Supplementary Appendix to "Learning to Love Democracy: Electoral Accountability and the Success of Democracy"

This appendix contains i) proofs and explanations of those technical results that do not follow directly from the discussion in the text; ii) figures that portray the timing of moves in the accountability game in Section 2.2, and the simulated distributions of time to breakdown and consolidation; and iii) a preliminary empirical analysis of the age-conditional relationship between economic downturns and democratic breakdowns discussed in Section 3.

1 Proofs

As in the text, all proofs are stated for fixed player labels (typically assuming that candidate 1 is the incumbent in the current period). All proofs carry through analogously after switching player labels.

Proposition 2

Figure 1 portrays the timing of moves in the accountability game in Section 2.2. The following lemmas will be useful in proving the claims in Proposition 2.

Lemma 1. $v^{1N} > v^{1B}$.

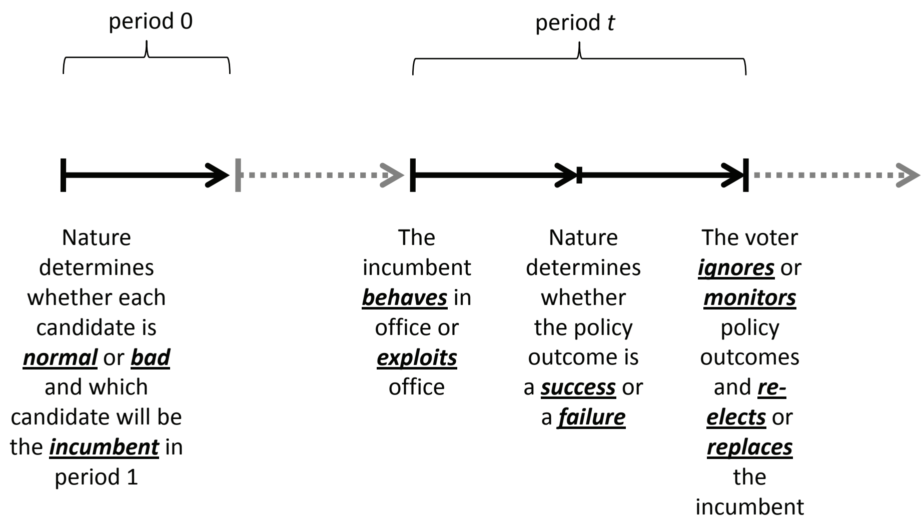

Figure 1: The timing of moves in the accountability game in Section 2.2

Proof. Recall that the voter's expected discounted payoff when candidate 1 is in office is

$$v^1(\pi_1^{(k)}, \pi_2^{(l)}) = \pi_1^{(k)} v^{1N} + (1 - \pi_1^{(k)}) v^{1B}, \tag{1}$$

$$v^{1N} = -m + \gamma_b(s + \delta v^{1N}) + (1 - \gamma_b)\delta v^2(\pi_1^{(k-1)}, \pi_2^{(l)}), \tag{2}$$

$$v^{1B} = -m + \gamma_e(s + \delta v^{1B}) + (1 - \gamma_e)\delta v^2(\pi_1^{(k-1)}, \pi_2^{(l)}). \tag{3}$$

We can rewrite (2) and (3) as

$$v^{1N} = \frac{\gamma_b s - m + (1 - \gamma_b)\delta v^2(\pi_1^{(k-1)}, \pi_2^{(l)})}{(1 - \gamma_b \delta)},$$
$$v^{1B} = \frac{\gamma_e s - m + (1 - \gamma_e)\delta v^2(\pi_1^{(k-1)}, \pi_2^{(l)})}{(1 - \gamma_e \delta)}.$$

After some algebra, we obtain

$$v^{1N} - v^{1B} = \frac{(\gamma_b - \gamma_e)\left[s - \delta m - (1 - \delta) v^2(\pi_1^{(k-1)}, \pi_2^{(l)})\right]}{(1 - \gamma_e \delta)(1 - \gamma_b \delta)}. \tag{4}$$

The discussion in section 2.1 implies that, if both candidates were normal, the voter's expected discounted payoff would be $\frac{\gamma_b s-m}{1-\delta}$. Alternatively, if both candidates were bad, the voter's expected discounted payoff would be $\frac{\gamma_e s-m}{1-\delta}$. Since $\frac{\gamma_b s-m}{1-\delta} > \frac{\gamma_e s-m}{1-\delta}$, and $v^2(\pi_1^{(k-1)}, \pi_2^{(l)})$ is a linear combination of v^{2N} and v^{2B}, $v^2(\pi_1^{(k-1)}, \pi_2^{(l)})$ cannot be smaller than $\frac{\gamma_e s-m}{1-\delta}$ and larger than $\frac{\gamma_b s-m}{1-\delta}$. After substituting $v^2(\pi_1^{(k-1)}, \pi_2^{(l)}) = \frac{\gamma_b s-m}{1-\delta}$ into (4), we see that

$$v^{1N} - v^{1B} = \frac{(\gamma_b - \gamma_e)\left[(1-\gamma_b)s + (1-\delta)m\right]}{(1-\gamma_e\delta)(1-\gamma_b\delta)} > 0\,.$$

