# *Online Appendix for*
# Political Competition over Property Rights Enforcement

Jan U. Auerbach*

This online appendix contains additional discussion and extensions of the model in the paper "Political Competition over Property Rights Enforcement." Section A relaxes assumptions about economic activity. Section B analyzes an alternative timing of the political process.

## A The Security of Property Rights and Economic Activity

In the paper, my focus is on how political institutions affect society's choice of an enforcement regime. I opted for simplicity and assumed that individual production and thus aggregate output is fixed. This assumption is not essential because the economic mechanism works through the outside options of the players, not the size of the pie. In this section, I alter the model to allow for individual and thus aggregate output to depend on the security of property rights. I then show that Proposition 1 is unaffected. In particular, if the election loser's project, i.e., their outside option, is more productive, then the winning regime in the equilibrium of the political game provides less secure property rights, a higher payoff for the office holder, and lower payoffs for producers.

To make this point as simply as possible, suppose that the output of a producer's project depends on the amount of time or effort they devote to implementing it. This work effort is independent of the project's productivity and increases with the security of property rights. It is captured by the function $l : [0,1] \to [0,1]$ that maps the security of property rights $(1-\theta)$ into work effort $l(1-\theta) \in [0,1]$. Assume that $l(0) = 0$; for all $(1-\theta) \in (0,1)$, $l(1-\theta) > 0$,

$$(26) \qquad l'(1-\theta) > 0, \quad l''(1-\theta) \leq 0, \quad \frac{l'(1-\theta)(1-\theta)}{l(1-\theta)} \leq 1, \quad -\frac{l'''(1-\theta)(1-\theta)}{l''(1-\theta)} \leq 3,$$

where the last requirement applies if $l''(1-\theta) < 0$; and that $\lim_{(1-\theta)\to 1} l(1-\theta) = l(1) = 1$,

$$(27) \qquad \lim_{(1-\theta)\to 0} l'(1-\theta) > 0, \quad \lim_{(1-\theta)\to 0} l'(1-\theta)(1-\theta) \geq 0, \quad \lim_{(1-\theta)\to 1} l'(1-\theta) < 1.$$

*University of Exeter. E-mail: *j.auerbach@exeter.ac.uk*. Phone: +44 (0) 1392 72 6115. Postal address: University of Exeter Business School, Streatham Court, Rennes Drive, Exeter EX4 4PU, United Kingdom.

That is, individual economic activity $l(1-\theta)$ and thus output $l(1-\theta)w$ is an increasing and concave function of the security of property rights. Finally, in addition to the assumptions on the technology $g$ already made in the paper, let $g'''(1-\theta) \geq 0$ for all $(1-\theta) \in (0,1)$ and

$$\lim_{(1-\theta)\to 0} g'(1-\theta) = 0, \quad \lim_{(1-\theta)\to 1} g'(1-\theta) > 1. \tag{28}$$

Following these assumptions, given a regime $(\theta, \tau)$, a producer $w_i$'s payoff is

$$\hat{\varphi}(\theta,\tau)w_i = \varphi(\theta,\tau)l(1-\theta)w_i = (1-\theta)(1-\tau)l(1-\theta)w_i. \tag{29}$$

The new producer payoff factor $\hat{\varphi}(\theta,\tau)$ is nonnegative for all $(\theta,\tau) \in [0,1]^2$ and strictly increasing in both $(1-\theta)$ and $(1-\tau)$. Assume that it is quasiconcave. Given a regime $(\theta,\tau)$, because $\sum_i w_i = 1$, aggregate output, before taxation and appropriation, is given by

$$\sum_i l(1-\theta)w_i = l(1-\theta).$$

That is, aggregate economic activity and thus output decrease with less secure property rights. The office holder's payoff is given by the function $\hat{\tilde{w}} : [0,1]^2 \to \mathbb{R}$, defined as

$$\hat{\tilde{w}}(\theta,\tau) = \tau l(1-\theta) - g(1-\theta), \tag{30}$$

which is strictly increasing in $\tau$ for all $(\theta,\tau) \in (0,1)^2$. Assume that $\hat{\tilde{w}}(\theta,\tau)$ is quasiconcave. Finally, given a regime $(\theta,\tau)$, an appropriator's payoff is some nonzero share of

$$\hat{\nu}(\theta,\tau) = \theta(1-\tau)l(1-\theta). \tag{31}$$

For this altered environment with the above assumptions, the following result obtains.

**Proposition 8.** *Under the above assumptions, Proposition 1 holds unchanged.*

That is, Proposition 1 is unaffected. Both in anarchy and with a dictator—who simply chooses $(\theta,\tau)$ to maximize $\hat{\tilde{w}}(\theta,\tau)$, a problem discussed at the top of the proof of Proposition 8—the producer payoff factor equals zero. Therefore, all other results in Section 4 of the paper remain unaffected as well. Due to the unchanged effects of variations in $w_H$ on the outcome of the political game, the mechanics of the rest of the analysis remain unchanged. The related proofs only require notational adjustments. The reason for this result is that the relevant economic mechanism works through the outside options of the players, not the size of the pie. The simplifying assumption that economic activity is unaffected by the property rights enforcement regime is not driving the results.

Finally, as an example, functional forms for $g$ and $l$ that satisfy all of the above assumptions are $g(1-\theta) = (1-\theta)^2$ and $l(1-\theta) = (1-\theta)^{1/2}$.

