Using the Proportional Hazards Cure Model to Improve the Study of International Relations

by

George Williford

(Under the Direction of Andrew P. Owsiak)

Abstract

Although survival analysis has become a staple in political science research, many scholars ignore one of the fundamental assumptions that these models make: that all observed subjects will eventually experience the event of interest. In this dissertation, I introduce readers to the semiparametric proportional hazards cure model, a model designed to deal with data that violate these assumptions. To facilitate the implementation of these models, I introduce new software designed to estimate these models in the R statistical computing environment. To demonstrate the usefulness of the cure model, I also present two novel theoretical chapters that use cure models to test their theoretical propositions. The first substantive chapter examines why and when states become involved in territorial claims. The second examines whether economically interdependent states are more likely to resolve contentious claims over territorial, river, and maritime claims.

Index words: [Conflict Management, International Conflict, Economic Interdependence, Contentious Issues, International Politics, Territorial Disputes, River Disputes, Maritime Disputes, Political Methodology, Survival Analysis, Statistical Modeling]

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Dedication

To Diane, Walter, Gillian, Oakley, and Sokka Williford.

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Chapter 1

Introduction

Over the past two decades, survival analysis has become one of the fundamental components of political scientist's methodological toolkit. The ability to model the timing and duration of events has greatly improved scholars' ability to analyze change over time. Scholars have applied these techniques widely to examine diverse phenomena, including regime change (Gates et al., 2016), cease-fire duration (Fortna, 2004), war termination (Weisiger, 2013), civil conflict recurrence (Loyle and Appel, 2017), rivalry onset and termination (Owsiak and Rider, 2013; Rider and Owsiak, 2015), Congressional position-taking (Box-Steffensmeier, Arnold, and Zorn, 1997), cabinet dissolution (Somer-Topcu and Williams, 2008), and regime stability (Gates et al., 2006), among a host of other political phenomena.

Although survival analysis is common in political science, many scholars overlook one of the fundamental assumptions made by these models: that all subjects in the population will fail at some point in the future. While this may be tenable in some cases (e.g., all individuals will die), many of the subjects that we study do not conform to this assumption. For example, in studies of civil conflict recurrence, many countries will never experience another civil war. In these cases, subjects may be thought of as "cured" or "immune" to experiencing the event of interest. When cured observations are present in a dataset, standard survival models do not accurately describe the data-generating process that underlies observed phenomena. Unless there is no systematic difference in the cured and uncured populations (which is extremely unlikely), the inclusion of cured subjects will introduce unobserved heterogeneity and create biased and

inconsistent estimates of the population parameters among those that are. As a result, the conclusions drawn regarding the statistical and substantive significance of a variable are likely to be wrong.

The goal of this dissertation is to discuss the problems that arise due to the presence of cured observations, discuss potential solutions to them, and to provide applied examples of their use to analyze political phenomena. Scholars in other disciplines have developed solutions known as *cure models*. Cure models deal with the problem of cured observations by jointly modeling the probability that a subject is prone to failure and the rate of failure among those subjects that are susceptible (Farewell, 1982; Kuk and Chen, 1992; Peng and Dear, 2000; Sy and Taylor, 2000; Taylor, 1995). Although cure models have seen limited use in political science (e.g., Box-Steffensmeier, Radcliffe, and Bartels, 2005; Clark and Nordstrom, 2003; Findley and Teo, 2006; Hettinger and Zorn, 2005; Svolik, 2008), they have yet to be applied widely.

In particular, I introduce readers to a form of cure model that has not previously been used in political science: the proportional hazards cure model (PHCM). The PHCM is based on the familiar Cox proportional hazards model (Cox, 1972) and provides a flexible form of model that does not require the restrictive assumptions made by the parametric cure models used in political science thus far. In addition to introducing readers to cure models, I also provide new software to implement these models in R in the form of the **tvcure** package. Unlike previous software, **tvcure** can accommodate the use of time-varying covariates and therefore greatly expands the type of data that can be analyzed using the PHCM.

Chapter 2 constitutes the methodological chapter of the dissertation. In it, I discuss in detail the problems associated with cured observations. I then introduce the reader to the PHCM and discuss its advantages related to parametric cure models. I also discuss the software I created to estimate these models and provide an applied application using that software to demonstrate how using standard survival models and the PHCM can produce different results.

To provide additional examples of use cases where cure models are necessary and helpful, the next two chapters present novel theoretical arguments which are tested using the PHCM. The two substantive chapters are unified around the themes of contentious issues in international politics and the influence of domestic politics on international relations. The literature on contentious issues has endeavored to

explain how the issues that states compete over influence their behavior toward each other. An extensive body of work has developed to explain when and why states engage in both militarized and peaceful conflict management attempts over contentious issue claims, as well as how these claims are resolved (e.g., Brochmann and Hensel, 2009; Hensel, 1996; Hensel, 2001a; Hensel and Mitchell, 2005; Hensel, Mitchell, and Sowers, 2006; Hensel et al., 2008; Holsti, 1991; Huth, 1996; Mansbach and Vasquez, 1981; Mitchell and Hensel, 2007; Mitchell and Thyne, 2010; Mitchell and Thies, 2011; Mitchell, 2020; Owsiak, 2012; Owsiak, Diehl, and Goertz, 2019; Rosenau, 1971; Vasquez, 2009; Zawahri and Mitchell, 2011). I seek to contribute to this literature by examining how territorial claims begin in Chapter 3, and how maritime, river, and territorial claims are resolved in Chapter 4. In each chapter, I examine how domestic politics interacts with international relations to affect the emergence, management, and resolution of these claims.

Chapter 3 examines the onset of territorial claims between states. Among all the issues that states compete over, territorial claims tend to be the most dangerousS. Compared to other issues, they are the most likely to lead to militarized interstate disputes (MIDs), escalate to war, or produce interstate rivalries (e.g., Colaresi, Rasler, and Thompson, 2007; Hensel et al., 2008; Huth, 1996; Rasler and Thompson, 2006; Tir and Diehl, 2002; Vasquez, 2009). Existing research has demonstrated that resolving these claims greatly reduces the probability of future conflict between disputants (Carter and Goemans, 2011; Kocs, 1995; Owsiak, 2012; Schultz, 2014; Vasquez, 2009) and facilitates rivalry termination (Owsiak, 2013; Owsiak, Cuttner, and Buck, 2016; Goertz, Diehl, and Balas, 2016). imilarly, peaceful transfers of territory are associated with a decreased probability of violent conflict in the future (Tir, 2006; Gibler and Tir, 2010; Kohama, 2018). Although scholars have studied the management and militarization of territorial claims extensively, relatively few studies have examined the political causes of territorial claims (exceptions include Abramson and Carter, 2016; Burghardt, 1973; Englebert, Tarango, and Carter, 2002; Goemans and Schultz, 2016; Huth, 2009; Murphy, 1990; Schultz, 2017; Zartman, 1969). Understanding why territorial claims emerge has the potential to shed light on why such contentious relationships form to begin with and how the emergence of new claims might be prevented.

To the extent that claim onset has been studied, previous research focuses on the structural determinants of claim onset: slow-moving or time-invariant factors that create the potential for claims to emerge between states. While these factors are undoubtedly important, they do little to tell us about the timing of claim onset or the proximate causes that precipitate claims among susceptible states. I argue that one cause of claim onset is changes in those who control the levers of power within a country. All leaders are beholden to a set of domestic constituents who have the power to sustain or remove them from office, a group known as the winning coalition (de Mesquita et al., 2003). As such, the underlying preferences of the winning coalition have a substantial influence on the policy decisions that leaders make. Chapter 3 argues that it is changes in the winning coalition and the concomitant change in preferences that guide the state that often leads to major shifts in foreign policy, such as issuing a territorial claim.

The second substantive chapter (Chapter 4) examines the relationship between economic interdependence and the peaceful management of issue claims involving territory, rivers, or maritime zones. Though a vast body of literature examines the relationship between economic interdependence and conflict (e.g., Choi, 2011; Doyle, 1997; Li and Sacko, 2002; Gartzke, Li, and Boehmer, 2001; Gartzke, 2007; Hegre, Oneal, and Russett, 2010; Keshk, Pollins, and Reuveny, 2004; Kim and Rousseau, 2005; Mansfield, 1994; Morrow, 1999; Polachek, 1980; Pollins, 1989a; Reuveny and Kang, 1996; Rosecrance, 1986; Russett and Oneal, 2001; Oneal and Russet, 2002), little research has been done on whether interdependence increases the occurrence or the success of peaceful conflict management attempts such as negotiation, mediation, adjudication, and arbitration (one exception is Lee and Mitchell, 2012).

Chapter 4 argues that, beyond simply deterring the use of military force, economic linkages provide states with incentives to settle their ongoing claims. Previous research shows that the existence of territorial claims alone is enough to dampen international trade and investment (Lee and Mitchell, 2012; Schultz, 2015; Simmons, 2005; Simmons, 2006). Likewise, river and maritime claims are likely to result in decreased trade by creating issues with navigation. Due to the opportunity costs associated with a claim, pro-trade interest groups have an incentive to pressure leaders to resolve the underlying claims as a means of promoting better relations with their opponents. I demonstrate that states that are economically inter-

dependent tend to resolve their issue claims via nonviolent means faster than those that are not. Chapter 5 concludes with a discussion of the limitations of cure models and the situations in which they are most likely to be beneficial. I also discuss future directions for extending the research conducted in each of the substantive chapters.

Chapter 2

Using The Proportional Hazards Cure Model to Improve the Study of International Relations [1]

[1] George Williford. To be submitted to *Political Analysis*.