After substituting $v^2(\pi_1^{(k-1)}, \pi_2^{(l)}) = \frac{\gamma_e s-m}{1-\delta}$ into (4), we obtain

$$v^{1N} - v^{1B} = \frac{(\gamma_b - \gamma_e)\left[(1-\gamma_e)s + (1-\delta)m\right]}{(1-\gamma_e\delta)(1-\gamma_b\delta)} > 0\,.$$

□

Lemma 2. *$v^1(\pi_1^{(k)}, \pi_2^{(l)})$ is increasing in $\pi_1^{(k)}$ and $\pi_2^{(l)}$.*

Proof. According to (1),

$$v^1(\pi_1^{(k)}, \pi_2^{(l)}) = \pi_1^{(k)} v^{1N} + (1-\pi_1^{(k)})v^{1B} = \pi_1^{(k)}[v^{1N} - v^{1B}] + v^{1B}\,.$$

According to Lemma 1, $v^{1N} - v^{1B} > 0$. Thus $v^1(\pi_1^{(k)}, \pi_2^{(l)})$ is increasing in $\pi_1^{(k)}$.

To see that $v^1(\pi_1^{(k)}, \pi_2^{(l)})$ is increasing in $\pi_2^{(l)}$, substitute v^{1N} from (4) and v^{1B} from (4) into (1) and rewrite as

$$\pi_1^{(k)}\frac{\gamma_b s - m}{1-\gamma_b\delta} + (1-\pi_1^{(k)})\frac{\gamma_e s - m}{1-\gamma_e\delta} + \left[\pi_1^{(k)}\frac{(1-\gamma_b)}{1-\gamma_b\delta} + (1-\pi_1^{(k)})\frac{(1-\gamma_e)}{1-\gamma_e\delta}\right]\delta v^2(\pi_1^{(k-1)}, \pi_2^{(l)})\,.$$

Since the term multiplying $v^2(\pi_1^{(k-1)}, \pi_2^{(l)})$ is positive and, by the same argument as above,

$v^2(\pi_1^{(k-1)}, \pi_2^{(l)})$ is increasing in $\pi_2^{(l)}$, then $v^1(\pi_1^{(k)}, \pi_2^{(l)})$ must be increasing in $\pi_2^{(l)}$. $\square$

Lemma 3. $\lim_{\pi_2^{(l)} \to 0^+} \left[\lim_{\pi_1^{(k)} \to 0^+} v^1(\pi_1^{(k)}, \pi_2^{(l)}) \right] = \frac{\gamma_e s - m}{1-\delta}$.

Proof. From (1),

$$\lim_{\pi_1^{(k)} \to 0^+} v^1(\pi_1^{(k)}, \pi_2^{(l)}) = v^{1B} = -m + \gamma_e(s + \delta v^{1B}) + (1-\gamma_e)\delta v^2(\pi_1^{(k-1)}, \pi_2^{(l)}).$$

By an analogous argument,

$$\lim_{\pi_2^{(l)} \to 0^+} \left[\lim_{\pi_1^{(k)} \to 0^+} v^1(\pi_1^{(k)}, \pi_2^{(l)}) \right] = \lim_{\pi_2^{(l)} \to 0^+} v^{1B} = -m + \gamma_e(s + \delta v^{1B}) + (1-\gamma_e)\delta v^{2B}. \tag{5}$$

For the two candidates, (5) describes a system of two linear equations in two unknowns with the solution

$$v^{1B} = v^{2B} = \frac{\gamma_e s - m}{1-\delta}.$$

$\square$

Lemma 4. $\underline{\pi}_1(\pi_2^{(l)})$ *exists for some* $\pi_2^{(l)}$.

