Was Jefferson Right? A Machine Learning Approach to Charting Constitutional Life Cycles and Democratic Backsliding

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Abstract

In this article, I synthesize Thomas Jefferson's argument for 19-year term limits on constitutions with modern theories of constitutional endurance and democracy. I argue that periodic constitutional revision lowers a country's risk for democratic backsliding. However, the culture of a constitution matters more than its content; routine maintenance keeps the public engaged in politics, normalizes institutional upkeep when necessary, and signals higher costs to elites for exploiting loopholes. This, in turn, helps constitutions adapt enough to satisfy Jefferson's concerns. My theory predicts that democracy is likely to recess when a constitution remains unchanged longer than we would expect given its design, environment, and history. Taking these into account, I train a random survival forest algorithm to compute optimized revision intervals tailored to each country, which I offer as a state-of-the-art version of Jefferson's 19-year figure. I then test whether countries are at a greater risk of democratic backsliding when their constitutions remain unchanged longer than expected or when constitutions are revised more proactively.

Introduction

Three weeks before the US Congress passed the Bill of Rights, Thomas Jefferson wrote a letter to James Madison arguing that the Constitution needed an expiration date. In his view, imposing an immortal constitution on future generations would impede on their right to self-govern. "The earth belongs always to the living generation," he wrote. "The dead have neither powers nor rights" (1789). He suggested that all constitutions and laws should expire after 19 years, a number he arrived at by calculating that half of all voting-age citizens at the time were expected to be dead within 19 years. By the time a majority of the public that promulgated a constitution is gone, its institutions become vulnerable to self-reinforcing corruption that can only be prevented by mandating a periodic reset of the system.

Although Jefferson's method and measure were somewhat rudimentary, scholars in recent years have come to an eerie finding: the median lifespan of a national constitution, out of all constitutions in the world since 1789, happens to be 19 years (Elkins, Ginsburg, and Melton 2009). Was Jefferson onto something? Perhaps his ideal life expectancy matches actual life expectancies by mere coincidence, but his argument still raises some questions: do constitutions risk decaying beyond repair when they age past their prime? Or is endurance beyond expectations a sign that a constitution is resilient enough to withstand democratic backsliding indefinitely into the future?

The United States is one of the only countries in the world that has kept the same core constitutional text for more than two centuries, and it is one of the only countries that has not amended its constitution in three decades. Even then, the most recent amendment (ratified 1992) was minor; the last significant change to the Constitution was adopted in 1971. Half a century later, around 2016, the United States began falling into its sharpest episode of democratic backsliding in its history, according to most major democracy indices (Coppedge et al. 2021; Marshall 2020). My theory suggests that these are connected. Constitutions that are easier to amend or replace are stronger bulwarks against threats to democracy than rigid constitutions. Periodic revisions keep the public more engaged in politics, strengthen the polity's reflexes against new forms of loopholes, and facilitate advancement away from old forms of oppression.

I investigate this theory in a number of ways. First, I expand previous work on constitutional endurance by easing the distinction between new constitutions and significant amendments. I then expand on the constitutional survival models by Elkins, Ginsburg, and Melton (2009), switching the dependent variable from full constitutional lifespans to durations of constitutional periods between significant amendments or replacements. The models are also updated to account for competing risks for amendment or replacement.

Second, I test the effects of constitutional revisions on democracy. I hypothesize that constitutional revisions tend to boost participation and prevent democratic backsliding, and they can even reverse backsliding if they include public input and referendum requirements. Third, I revisit Jefferson's claim that 19 years is the optimal frequency for constitutional revisions. Jefferson argued that *all* constitutions should have 19-year term limits, assuming that 19 years is a universal estimate of the optimal lifespan of a constitution. I argue that constitutional life cycles are heterogeneous and cannot be evaluated around a single number, but they do follow predictable patterns based on their design and environment.

I propose a more powerful, state-of-the-art alternative to Jefferson's ideal constitutional lifespan: optimized revision intervals computed by a supervised machine learning algorithm, tailored for each country at each phase of its constitution's life cycle. The algorithm estimates expected intervals between constitutional revisions, accounting for its design, environment, and history. My theory predicts that democracy is likely to slip when countries refrain from substantially revising their constitutions longer than expected. The models of democratic backsliding are updated with these optimal terms to assess this hypothesis.

The Epidemiology of Constitutions

Although the term *constitution* can refer to political institutions in the abstract, here I use it to refer to written texts that serve as the foundation of a country's political institutions. A constitution is different from a *regime*, which is characterized more by informal rules determining who holds power (Stein 1982). Regimes can transition without a new constitution, and constitutions

can transition without a new regime.[1] Scholars have paid considerable attention to the factors affecting regime survival (Tansey, Koehler, and Schmotz 2016; Wright, Frantz, and Geddes 2013; Knutsen and Nygård 2015; Andersen et al. 2014). In recent years, scholars have also begun paying more attention to the factors affecting constitutional survival.

Constitutional Endurance and Flexibility

For more than two centuries, the consensus among legal and political scholars was that short, vague constitutions are more durable than longer, more specific constitutions (Hammons 1999), a theory typically attributed to James Madison. When constitutions provide less detail and merely lay out the basic institutional framework, the political system is more flexible and stable (Przeworski 1991; Elazar 1985; Friedman 1988). The constitution can stand as a "living constitution," a foundational document that leaves controversial statutory provisions to the legislative process rather than codifying them as the law of the land. In short, brevity enables flexibility, flexibility creates stability, and stability brings endurance.