Abstract: Survival analysis has become an essential tool used by political scientists to study the timing and onset of diverse phenomena. However, scholars often use these models without regard for one of the fundamental assumptions they make, namely, that all observed subjects eventually experience the event of interest. Political scientists are often interested in events that could only feasibly occur among a subset of the subjects in their samples. Subjects that are not at risk of experiencing the event are often described as "cured" or "immune" to the event. Using standard models to analyze such data clearly violates the assumption above and may result in biased and inefficient coefficient estimates and lead scholars to make incorrect inferences. Cure models account for the presence of cured observations by modeling the probability of being at risk of experiencing an event of interest and reweighting the estimates of the hazard rate accordingly. This article makes three primary contributions. First, it introduces political scientists to the proportional hazards cure model (PHCM). Compared to the parametric cure models that have been used in political science thus far, the PHCM provides a flexible alternative that does not depend on restrictive distributional assumptions. Second, I present new software that I developed to estimate these models in R using time-varying covariates. Third, I demonstrate the potential advantages of using cure models by replicating an analysis of civil conflict recurrence.

2.1 Introduction

Survival analysis has become one of the fundamental components of the political scientist's methodological toolkit.[2] Scholars of international relations have applied these techniques widely to examine the duration and timing of diverse phenomena, such as regime change (Gates et al., 2016), cease-fire duration (Fortna, 2004), and war termination (Weisiger, 2013). Unfortunately, many scholars ignore one of the fundamental assumptions that standard survival models make: that all subjects will eventually experience the event of interest. Though this assumption is sometimes justified (e.g., all wars eventually end), it is often indefensible. A prime example is civil conflict recurrence; although some states may find themselves involved in civil wars again in the future, most will not (see, e.g., Walter, 2004).

The fact that some individuals are not at risk constitutes a form of unobserved heterogeneity and therefore has the potential to produce biased and inconsistent coefficient estimates. As a consequence, scholars cannot be confident that their results accurately approximate the substantive effects of their variables and cannot be certain that the results of significance tests are valid. To deal with these issues, scholars have developed models known as *cure models*. Developed primarily in the fields of biostatistics and medicine, cure models account for the fact that some subjects may be "cured" of a particular disease and are therefore "immune" to failure. Cure models typically account for this by assuming that subjects are drawn from two different populations: a group of subjects that are susceptible to experiencing the event of interest and another group of those who are not.[3]

The primary goal of this article is to introduce readers to cure models, and in particular, the semi-parametric proportional hazards cure model (PHCM). To date, cure models have rarely been used in the study of international relations and political science more generally (exceptions include Box-Steffensmeier, Radcliffe, and Bartels (2005), Clark and Nordstrom (2003), Findley and Teo (2006), Hettinger and Zorn

[2] Survival analysis is also referred to by many different names including event-history analysis, duration analysis, and failure-time.

[3] I use the terms cured, immune, and unsusceptible synonymously throughout the manuscript to refer to subjects that are not at risk of experiencing an event. Likewise, I use uncured and susceptible interchangeably to refer to subjects that are at risk.

(2005), and Svolik (2008)). Each of these studies uses parametric cure models, which require making restrictive assumptions about the distribution of survival times. Incorrectly imposing a particular parametric form on the data represents a form of specification bias that potentially influences the results obtained (Box-Steffensmeier and Jones, 2004). Thus, in the absence of strong theoretical expectations about the shape of the baseline hazard, the PHCM provides a flexible alternative that is free of such assumptions.

The use of cure models also has theoretical advantages by allowing analysts to test whether a variable affects the probability that a subject is cured or affects the hazard rate conditional on the fact that a subject is susceptible. Which process a variable influences alters the interpretation of that variable and may therefore provide more nuanced understandings of how they affect the dependent variable. For example, when studying the duration of peace after conflict, it is of interest to know whether a variable decreases susceptibility to conflict onset or merely increases the time until conflict recurrence. Standard duration models can only tell us that a variable extends the duration of peace, but cannot distinguish between these mechanisms.

I also present a new R package I developed to estimate the PHCM in R using time-varying covariates. Existing software packages are incapable of incorporating data using time-varying covariates and therefore only allow scholars to analyze purely cross-sectional data. This represents a substantial limitation on the types of phenomena and data that can be used. As such, releasing this open-source software package will greatly expand the ability of analysts to apply these models in a variety of fields. To compare the performance of the standard Cox model and PHCM, I replicate an analysis of civil conflict recurrence by Loyle and Appel (2017). The results demonstrate that the two models produce different inferences and lead to large differences in the size of the substantive results.

The rest of this chapter proceeds as follows. Section 2.2 discusses the problems associated with the presence of cured observations. It demonstrates that cured observations have the potential to produce biased and inconsistent estimates of the regression parameters and discusses how analysts can determine whether a sample contains cured observations. Section 2.3 introduces the PHCM, discusses the relative advantages and disadvantages of using parametric and semiparametric cure models, and discusses how to

test the proportional hazards assumption. Section 2.4 describes the software I developed to implement the PHCM in R. Section 2.5 discusses the advantages that cure models have over standard survival models when it comes to theory-testing and outlines how cure models can be used to improve tests of theories of international relations. Section 2.6 presents the replication analysis of civil conflict recurrence. Section 2.7 concludes.

2.2 The Problem of Cured Observations

The fundamental problem raised by the presence of cured individuals is the fact that they have the potential to introduce bias, which may in turn lead to incorrect substantive effects and inferences. To illustrate why, let T be a positive, random variable representing the time at which subjects experience the event of interest, referred to as the *survival time* or *failure time*. The survival function, $S(t)$, describes the probability that a subject survives at least until time t, given by $S(t) = \Pr(T \geq t)$. Subjects that are not observed to fail by the end of the observation period are considered *right-censored*. Whether a subject's failure is observed is recorded by a dummy variable, δ, equal to one if a subject fails and zero if not.

Standard survival models make the implicit assumption that all subjects eventually fail, i.e., that $S(t)$ approaches zero as t goes to infinity. Although some observations may be right-censored, this fact is typically attributed to the fact that some subjects simply have failure times that exceed the time span covered by the available data. However, the prospect of cured individuals provides an alternative reason why subjects may be right-censored. It is useful to conceive of a population of subjects containing cured individuals as being drawn from two different subpopulations: one that is susceptible to failure and another that is not.

Systematic differences in the two subpopulations constitute unobserved heterogeneity and therefore manifest as endogeneity. This leads the model to produce estimates of the survival function and covariate effects that are biased and inconsistent. Cured observations are analogous to the "excess zeroes" that may arise when working with count data and ordinal dependent variables, among others (e.g., Bagozzi et al., 2015; Lambert, 1992). Many scholars of international relations are familiar with the problems of

including observations that are not at risk in other contexts, such as when data contain excess zeroes or when dealing with rare events. For example, count data may contain subjects that cannot experience an event for some reason ("structural" or "excess" zeroes) and those that simply did not experience an event ("random zeroes"). If the excess and random zeroes differ systematically, the use of standard event count models will produce bias. Likewise, in the context of rare events, scholars often attempt to eliminate subjects that are not at risk by removing certain observations from the sample. For example, scholars often attempt to limit the sample to the subjects that are most at risk of experiencing an event by only including politically relevant dyads. Another approach taken by Xiang (2010) is to model this unobserved heterogeneity using split population binary response models (see below).

In practice, including cured subjects increases the number of subjects with long survival times. As a result, conventional models will overestimate the probability of survival among the susceptible population and, conversely, underestimate the hazard rate. Likewise, the model will overpredict the survival time of individuals that are susceptible and underpredict the (infinite) survival time of those who are not (Beger et al., 2017). Since the unobserved differences across populations introduce heterogeneity in covariates' effects, these models will also produce biased and inconsistent estimates of the coefficients. Coefficients may be either too small or too large depending on the nature of the differences between the two populations.

Ideally, the easiest way to deal with cured subjects would be to simply remove them from the sample to obtain unbiased estimates of the hazard rate among the uncured subjects. The difficulty of doing this arises from the fact that they typically cannot be identified a priori. Although the status of the subjects whose failure is observed is known, those that are right-censored may belong to either class. The presence of a large number of right-censored observations is not necessarily an indicator that a cure model is necessary. Heavy censoring may merely be an indicator that a study was not run long enough to observe the failure of most of the subjects.

Determining whether the right-censored observations in a sample contain cured subjects is primarily a theoretical exercise. Sy and Taylor (2000) state that "there are a number of ways that one might address

whether a cure model is appropriate, the most important of which is having a biological rationale from the underlying science," (234). Translated to the realm of social science, analysts must consider whether the assumption that all subjects fail makes theoretical sense in terms of the phenomenon they are evaluating. In cases where the assumption that all units fail is plausible, the presence of a large number of right-censored observations is likely due to inadequate follow-up time. However, when there is strong reason to believe that some subjects will not fail, standard duration models will not accurately reflect the data-generating process that produced the observed data. The second condition is more likely to hold when examining conflict data, for example, since there are often conflict-free periods that span decades (see the replication analysis below).

Empirically, the extent to which long-term survivors are present in the data can be assessed using a nonparametric Kaplan-Meier survival curve. If the Kaplan-Meier estimates approach zero, it provides evidence that the right-censored subjects are likely to eventually fail. However, the presence of a long right tail that plateaus above zero is a likely indicator that there is a set of individuals in the population that survive long after most susceptible subjects have failed Sy and Taylor (2000).