## A.1 Proof of Proposition 8

*Proof.* This proof replicates the proof of Proposition 1 step by step. The relevant payoff functions are given by (29)–(31). Let $(\bar{\theta}, \bar{\tau})$ solve the problem of maximizing $\hat{\bar{w}}(\theta, \tau)$, i.e.,

$$(\bar{\theta}, \bar{\tau}) \in \arg \max_{(\theta,\tau)\in[0,1]^2} \quad \tau l(1-\theta) - g(1-\theta).$$

Because $l(1-\theta) > 0$ for all $(1-\theta) > 0$ and due to $l(1-\theta) - g(1-\theta)$ being strictly concave and satisfying $l(0) - g(0) = 0$, $l(1) - g(1) \leq 0$, and $\lim_{(1-\theta)\to 0}(l'(1-\theta) - g'(1-\theta)) > 0$, $(\bar{\theta}, \bar{\tau})$ is unique, and $(\bar{\theta}, \bar{\tau}) = (\bar{\theta}, 1)$, where $\bar{\theta} \in (0,1)$ solves $l'(1-\bar{\theta}) = g'(1-\bar{\theta})$. The payoffs associated with $(\bar{\theta}, 1)$ are $\hat{\bar{w}}(\bar{\theta}, 1) > 0$, $\hat{\varphi}(\bar{\theta}, 1)w_i = 0$, and $\hat{\nu}(\bar{\theta}, 1) = 0$, respectively.

**1.** *In equilibrium, the proposed regimes $(\theta_k, \tau_k)$ and $(\theta_{-k}, \tau_{-k})$ satisfy $\hat{\varphi}(\theta_k, \tau_k) = \hat{\varphi}(\theta_{-k}, \tau_{-k}) > 0$.* The proof is similar to Step **1** of the proof of Proposition 1, noting that $\hat{\bar{w}}(\cdot, \cdot)$ is strictly increasing in $\tau$ for all $(1-\theta) > 0$ and that the maximum possible in-office payoff is $\hat{\bar{w}}(\bar{\theta}, 1) > 0$ (but less than 1).

**2.** *In equilibrium, if $w_k$ proposes $(\theta_k, \tau_k)$ and wins the election with positive probability against $w_{-k}$, who proposes $(\theta_{-k}, \tau_{-k})$, then $\hat{\bar{w}}(\theta_k, \tau_k) \geq \hat{\varphi}(\theta_{-k}, \tau_{-k})w_k$.* The proof is similar to Step **2** of the proof of Proposition 1.

**3.** *In equilibrium, if $w_k$ proposes $(\theta_k, \tau_k)$ and wins the election with positive probability against $w_{-k}$, who proposes $(\theta_{-k}, \tau_{-k})$, then $\hat{\bar{w}}(\theta_k, \tau_k) \geq \hat{\bar{w}}(\theta_{-k}, \tau_{-k})$.* The proof is similar to Step **3** of the proof of Proposition 1.

**4.** *In equilibrium, if $w_k$ proposes $(\theta_k, \tau_k)$ and wins the election with positive probability against $w_{-k}$, who proposes $(\theta_{-k}, \tau_{-k})$, then $\hat{\varphi}(\theta_k, \tau_k)w_{-k} \geq \hat{\bar{w}}(\theta_k, \tau_k)$.* The proof is similar to Step **4** of the proof of Proposition 1.

**5.** *In equilibrium, $w_L$ wins the election with certainty.* The proof is similar to Step **5** of the proof of Proposition 1.

**6.** *In equilibrium, $(\theta_L, \tau_L) \neq (\theta_H, \tau_H)$.* See Step **6** of the proof of Proposition 1.

**7.** *In equilibrium, $\hat{\nu}(\theta_L, \tau_L) > \hat{\nu}(\theta_H, \tau_H)$ and $(1-\theta_L) < (1-\theta_H)$.* The proof is similar to Step **7** of the proof of Proposition 1. Thus,

$$\hat{\nu}(\theta_L, \tau_L) > \hat{\nu}(\theta_H, \tau_H). \tag{32}$$

**8.** *In equilibrium, the regime $(\theta_L, \tau_L)$ that $w_L$ proposes solves*

$$\max_{(\theta,\tau)\in[0,1]^2} \hat{\bar{w}}(\theta, \tau) \quad s.t. \quad \hat{\varphi}(\theta, \tau) \geq \bar{\varphi} = \hat{\varphi}(\theta_H, \tau_H). \tag{P''}$$

The proof is similar to Step **8** of the proof of Proposition 1. Thus, $(\theta_L, \tau_L)$ and $(\theta_H, \tau_H)$ satisfy (the constraint and Steps **2** and **1** imply that $(\theta_L, \tau_L) \in (0,1)^2$)

$$\frac{(g'(1-\theta_L) - l'(1-\theta_L))(1-\theta_L)}{l(1-\theta_L)} = (1-\tau_L), \tag{33}$$

$$\hat{\varphi}(\theta_H, \tau_H) = \hat{\varphi}(\theta_L, \tau_L). \tag{34}$$

**9.** *In equilibrium, $\hat{\varphi}(\theta_L, \tau_L) w_H = \hat{\hat{w}}(\theta_L, \tau_L)$ and the preference shock gives neither candidate an advantage and thus has no effect.* The proof is similar to Step **9** of the proof of Proposition 1. Thus,

$$\hat{\varphi}(\theta_L, \tau_L) w_H = \hat{\hat{w}}(\theta_L, \tau_L) = \tau_L l(1-\theta_L) - g(1-\theta_L). \tag{35}$$

**10.** *In equilibrium, $(\theta_L, \tau_L)$ is unique and only depends on $w_H$. A higher $w_H$ implies less enforcement, lower producer payoffs, and a higher office-holder payoff.* Collecting (32)–(35):

$$\hat{\varphi}(\theta_L, \tau_L) w_H = \tau_L l(1-\theta_L) - g(1-\theta_L), \tag{36}$$

$$\frac{(g'(1-\theta_L) - l'(1-\theta_L))(1-\theta_L)}{l(1-\theta_L)} = (1-\tau_L), \tag{37}$$

$$\hat{\varphi}(\theta_H, \tau_H) = \hat{\varphi}(\theta_L, \tau_L) \text{ and } \hat{\nu}(\theta_H, \tau_H) < \hat{\nu}(\theta_L, \tau_L). \tag{38}$$