While the logic of the Madisonian theory is intuitive, it has little to no empirical support. Instead, the evidence has consistently shown the opposite: longer, more detailed constitutions last longer—even those that include unnecessary provisions that could just be laws. This was first observed by Hammons (1999) in the context of US state constitutions; by Negretto (2012) in the context of Latin American constitutions; and by Elkins, Ginsburg, and Melton (2009, hereafter "EGM") in the global context with all national constitutions on record. Constitutions that are more amendable over time tend to endure longer than those that are not. Overall, variables that the authors of constitutions can control—especially the ease of amendment and the specificity of the document—generally have stronger effects on constitutional lifespans than exogenous variables.

EGM offer the most comprehensive explanation, part of their constitutional renegotiation theory: specificity encourages flexibility. Including details that lose relevance over time incentivizes political actors to perform routine maintenance on the constitution. The public keeps a

[1] For example, Geddes, Wright, and Frantz (2014) code the Somoza regime in Nicaragua as a continuous regime despite constitutional turnover.

more critical eye for outdated provisions that could be removed and relegated to laws, which brings a more critical eye for outdated provisions of the framework as well. Additionally, clarity fosters a more universal understanding of what the constitution says, preventing contention over disagreements in interpretation.

The main hole in the Madisonian theory of constitutional endurance is that brevity does not imply flexibility. Even if the particular rules and arrangements beyond the core framework of the political system are flexible, the framework itself may not be. A flawed framework that is nearly impossible to amend can easily become the very force that suppresses flexibility. On the other hand, detail normalizes the amendment process so the polity can adapt its constitution to the changing world. For the most part, the US Constitution has neither detail nor frequent amendments, yet it is the longest lasting in the world. Why does the Madisonian theory only seem to hold up for Madison's own document? EGM offer many ideas, including that the courts' power of judicial review on constitutional matters has let it take on the role of providing flexibility and specificity in the constitutional order. It is worth noting, though, that constitutional review by courts has become the global norm (Ginsburg 2008), so it is unclear if judicial review can sufficiently explain the US constitution's endurance.

EGM also suggest that the US Constitution has had more detail than it seems, at least at times—it initially prohibited a ban on slavery, it briefly prohibited alcohol, and it has an unusually specific procedure for executive selection—but comparatively speaking, it is still one of the most bare-bones, framework-oriented constitutions in history. Furthermore, EGM's model predicts the age of the US Constitution with surprising accuracy, considering that their theory does not seem to explain its endurance. They do not state this explicitly, but I replicated their Cox proportional hazard model as closely as possible (details are in the Data and Methods section) and found that the life expectancy of the US Constitution is almost exactly its current age. Figure @ref(fig:plot-cox) shows a plot comparing the errors of the predictions of the model.

While not a standard diagnostic plot for this type of model (Cox proportional hazards models), this plot reveals two challenges for modeling constitutional survival. First, the model is significantly more accurate for Western democracies than for the rest of the world, probably because the US holds disproportionate influence in the theory development and the model calcu-

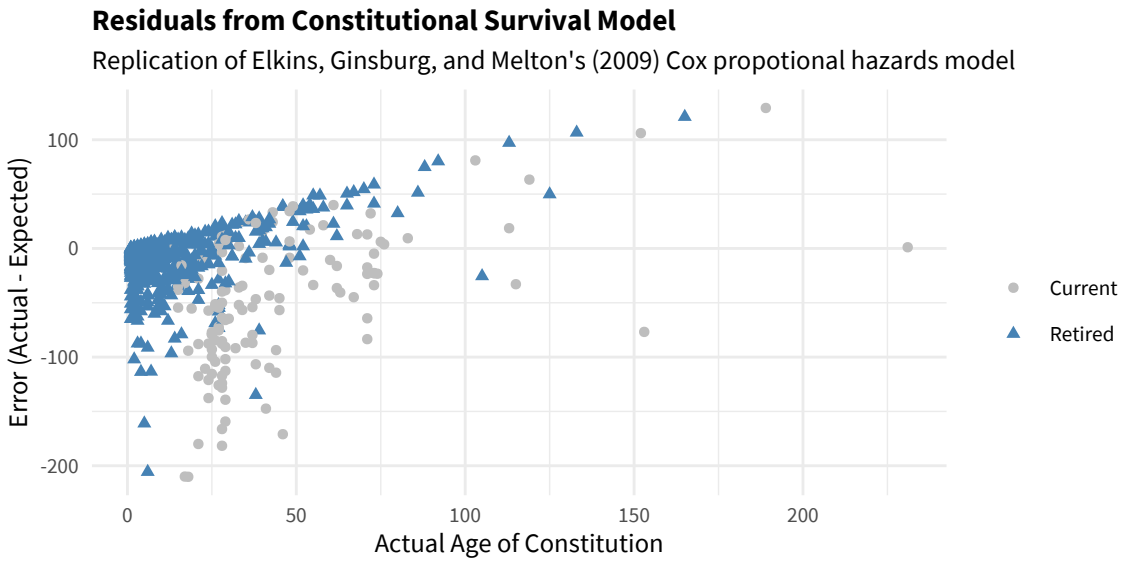

Figure 1: Basic residuals (actual minus predicted constitutional age) vs. actual constitutional age, from replication of the Cox proportional hazards model by Elkins, Ginsburg, and Melton (2009). The US is the farthest right dot.

lations. The fact that the model's prediction for the US Constitution's lifespan almost exactly matches its current age despite most other long-lasting constitutions being underestimated may indicate that the model is calibrated too heavily with US-oriented interpretations of constitutions and the determinants of their survival.[2]

Second, errors are not random, and the model systematically underestimates survival of older constitutions. This is likely due in part to nonproportional hazards: for a Cox model to fit data approporiately, the effect of each variable must not change over time, or else it may bias the results (Box-Steffensmeier and Zorn 2001). EGM note that hazards of many covariates—including specificity of the constitution—are not proportional over time, although they report that correcting for this did not change the results (128). However, this does not indicate the non-proportionality can be ignored; rather, more advanced techniques are needed (Licht 2011). In the case of constitutions, nonproportionality may be exacerbated by correlations among constitutions within the same country (as Box–Steffensmeier and Zorn (2002) point out), separate processes for short-lived constitutions (Alt, King, and Signorino 2001), or some combination of these phenomena. Figure @ref(fig:cox-ph) indicates that nonproportional hazards are present and influencing

[2]Or perhaps the model is accurate and is trying to tell us that the US is in imminent danger of failing.

the model, as the cumulative sum of martingale residuals should fluctuate continuously around the x-axis (Xue and Schifano 2017).