Proof. Recall that the expected discounted payoff that the voter obtains when both candidates exploit office while the voter ignores the incumbent's performance is $\underline{v} = \gamma_e s/(1-\delta)$. Therefore jointly, Lemmas 2 and 3 imply that, for some $\pi_2^{(l)}$, there will be a threshold belief $\underline{\pi}_1(\pi_2^{(l)}) = \pi_1^{(k)}$ such that, if a policy failure occurs in the current period and the incumbent's reputation drops to $\pi_1^{(k-1)}$, the voter prefers to ignore candidate performance in any period in which candidate 1 enters office. $\square$

Lemma 5. *If* $s > \frac{m}{\gamma_e(\gamma_b - \gamma_e)\delta}$, $\underline{\pi}_1(\pi_2^{(l)})$ *does not exist if* $\pi_1^{(k)} \to 0^+$ *and* $\pi_2^{(l)} \to 1^-$.

Since $\lim_{\pi_1^{(k)}\to 0^+} v^1(\pi_1^{(k)}, \pi_2^{(l)}) = v^{1B}$ and $\lim_{\pi_2^{(l)}\to 1^-} v^2(\pi_1^{(k)}, \pi_2^{(l)}) = v^{2N}$, (1) implies that

$$v^{1B} = -m + \gamma_e(s + \delta v^{1B}) + (1-\gamma_e)\delta v^{2N},$$
$$v^{2N} = -m + \gamma_b(s + \delta v^{2N}) + (1-\gamma_b)\delta v^{1B}.$$

Solving this system of two equations in two unknowns, we obtain

$$v^{1B} = \frac{[\gamma_e + \gamma_b(\gamma_b - \gamma_e)\delta]s - m}{1-\delta}.$$

Then $\underline{\pi}_1(\pi_2^{(l)})$ will not exist if $v^{1B} > \gamma_e s/(1-\delta)$, or equivalently,

$$s > \frac{m}{\gamma_e(\gamma_b - \gamma_e)\delta}.$$

Note that the above is equivalent to $\delta > \frac{m}{\gamma_e(\gamma_b-\gamma_e)s}$ and is a more stringent requirement on δ than the assumption that $\delta \geq \frac{m}{(\gamma_b-\gamma_e)s}$ from section 2.1 of the paper.

Lemma 6. $\underline{\pi}_1(\pi_2^{(l)})$ *is weakly decreasing in* $\pi_2^{(l)}$.

Proof. Suppose candidate 1 is in office and the voter's beliefs about 1 and 2, $\pi_1^{(k)}$ and $\pi_2^{(l)}$, are at the threshold $\underline{\pi}(\pi_2^{(l)}) = \pi_1^{(k)}$. By lemma 2, $v^1(\pi_1^{(k)}, \pi_2^{(l)})$ is increasing in $\pi_2^{(l)}$. Then an increase from $\pi_2^{(l)}$ to $\pi_2^{(l+1)}$ will either be sufficiently large so that both $v^1(\pi_1^{(k)}, \pi_2^{(l+1)}) > \underline{v}$ and $v^1(\pi_1^{(k-1)}, \pi_2^{(l+1)}) > \underline{v}$, in which case $\pi_1^{(k)}$ will no longer be a threshold belief, or the increase from $\pi_2^{(l)}$ to $\pi_2^{(l+1)}$ will not be sufficiently large and $v^1(\pi_1^{(k)}, \pi_2^{(l+1)}) > \underline{v}$ but $v^1(\pi_1^{(k-1)}, \pi_2^{(l+1)}) < \underline{v}$. □

Proof of Proposition 2: Lemmas 4-6 prove all claims in Proposition 2. □

		Challenger	
		Subvert	*Comply*
Incumbent	*Subvert*	$\frac{1}{2}w, \frac{1}{2}w$	$w, 0$
	Comply	$0, w$	$\frac{1}{2}w, \frac{1}{2}w$

Figure 2: The incumbent and challenger's expected per-period payoffs if the voter acquiesces in the trap of pessimistic expectations

Proposition 3

Proof of Proposition 3: As long as the voter defends democracy, any candidate will comply with democracy because his per-period payoff is nonnegative, regardless of whether he is in office or out of office. By contrast, if the voter defends democracy and the candidate subverts democracy, he receives a negative payoff $\underline{u} < 0$.

If the voter acquiesces, the candidate who unilaterally subverts democracy obtains the per-period payoff w, which is greater that the per-period payoff $\frac{1}{2}w$ that he would obtain under a democracy in the trap of pessimistic expectations. Meanwhile, a candidate who subverts democracy while the other candidate does so too raises his expected per-period payoff from 0 to $\frac{1}{2}w$. These payoffs are portrayed in Figure 2. We see that subverting strictly dominates compliance; subversion by both candidates and the voter's acquiescence are therefore sequentially rational below the breakdown threshold.