Now, (36) and (37) are two equations in two unknowns that can be solved for $(\theta_L, \tau_L)$. The solution only depends on $w_H$ and has to be interior. Then, any regime $(\theta_H, \tau_H)$ that satisfies (38) completes a candidate equilibrium. Consider Equations (36) and (37). From (37),

$$(1-\tau_L) = \frac{(g'(1-\theta_L) - l'(1-\theta_L))(1-\theta_L)}{l(1-\theta_L)} \tag{39}$$

and thus

$$\tau_L = 1 - \frac{(g'(1-\theta_L) - l'(1-\theta_L))(1-\theta_L)}{l(1-\theta_L)}. \tag{40}$$

It will have to be verified that $\tau_L \in (0,1)$. Plugging (39) and (40) into (36) using $\hat{\varphi}(\theta_L, \tau_L) = (1-\theta_L)(1-\tau_L) l(1-\theta_L)$ and rewriting gives

$$(g'(1-\theta_L) - l'(1-\theta_L))(1-\theta_L)[1 + (1-\theta_L) w_H] = l(1-\theta_L) - g(1-\theta_L).$$

Let $h : (0,1) \times (0,1) \to \mathbb{R}$ be given by

$$h((1-\theta); w_H) = (g'(1-\theta) - l'(1-\theta))(1-\theta)[1 + (1-\theta) w_H] - (l(1-\theta) - g(1-\theta)).$$

Fix any $w_H \in (0,1)$. As $(1-\theta)$ approaches zero, this function is nonpositive because

$$\lim_{(1-\theta)\to 0} h((1-\theta);w_H) \le \lim_{(1-\theta)\to 0} g'(1-\theta)(1-\theta) - \lim_{(1-\theta)\to 0} l'(1-\theta)(1-\theta) \le 0,$$

due to properties of $l$ and $g$, (27)–(28). As $(1-\theta)$ approaches one, it is strictly positive since

$$\begin{aligned}\lim_{(1-\theta)\to 1} h((1-\theta);w_H) &= (\lim_{(1-\theta)\to 1} g'(1-\theta) - \lim_{(1-\theta)\to 1} l'(1-\theta))[1+w_H] + g(1) - l(1)\\ &\ge (\lim_{(1-\theta)\to 1} g'(1-\theta) - \lim_{(1-\theta)\to 1} l'(1-\theta))[1+w_H]\\ &> (1 - \lim_{(1-\theta)\to 1} l'(1-\theta))[1+w_H]\\ &> (1-1)[1+w_H] = 0,\end{aligned}$$

due to properties of $l$ and $g$, (27)–(28). At $(1-\bar{\theta}) \in (0,1)$, as shown at the top of the proof, $l(1-\bar{\theta}) - g(1-\bar{\theta}) > 0$, i.e., $\hat{w}(\bar{\theta},1) > 0$, and $l'(1-\bar{\theta}) - g'(1-\bar{\theta}) = 0$. Thus, at $(1-\bar{\theta})$,

$$\begin{aligned}h((1-\bar{\theta});w_H) &= (g'(1-\bar{\theta}) - l'(1-\bar{\theta}))(1-\bar{\theta})[1+(1-\bar{\theta})w_H] - (l(1-\bar{\theta}) - g(1-\bar{\theta}))\\ &= -(l(1-\bar{\theta}) - g(1-\bar{\theta})) < 0.\end{aligned}$$

It follows that there exists $(1-\theta_L) \in (0,1)$ such that $h((1-\theta_L);w_H) = 0$. In fact, there is a unique such $(1-\theta_L)$ because $h$ is a strictly convex function of $(1-\theta)$ that attains nonpositive values for low $(1-\theta)$, strictly negative values for intermediate $(1-\theta)$, and strictly positive values for high $(1-\theta)$. The strict convexity can be seen from the fact that the derivative of $h$ with respect to $(1-\theta)$ is increasing in $(1-\theta)$ because, due to $g'''(\cdot) \ge 0$ and $g''(\cdot) > 0$,

$$\begin{aligned}h_{(1-\theta)}((1-\theta);w_H) &= (g''(1-\theta) - l''(1-\theta))(1-\theta)[1+(1-\theta)w_H]\\ &\quad + (g'(1-\theta) - l'(1-\theta))[1+(1-\theta)w_H]\\ &\quad + (g'(1-\theta) - l'(1-\theta))(1-\theta)w_H - (l'(1-\theta) - g'(1-\theta))\\ &= (g''(1-\theta) - l''(1-\theta))(1-\theta)[1+(1-\theta)w_H]\\ &\quad + 2(g'(1-\theta) - l'(1-\theta))[1+(1-\theta)w_H]\\ &= [1+(1-\theta)w_H]\Big(2g'(1-\theta) + g''(1-\theta)(1-\theta)\\ &\quad - \Big(2l'(1-\theta) + l''(1-\theta)(1-\theta)\Big)\Big),\end{aligned}$$

is increasing in $(1-\theta)$ if $2l'(1-\theta) + l''(1-\theta)(1-\theta)$ is nonincreasing in $(1-\theta)$, which is the case due to the properties listed in (26): if $l''(1-\theta) = 0$, then it holds trivially; if $l''(1-\theta) < 0$, then it holds due to the fact that this expression's derivative satisfies

$$2l''(1-\theta)+l''(1-\theta)+l'''(1-\theta)(1-\theta)\leq 0 \quad\Leftrightarrow\quad 3\geq -\frac{l'''(1-\theta)(1-\theta)}{l''(1-\theta)}.$$