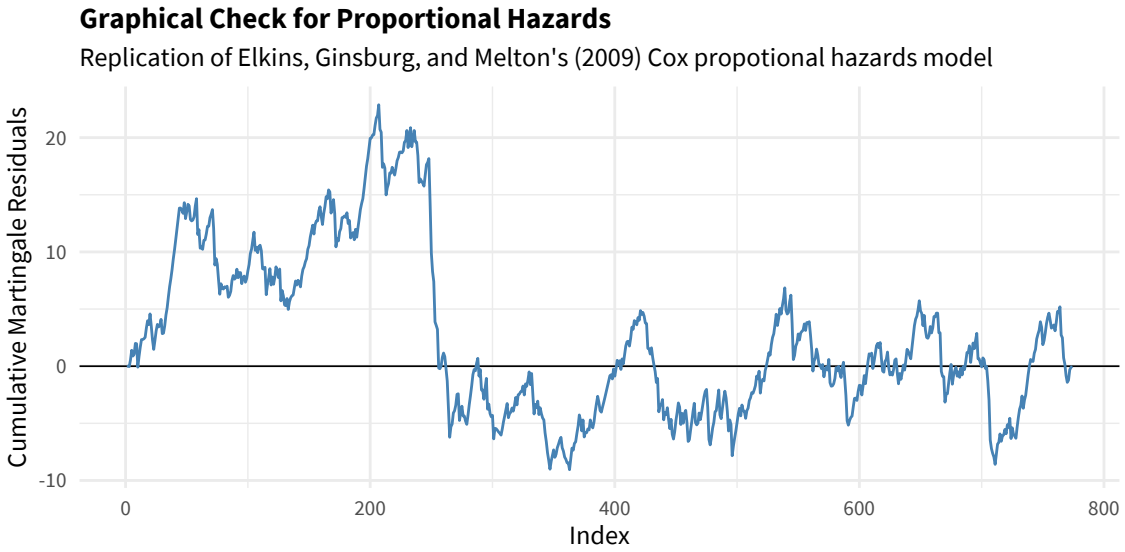

Figure 2: Cumulative sum of martingale residuals, ordered by constitutional age, from replication of the Cox proportional hazards model by Elkins, Ginsburg, and Melton (2009).

These challenges are far from fatal to studies of constitutional design. On the contrary, they show that EGM's pioneering work on this area is only the beginning. The paradoxes among the hypotheses, general results, and specific predictions for the US can still be explained. The literature is full of suggestions for how scholars can approach time-to-event data with the properties described here. Importantly, the presence of nonproportionality, repeated events, and separate data generation processes have implications for both theory development and methodological choices. I begin with theory development, and methodological considerations will be discussed in the Data and Methods section.

Conceptualizing Constitutions

Constitutions take many forms around the world—everything from loose collections of acts and precedents to rigid formal documents explicitly labeled constitutions. To account for this heterogeneity, EGM spell out a general definition that can apply to at least one text in most countries (49):

> Constitutions consist of those documents that either: (1) are identified explicitly as the *Constitution, Fundamental Law*, or *Basic Law* of a country; OR (2) contain explicit provisions that establish the documents as the *highest* law, either through entrenchment or limits on future law; OR (3) define the basic pattern of authority by establishing or suspending an executive branch of government.

Furthermore, EGM do not consider constitutional amendments to be replacements. They only consider a constitution to be an altogether new constitution if it is revised outside of the normal amending procedures of the preceding constitution (55). For example, EGM mention that each of South Korea's six republics effectively rewrote its constitution through formal amendment processes, which they code as a continuous constitution. This may not be appropriate for most constitutional research. Jefferson may be satisfied by South Korea's constitutional turnover despite its constitution technically remaining in place. If the only continuity in the foundational document of a country is a single thread of formal amendment processes, then models are not fully capturing the variation across constitutions and are overestimating the variation within constitutions.

Even beyond amendments, constitutional orders can fundamentally shift over the course of a constitution's lifetime. Ackerman (2000) argues that the US has effectively had three constitutions (not including the Articles of Confederation), with fundamental shifts after the Civil War and during the New Deal. The post–Civil War shift came with three transformative amendments, while the paradigm shift of the New Deal had no corresponding amendments. How, then, should scholars conceptualize constitutions? How are we to distinguish between amendments that effectively overhaul their constitutions and amendments that merely change minor details? How can we account for de facto revisions of political arrangements that come with no de jure revisions?

In a forthcoming review piece, Elkins and Ginsburg (2021) step back from focusing on core constitutional texts as the unit of analysis and argue that the "small-c" constitution is more important than the formal document. Constitutions are only the surface of political environments, and they are too heterogeneous to show consistent patterns. Indeed, this is likely why their constitutional survival models had so many odd features. The effect of specificity, for example, on a constitution's hazard for failure may invert over time as norms fill in ambiguities or retire unneeded details (Wiener 2008). Some cultures may prefer frequent constitutional turnover as

insurance against legacies of oppression, while other cultures may prefer endurance as insurance against short-term whims. Scholars may need to reorient the scope of their theory and sample to particular types of constitutions at particular phases of their life cycles (Geddes 2003).