2.3 The Proportional Hazards Cure Model

Cure models deal with the fact that the cure status of right-censored subjects is unknown by assuming that the cure process is probabilistic. Most cure models, take the form of *mixture models*, also known as *split-population models*.[4] Mixture models are a broad class of models used when a population is composed of multiple latent subpopulations that cannot be fully separated a priori. They assign each subject a probability of belonging to a particular class and then weight their contribution to the likelihood function accordingly. Many political scientists are already familiar with mixture models in the form of zero-inflated models, which assume that some subset of the observations cannot take on values above zero (Lambert, 1992; Bagozzi et al., 2015).

[4] An alternative class of models known as *nonmixture* cure models corrects for these problems by imposing an upper bound on the cumulative hazard rate. Although these models have been used widely in biostatistics, they have seen limited applications in social scientific fields and are not considered further here.

Specifying a mixture cure model entails modeling the population survival function as a function of both the probability of failure and the survival function for those observations that do fail. Let p represent the probability of belonging to the susceptible class and $1 - p$ represent the probability of being cured. Conditional on being in the uncured class, the probability of surviving until at least time t is given by $S_u(t)$, referred to as the *conditional survival function*. For individuals in the cured class, the survival function can be assumed to equal one at all t. The probability that an uncured individual is alive at time t is thus $1 \times (1 - p)$, which reduces to $1 - p$. The overall probability of being alive at time t for an individual randomly drawn from the population is thus given by

$$S_{pop}(t) = pS_u(t) + (1 - p), \tag{2.1}$$

where S_{pop} is referred to as the *population survival function* or *marginal survival function*.

Covariates can be incorporated into Equation 2.1 by constructing models for p and $S_u(t)$. The proportional hazards cure model (PHCM) is a variant of mixture cure model that uses the standard Cox model survival function to model $S_u(t)$. If $\mathbf{x}$ is a vector of covariates and $\boldsymbol{\beta}$ is a vector of associated regression coefficients, the formula for the conditional survival function is given by

$$S_u(t) = S_{u0}(t)^{\exp(\mathbf{x}\boldsymbol{\beta}')}, \tag{2.2}$$

where $S_{u0}(t)$ is the *baseline conditional survival function* that describes how susceptible subjects' probability of failure changes over time, independent of covariates. Substituting Equation 2.2 into Equation 2.1 yields the semiparametric mixture cure model:

$$S_{pop}(t) = p[S_{u0}(t)^{\exp(x\boldsymbol{\beta})}] + (1 - p). \tag{2.3}$$

The coefficients in Equation 2.3 are interpreted in the same way as the standard Cox model. Positive coefficients indicate that a variable is positively correlated with the hazard rate, and therefore associated

with decreased survival times. As with the standard Cox model, the PHCM requires assuming that the effect of covariates is proportional over time (discussed further below).

Whether a subject is susceptible to an event be modeled as a function of covariates using a binary-response model to construct a model of p. Let Y be a dependent variable coded one if a subject eventually fails and zero otherwise. Further, let $\mathbf{z}$ be a vector of covariates and their associated coefficients be represented by $\boldsymbol{\gamma}$. The probability that a subject is at risk for failure is typically modeled using a logistic regression model, given by

$$p = \Pr(Y = 1) = \frac{\exp(\mathbf{z}\boldsymbol{\gamma}')}{1 + \exp(\mathbf{z}\boldsymbol{\gamma}')}. \tag{2.4}$$

The use of other binary response models such as a probit model is also possible. Analysts can also allow covariates to have a non-linear additive effect on the probability of failure by using generalized additive models in place of a binomial generalized linear model for $\boldsymbol{\gamma}$ (Peng, 2003; Ramires et al., 2018).

Determining which covariates to include in each equation is a theoretical exercise that depends on the causal mechanism connecting a covariate to the observed survival times. Variables that are thought to increase or decrease an individual's susceptibility should be included in the cure equation, while those thought to shorten or extend the time until a susceptible subject experiences an event should be included in the cure equation.

It is important to note that there is no restriction on including variables in both the cure and hazard equations. This allows for the possibility that a variable may influence both subjects' susceptibility at large and the timing of failure among the class of susceptible individuals. Incorporating a variable in both equations makes it possible to test whether an independent variable influences p, S_u, or both. For example, it is possible to test whether a treatment increases the probability that an individual survives long-term or merely extends the time until susceptible patients die. Likewise, peacekeeping operations may be thought to eliminate the possibility of a civil war while also decreasing the hazard rate among susceptible observations.

The PHCM can easily accommodate time-varying covariates using the "counting process" or "start-stop" data structure to include one observation for each subject in the riskset at each of the observed failure times (see, e.g., Box-Steffensmeier and Jones, 2004, Chapter 7). It is important to note, however, that incorporating time-varying covariates changes the interpretation of the cure portion of the model. Rather than merely identifying which individuals are and are not susceptible, the inclusion of time-varying covariates introduces the possibility that subjects may be susceptible at some times and not at others. Although this can make substantive sense, it complicates the interpretation of the variables in the cure equation. It may thus be easier to include only time-invariant or slowly-changing covariates in the cure equation (Beger et al., 2017; Dirick et al., 2017).[5]

Estimating the parameters for the PHCM can be estimated using maximum likelihood methods. The complete data log-likelihood for Equation 2.3 is given by

$$\mathcal{L}_C(\Theta) = \prod_{i=1}^{n} p_i^{y_i}(1-p_i)^{1-y_i} \prod_{i=1}^{n} \{h_u(t_i)^{\delta_i y_i}(S_u(t_i))^{y_i}\}. \tag{2.5}$$

The first product term in Equation 2.5 contains the parameters related to the cure component of the model, where p_i is the probability that a subject is susceptible to the event and y_i is a binary indicator of whether a subject eventually fails. For subjects that eventually fail, this term reduces to p_i, while for those that do not, it reduces to (1-p_i).

The second product term in Equation 2.5 contains the parameters related to the hazard component, where $h_u(t_i)$ represents the baseline hazard rate for subjects that are not cured and δ_i is a censoring indicator coded one if a subject is observed to fail and zero if not. For subjects that are not cured (i.e., $y_i = 1$), this term reduces to

$$h_u(t_i)^{\delta_i} S_u(t_i). \tag{2.6}$$

[5]This does not imply that time-invariant covariates must be included in the cure equation or that they should not be included in the hazard equation.

Subjects that are observed to fail (i.e., $\delta_i = 1$) contribute information to both the hazard term and survival term in Equation 2.6. However, for subjects that are not observed to fail (i.e., $\delta_i = 0$), the hazard term reduces to one. This is because subjects that are not observed to fail do not contribute information about the hazard function or failure times. For subjects that are cured (i.e., $y_i = 0$), the product term reduces to a value of one as each term is raised to the zeroth power. This is because cured subjects do not contribute information about the failure time and survival time of uncured subjects.

Maximizing the likelihood function in Equation 2.5 is difficult because y_i is not known for all subjects. Although y_i = 1 for subjects that are observed to fail, it is unknown whether censored subjects are cured or not. Put otherwise, for subjects that are not observed to fail, y_i could equal zero or one. To deal with this, Peng and Dear (2000) and Sy and Taylor (2000) derived an expectation maximization algorithm to obtain the maximum likelihood estimates by iteratively estimating the model parameters (β and γ) and using these to estimate the value of y_i. The algorithm and estimation procedure is described in full in Appendix A.1.

Compared to parametric cure models, the PHCM has two advantages. First the validity of the results obtained from parametric models depends upon choosing an appropriate distribution for the failure times. Using a distribution that does not accurately describe the baseline survival function constitutes specification bias and thereby produces biased and inconsistent estimates of the model's parameters. In many cases it is difficult to verify that a particular parametric distribution is appropriate. As such, without strong theory or evidence to support the use of a particular distribution, semiparametric approaches that leave the baseline hazard unspecified are a safer alternative.

Second, simulation studies demonstrate that the PHCM produces more efficient estimates of $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ than parametric cure models under certain conditions (Kuk and Chen, 1992; Sy and Taylor, 2000). When censoring is mild and a parametric model accurately describes the baseline survival function, the parametric cure model tends to be more efficient. This is comparable to standard survival models, where parametric models are more efficient when they correctly specify the baseline hazard (see Box-Steffensmeier and Jones, 2004). However, when there are high levels of censoring, the PHCM tends to be more efficient,

even when the parametric model accurately describes the baseline survival function. This is due to the fact that the procedure used to estimate semiparametric cure models constrains S_{u0} to be zero following the final failure time (see Appendix A.1 for more details). As a result, the PHCM has an advantage when dealing with rare events data.

On the other hand, the PHCM depends on the proportional hazards assumption. Violations of the proportional hazards assumption create the potential for biased coefficient estimates and standard errors (Box-Steffensmeier and Zorn, 2001). The proportional hazards assumption also has implications for the interpretation of coefficients and the substantive conclusions drawn from a model. The effect of many social scientific variables may be expected to change over time. As Box-Steffensmeier and Zorn (2001) note, "the influence of an independent variable may be greater or smaller, or even change signs, depending on the amount of time that has elapsed for that observation," (974).

As such, it is necessary to test whether each covariate violates the proportional hazards assumption. One common method of detecting violations of the proportional hazards assumption in standard survival models is by assessing the Schoenfeld residuals (Grambsch and Therneau, 1994; Schoenfeld, 1982). Schoenfeld residuals are covariate specific and indicate departures for the expected value of a covariate x_k at failure time t_i. Violations of the proportional hazards assumption can be detected by assessing whether the Schoenfeld residuals for a given covariate are correlated with time. Any significant correlation indicates that a covariate's effect changes over time and therefore violates the proportional hazards assumption.