Therefore, there exists a unique $(1-\theta_L)\in(0,1)$ such that $h((1-\theta_L);w_H)=0$. Because $h((1-\bar{\theta});w_H)<0$, it follows that $(1-\theta_L)>(1-\bar{\theta})$. Given the unique $(1-\theta_L)$, there is a unique $(1-\tau_L)$ via (39):

$$(1-\tau_L)=\frac{g'(1-\theta_L)-l'(1-\theta_L)}{\frac{l(1-\theta_L)}{(1-\theta_L)}}. \tag{41}$$

Because $l(1-\theta)-g(1-\theta)$ is strictly concave, $l'(1-\bar{\theta})-g'(1-\bar{\theta})=0$, and $(1-\theta_L)>(1-\bar{\theta})$, it follows that $g'(1-\theta_L)-l'(1-\theta_L)>0$ so that $(1-\tau_L)>0$. Also, $\tau_L>0$ since $l(1-\theta_L)>(g'(1-\theta_L)-l'(1-\theta_L))(1-\theta_L)$: if $l(1-\theta_L)\leq(g'(1-\theta_L)-l'(1-\theta_L))(1-\theta_L)$, then

$$\begin{aligned}
0&=h((1-\theta_L);w_H)\\
&=(g'(1-\theta_L)-l'(1-\theta_L))(1-\theta_L)[1+(1-\theta_L)w_H]-(l(1-\theta_L)-g(1-\theta_L))\\
&\geq l(1-\theta_L)[1+(1-\theta_L)w_H]-l(1-\theta_L)+g(1-\theta_L)\\
&=l(1-\theta_L)(1-\theta_L)w_H+g(1-\theta_L)\\
&>0,
\end{aligned}$$

a contradiction. Therefore, $\tau_L\in(0,1)$.

As $(1-\bar{\theta})$ is determined by $l'(1-\bar{\theta})=g'(1-\bar{\theta})$ and thus independent of $w_H$, $h((1-\bar{\theta});w_H)<0$, and $g'(1-\theta)-l'(1-\theta)>0$ for all $(1-\theta)>(1-\bar{\theta})$, a higher $w_H$ increases $h((1-\theta);w_H)$ for all $(1-\theta)>(1-\bar{\theta})$. Thus, as $(1-\theta_L)>(1-\bar{\theta})$ for all $w_H$, it follows that a higher $w_H$ implies a smaller $(1-\theta_L)$. From (41), it follows that a smaller $(1-\theta_L)$ implies a smaller $(1-\tau_L)$ as well because as functions of $(1-\theta)$, and due to

$$g''(1-\theta)-l''(1-\theta)>0,$$

the nominator increases with $(1-\theta)$ while the denominator decreases with $(1-\theta)$ since

$$\frac{l'(1-\theta)(1-\theta)-l(1-\theta)}{(1-\theta)^2}\leq 0 \quad\Leftrightarrow\quad \frac{l'(1-\theta)(1-\theta)}{l(1-\theta)}\leq 1,$$

which holds due to the properties listed in (26).

Thus, for any $w_H\in\mathcal{W}$, there exists a unique $(1-\theta_L)$ such that $h((1-\theta_L);w_H)=0$, and that $(1-\theta_L)$ is strictly smaller the higher $w_H$ is. The unique $(1-\theta_L)$ implies a unique $(1-\tau_L)$, which is strictly increasing in $(1-\theta_L)$. So, a higher $w_H$ strictly decreases both

$(1-\theta_L)$ and $(1-\tau_L)$ and thus $\hat{\varphi}(\theta_L,\tau_L)$. Given the regime, using (40), the in-office payoff is

$$\tau_L l(1-\theta_L) - g(1-\theta_L) = \left(1 - \frac{(g'(1-\theta_L) - l'(1-\theta_L))\,(1-\theta_L)}{l(1-\theta_L)}\right) l(1-\theta_L) - g(1-\theta_L)$$
$$= l(1-\theta_L) - g(1-\theta_L) - (g'(1-\theta_L) - l'(1-\theta_L))\,(1-\theta_L).$$

This office-holder payoff decreases in $(1-\theta_L)$ since the derivative w.r.t. $(1-\theta_L)$ satisfies

$$2\,(l'(1-\theta_L) - g'(1-\theta_L)) - (g''(1-\theta_L) - l''(1-\theta_L))\,(1-\theta_L) < 0$$

because $g''(\cdot) > 0$, $l''(\cdot) \leq 0$, and $(1-\theta_L) > (1-\bar{\theta})$ for all $w_H$, so that $l'(1-\theta_L) - g'(1-\theta_L) < 0$. Thus, a higher $w_H$, via a strictly lower $(1-\theta_L)$, strictly increases the in-office payoff. Finally, given $(\theta_L,\tau_L)$, to complete the set of proposals, pick any $\tau_H$ such that $(1-\theta_L)(1-\tau_L)l(1-\theta_L) < (1-\tau_H) < (1-\tau_L)$ and find $(1-\theta_H)$ from the equation in (38), using the fact that $(1-\theta)l(1-\theta)$ is strictly increasing in $(1-\theta)$, approaching 0 and 1. As $(1-\tau_H) < (1-\tau_L)$, for this equation to hold, $(1-\theta_H) > (1-\theta_L)$ and thus $\theta_H < \theta_L$ must hold. Using the former in the equation in (38) shows that $(1-\tau_H)l(1-\theta_H) < (1-\tau_L)l(1-\theta_L)$, which with $\theta_H < \theta_L$ shows that the inequality in (38) holds. Thus, $(\theta_H,\tau_H)$ satisfies (38).