Even when patterns emerge, Elkins and Ginsburg are doubtful that constitutional texts have much of an effect on political outcomes. They argue that their work on the determinants of constitutional endurance still has causal validitiy because the variation in the types of constitutions around the world is precisely the variation that they sought to explain. It seems, then, that really the only universal conclusions scholars can draw about causal effects of constitutional design are how long the core texts last. But if the core texts do not matter, then the endurance of a constitution does not matter either. In the next section, I argue that constitutional endurance does matter to some degree, but not because of the text itself—rather, endurance shapes the political culture.

The Role of Constitutional Endurance in the Current Democratic Recession [In Progress]

Although a long-lasting constitution can be desirable, survival is not the end goal of a constitution; it is more of a means to an end. Throughout the preambles and purpose statements of constitutions, the closest goal to survival is stability (Elkins et al. 2014), although these are not the same. Survival often indicates stability, but it can also indicate impending instability. If the framework of a political system is flawed, then the survival of its constitution can come at the cost of stability. Autocratic regimes, for example, sometimes democratize and install a new constitution when public dissatisfaction with the status quo becomes dangerously high (Huntington 1991). In these moments, lengthening the lifespan of the constitution any more would become the *cause* of instability.

Constitutions are usually designed with many other goals in mind, such as security, state capacity, representativeness, economic prosperity, and civil liberties. The literature is rich with evidence that constitutional design affect these outcomes. Lederman, Loayza, and Soares (2001) find that parliamentary systems and states with strong protections for the freedom of the press

have less corruption. Lijphart (1997) identifies many electoral rules that increase participation. Golder and Stramski (2010) find that systems with proportional representation are more representative of their constituencies than majoritarian systems. Likewise, Anderson and Guillory (1997) find that constituents are more satisfied with their government under proportional representation. Birchfield and Crepaz (1998) find that constitutions calibrated toward consensus democracy have lower levels of income inequality than those calibrated toward majoritarian democracy.

> *Hypothesis 1.* Controlling for environment, countries are at higher risk for democratic backsliding when their constitutions remain unchanged longer than predicted.

> *Hypothesis 2.* Controlling for environment, countries are at lower risk for democratic backsliding during periods when their constitution is revised at an expected rate.

Overall, my theory suggests that the link between frequent amendments and instability, associated with the Madisonian theory of constitutional endurance, is merely a correlation. When accounting for design, history, and environment, constitutional revisions generally help countries that are relatively stable by normalizing adaptations to the changing environment.

Data and Methods

The data compiled by EGM in preparation for their book were obtained from the Comparative Constitutions Project (CCP, see Elkins, Ginsburg, and Melton 2005). It includes information on all known constitutions in the world since 1789; it has 1,048 constitutions across 216 countries. The dataset only contains variables relating to the design of each constitution, as the environmental variables were obtained from outside sources. I compiled these data independently, sticking to EGM's sources and measures as much as possible.[3] Four datasets come from the Correlates of War Project (COW): Territorial Change (Tir et al. 1998), Militarized Interstate Disputes (Palmer et al. 2020), Intra-State War Data (Dixon and Sarkees 2016), and National Material Capabilities (Singer, Bremer, and Stuckey 1972). Additionally, political regime data were obtained from the

[3]For some of the variables, I used different data from EGM simply because I could not access the dataset they used. For others, better data are now available since it has been 12 years since their book was published (and probably even more since they collected their data). For example, they use Fearon's (2003) ethnic fractionalization index to measure ethnic diversity, but this index is time-invariant. Drazanova (2020) extends Fearon's index and produces yearly data, so her data are used instead.

Polity Project (Marshall 2020), ethnic fractionalization data were obtained from Drazanova (2020), and leadership transition data were obtained from Goemans, Gleditsch, and Chiozza (2009). Table A2 of the Appendix shows the details of each variable.

EGM model constitutional survival with Cox proportional hazard models. Cox models are a common technique for survival analysis, otherwise known as event history modeling or duration modeling. The models I use in this article come from this family of statistical techniques as well. The main advantage of survival analysis is that it accounts for right-censoring, which is when the event of interest has not yet occurred for a particular observation. In the context of constitutional survival, all current constitutions are right-censored; they could be replaced next year, or they could last for centuries. Excluding these cases or marking their duration as their current age can bias regression models (Box-Steffensmeier and Jones 2004). Survival analysis circumvents this problem by modeling conditional probabilities of survival rather than lifespans.

The present study has two main steps. The first is to measure expected intervals between significant constitutional revisions, and the second is to model the effects of exceeding these intervals on democratic backsliding. Expected revision intervals could be estimated with Cox proportional hazard model, but I would run into the same problems EGM faced. In particular, accounting for repeated events is even more important for these shorter, more numerous durations. Luckily, this stage only seeks to *predict* durations, not to *explain* them, which opens the door to a whole new toolbox. For starters, many of the issues that analysts must think through when constructing models for causal inference—variable selection, interactions, multicollinearity, endogeneity, heteroskedasticity, model efficiency, and bias reduction, to name a few—are less relevant (or not relevant at all) for prediction (Shmueli 2010). Machine learning algorithms offer even more power for predictive modeling as they allow computers to search for patterns that analysts might not have modeled on their own (Cranmer and Desmarais 2017). They are also useful measurement strategies (Grimmer, Roberts, and Stewart 2021), which is essentially the goal of this stage.

To fully take advantage of the lighter restrictions on predictive modeling, I use random survival forests on the durations between revisions. Random forests, as originally developed by Breiman (2001), are a common algorithm for classification and regression, although they generally

cannot handle right-censored data. Ishwaran et al. (2008) developed random survival forests to solve this problem, and they show that their random survival forests perform better than Cox hazard models in an epidemiological application. To my knowledge, random survival forests have not yet been applied in political science.