It is also possible to assess departures from the proportional hazards assumption graphically by plotting the Schoenfeld residuals against time. Any visual pattern in the residuals with respect to time indicates a violation of the proportional hazards assumption. These techniques can be implemented with semiparametric cure models by using the modified Schoenfeld residuals developed for use with cure models by Peng and Taylor (2017) and Wileyto et al. (2013). Covariates that do not meet this assumption may be dealt with in the usual ways, i.e., by stratifying on the offending covariate or by incorporating interactions with the log of time (Peng, 2003).

The PHCM has been extended to accommodate a number of other issues that are common with survival data. Stratification can be used to allow the conditional baseline hazard to vary by groups of observations (Peng, 2003). Non-linear effects may also be incorporated using the univariate transformations of the covariates (see Therneau and Grambsch, 2000b). Variants of the semiparametric proportional hazards mixture model have been developed that can accommodate interval-censored data (Liu and Shen, 2009; Hu and Xiang, 2013; Lam, Wong, and Zhou, 2013), frailty terms (Price and Manatunga, 2001; Peng and Zhang, 2008a; Peng and Zhang, 2008b), and covariate and time-dependent censoring (Lu and Ying, 2004; Othus, Li, and Tiwari, 2009).

2.4 Software

At present, several options exist for estimating the PHCM in R, including the **intercure, mixcure, rcure**, and **smcure** packages (Brettas, 2016; Cai et al., 2012; Han, Zhang, and Shao, 2017; Peng and Taylor, 2017). Although each of these packages has their advantages, none of the them are able to fit models on data with time-varying covariates. This is an important limitation, as it limits researchers to analyzing purely cross-sectional datasets.

To fill this gap, I developed the **tvcure** R package. The package allows for estimating the PHCM using time-varying covariates using the standard syntax of the **survival** package (Therneau and Grambsch, 2000a). Estimation is performed using the expectation maximization algorithm described in Appendix A.1. The package currently supports the use of logit or probit models for the cure equation. Because the results of the cure equation are prone to experience quasi-complete separation, I also include the functionality to allow the generalized linear model to be estimated using biased-reduced generalized linear models (such as Firth's (1993) bias-reduced logistic regression) using the **brglm** package (Kosmidis, 2020). Standard errors for the coefficients are estimated using a nonparametric bootstrap with stratified random sampling. The package supports the use of parallel processing through the **foreach**, **snow**, and **doSNOW** (**microsoftcorporation2019**; Microsoft and Weston, 2020; Tierney et al., 2018) packages.

In addition, the **tvcure** package includes several functions designed to facilitate the interpretation and presentation of results. The package includes a prediction function for computing and plotting various quantities of interest for different covariate profiles, including the probability of being susceptible, probability of cure, conditional survivor function, conditional baseline survivor function, and the population survival function. At present, these functions are not capable of estimating confidence intervals for these quantities. However, the functionality to do so using simulation-based methods, as employed by Beger et al. (2017), is currently in development. In addition, a function designed to help produce publication ready tables in conjunction with the **xtable** package is included (Dahl et al., 2019). These functions were used to create all results tables and plots presented in the replication analysis.

2.5 Applying Cure Models to International Relations

The problem of cured observations is common in international relations. Many of the phenomena studied only affect a portion of the observations studied over the long term, especially when dealing with rare events such as war onset, assassinations, and coups. While the use of survival analysis can and should be used to model these phenomena when appropriate, using these models without regard for their underlying assumptions undercuts the validity of the results obtained.

Some analysts attempt to address this by removing subjects from the sample using heuristic shortcuts. The most common example of this in international relations is the use of politically relevant dyads, which are typically defined as pairs of states that are contiguous or contain at least one major power. Scholars often assume that phenomena of interest, such as military disputes, are highly unlikely to occur within non-relevant dyads and use this as a justification to remove those dyads from the sample. Unfortunately, the use of politically relevant dyads as a criteria does not cleanly divide dyads that are susceptible from those that are not. As Lemke and Reed (2001) point out, many non-relevant dyads experience militarized disputes, while many politically relevant dyads are extremely unlikely to go to war.

For this reason, it is better to model the probability that states are susceptible to war and use this model to correct the estimates of the hazard equation accordingly. Xiang (2010) shows that this approach

is superior in the context of binary response models. He demonstrates that the results of an analysis of all dyads using a split population probit model outperforms the use of a simple probit using politically relevant dyads when analyzing militarized interstate dispute onset. For similar reasons, the use of a cure model should outperform the use of politically relevant dyads in the context of duration models. The cure model has the additional advantage over Xiang's (2010) approach insofar as it also accounts for time.

The other major advantage of cure models is their ability to help test theoretical arguments that distinguish between factors that affect susceptibility and event onset. The underlying data-generating process assumed by cure models maps well onto certain theoretical constructs that are frequently used in international relations. For example, theories that distinguish between the underlying and proximate causes of a phenomena reflect the logic underlying cure models. For example, Vasquez (2009) distinguishes between the underlying and proximate causes of war, and Belkin and Schofer (2003) theorize about the structural and proximate causes of coups (see also Beger et al., 2017). These theories typically assume that some subjects are structurally predisposed to experiencing an event, but do not actually experience the event until a proximate cause triggers the event. According to this logic, both underlying and proximate causes must be present in order for the event to occur. Cure models capture the data-generating process underlying the logic of structural and proximate causes well. Whereas structural causes influence whether an individual is at risk or cured, proximate causes affect the timing and onset of an event.

Others have argued that forecasting models of intrastate conflict need to incorporate both structural and proximate causes. This is due to the fact that causes of instability (e.g., mass protests) may have little chance of precipitating civil conflict in states that are structurally unlikely to experience conflict but may have a very large effect in those that are predisposed. However, existing attempts to forecast conflict events using a combination of structural and proximate causes have still been found wanting (Tikuisis, Carment, and Samy, 2013). The use of cure models to account for structural causes of instability using the cure equation and the proximate causes of instability using the hazard equation may represent one avenue by which scholars could attempt to improve the forecasting of such events.

Cure models may also be useful in testing theories that distinguish between short-term and long-term effects. One example involves factors that decrease the probability of civil war recurrence (see e.g., Braithwaite and Sudduth, 2016; Collier, Hoeffler, and Soderbom, 2008; Hartzell and Hoddie, 2003; Joshi and Mason, 2011; Loyle and Appel, 2017; Mason et al., 2011; Mason and Greig, 2017; Quinn, Mason, and Gurses, 2007; Rustad and Binningsbø, 2012; Walter, 2004; Walter, 2015). Although roughly 30-50 percent of countries experience renewed fighting after civil conflicts (depending on the data used), most do not. Theoretically, while some variables may influence the probability of permanent peace within a country, others may have temporary effects and simply extend the time until a war recurs. In most cases, however, what is really of interest is whether a variable affects the probability that a conflict occurs altogether. Standard survival models merely demonstrate that a variable influences the time until war recurs, which may be due to either a short or long-term effect. By contrast, cure models can be used to assess whether a variable influences the time until war recurrence as well as whether a country is "cured" of war.

2.6 Replication Analysis of Civil Conflict Recurrence

To illustrate how standard Cox models and the PHCM can produce different results, I replicate an analysis of the duration of peace after civil conflict by Loyle and Appel (2017). As discussed above, civil conflict recurrence is a prime example of a phenomenon which not all subjects will experience. Loyle and Appel (2017) examine the recurrence of civil conflict during the period 1950-2006 using data from the UCDP/PRIO Armed Conflict Dataset (Gleditsch et al., 2002) and the UCDP Conflict Termination Dataset (Kreutz, 2010). The conflict termination data divides the internal conflicts contained in the UCDP data into episodes based on the extent of the fighting in each year. Episodes of civil conflict must entail fighting between a country's government and at least one armed opposition group and must produce at least 25 battle-related deaths a year. Conflict episodes begin in the year that fatalities first exceed 25 deaths and end when fatalities drop below this threshold.

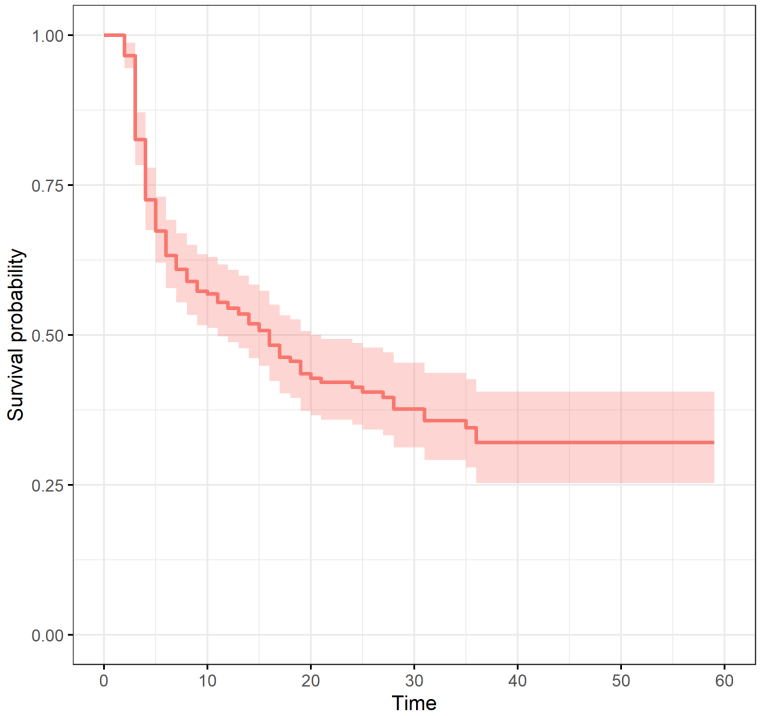

Figure 2.1: Kaplan-Meier Survival Estimate for Civil Conflict Recurrence

The dependent variable is the time between the end of a conflict episode and the beginning of a new episode of the same conflict. The unit-of-analysis is the post-conflict-episode country-year (since countries may be involved in multiple civil conflicts at one time, there may be multiple observations for each country-year). Subjects enter the dataset following the end of a civil conflict episode and remain until the same conflict produces another episode of fighting (i.e., failure) or are right-censored in 2006. The dataset used contains data on a total of 297 conflict episodes, of which 154 recur.