**11.** *Neither candidate can profitably deviate.* The proof is similar to Step **11** of the proof of Proposition 1. Thus, the set of proposals described is an equilibrium. ■

# B The Timing of The Political Process

The timing of the political process assumed in the paper does not seem absurd. Arguably, candidates often seem to announce their candidacy and initiate their political campaigns on vague and general platforms, or even simply on what voters perceive to be policy stances the now-candidate has held thus far. The candidates' precise platforms then crystallize only in political campaigns that do in fact react to and act on who the political opponent is and what their platform crystallizes to be.

However, suppose that the entry decisions and the platforms on which candidates run have to be determined and announced simultaneously. As before, if there is no candidate then the anarchy regime prevails; if there is exactly one candidate, then this candidate becomes the office holder—but in this case, committed to enacting the regime they have proposed; if voters are indifferent among all proposed regimes, then they abstain—unless the preference shock compels them to vote for one candidate or randomize between a subset of the candidates; candidates cannot vote. I further assume that if voters are not indifferent among all regimes, if there are multiple candidates who propose regimes that offer them the (same) highest payoff, then they randomize their vote among those candidates—again, unless the preference shock compels them to vote for one of those candidates or randomize between a subset of them.

The candidate with the most votes wins the election. If multiple candidates tie with the most votes, then the office holder is selected at random from among those candidates. The expected payoff of a potential candidate, running for office or not, is the weighted average of their payoffs associated with the proposed regimes, where the weights are the probabilities of the candidates who propose those regime to win the election.

There are at least two potential candidates, $|N| \geq 2$, and with up to three candidates, there are more than twice as many producers who can vote as appropriators, $p - 3 > 2a > 0$. That is, with up to three candidates, an *admissible qualified electorate* has at least one appropriator and more than twice as many producers as appropriators.

A profile of entry and platform decisions is an *equilibrium* if and only if, given all other potential candidates' entry and platform decisions, candidates cannot profitably deviate to either not running or proposing a different regime, and potential candidates who are not running cannot profitably deviate to running on some platform.

In this changed environment, there are always at least two candidates for office because every potential candidate strictly prefers running to enduring anarchy or a dictatorship.

**Lemma 1.** *In equilibrium, at least two candidates run for office.*

A one-candidate equilibrium does not exist. The reason for this implication is the fact that agents' preferred regime depends on their role in society. Consider a potential candidate. If they are a producer who does not hold office, then they prefer low taxes and high enforcement expenditures. If they are the office holder, then they prefer high taxes and low enforcement expenditures. That is, a single candidate always wants to enact (or deviate to) the dictator regime. The only way to prevent the dictator outcome, which implies a payoff of zero for all agents other than the dictator, is for a second potential candidate to run for office.

To parallel the analysis in Section 4 of the paper, I focus on two-candidate equilibria. Given the above assumptions, all previous results hold for two-candidate equilibria.

**Proposition 9.** *(1) Given a set $N$ of potential candidates, a two-candidate equilibrium exists and the winning regime is unique. In every two-candidate equilibrium, the candidates are $w_1^N$ and $w_2^N$, and $w_1^N$ wins with certainty while $w_2^N$ proposes more enforcement. (2) All else equal, a broader political elite, i.e., a larger $n$, implies more secure property rights while all admissible qualified electorates result in the same equilibrium outcome.*

A two-candidate equilibrium requires that, given the two candidates and their platforms, both candidates cannot profitably deviate to either not running or proposing a different regime, and potential candidates who are not running cannot profitably deviate to running on some platform. In particular, therefore, given two candidates who are running for office, and given their platforms, neither candidate should be able to profitably deviate to a different regime proposal. This requirement is exactly what an equilibrium of the political game given two candidates requires in the case with the original timing. Therefore, equilibrium regime proposals have to satisfy the same requirements irrespective of the timing. That is, given the two candidates, as with the original timing, the candidate with the less productive project wins with certainty; the winning regime is unique; the losing regime is indeterminate in the sense that it only has to make producers indifferent among both regimes while offering appropriators a lower payoff, which it does by proposing more enforcement; the productivity of the election loser's project determines the winning regime, and the less productive the loser's project is, the more secure are property rights.

With the alternative timing in this section, it must in addition be the case that neither candidate prefers to drop out of the race, and that no potential candidate who is not running for office prefers to run on some platform. The former requirement is satisfied. Given the election winner's regime, the election loser receives the same payoff from deviating to not running as from losing the election—i.e., their out-of-office payoff given the winner's regime. As with the original timing, the election winner, who otherwise has a relatively less productive project, secures a payoff that is high enough to make their opponent, who has a more productive project, indifferent between holding office and not holding office. If they were to deviate to not running, then they would collect a strictly smaller payoff associated with their less productive project. The latter requirement is also satisfied. Potential candidates who are not running for office have more productive projects than the two candidates, and both candidates' regime proposals offer them the same payoff. They thus require a high enough in-office payoff to possibly profit from deviating to running. However, all regimes that are associated with such a high enough in-office payoff—e.g., by collecting relatively high taxes or incurring relatively low enforcement costs, or both—cannot win the election because producers are a large enough majority among the voters.

As with the original timing, the potential candidate with the least productive project always runs for office because, being relatively unproductive, doing so improves their outcome. Similarly, given that the least productive potential candidate runs for office, having the potential candidate with the second least productive project run for office and lose the election ensures the highest possible producer payoff, because less productive losers lead to more secure property rights. Thus, in equilibrium, the second least productive potential candidate also runs for office while all other potential candidates refrain from running. That is, the two candidates for office are the producers with the two least productive projects among the potential candidates, the election loser having the second least productive project. Therefore, on the one hand, as less productive losers imply more secure property rights, by decreasing the productivity of the second least productive project, allowing for a broader political elite leads to more secure property rights. However, on the other hand, all admissible qualified electorates result in the same equilibrium outcome. That is, allowing more people to vote only has an effect if at the same time, also more people can run for office.