I. Replicating Elkins, Ginsburg, and Melton (2009)

As Shmueli (2010) notes, predictive modeling can be useful for theory development and providing a "reality check" on the accuracy of theories. Hence, this stage of the study is a useful opportunity to double check EGM's findings that specificity, flexibility, and inclusively of constitutions have a bigger impact on their survival than environmental factors. I replicated EGM's Cox models with random survival forests using `randomForestSRC`, a package developed by two of the statisticians who introduced random survival forests (Ishwaran and Kogalur 2021). Two methods are used to compare the predictive importance of design and environmental variables. First, Breiman-Cutler permutation statistics are run on the random forests with the training data to estimate the importance of each variable. The average and total scores of design variables and environmental variables are then compared to see which set of variables tends to be more important. Higher scores for design variables would suggest that design variables are more important for predictive accuracy than environmental variables.

Second, a series of random forests are run with various specifications of variables. The dataset includes 9 design variables and 17 environmental variables, so only the 9 most important environmental variables are used. One set of forests only includes design variables, the next one only includes environmental variables, and the final one includes all variables. If adding design variables minimizes error rates more than adding environmental variables, EGM's finding would be corroborated.

II. Measuring Revision Intervals

In this stage, I measure the frequencies at which each country typically revises its constitution. To maximize the power of inferences that can be drawn, the measurements need to be flexible

enough to work in a variety of contexts while capturing a common theme (Adcock and Collier 2001). Therefore, sound definitions are critical. Broadly speaking, the unit of time I am interested in is the intervals between episodes of significant revision to constitutional texts. A *revision* can be any amendment or replacement, but a *significant revision* has greater importance. In line with my theory, *significant revision* refers not to the substance of the changes to the text, but to the noteworthiness of the event. In countries where amendments are rare, a single amendment—even one that seems to be of little consequence—may be enough to refresh public engagement with the political system. In countries where frequent amendments are commonplace, a new constitution may be needed to activate the same response.

When considering the frequency of both amendments and replacements, four patterns of revision emerge: (a) frequent revisions of any type, (b) frequent replacements with few amendments in between, (c) frequent amendments to a constant constitution, and (d) infrequent amendments to a constant constitution. Each country usually follows the same general pattern throughout time, with exceptions of course. Figure @ref(fig:cycles) shows examples of these patterns. For the first two types of cycles, countries with frequent replacements, a significant revision is a new constitution. For countries with infrequent amendments, the definition is not so straightforward. In future research, it would be useful to specify a precise method of measuring which amendments are the most noteworthy in the public's eye. For now, though, I will consider a significant revision to be a streak-ending amendment: the first revision after an above-average timespan of no revisions. For example, the United States has amended its constitution 17 times over 231 years, so any amendment that ends a streak of at least 14 years with no amendments counts as significant for purposes of this study.

I could simply use the average durations between revisions as the expected intervals and proceed straight to the next stage, but this would be too simplistic of a measure. The average durations are often skewed down by clusters of many revisions in a small time frame. Furthermore, contextual factors can affect a country's need for revising their constitution, so modeling intervals in context is important. With this in mind, I filtered the data to significant revisions and calculated the time since the last significant revision. This returns 1,535 observations from 208 countries across 721 constitutions. The average duration is 10.6 years with a standard deviation of 11.2 .

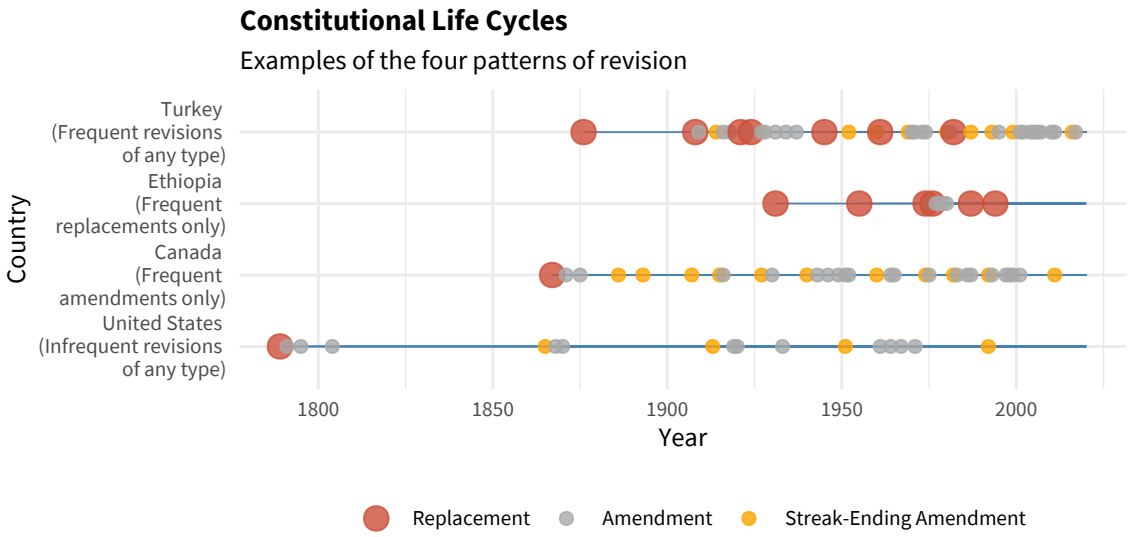

Figure 3: Examples of the four patterns of revision for constitutional life cycles.

Figure @ref(fig:plot-density) displays the distribution.