Let $\overline{d}$ be the maximum value of d for which the voter will defend democracy. By arguments analogous to those in Lemma 3,

$$\lim_{\pi_2^{(l)} \to 1^-} \left[\lim_{\pi_1^{(k)} \to 1^-} v^1(\pi_1^{(k)}, \pi_2^{(l)}) \right] = \frac{\gamma_b s - m}{1 - \delta} = \overline{v}.$$

Thus $\overline{v}$ is the largest expected discounted payoff that the voter can obtain under democracy.

In turn, the voter will defend democracy for a nonempty set of beliefs $(\pi_1^{(k)}, \pi_2^{(l)})$ as long as

$$\overline{v} - d > \underline{v} \quad \text{or equivalently} \quad \frac{\gamma_b s - m}{1-\delta} - d > \frac{\gamma_e s}{1-\delta}.$$

Solving for d, we obtain

$$\overline{d} = \frac{(\gamma_b - \gamma_e)s - m}{1-\delta}.$$

□

Proposition 4

The following lemmas will be useful in proving the claims in Proposition 4.

Lemma 7. *$u_{1B}^I(\pi_1^{(k)}, \pi_2^{(l)}) > u_{1B}^C(\pi_1^{(k)}, \pi_2^{(l)})$ and $u_{1N}^I(\pi_1^{(k)}, \pi_2^{(l)}) > u_{1N}^C(\pi_1^{(k)}, \pi_2^{(l)})$.*

Proof. In any state $(\pi_1^{(k)}, \pi_2^{(l)})$, a candidate obtains a positive per-period payoff while in office ($w - c$ for the normal type, w for the bad type) but a zero per-period payoff while out of office. The state $(\pi_1^{(k)}, \pi_2^{(l)})$ only affects challenger 1's probability of returning to office via the incumbent's type. Candidate 1's probability of re-election (when he is the incumbent) is smallest when 1 is bad, while his probability of return to office (when he is the challenger) is greatest when 2 is bad. Thus this is a combination of types under which the challenger obtains the largest expected discounted payoff. Suppose that is the case. Then

$$u_{1B}^I = w + \delta[\gamma_e u_{1B}^I + (1-\gamma_e)u_{1B}^C],$$

$$u_{1B}^C = \delta[(1-\gamma_e)u_{1B}^I + \gamma_e u_{1B}^C].$$

Solving for u_{1B}^I and u_{1B}^C, we obtain

$$u_{1B}^I = \frac{w(1-\gamma_e\delta)}{(1-\delta)(1+\delta-2\gamma_e\delta)} \quad \text{and} \quad u_{1B}^C = \frac{w(1-\gamma_e)\delta}{(1-\delta)(1+\delta-2\gamma_e\delta)}. \tag{6}$$

We see that even after assuming a combination of types that yields the largest payoff to the challenger, candidate 1's expected discounted payoff is greater when he is the incumbent then when he is the challenger, $u_{1B}^I > u_{1B}^C$. Therefore, 1's expected discounted expected payoff must be greater when he is the incumbent than when he is the challenger for all other combinations of 1's types and beliefs about 2's type. The existence of the breakdown threshold does not affect this conclusion since the expected discounted expected payoff after the threshold is the same for both the incumbent and the challenger. An analogous reasoning implies $u_{1N}^I > u_{1N}^C$. □

Lemma 8. $\lim_{\pi_2^{(l)}\to 1^-} u_{1N}^C(\pi_1^{(k)}, \pi_2^{(l)}) > \lim_{\pi_2^{(l)}\to 1^-} u_{1B}^C(\pi_1^{(k)}, \pi_2^{(l)})$.

Proof. When $\pi_2^{(l)} = 1$, the expected discounted payoff of the normal type of candidate 1 in and out of office is characterized by

$$\begin{aligned} u_{1N}^I &= w - c + \delta[\gamma_b u_{1N}^I + (1-\gamma_b)u_{1N}^C], \\ u_{1N}^C &= \delta[(1-\gamma_b)u_{1N}^I + \gamma_b u_{1N}^C]. \end{aligned}$$

Since $\pi_2^{(l)}$ only affects candidate 1's payoff by decreasing his chances of re-election, solving the above system for u_{1N}^C yields

$$\lim_{\pi_2^{(l)}\to 1^-} u_{1N}^C(\pi_1^{(k)}, \pi_2^{(l)}) = \frac{(1-\gamma_b)\delta(w-c)}{(1-\delta)(1+\delta-2\gamma_b\delta)}.$$

Analogously, when $\pi_2^{(l)} = 1$, the expected discounted payoff of the bad type of candidate 1 in and out of office is characterized by

$$
\begin{aligned}
u_{1B}^{I} &= w + \delta[\gamma_e u_{1B}^{I} + (1-\gamma_e) u_{1B}^{C}], \\
u_{1B}^{C} &= \delta[(1-\gamma_b) u_{1B}^{I} + \gamma_b u_{1B}^{C}].
\end{aligned}
$$

