
Proof. Follows from the previous lemma, because F is increasing and $F(w+\tau)=1$ when $w+\tau > H$.

Fact. $E(\tilde{u}) \geq H-\alpha\tau^2/(\delta G)$.
Proof. $E(H-\tilde{u}) = \int_G^H (H-u)\, dF(u) = \int_G^H F(u)\, du \leq \sum_{n=0}^{\infty} \tau\, [\alpha\tau/(\delta G+\alpha\tau)]^{m+1} = \alpha\tau^2/(\delta G)$.

Fact $P(\tilde{u}=H) = 1-F(H) \geq (\delta H-\alpha\tau^2/G)/(\delta H+\alpha\tau)$, and this lower bound goes to 1 as $H\rightarrow\infty$.
Proof. $0 \geq F(H)\, E(\delta\tilde{u} \mid \tilde{u}<H) - \alpha\tau[F(H+\tau)-F(H)] = E(\delta\tilde{u}) - (\delta H+\alpha\tau)[1-F(H)]$
$\geq \delta H-\alpha\tau^2/G, - (\delta H+\alpha\tau)[1-F(H)]$.