Figure 2.1 plots the nonparametric Kaplan-Meier survival estimate for time to conflict recurrence. After 57 years, an estimated 30 percent of cases have yet to produce another conflict, indicating that many cases are unlikely to experience conflict recurrence. This provides additional evidence that the use of a cure model is necessary to accurately model the data-generating process.

2.6.1 Independent Variables

The theoretical question Loyle and Appel (2017) address concerns the effect of post-conflict justice (PCJ) processes on conflict recurrence. They argue that PCJs reduce the probability of conflict recurrence by either decreasing the motivations for rebellion or decreasing the opportunity to successfully rebel. Motivation-focused PCJ processes include measures such as reparations, amnesty, truth and reconciliation commissions, and judicial proceedings that include government agents accused of wrongdoing. These measures are intended to address the grievances that former rebels or other individuals may harbor against the government due to its conduct during the conflict. By contrast, opportunity-reducing mechanisms are aimed primarily at deterring potential rebels from taking up arms or otherwise undercutting the ability of these groups to effectively fight against the government. These include processes such as trials directed solely at the opposition, exiling members of the opposition group, and purging politicians or other members of society that threaten the incumbent government.

Using data from the Postconflict Justice dataset (Binningsbø et al., 2012), Loyle and Appel (2017) construct indices for the number of motivation and opportunity-reducing PCJ processes implemented in the five years following each conflict episode. The motivation index includes one point each if the government implements reparation programs designed to address losses caused by the conflict, amnesty provisions, and trials that include government agents. The opportunity index includes one point each for the use of exiles, purges, or trials directed solely at the opposition. Loyle and Appel (2017) find that motivation-decreasing processes reduce the probability of conflict recurrence while opportunity-decreasing processes do not. I examine the robustness of these findings by estimating a Cox and cure model and comparing the results. Before doing so, it is necessary to specify which variables will be included in each equation of the cure model.

Based on Loyle and Appel's findings, a potential follow-up question may be whether these policies have short or long-term effects. For example, it is possible that motivation-decreasing PCJ processes may temporarily resolve grievances of individuals against the government due to its actions during the conflict without resolving the underlying issue that motivated the conflict. In this scenario, these policies would be

associated with an increased duration of peace but would not reduce the probability of eventual conflict recurrence. In order to address this question, I include the motivation and opportunity PCJ indices in both equations. This allows me to examine whether these policies had short or long-term effects on the probability of conflict recurrence.

Loyle and Appel (2017) also include a litany of control variables related to the recurrence of civil conflict. The control variables are assigned to each equation as follows: First, like PCJ processes, the implementation of power-sharing provisions and peacekeeping operations are policy interventions that may have short or long-term effects. As such, I include them in both equations. Power-sharing is measured using a dummy variable for whether a power-sharing agreement was implemented in the post-conflict state (Hartzell and Hoddie, 2003; Harbom, Hogbladh, and Wallensteen, 2006; Loyle and Appel, 2017; Mattes and Savun, 2010). Peacekeeping is measured using a dummy variable for whether peacekeepers were present in the country in a given year.

I include two additional variables in the hazard equation that speak to changing conditions that may create windows of volatility during which civil conflict may be especially likely. First, Loyle and Appel (2017) use the number of military personnel controlled by the government to control for variations in rebels' opportunity to challenge the government over time. Data comes from the Correlates of War National Military Capabilities dataset (Singer, Bremer, and Stuckey, 1972; Singer, 1987). To control for grievances related to changing economic conditions, Loyle and Appel (2017) include a measure for growth in real gross domestic product (GDP) per capita using data from Gleditsch (2002).

I include the following three variables in the cure equation to account for fixed, structural characteristics that create the potential for grievances to intensify or reemerge in the post-conflict environment: the log of GDP per capita (Gleditsch, 2002), whether the conflict occurred over an ethnic issue (Gleditsch et al., 2002), and whether a country is a democracy. Democracy is measured using a dummy variable for whether a post-conflict state has a Polity score above five (Marshall and Jaggers, 2002; Marshall and Jaggers, 2013).

I include five variables related to the previous conflict and its termination in the cure equation: the log of conflict duration (Binningsbø et al., 2012), the log of battle deaths per capita, a dummy variable for whether the conflict ended in victory (Kreutz, 2010), the number of rebel groups active during the conflict Gleditsch et al. (2002), and whether the conflict ended in a peace agreement (Kreutz, 2010). The first three variables speak to the information that a conflict conveyed about the strength of the government and the relative capabilities of the disputants. These qualities are fixed with respect to time and act as a constraint on the opportunity for rebel groups to effectively challenge the government. The number of rebel groups speaks to the number of organized groups that could potentially attempt to challenge the status quo in the post-conflict environment. Conflicts that ended with a peace agreement are more likely to last by resolving disputed issues and/or creating mechanisms that prevent the combatants from engaging in renewed fighting. Finally, I include a dummy variable for whether the conflict occurred following the Cold War, which accounts for the fact that the opportunity for rebels to successfully wage military campaigns is higher in the post-Cold War environment.

2.6.2 Substantive Results

Table 2.1 presents the results of the analysis. Model 1 is a standard Cox proportional hazard model. Model 2 is a PHCM including select variables in each equation based on the logic outlined above.[6] I conducted proportional hazards tests for each model and found that none of the models required proportional hazards corrections.

The Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) for both models are presented at the bottom of Table 2.1. Conventionally, the model with the lower AIC and BIC scores is considered to fit the data better. In this case, the AIC and BIC scores for Model 1 are lower than Model 2. As such, on the basis of these indicators, Model 1 may fit the data better than Model 2.

Nonetheless, the question remains as to whether to trust the results of Model 1, given that Model 2 theoretically matches the data-generating process for the phenomenon of interest much better. The

[6] For the sake of comparison, I present the results of a cure model that includes all variables in both equations in Appendix A.3.

question is whether a better-fitting model that does not accurately describe the data-generating process is more useful than one that does. As noted above, it is highly questionable whether the use of Model 1 makes sense given the fact that one of the model's assumptions clearly does not hold. In this sense, there is reason to believe that the results of this model will be less reliable in terms of the inferences drawn by the model due to biased and insignificant coefficient estimates. Failure to account for the structural differences in susceptibility is tantamount to omitted variable bias, and therefore undermines the validity of the estimates.

Another question that arises is how well the predictions of each model generalize to out-of-sample data. The AIC and BIC used here speak to how well the models fit the data used to train the model. They do not speak to which model would perform the best when making predictions out of sample. As such, they cannot speak to whether the models are overfitting or underfitting the data. The ideal way to compare model performance would be to use cross-validation to determine which model is the best at predicting unseen observations. Unfortunately, measures of predictive performance have not yet been developed for the proportional hazards cure model. Theoretically, the model that best describes the underlying data-generating process should perform the best at making out of sample predictions because it would better model the general trends underlying the data. Put another way, it may be that the Cox model is overfitting the data while the cure model is better at capturing the general relationships in the data. Future research should focus on developing measures of the PHCM's predictive performance as a means of truly evaluating the generalizability of these models. The question of model fit is discussed further in the concluding chapter.

Regardless of model fit, it is still of interest to compare how the two models may lead to different conclusions about the statistical and substantive significance of each of the independent variables. The entries in Table 2.1 for Model 1 are hazard coefficients. Positive values indicate that a variable is positively associated with an increased hazard rate, and therefore, decreased survival times. The results for Model 2 are split across two columns. The first column contains the logistic regression coefficients for the model of whether a country is susceptible to civil war recurrence. Positive coefficients indicate that a variable is

positively correlated with a higher likelihood of repeat civil war. The second column of results for Models 2 contains the hazard coefficients that describe the effect of variables on the survival times of susceptible subjects. The interpretation of these coefficients is the same as in Model 1: positive coefficients indicate that a variable is associated with an increased hazard rate.

I begin by discussing the results with respect to Loyle and Appel's (2017) primary independent variables. The results of both models indicate that motivation-decreasing PCJ processes increase the duration of post-conflict peace while opposition-decreasing PCJ processes do not. The estimated coefficients for motivation-decreasing processes produced by each model are negative and significant, indicating that those processes are associated with a decreased hazard rate. However, the fact that motivation-decreasing processes do not have a significant effect on the probability that a subject is cured or not provides additional detail about the nature of the effects of motivation-decreasing processes. Specifically, these processes appear to forestall the recurrence of civil conflict but do not prevent its eventual recurrence.