## B.1 Costs of running for Office

With this alternative timing, any positive fixed costs of running for office render two-candidate equilibria nonexistent. In every two-candidate equilibrium, one candidate has to lose the election with certainty. Suppose that both candidates have a positive probability of winning. It must be the case that both proposed regimes offer producers the same payoff as one of them would win with certainty otherwise. As both candidates may lose the election, producer payoffs have to be strictly positive as well. Otherwise, one could deviate to a regime that offers a strictly positive payoff to producers and thus wins the election with certainty while giving the office holder a payoff arbitrarily close to the dictator payoff. It must also be the case that both candidates are indifferent between winning the office and being a producer given their opponent's regime. Otherwise, they could profitably deviate to a regime that wins (with a payoff arbitrarily close to their original payoff from winning) or loses with certainty. Thus, both candidates' payoff from holding office given their proposed regime equals their payoff from producing given their opponent's proposed regime. That is, since both regimes offer the same producer payoff factor, the candidate with the more productive project must have a higher payoff in office than the candidate with the less productive project. The latter candidate can thus profitably deviate to proposing the same level of enforcement as their opponent combined with a slightly lower tax rate to win the election with certainty and secure a payoff that is strictly greater than before. Thus, in a two-candidate equilibrium, one candidate has to lose the election with certainty. Since running is costly, that candidate can profitably deviate to not running. Hence, a two-candidate equilibrium does not exist. The reason for an equilibrium requiring a certain winner is that for any two candidates, one of them has a more productive project than the other, and thus a more valuable outside option associated with higher payoffs. It can thus not be the case that at the same time, both candidates are indifferent between the same in-office payoff and their respective payoffs from not holding office.

What is more, as potential candidates strictly prefer running for office over enduring anarchy or a dictatorship, with this alternative timing, there is no equilibrium with fewer than two candidates when running is costless. This result is unaffected for small enough costs of running. Suppose for example that the costs are strictly less than $1/2$. In this case, if nobody is running for office, then again producers have a payoff of zero. Again, deviating to running means to become the office holder, and enacting the dictator regime gives an in-office payoff of 1, which net of the costs of running is still greater than zero. That is, there has to be a candidate in equilibrium. If only one potential candidate is running for office, then that candidate has to propose the dictator regime because they could profitably deviate otherwise. Producers thus have a payoff of zero. For another potential candidate to deviate to running and proposing the dictator regime as well means to win the office and the associated payoff of

1 with probability 1/2 so that their expected payoff is 1/2 minus the costs of running, which is still greater than zero. That is, there is no one-candidate equilibrium. The underlying reason is that agents' preferred regime depends on their role in society. The same potential candidate who prefers low taxes and high enforcement expenditures when a private citizen prefers high taxes and low enforcement expenditures when in office. It then follows that a single candidate always chooses to implement the dictator regime, which is associated with a payoff of zero for all agents other than the dictator. The only way to prevent the dictator outcome is for a second potential candidate to run for office. Taken together, for small enough positive costs of running for office, there is no equilibrium with fewer than three candidates.

The interesting flip side is that when running is costless, possibly many potential candidates refrain from running even though the office holder can extract rents from society. They do so in order to ensure the best possible outcome they can hope for.

## B.2 Proofs of Lemma 1 and Proposition 9

### Lemma 1

*Proof.* (1) Suppose for a contradiction that in some equilibrium, nobody is running for office. Then, the regime in place is the anarchy regime $(1, 0)$ which implies that all producers have payoff 0 because $\varphi(1, 0) = 0$. Every potential candidate in $N$ can profitably deviate to running for office with the dictator regime as their platform to secure a payoff $\tilde{w}(1, 1) = 1 > 0$, a contradiction. Thus, at least one candidate runs for office in equilibrium.

(2) Suppose for a contradiction that in some equilibrium, exactly one candidate is running for office. There are two cases: either (i) the proposed regime is some $(\theta, \tau) \neq (1, 1)$, or (ii) the proposed regime is $(\theta, \tau) = (1, 1)$. In Case (i), the candidate has payoff $\tilde{w}(\theta, \tau) < 1$ and can profitably deviate to proposing $(\theta', \tau') = (1, 1)$ to secure a higher payoff $\tilde{w}(1, 1) = 1 > \tilde{w}(\theta, \tau)$, a contradiction. In Case (ii), all producers, including all potential candidates who are not running for office, have expected payoff 0 because $\varphi(1, 1) = 0$. Every potential candidate who is not running can profitably deviate to running and proposing the regime $(1 - \epsilon, 1 - \epsilon)$ for some small enough $\epsilon > 0$ so that $\tilde{w}(1 - \epsilon, 1 - \epsilon) > 0$ to win the election with certainty, as $\varphi(1 - \epsilon, 1 - \epsilon) > 0 = \varphi(1, 1)$, and secure a higher expected payoff $\tilde{w}(1 - \epsilon, 1 - \epsilon)$, a contradiction. Thus, at least two candidates run for office in equilibrium. ■

### Proposition 9

*Proof. (1)* Fix the set $N$. I proceed in 3 steps. In Step **1**, I show that a specific profile is a two-candidate equilibrium so that a two-candidate equilibrium exists. In Step **2**, I show that in every two-candidate equilibrium, the candidates have to be the two smallest elements of the set $N$. In Step **3**, I show that $w_1^N$ wins with certainty, that $w_2^N$ proposes more enforcement, and that the winning regime is the same unique regime in all equilibria.

To start, notice that an admissible qualified electorate has at least one appropriator and more than twice as many producers as appropriators, and thus a majority of producers.