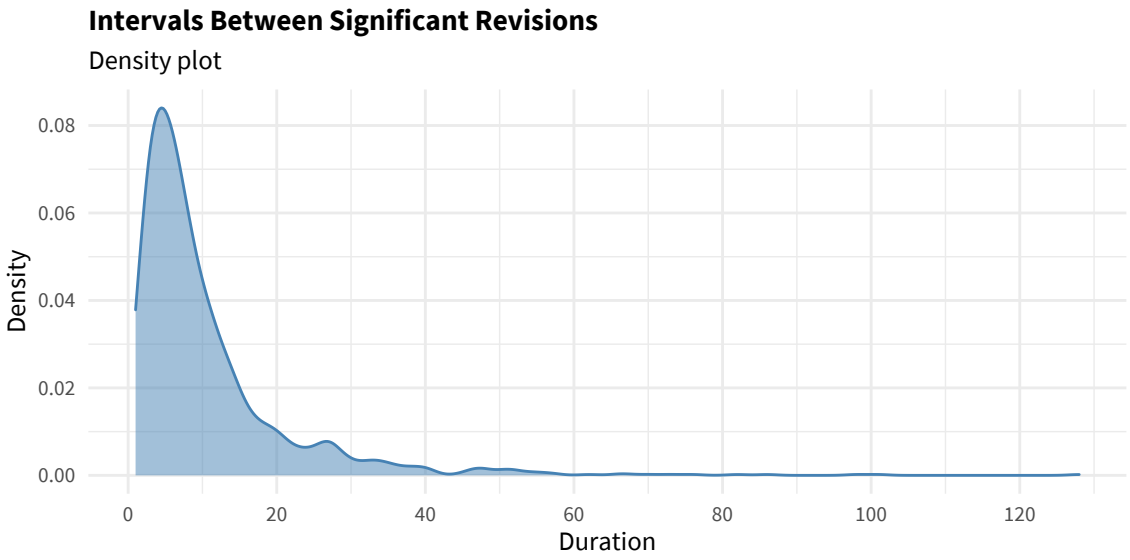

Figure 4: Distribution of durations between constitutions and streak-ending amendments.

The predicted duration intervals need to account for constitutional design, history, and environment to fit the substantive purpose of the measurement. For the environmental variables, I use the same variables as the ones in EGM's models. For constitutional history, I include variables with the age of the constitution and the number of previous significant revisions in the country's history. The design variables are less conventional. Because I only seek to predict,

the variables do not have to be substantively meaningful; they just need to account for variation in constitutional design. Therefore, I begin by pulling EGM's full dataset of characteristics of national constitutions, which has longitudinal data on more than 600 variables of constitutions. After cleaning the data and recoding categorical variables as dummy variables, the dataset includes 1,087 variables. Many of these variables cover similar topics that are correlated with each other, so condensing the data is a prudent step for streamlining the computations of the random forests. To reduce the dimensions, Iran principal components analysis on the data. The scree plot in Figure @ref(fig:plot-scree) shows the first 25 dimensions.

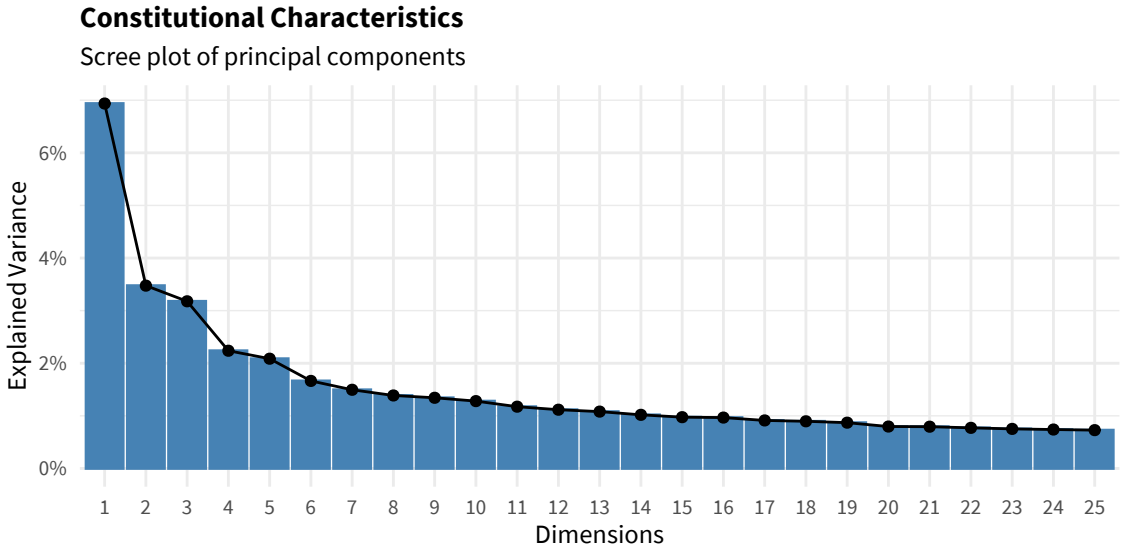

Figure 5: Scree plot of the first 10 dimensions from the principal component analysis of the full constitutional characteristics data. The bars show the percent of the variance in each the data explained by each dimension.

Due to the high dimension of the data, most of the variance is not able to be explained by just a few components. However, because I am not attempting to make inferences based on the principal components, I retain 25 dimensions, which account for around half of the variance in constitutional characteristics. Random survival forests are then run on these design components, constitutional history statistics, and environmental variables. Specifically, I ran random forests for competing risks to predict not just the duration until the next revision but what type of revision it will be. I then compared various specifications of the model and retained predicted values for use in the final stage.

III. Testing the Effects of Constitutional Change on Democracy

For the final stage, an extension of the Cox proportional hazard model for repeated events will be constructed to model risks for democratic backsliding. The main independent variable is a time-variant indicator of whether a constitution has exceeded its expected revision interval. Other variables include: (1) lagged democracy, using the value of the dependent variable at $t-1$; (2) state antiquity, the age of the state; (3) constitutional turnover, the number of constitutions and amendments preceding the current one; (4) state capacity; (5) internal dissent, as measured by frequency of protest; (6) interstate conflict; (7) ethnic fractionalization; (8) income inequality, measured with Gini coefficients; (9) income, in terms of GDP per capita; (10) natural resources, estimated by oil reserves worth.