Solving the system for u_{1B}^{C}, we obtain

$$
\lim_{\pi_2^{(l)} \to 1^-} u_{1B}^{C}(\pi_1^{(k)}, \pi_2^{(l)}) = \frac{(1-\gamma_b)\delta w}{(1-\delta)}.
$$

We see that $\lim_{\pi_2^{(l)} \to 1^-} u_{1N}^{C}(\pi_1^{(k)}, \pi_2^{(l)}) > \lim_{\pi_2^{(l)} \to 1^-} u_{1B}^{C}(\pi_1^{(k)}, \pi_2^{(l)})$ as long as

$$
\begin{aligned}
\frac{(1-\gamma_b)\delta(w-c)}{(1-\delta)(1+\delta-2\gamma_b\delta)} &> \frac{(1-\gamma_b)\delta w}{(1-\delta)} \\
(w-c) &> w(1+\delta-2\gamma_b\delta) \\
-c &> \delta w(1-2\gamma_b) \\
-c &> \delta w(\gamma_b - \gamma_e) \\
\delta &> \frac{c}{(\gamma_b-\gamma_e)w}.
\end{aligned}
$$

The last inequality was assumed to hold for the candidate's discount factors in section 2.1 of the paper. □

Proof of Proposition 4: Lemma 8 implies that, as challenger 2's belief about incumbent 1's type approaches 1, $\pi_1^{(k)} \to 1^-$, there will be a range of discounted exit payoffs $u(exit) = x/(1-\delta)$, for which bad types of challenger 2 prefer to exit but normal types prefer to run. Denote the highest value of the incumbent's reputation $\pi_1^{(k)}$ at which bad challenger 2 still prefers running to exiting, $u_{2B}^{C}(\pi_1^{(k)}, \pi_2^{(l)}) \geq u(exit)$, by $\overline{\pi}_1(\pi_2^{(l)})$.

We need to verify that as long as

$$\frac{(1-\gamma_b)\delta w}{(1-\delta)} < u(exit) < \frac{(1-\gamma_b)\delta(w-c)}{(1-\delta)(1+\delta-2\gamma_b\delta)},$$

neither type of challenger has an incentive to exit in states below the threshold $\overline{\pi}_1(\pi_2^{(l)})$. Recall that after the breakdown threshold is crossed, each candidate obtains the expected discounted payoff $\frac{w}{2(1-\delta)}$. We can check that $\frac{w}{2(1-\delta)} > \lim_{\pi_1^{(k)} \to 1^-} u^C_{2N}(\pi_1^{(k)}, \pi_2^{(l)})$,

$$\begin{aligned} \frac{w}{2(1-\delta)} &> \frac{(1-\gamma_b)\delta(w-c)}{(1-\delta)(1+\delta-2\gamma_b\delta)}, \\ \frac{1}{2}w(1+\delta-2\gamma_b\delta) &> (1-\gamma_b)\delta(w-c), \\ (1-\delta)w + 2\gamma_e\delta c &> 0. \end{aligned}$$

In turn, neither type of challenger has an incentive to exit in states below the threshold $\overline{\pi}_1(\pi_2^{(l)})$ given our assumptions about $u(exit)$.

□

2 The Numerical Example

The numerical example can only be approximated since the number of transient states (transitional democracy) is infinite (because the voter's belief about any single candidate may drop arbitrarily low for some parameter values.) I first chose a large set of beliefs $\{\pi^{(1)}, \ldots, \pi^{(M)}\}$ that the voter may hold about each candidate. The transition between the M^2 states can be described by $2M^2$ linear equations in $2M^2$ unknowns, M^2 equations for each candidate. The system has a full rank and thus yields a unique solution for the voter's and candidates' expected discounted payoffs in each state. I started by assuming that bad challenger types exit when the voter's belief about the incumbent becomes larger than $\pi^{(M)}$ and that the trap of pessimistic expectations occurs if the voter's belief about the incumbent becomes smaller than $\pi^{(1)}$. I then repeatedly adjusted the transition matrix for those states in which the solved expected discounted payoffs violated either the breakdown threshold (the voter was expected to monitor in a state in which her computed payoff was less than the breakdown payoff) or the consolidation threshold (a challenger was expected to run in a state in which his payoff was lower that the exit payoff), until I arrived at a set of voter's and candidates' expected discounted payoffs that is consistent with all thresholds.

In Figure 3, I plot the distribution of time to breakdown and consolidation based on the simulations in the paper. We see that the simulated distribution of time to breakdown is close to its distribution in actual data, which I plot in the bottom part of Figure 4.