A two-candidate equilibrium requires that given the two candidates and their platforms, both candidates cannot profitably deviate to either not running or proposing a different regime, and potential candidates who are not running cannot profitably deviate to running on some platform. In particular, given two candidates who are running for office, and given their platforms, ignoring the fact that candidates could deviate to not running, neither candidate should be able to profitably deviate to a different regime proposal. That is, letting $w_L$ and $w_H > w_L$ denote the candidates, by Steps **1**–**9** of the proof of Proposition 1, the set of equilibrium regime proposals $\{(\theta_L, \tau_L), (\theta_H, \tau_H)\}$ has to satisfy (Equations (9)–(12))

$$\varphi(\theta_L, \tau_L)w_H = \tilde{w}(\theta_L, \tau_L), \tag{42}$$

$$g'(1-\theta_L)(1-\theta_L) = (1-\tau_L), \tag{43}$$

$$\varphi(\theta_H, \tau_H) = \varphi(\theta_L, \tau_L), \tag{44}$$

$$\nu(\theta_H, \tau_H) < \nu(\theta_L, \tau_L). \tag{45}$$

That is, $(\theta_L, \tau_L)$ solves Problem (P) and $w_L$ wins the election with certainty because all producers are indifferent among both regimes by (44) and thus abstain because neither candidate is public-spirited while all appropriators strictly prefer and thus vote for $(\theta_L, \tau_L)$ by (45).

**1.** Consider the strategy profile in which $w_L = w_1^N$ and $w_H = w_2^N$ run for office, and nobody else, and their proposed platforms $\{(\theta_L, \tau_L), (\theta_H, \tau_H)\}$ satisfy (42)–(45).

First, consider agent $w_L = w_1^N$, who wins the election with certainty and has payoff $\tilde{w}(\theta_L, \tau_L)$. Given $(\theta_H, \tau_H)$, $w_L$ cannot increase expected payoffs by deviating. Deviating to not running has $w_H$ enact $(\theta_H, \tau_H)$, giving $w_L$ a payoff $\varphi(\theta_H, \tau_H)w_L < \varphi(\theta_H, \tau_H)w_H = \varphi(\theta_L, \tau_L)w_H = \tilde{w}(\theta_L, \tau_L)$. Suppose that $w_L$ deviates to another proposal $(\theta', \tau')$. If $\varphi(\theta', \tau') < \varphi(\theta_H, \tau_H)$, then $w_L$ loses the election with certainty, earning a strictly smaller payoff $\varphi(\theta_H, \tau_H)w_L < \tilde{w}(\theta_L, \tau_L)$. If $\varphi(\theta', \tau') \geq \varphi(\theta_H, \tau_H)$, then $(\theta', \tau')$ is in the constraint set of Problem (P) so that $\tilde{w}(\theta', \tau') \leq \tilde{w}(\theta_L, \tau_L)$ because $(\theta_L, \tau_L)$ solves Problem (P). Thus, $w_L$'s expected payoff from this deviation is $\tilde{w}(\theta', \tau') \leq \tilde{w}(\theta_L, \tau_L)$, $\varphi(\theta_H, \tau_H)w_L < \tilde{w}(\theta_L, \tau_L)$, or some convex combination of those.

Second, consider agent $w_H = w_2^N$, who loses the election with certainty and has payoff $\varphi(\theta_L, \tau_L)w_H = \tilde{w}(\theta_L, \tau_L)$. Given $(\theta_L, \tau_L)$, $w_H$ cannot increase expected payoffs by deviating. Deviating to not running has $w_L$ enact $(\theta_L, \tau_L)$, leaving $w_H$'s payoff unchanged at $\varphi(\theta_L, \tau_L)w_H$. Suppose that $w_H$ deviates to another proposal $(\theta', \tau')$. If $\varphi(\theta', \tau') < \varphi(\theta_L, \tau_L) = \varphi(\theta_H, \tau_H)$, then $w_H$ still loses the election with certainty, getting unchanged payoff $\varphi(\theta_L, \tau_L)w_H = \tilde{w}(\theta_L, \tau_L)$. If $\varphi(\theta', \tau') \geq \varphi(\theta_L, \tau_L) = \varphi(\theta_H, \tau_H)$, then $(\theta', \tau')$ is in the constraint set of Problem (P) so that $\tilde{w}(\theta', \tau') \leq \tilde{w}(\theta_L, \tau_L) = \varphi(\theta_L, \tau_L)w_H$ because $(\theta_L, \tau_L)$ solves Problem (P). Thus, $w_H$'s expected payoff from this deviation is

$\tilde{w}(\theta', \tau') \leq \tilde{w}(\theta_L, \tau_L) = \varphi(\theta_L, \tau_L)w_H$, $\varphi(\theta_L, \tau_L)w_H$, or some convex combination of those.

If $|N| = 2$, then Step **1** ends here, and a two-candidate equilibrium exists. Suppose that $|N| > 2$.

Third, consider any potential candidate $w_j^N$, $j > 2$, who is not running for office and has payoff $\varphi(\theta_L, \tau_L)w_j^N$. Note that $w_j^N > w_H > w_L$. Suppose that $w_j^N$ deviated to running for office, proposing the regime $(\theta_j, \tau_j)$. There are $p - 3 > 2a$ producers who can vote (i.e., they are the majority among voters) and two cases: *(i)* $\varphi(\theta_j, \tau_j) < \varphi(\theta_L, \tau_L) = \varphi(\theta_H, \tau_H)$; or *(ii)* $\varphi(\theta_j, \tau_j) \geq \varphi(\theta_L, \tau_L) = \varphi(\theta_H, \tau_H)$. Consider each case in turn.