Results

I. Constitutional Survival

I begin with the replication of EGM's models. Figure @ref(fig:plot-vimp) shows the relative importance of each variable. Higher-scoring variables tend to be design variables, although both environmental and design variables seem to be important. On average, the 9 design variables scored around twice as high as the 17 environmental variables. Summing the scores shows that the total variable importance of design variables is 4.8 compared to 4.89 for environmental variables. Collectively, the design variables have about as much predictive power as the environmental variables, but it is noteable that there are only around half as many design variables. Overall, design variables appear to be more influential for predicting constitutional lifespans.

For the next comparison of variables, we turn to the error rates of the random forests. Figure @ref(fig:plot-acc-pca) shows the effects of adding variables on the error rates of these forests. Here, the results show the opposite—models with environmental variables tend to perform slightly better, although not by much. Overall, we have mixed results regarding the predictive power of design variables relative to environmental variables. When controlling for environmental variables, EGM found that design variables have strong explanatory power, but environmental

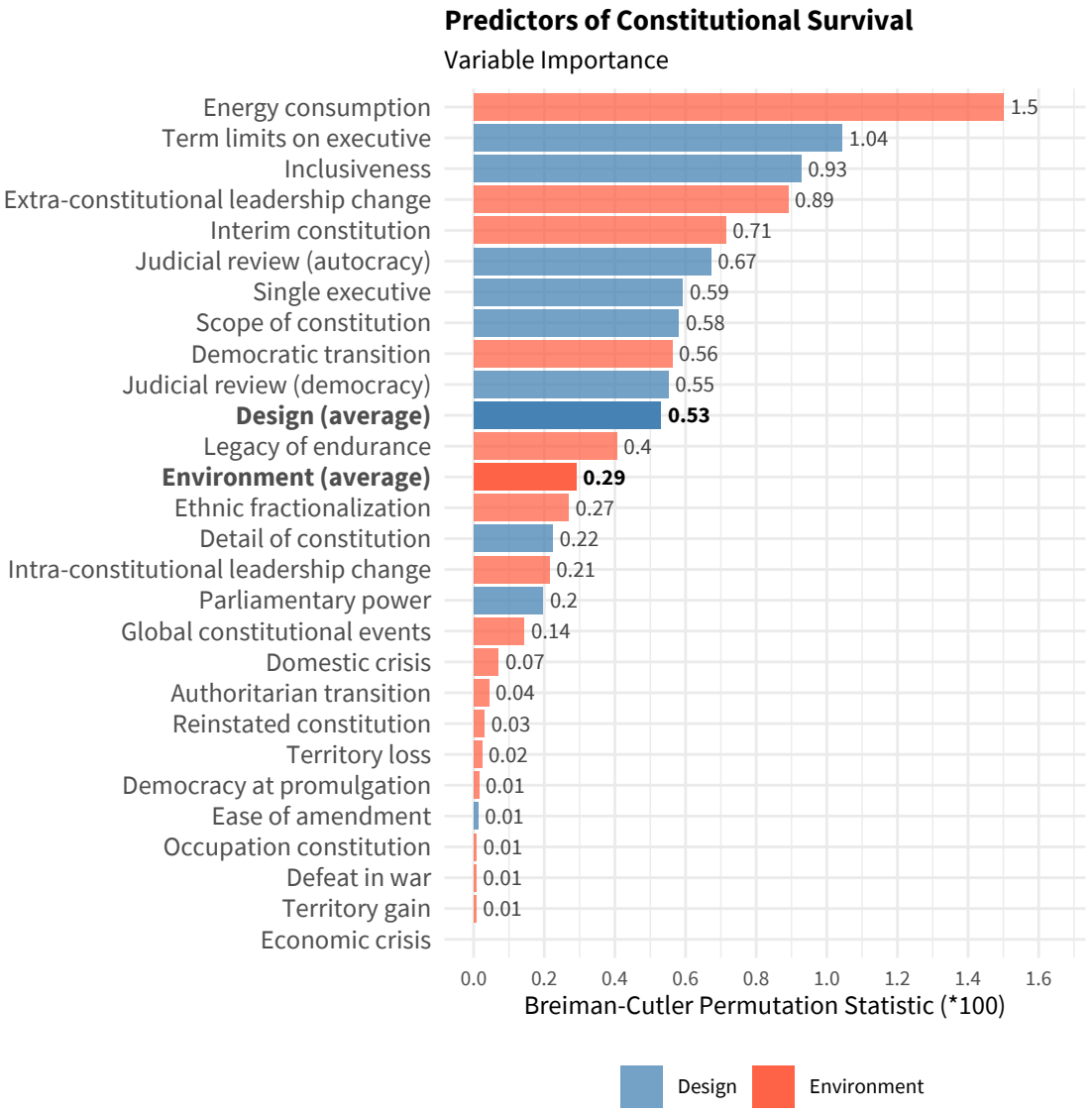

Figure 6: Variable importance scores. Higher scores indicate higher predictive value for constitutional survival. All scores are multiplied by 100.

variables seem to have slightly more predictive power. This shows the importance of accounting for both design and environment when analyzing constitutions.