3 Economic Downturns, the Age of Democracy, and Democratic Breakdowns

The discussion in Section 3.1 implies that the effect of economic downturns on democratic breakdowns should be conditional on the age of democracy. As an initial step toward evaluating this hypothesis, I estimate an extension of the standard Cox survival model according to which the effect of economic growth on the hazard rate of democratic breakdowns may change at an unknown *change-point* in time τ. This approach dos not make any assumptions about when the hypothesized change in the effect of economic growth on breakdowns occurs or whether it occurs at all – both are estimated.

More specifically, I estimate a change-point Cox survival model, according to which the

Table 1: Descriptive statistics of covariates in the change-point analysis in section 3 of the paper

	Mean	**Std.Dev.**	**Source**
GDP growth	2.126	5.397	Maddison (2008)
Log of GDP per capita	8.426	0.933	Maddison (2008)
Fuel and ore exporter	0.133	0.340	World Bank (2008)
Presidential	0.310	0.466	Przeworski et al. (2000),Cheibub and Gandhi (2005)
Mixed	0.100	0.299	Przeworski et al. (2000),Cheibub and Gandhi (2005)
Military	0.244	0.430	Cheibub and Gandhi (2005)
Monarchy	0.064	0.245	Cheibub and Gandhi (2005)
Communist	0.048	0.214	Author
Cold War	0.414	0.493	Author
Democratic neighbors	0.583	0.338	Author, Correlates of War Project (2006), Przeworski et al. (2000), Boix (2003), Cheibub and Gandhi (2005)

Note: The unit of observation is a country-year.

effect of economic growth β on the hazard rate λ changes at an unknown point in time τ,

$$\lambda(t, Z, \mathbf{X}) = \lambda_0 \exp[\beta_{t\leq\tau} Z + \beta_{t>\tau} Z + \boldsymbol{\gamma}'\mathbf{X}]. \tag{7}$$

In (7), λ_0 is an unspecified baseline hazard rate, $\beta_{t\leq\tau}$ and $\beta_{t>\tau}$ capture the time-dependent effect of growth Z on the hazard rate λ, and $\boldsymbol{\gamma}$ is a vector of coefficients that capture the time-independent effect of control covariates $\mathbf{X}$ on the hazard rate λ. The unknown change-point τ is estimated along with the coefficients $\beta_{t\leq\tau}$, $\beta_{t>\tau}$, and $\boldsymbol{\gamma}$ by maximizing the partial log-likelihood of the Cox model over a set of candidate change-points corresponding to all breakdown times in the data.[1]

[1] I estimate a change-point Cox model because it does not rely on parametric assumptions about the shape of the baseline hazard rate. Thus any estimated changes in the effect of economic downturns on the likelihood of democratic breakdowns will be due this change and not due to a possibly misspecified parametric restriction placed on the shape of the baseline hazard rate. The literature on the Cox model with a change-point is large; see e.g. Matthews and Farewell (1982) and Luo, Turnbull, and Clark (1997).

I use data on democratic survival that cover the period 1841-2007 and are based on the regime type data compiled by Przeworski et al. (2000), Boix (2003), Cheibub and Gandhi (2005), and my own coding. The complete data contain 4,390 democracy-years with 73 breakdowns in 193 democratic spells from 133 countries. My key covariate of interest is *GDP growth*, which is based on data in Maddison (2008). I also include controls typically employed in the literature on democratic survival (see e.g. Przeworski et al. 2000; Bernhard, Nordstrom, and Reenock 2001; Boix 2003; Cheibub 2007; Ulfelder and Lustik 2007). I control for *GDP per capita*, *fuel and ore exports* (a dummy variable that takes the value one if a country's fuel and ore production amounts to more than 40% of its exports and zero otherwise), the constitutional foundation for the executive (*parliamentary*, *presidential*, or *mixed*), the type of the dictatorship that preceded the transition to democracy (*military*, *civilian*, *monarchy*, *Communist*, or *not-independent*), the fraction of a democracy's *neighbors* that were democratic in any given year, and a *Cold War* period effect (a dummy that takes the value one between the years 1945 and 1990, and zero otherwise.) These data come from Maddison (2008), the World Bank (2008), Cheibub and Gandhi (2005), and my own data collection or transformation. Table 1 contains descriptive statistics for these covariates. After accounting for missing covariates, the data cover 3,769 democracy-years with 72 breakdowns in 173 democratic spells from 138 countries.