*Case (i):* If $\varphi(\theta_j, \tau_j) < \varphi(\theta_L, \tau_L) = \varphi(\theta_H, \tau_H)$, then producers randomize their vote among $(\theta_L, \tau_L)$ and $(\theta_H, \tau_H)$. There are only two possible outcomes: either both regimes $(\theta_L, \tau_L)$ and $(\theta_H, \tau_H)$ receive $(1/2)(p - 3)$ votes from producers each, or one of the regimes receives more than $(1/2)(p - 3)$ votes from producers. That is, even if $(\theta_j, \tau_j)$ receives the votes of all appropriators, due to $p - 3 > 2a$, $(\theta_j, \tau_j)$ loses the election with certainty. The enacted regime is either $(\theta_L, \tau_L)$ or $(\theta_H, \tau_H)$, so that the payoff associated with this deviation equals $\varphi(\theta_H, \tau_H)w_j^N = \varphi(\theta_L, \tau_L)w_j^N$ in any case. That is, this deviation is not profitable.

*Case (ii):* If $\varphi(\theta_j, \tau_j) \geq \varphi(\theta_L, \tau_L) = \varphi(\theta_H, \tau_H)$, then the regime $(\theta_j, \tau_j)$ is in the constraint set of Problem (P). Therefore, as $(\theta_L, \tau_L)$ solves Problem (P), $\tilde{w}(\theta_j, \tau_j) \leq \tilde{w}(\theta_L, \tau_L) = \varphi(\theta_L, \tau_L)w_H < \varphi(\theta_L, \tau_L)w_j^N$ because $w_j^N > w_H$. Thus, $w_j^N$'s expected payoff from this deviation is $\tilde{w}(\theta_j, \tau_j) < \varphi(\theta_L, \tau_L)w_j^N$, $\varphi(\theta_L, \tau_L)w_j^N$, $\varphi(\theta_H, \tau_H)w_j^N = \varphi(\theta_L, \tau_L)w_j^N$, or some weighted average of those, which is thus not profitable.

Therefore, a two-candidate equilibrium exists.

**2.** Suppose for a contradiction that there is a two-candidate equilibrium with candidates $w_L$ and $w_H > w_L$, proposing regimes $(\theta_L, \tau_L)$ and $(\theta_H, \tau_H)$, respectively, and $w_L > w_1^N$. The set of regime proposals $\{(\theta_L, \tau_L), (\theta_H, \tau_H)\}$ has to satisfy (42)–(45). Agent $w_1^N$ has certain payoff $\varphi(\theta_L, \tau_L)w_1^N$ while $\tilde{w}(\theta_L, \tau_L) = \varphi(\theta_L, \tau_L)w_H > \varphi(\theta_L, \tau_L)w_1^N$ because $w_H > w_L > w_1^N$. By continuity, $w_1^N$ can profitably deviate to running for office and proposing the regime $(\theta', \tau') = (\theta_L, \tau_L - \epsilon)$ for a small enough $\epsilon > 0$ so that $\tilde{w}(\theta', \tau') > \varphi(\theta_L, \tau_L)w_1^N$ to win the election with certainty, as $\varphi(\theta', \tau') > \varphi(\theta_L, \tau_L) = \varphi(\theta_H, \tau_H)$, and secure a higher expected payoff $\tilde{w}(\theta', \tau')$, a contradiction. Thus, in every two-candidate equilibrium, $w_L = w_1^N$.

Similarly, suppose for a contradiction that there is a two-candidate equilibrium with candidates $w_L = w_1^N$ and $w_H > w_L$, proposing regimes $(\theta_L, \tau_L)$ and $(\theta_H, \tau_H)$, respectively, and $w_H > w_2^N$. The set of regime proposals $\{(\theta_L, \tau_L), (\theta_H, \tau_H)\}$ has to satisfy (42)–(45). Agent $w_2^N$ has certain payoff $\varphi(\theta_L, \tau_L)w_2^N$ while $\tilde{w}(\theta_L, \tau_L) = \varphi(\theta_L, \tau_L)w_H > \varphi(\theta_L, \tau_L)w_2^N$ because $w_H > w_2^N$. By continuity, $w_2^N$ can profitably deviate to running for office and proposing the regime $(\theta', \tau') = (\theta_L, \tau_L - \epsilon)$ for a small enough $\epsilon > 0$ so that $\tilde{w}(\theta', \tau') > \varphi(\theta_L, \tau_L)w_2^N$ to win the election with certainty, as $\varphi(\theta', \tau') > \varphi(\theta_L, \tau_L) = \varphi(\theta_H, \tau_H)$, and secure a higher expected payoff $\tilde{w}(\theta', \tau')$, a contradiction. Thus, in every two-candidate equilibrium, $w_H = w_2^N$.

Therefore, in every two-candidate equilibrium, the candidates are $w_1^N$ and $w_2^N$.

**3.** As $w_L = w_1^N$ and $w_H = w_2^N$ in every two-candidate equilibrium, it follows from (44)–(45) that all producers abstain from voting while all appropriators vote for $w_1^N$, who thus wins the election with certainty. By the same argument as in Step **7** of the proof of Proposition 1, it follows from (44)–(45) that $(1-\theta_H) > (1-\theta_L)$, i.e., $w_2^N$ proposes more enforcement. By Step **10** of the proof of Proposition 1, the winning regime $(\theta_L, \tau_L)$ is unique.

*(2)* The regime $(\theta_L, \tau_L)$ is fully determined by Equations (42)–(43). It follows from the same arguments as in Step **10** of the proof of Proposition 1 that $(1-\theta_L)$ is strictly smaller the higher $w_H = w_2^N$ is. Enlarging the set $N$ by increasing $n$, implying that $w_H = w_2^N$ decreases, thus implies that $(1-\theta_L)$ increases, i.e., more secure property rights. The only assumption about the electorate the above arguments use is that it has at least one appropriator and more than twice as many producers as appropriators ($p - 3 > 2a > 0$). All arguments above thus hold without further qualification if the qualified electorate is admissible in the sense that it has at least one appropriator and more than twice as many producers as appropriators. Therefore, all admissible qualified electorates result in the same equilibrium outcome. ■