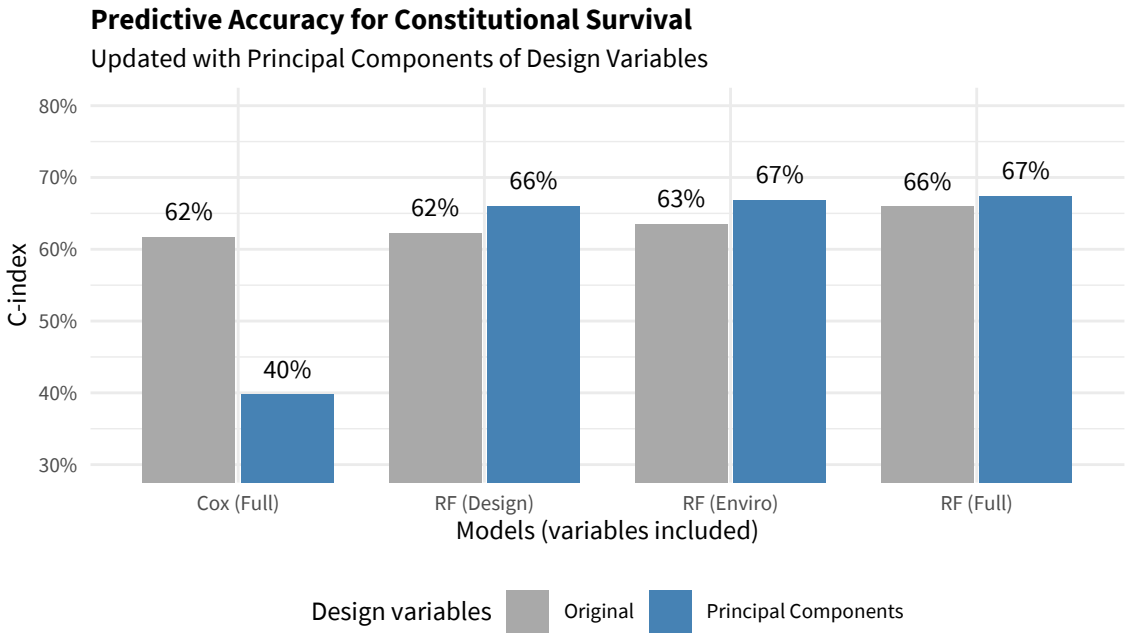

Figure 7: Changes to predictive accuracy of constitutional survival models when the original 9 design variables are switched out for the 5 principal components calculated from the full constitutional characteristics data. In theory, the RF (Enviro) models should not be affected, so the differences are due to random error and are insignificant.

II. Revision Intervals

For now, I had to run the random forests with only one type of event, merging replacements and significant amendments as the same category, since the cross-validation algorithm would not run on the competing risks forests. I also ran a Cox model as a baseline, but the cross-validation algorithm is also not running on that. I am still refining the specifications and processing the results, but Figure @ref(fig:plot-acc-2) shows some preliminary results. The original 9 design variables are actually stronger than the 25 principal components, so I will probably use both sets of variables.

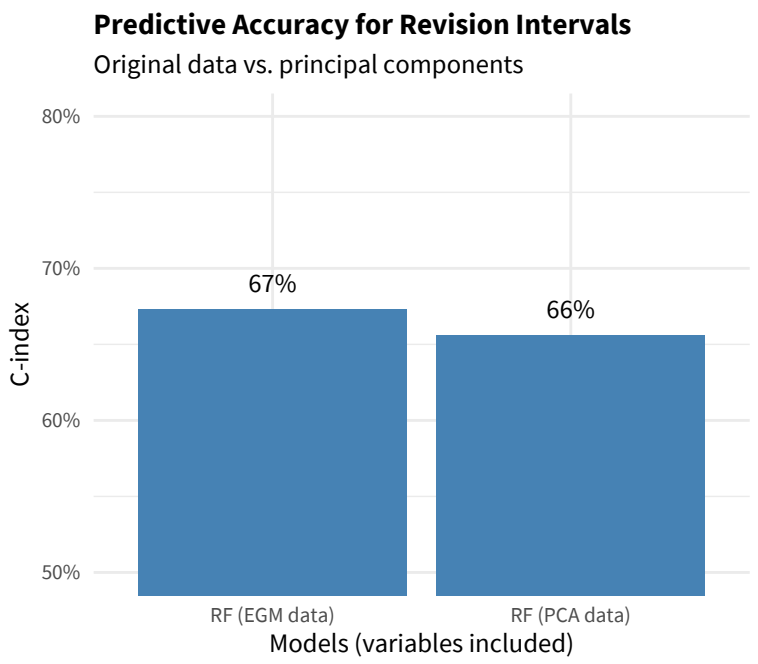

Figure 8: Predictive accuracy of random forests. RF (EGM data) uses the 9 variables from EGM's model for constitutional design, and RF (PCA data) includes the 25 principal components for constitutional design.

Discussion

My next step would be to broaden the study and employ a mixed-method strategy along the lines of Lieberman's (2005) nested analysis method. Given the complexity of the underlying processes and the limited data, I anticipate unsatisfactory results at first, so I would select cases for a model-building strategy. Specifically, I would choose six cases: two "on the line" and four "off the line." The four "off-the-line" constitutions would be selected as follows: (1) one that outlives its lifespan and outperforms on democracy; (2) one that outlives its lifespan and underperforms on democracy; (3) one that has not reached its lifespan and outperforms on democracy; (4) one that has not reached its lifespan and underperforms on democracy. This provides reasonable variation on both independent and dependent variables (Geddes 2003). The case studies will help me hone in on the best model specifications while also serving as illustrative examples to make the theory more compelling.

If supported, my theory implies that, constitutions struggle to adequately serve their constantly changing electorate when they are not able to adapt. Jefferson's calculation of 19 years

as an optimal lifespan is likely not universal, but more nuanced estimates that account for a constitution's design, history, and environment may be able to explain processes such as democratic backsliding. These results would suggest that periodic constitutional conventions could be an effective tool for maintaining democracy, insuring stability, and ridding institutions of harmful legacies leftover from past generations.

Appendix

See online appendix at http://nmorse.info/research/constitutions/#appendix

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