Table 2 summarizes estimation results from the change-point model. Model 1 preserves the largest number of observations, model 2 incorporates all control covariates, and model 3 controls for any unobserved, spell-level heterogeneity by including random effects (frailty).[2] Estimated coefficients are presented in the form of hazard ratios: a coefficient greater than

[2]A fixed-effects model is not suitable here because several covariates do not vary over time and many democracies do not experience a breakdown. These covariates and observations would have to be dropped from a fixed-effect estimation; see Beck and Katz (2001) and Cameron and Trivedi (2005, 701-2).

1 implies that the associated covariate raises the relative risk of democratic breakdowns.

The model in Section 2 predicts that economic downturns raise the risk of breakdown for young democracies, $\beta_{t \leq \tau} < 1$, but that this effect should become statistically insignificant over time, $\beta_{t > \tau} = 1$. Estimates from all models in Table 2 support this prediction: each percentage point decline in economic growth raises the risk of a democratic breakdown by about 5%, as long as a democracy has existed for no more than 22 years. The first and third quartiles of growth are 0.10 and 4.45; an interquartile decrease in economic growth thus corresponds to a 80% increase in the risk of a democratic breakdown. Yet after the age of 22 years, the effect of growth on breakdowns is no longer statistically significant.[3] Furthermore, one-tailed Wald and likelihood-ratio tests reject the null hypothesis $\beta_{t \leq \tau} = \beta_{t > \tau}$ at 5% and 10% significance levels, respectively. Hence we see support for the conditional, time-dependent effect of economic decline on the hazard of a democratic breakdown, as predicted by the theoretical model in Section 2.

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[3]There are eight breakdowns in a total of 2,350 country-years after the change-point estimate of 22 years.

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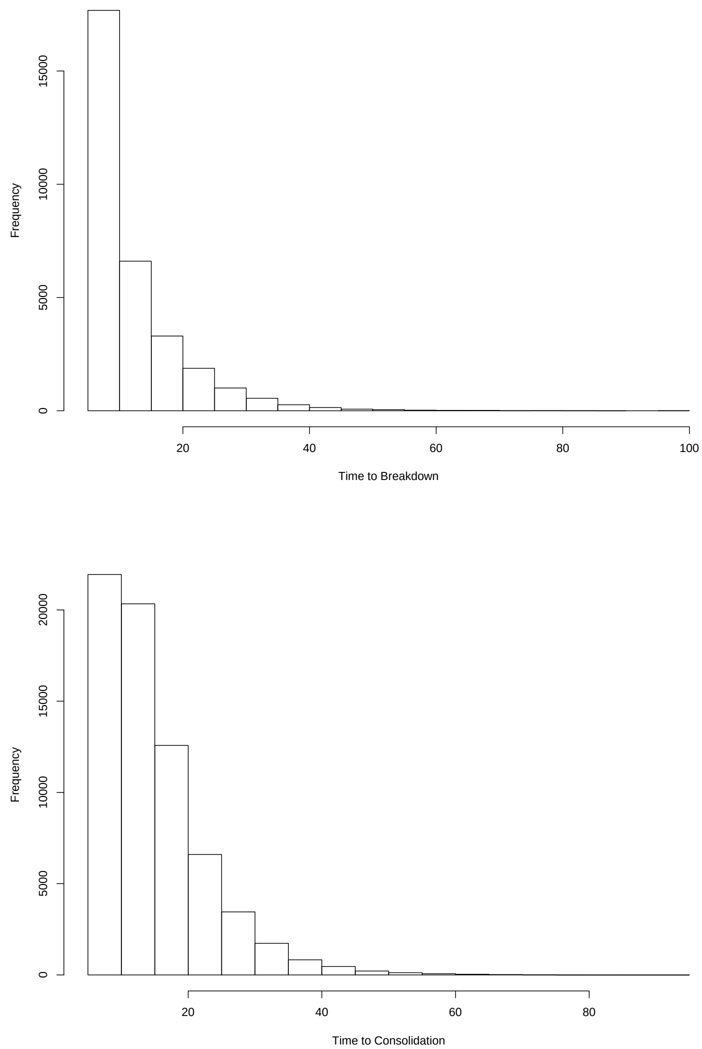