In addition, the size of the substantive effects differs between the two models. The substantive effect of Model 1 is much larger than that indicated by Model 2. Figure 2.2 plots the population survival curves for both Model 1 and 2 when zero motivation-decreasing PCJ processes are implemented in a post-conflict country versus when three processes are implemented (all other variables are held constant at their medians). Comparing these two graphs demonstrates that the relative effect of motivation-decreasing PCJ processes is much larger for Model 1 than for Model 2. For Model 1, the maximum expected difference in the probability of survival for countries that implement zero and three PCJ processes is roughly 0.45. By contrast, the maximum difference between the two curves produced by Model 2 is roughly 2 percent. Moreover, the survival curves in Model 2 converge after 36 years, indicating that there is no longer any difference in the probability between the two subjects. This is to be expected, since only cured subjects remain in the sample at this point. The results of Model 1 thus imply that the substantive effect of PCJ processes are much larger than the results of Model 2 do. When evaluating the differences between the two models above, it is natural to ask which model to believe. Since there are strong theoretical reasons to

Table 2.1: Models of Civil Conflict Recurrence

	Model 1	Model 2	
	Hazard Coef.	Logit Coef.	Hazard Coef.
Motivation Post-conflict Justice	-0.586*	-0.309	-0.163*
	(0.2)	(0.22)	(0.044)
Opportunity Post-conflict Justice	-0.098	-0.139	0.02
	(0.173)	(0.173)	(0.05)
Power Sharing	-0.605	-0.426	-0.107
	(0.45)	(0.502)	(0.879)
Peacekeeping	-0.94*	-0.806	-0.129
	(0.39)	(0.47)	(0.076)
Military Personnel	-0.366*		-0.139*
	(0.125)		(0.041)
GDP Growth	-1.222		-0.47
	(0.93)		(0.442)
ln GDP per Capita	-0.141	-0.286*	
	(0.102)	(0.102)	
Ethnic War	0.093	0.033	
	(0.198)	(0.221)	
Democracy	-0.157	-0.07	
	(0.234)	(0.231)	
Conflict Duration	-0.064	-0.179	
	(0.117)	(0.121)	
Battle Deaths per Capita	-0.039	-0.007	
	(0.048)	(0.043)	
Victory	-0.826*	-0.773*	
	(0.233)	(0.189)	
Peace Agreement	0.336	0.293	
	(0.348)	(0.414)	
Number of Rebel Groups	0.968*	1.051*	
	(0.118)	(0.121)	
Post-Cold War	0.502*	0.506*	
	(0.194)	(0.187)	
Intercept		1.771	
		(2.216)	
Number of Observations	3773	3773	
Number of Failures	154	3773	
AIC	1478	2977	
BIC	1523	3101	

Note: Standard errors in parentheses. Standard errors for Model 2 were estimated using 500 bootstrap replications. * $p < 0.05$.

believe that the cure model describes the data-generating process for civil-conflict much better than the Cox model, we should expect, a priori, that the cure model's results are more reliable.

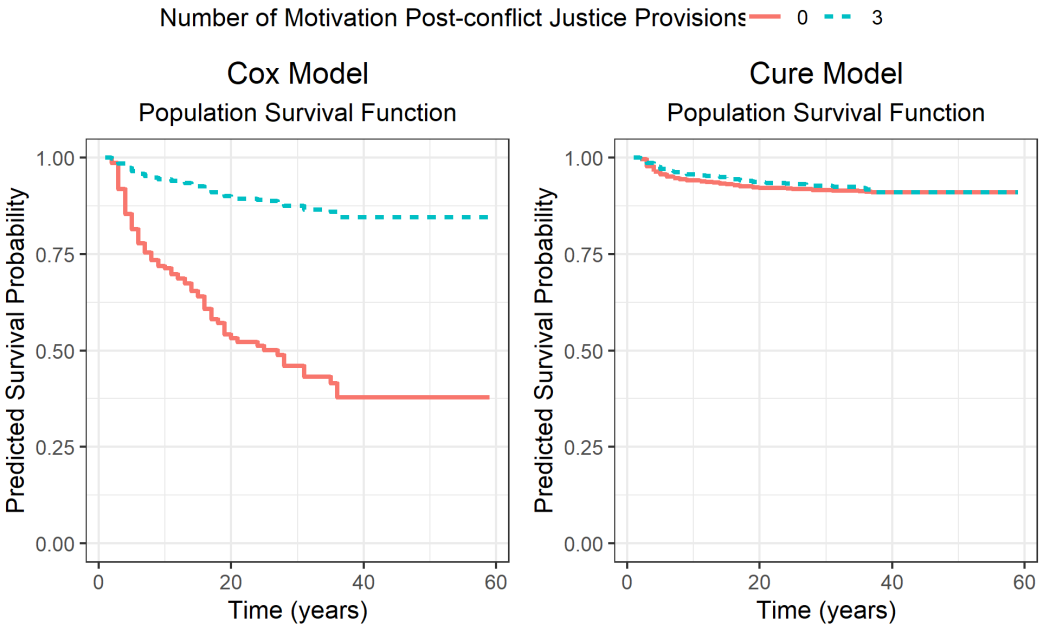

Figure 2.2: Effects of Motivation-Decreasing Post-Conflict Justice Processes on Conflict Recurrence

Another result worth highlighting is that peacekeeping is significant in Model 1 but is not significant in either equation for Model 2. The estimated coefficient of -0.94 indicates that peacekeepers are associated with a decrease in the hazard rate of conflict recurrence and an increase in the probability of survival. To assess the substantive effect of peacekeeping produced by Model 1, Figure 2.3 plots the survival probability when peacekeepers are present and when they are not. The effect-size is fairly large: After 36 years, the predicted survival probability when peacekeepers are present is 0.68, while it is only 0.38 when they are not. Each model thus implies very different results. Whereas Model 1 indicates that there is a large substantive effect, Model 2 indicates that we cannot be confident that peacekeepers have any effect, either on the short-term probability of survival or the overall probability that a case is susceptible to begin with.

The results with respect to military personnel display the same pattern as motivation-decreasing PCJ processes when comparing Models 1 and 2. Both coefficient estimates are negative and significant, indicating that subjects are more likely to experience conflict recurrence when their military personnel is low.

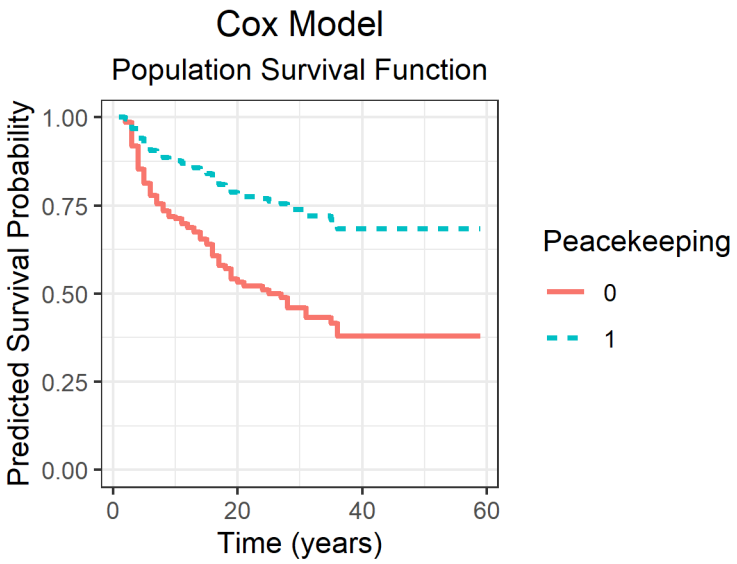

Figure 2.3: Effect of Peacekeeping on Timing of Conflict Recurrence

To compare the results, Figure 2.4 plots the survival curves for each model at the fifth and ninety-fifth percentiles for military personnel. As before, the survival function produced by the Cox model implies that military personnel has a large substantive effect: after 36 years, an average subject with a low number of military personnel is nearly 42 percentage points more likely to experience another conflict than one with a large number of personnel. However, the right-hand survival plot shows that the effect is predicted to be much smaller when a cure model is used. An average case with a low number of military personnel is never more than 2 percentage points more likely to experience conflict onset than one that does not.

Another difference can be seen between the results with respect to the variable for GDP per capita. Although the estimated coefficient for Model 1 is insignificant, the coefficient in the cure equation of Model 2 is negative and significant. This indicates that countries with high income levels are less likely to be at risk for additional conflicts. To assess the substantive effects, Figure 2.5 plots the predicted probability that a country is susceptible to another conflict across the range from the fifth to the ninety-fifth percentile of GDP. At the lowest value (roughly 537,000,000 dollars), the probability that a state is susceptible to additional conflicts is 0.13, while at the highest value (10,800,000,000 dollars), the probability of additional

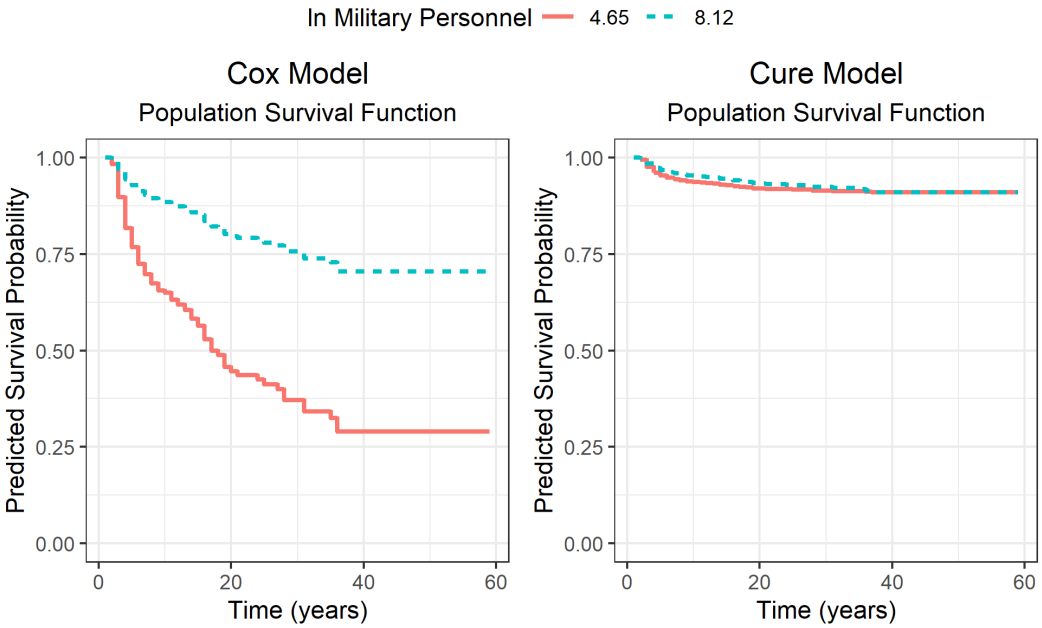

Figure 2.4: Effects of Military Personnel on Timing of Conflict Recurrence

conflicts is 0.06. There is thus a seven percentage point difference in the likelihood that an average country is susceptible to conflict in a given year between high-wealth (relative to the sample) and low-wealth countries. The fact that higher-income countries are less likely to experience civil war is a robust findings in the literature (Dixon, 2009). As such, the fact that GDP behaves as expected in Model 2 but not in Model 1 lends additional face validity to the notion that results of Model 2 should be preferred.

The remaining variables that are significant in Model 1 (victory, the number of rebel groups, and post-Cold War) are also significant in the cure equation of Model 2. The estimated coefficients for victory are negative and significant in both models. The substantive interpretation of each variable differs, however. The negative coefficient of -0.83 in Model 1 indicates that victory is associated with a lower hazard rate, while the negative coefficient of -0.77 indicates a lower probability of failure for Models 1 and 2, respectively. When a variable is significant in the Cox model and the cure equation of the PHCM, it is difficult to directly compare the relative size of the substantive effects across the two models. The coefficients of the two models are interpreted differently, as are survival probabilities and the probability of being cured. It

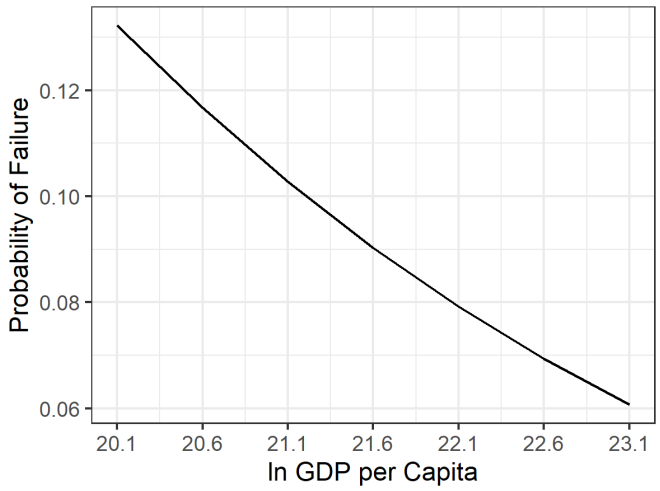

Figure 2.5: Effect of GDP per Capita on Susceptibility to Conflict Recurrence

may thus only be possible to make very general statements about effect size if, for example, the difference in survival probability is very large, while the difference in the predicted probability of the logit model is very small.

To assess the substantive effect of victory in Model 1 individually, Figure 2.6 plots the survival curve for cases which end in victory and those that do not. The difference between the predicted survival probability is relatively large. After 36 years, the probability of survival is roughly 0.38 when a conflict had a clear victor, but only about 0.24 for cases that did not. For Model 2, the predicted probability of failure is 0.09 for cases where a conflict ended in victory but a 0.18 probability of failure when it did not. Thus, the results of Model 2 indicate that there is a 0.09 change in the probability that a post-conflict country is susceptible to a civil war in a given year.

For rebel groups, the coefficient estimate has a significant value of 0.97, indicating that more rebel groups increase the probability of future rebellions. Figure 2.7 plots the survival curves for conflicts that involved one-four rebel groups. The difference in the probability of survival between conflicts involving one rebel group (the median) and two rebel groups is 30 percent after 30 years. Further, a conflict that involves four rebel groups only has a two percent chance of surviving five years, and conflicts involving

Figure 2.6: Effect of Victory on Timing of Conflict Recurrence

three or four rebel groups are virtually guaranteed to eventually fail. The results of Model 2 also show that rebel groups have a large effect. The predicted probability of failing in a given year when there is one rebel group is 0.09, while the predicted probability of failing when there are two is 0.21, a difference of 12 percentage points. When there are 4 rebel groups, the predicted probability of failing in a given year is 0.70.

The variable for post-Cold War is also positive and significant for both models. The positive hazard coefficient of 0.50 produced by Model 1 indicates that conflicts fail more quickly after the Cold War, while the positive coefficient of 0.51 for Model 2 indicates that conflicts that occur after the Cold War are more susceptible to failure. Figure 2.8 plots the predicted survival curves for conflicts that occur during and after the Cold War. The results show that the timing of conflict has a modest effect on the probability of survival. After 36 years, the survival probability for a conflict during the Cold War is 0.56, while the survival probability for conflicts afterwards is 0.38. For Model 2, the probability of failure prior to the Cold War is 0.06, while the probability of failure is 0.09. The effect size produced by Model 2 thus appears to be much smaller.

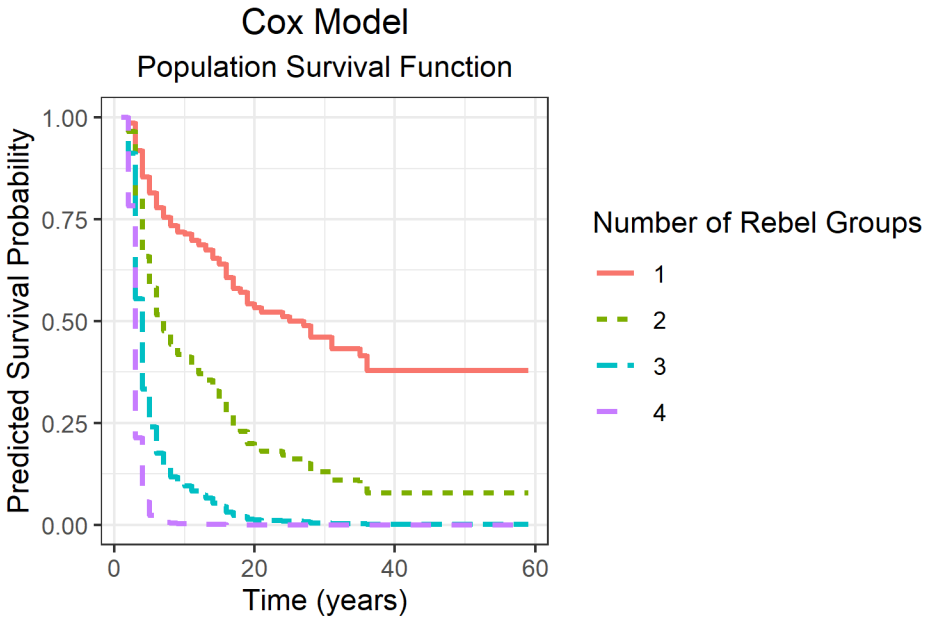

Figure 2.7: Effect of Number of Rebel Groups on Timing of Conflict Recurrence

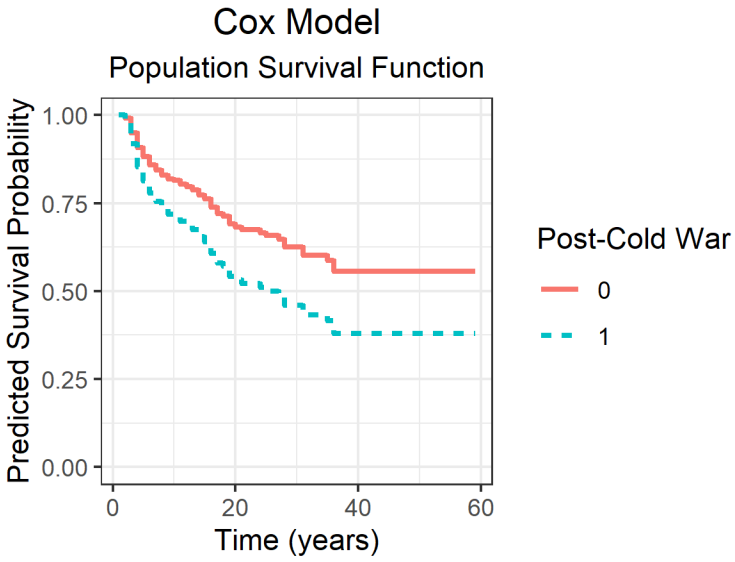

Figure 2.8: Effect of Post-Cold War on Timing of Conflict Recurrence

2.7 Conclusion

In this chapter I introduced readers to the proportional hazards cure model. Unlike traditional survival models, cure models account for the fact that some subjects may not experience an event. In doing so, they correct for the potential bias and inconsistency that can result from ignoring this assumption. Given that many international phenomena are only likely to occur between a small subset of countries, I argue that scholars of international relations would be well-served by using these models more frequently. In addition, this article introduces the **tvcure R package** I developed to fit the PHCM in R. This new package expands analysts' ability to apply the PHCM by allowing them to incorporate data that includes time-varying covariates.