Figure 3: Simulated distribution of time to breakdown and consolidation

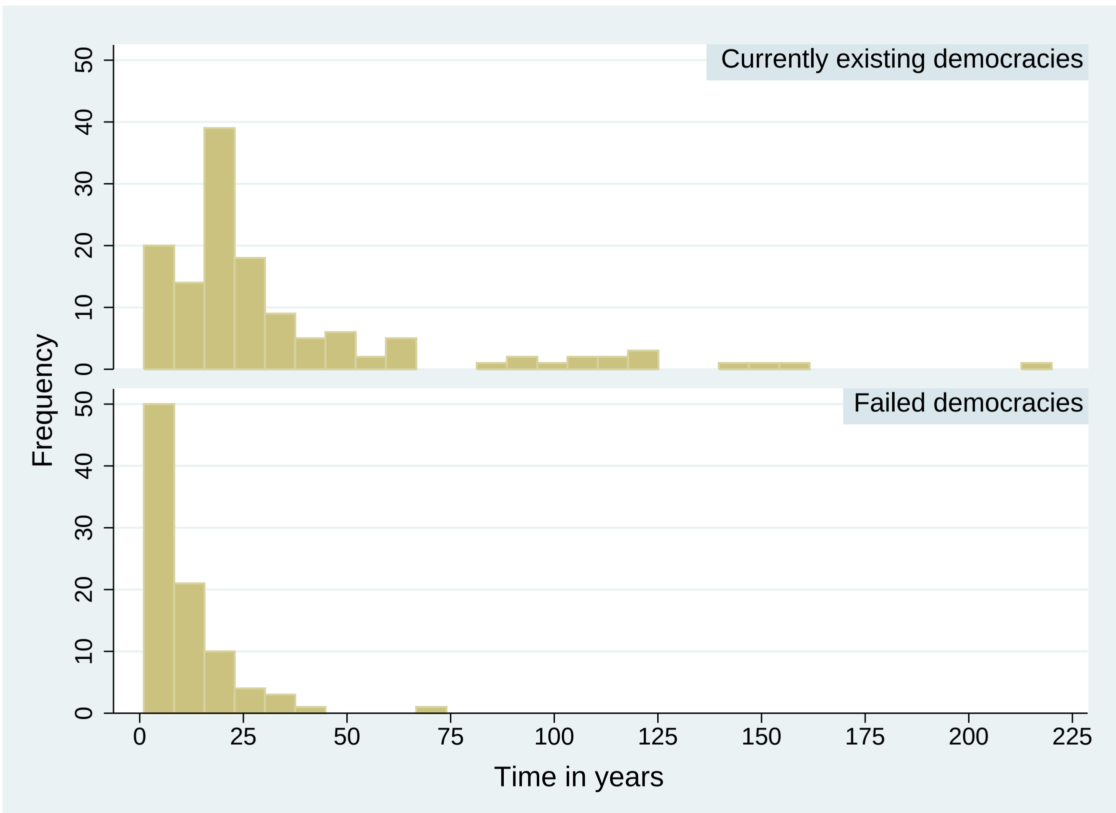

Figure 4: Empirical distribution of the survival time of currently existing and failed Democracies, 1789-2008

Table 2: The time-dependent effect of economic decline on the hazard of democratic breakdowns

	Partial (1)	**Full** (2)	**RE** (3)
GDP growth before τ, $\beta_{t\leq\tau}$	0.960***	0.952***	0.952***
	(0.012)	(0.013)	(0.014)
GDP growth after τ, $\beta_{t>\tau}$	1.101	1.134	1.134
	(0.077)	(0.099)	(0.115)
Log of GDP per capita	0.462***	0.527***	0.527***
	(0.067)	(0.104)	(0.099)
Fuel and ore exporter		0.984	0.984
		(0.265)	(0.265)
Presidential (v. parliamentary)		1.073	1.073
		(0.295)	(0.315)
Mixed (v. parliamentary)		1.206	1.206
		(0.570)	(0.527)
Military (v. civilian)		2.009**	2.009**
		(0.580)	(0.584)
Monarchy (v. civilian)		1.836	1.836
		0.944)	1.073)
Communist (v. civilian)		2.341	2.341
		(1.547)	(1.642)
Cold War		2.982***	2.982***
		(0.844)	(0.909)
Democratic neighbors		0.240***	0.240***
		(0.112)	(0.113)
Change-point τ	22	22	22
Wald test of $H_0 : \beta_{t\leq\tau} = \beta_{t>\tau}$	3.77**	4.06**	2.97**
LR test of $H_0 : \beta_{t\leq\tau} = \beta_{t>\tau}$	2.55	2.95*	2.95*
Variance of the random effect	–	–	0.00
Log-likelihood	-328.574	-298.223	-297.828
Democratic country-years	4,117	3,769	3,769
Democratic spells	177	173	173
Democratic breakdowns	74	72	72

Note: A change-point Cox survival model, coefficients are expressed as hazard ratios, Breslow method for ties. Significance levels *10%, **5%, ***1%; robust standard errors in parentheses. Gamma distributed, spell-level random effects (frailty).

Data Sources: See text. All covariates are lagged by one year.