I demonstrate the utility of the PHCM by replicating an analysis of civil conflict recurrence by Loyle and Appel (2017). The results of this analysis illustrate three generalizable differences that can result when using a Cox model when a cure model is more appropriate. First, the use of a standard Cox model can lead analysts to conclude that a variable has a significant effect when there is not (i.e., Type I errors). The results above provide an example of this in the form of the peacekeeping variable. Whereas the Cox model would lead analysts to conclude that there is a significant effect, the cure model does not support this finding.

Second, using a standard Cox model can lead analysts to conclude that a variable has an insignificant effect when the cure model would find that there is a significant effect (i.e., Type II errors). This is illustrated by the results each model produced with respect to the GDP per capita variable above. Whereas the Cox model did not detect a significant effect for this variable, the cure model found that it did have a significant effect on the probability of being susceptible or cured. This provides an even stronger substantive result than simply finding a significant effect in the cure model by implying that average income makes countries less likely to experience civil conflict altogether rather than simply delaying it.

Third, even when both models produce significant results, the substantive effects produced by both models may differ substantially. This is exemplified by the results with respect to motivation-decreasing

PCJ processes and military personnel. In both cases, the Cox model predicted much greater observable differences than the cure model did.

Chapter 3

The Domestic Proximate Causes of Territorial Claims[1]

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Abstract: When do states initiate territorial claims? Existing research focuses on the structural factors that make states more likely to contest particular pieces of territory, the normative justifications states can use to justify their claims, and a variety of dyadic factors. While these factors create the conditions under which a claim could emerge between two states, it does not explain why states issue claims when they do. I argue that territorial claims often emerge as the result of coalition changes within a state. In many cases, the decision to initiate a new claim reflects the differing incentives that new winning coalitions have to do so compared to the old coalition. Using a cure model, I model the probability that coalition changes will lead to claim onset, conditional on the structural factors that make some dyads susceptible to claims to begin with. I find that coalition changes are associated with an increased probability of claim onset.

3.1 Introduction

When do states initiate territorial claims against each other? In 1960, Cuba initiated a territorial claim against the United States (U.S.) over Guantanamo Bay following nearly 60 years of U.S. control. Yet the value of the territory itself, the historical relationship between the two actors, and certain features of the dyadic relationship (e.g., contiguity and major power status) did not change. Why did this claim emerge when it did? The answer lies in the change in the winning coalition of Cuba following the Cuban Revolution. With new actors in power with preferences starkly opposed to U.S. policy, the perspective of the government with respect to the territory changed and led the state to initiate a claim.[2]. By comparison, Nicaragua did not have the same response with respect to the Corn Islands, which would later became a point of contention with the U.S. Despite the fact that the two potential disputes were present in the same region, occurred under similar geopolitical circumstances (i.e., the Cold War), and arose from a similar root (the U.S. also leased these islands from Nicaragua), the lack of a proximate trigger prevented a dispute from emerging at this time. Similar examples can be found with respect to claims between Nicaragua and Colombia, Germany and Austria, Nigeria and Cameroon, and Uganda and Tanzania.

A vast literature has explored the relationship between territorial conflict and war, and found that territorial claims are closely associated with the onset of militarized disputes and war (e.g., Diehl and Goertz, 2002; Hensel, 2000; Hensel, 2001a; Hensel et al., 2008; Owsiak, 2012; Senese and Vasquez, 2008; Vasquez and Henehan, 2001; Vasquez, 2009). Compared to other issues, territorial conflicts are more likely to lead to militarized disputes and more likely to escalate to war. Moreover, territorial claims are closely associated with the onset of rivalrous relationships, which tend to emerge when territorial claims go unresolved and fester (Colaresi, Rasler, and Thompson, 2007; Rider and Owsiak, 2015; Vasquez, 2009). Despite these facts, relatively few studies have sought to understand why territorial claims emerge to begin with (exceptions include Abramson and Carter, 2016; Burghardt, 1973; Englebert, Tarango, and Carter,

[2] To be sure, the period in which this occurred did result in many changes in the dyadic relationship due to the Cold War. However, to the extent that dyadic factors did change, they were closely related to the new regime's decision to strengthen ties with the Soviet Union. Moreover, the dyadic factors which influence territorial changes discussed in the literature review did not change between the two countries.

2002; Goemans and Schultz, 2016; Huth, 2009; Murphy, 1990; Schultz, 2017; Zartman, 1969). Understanding why territorial claims emerge is necessary to shed light on why such contentious relationships emerge between states and how to prevent them from occurring to begin with.

The causes of claim onset identified by existing research tend to fall into three categories: the stakes attached to mutually desired territory (e.g., natural resources), dyadic factors (e.g., contiguity), and norms regarding what claims are legitimate (e.g., those based on historical sovereignty). Although all of these explanations undoubtedly contribute to our understanding of claim onset, each of these factors is relatively static over time. For the most part, the stakes attached to territory do not change over time, dyadic factors change slowly (if at all), and states' ability to appeal to normative arguments based on historical control or self-determination remain fixed. As such, these factors cannot explain changes in behavior over time. Assuming that state leaders are rational, the decision to forego a claim reflects the fact that issuing a claim is expected to be more costly than maintaining the status quo. Issuing territorial claims carries a variety of costs, including the potential for military conflict and rivalry (Vasquez, 2009), increased military spending (Gibler, 2012), and decreased trade and foreign direct investment (Lee and Mitchell, 2012; Simmons, 2005). As such, the decision to initiate a claim implies that the expected utility of issuing a claim has increased above that of doing nothing. Understanding why states issue claims when they do thus requires identifying the proximate factors that lead to changes in the expected utility of issuing a claim.

I propose that one major reason for change over time involves changes in the winning coalition, the group of actors that controls political power within a given country. Since different coalitions have different preferences and goals, major changes in state policy often precipitate major changes in policy (Cox, 1982; de Mesquita et al., 2003; Mattes, Leeds, and Carroll, 2015; Mattes, Leeds, and Matsumura, 2016). I argue that changes in the winning coalition act as shocks that have the potential to bring about major changes in a state's foreign policy, including the decision about whether to issue a territorial claim or not. In addition to changes in the underlying preferences of those who control power, new winning coalitions may also have instrumental incentives to issue new claims. Doing so may help the new coalition establish its own

legitimacy by diverting attention to international causes and may also allow the new coalition to repress rebel groups operating in claimed territory.

In this chapter I use a cure model to analyze the process of claim initiation. As discussed in Chapter 2, the logic of underlying and proximate causes maps well onto cure models. Whereas underlying causes reflect slowly-changing, structural factors that determine whether an event could possibly happen, proximate causes act as the trigger that precipitate an event and explain why events occur when they do. I test my argument on a global sample using data from the Issue Correlates of War Territorial Change dataset to identify the beginning of territorial claims (Frederick, Hensel, and Macaulay, 2017). Controlling for the structural characteristics that create the opportunity for claims to emerge, I demonstrate that coalition changes do, in fact, increase the hazard of claim onset among susceptible states. I discuss the implications of these findings in the conclusion.

3.2 The Causes of Territorial Claim Onset

The causes of claim onset identified by existing research fall into three general categories. First, states compete over territory that is attached to valuable stakes such as natural resources, strategic locations, and symbolically valuable land (e.g., Englebert, Tarango, and Carter, 2002; Goemans and Schultz, 2016; Huth, 2009; Mansbach and Vasquez, 1981; Vasquez, 2009). The second category involves the dyadic factors that influence states' desire and ability to pursue claims against a potential opponent. For example, contiguity, major power status, and rivalry all influence states calculations when deciding to initiate a claim against an opponent (e.g., Colaresi, Rasler, and Thompson, 2007; Huth, 2009; Rasler and Thompson, 2006; Vasquez, 2009). The third explanation for claim onset lies deals with states' ability to justify their claims in terms of principles such as self-determination or historical sovereignty (e.g., Abramson and Carter, 2016; Burghardt, 1973; Murphy, 1990; Zartman, 1969).

3.2.1 Territorial Stakes

The emergence of a territorial claim occurs when one state desires territory which the other controls or when two states desire control over the same piece of unclaimed territory. This only happens when there is some piece of territory that both states consider valuable. The literature on contentious issues has established that territory is often tied to tangible and intangible stakes that states prize (e.g., Hensel, 2001a; Hensel et al., 2008; Huth, 2009; Rosenau, 1971). Tangible stakes include a piece of territory's physical characteristics or its contents. These characteristics are often sources of potential economic or strategic value. For example, territory that contains natural resource deposits, arable land, or large population centers represents a potential source of economic gain and military power. Land may also possess strategic value due to its geographic characteristics, such as the presence of mountain ranges or access to the ocean.

In addition, territory frequently possesses intangible or symbolic value for domestic audiences. Land is often tied to the identity of a particular groups (national, ethnic, religious, linguistic, or other cultural groups) and thereby highly salient to those groups. Groups that have a cohesive sense of identity may push leaders to reclaim such territory (Englebert, Tarango, and Carter, 2002; Goemans and Schultz, 2016). Issues related to symbolic states tend to underlie claims based on irredentism, secessionism, group unification (e.g., pan-Arabism), and the mistreatment of transnational kin. These claims tend to be particularly salient when the contested territory is part of the state and/or in close proximity to its heartland. Such claims are more likely to threaten core interests of the groups living within the state and have strong nationalist implications.

Salience is related to claim onset insofar as states will not initiate highly costly claims over territory that does not possess some value for the state or the interest groups that control political power. Territory that is strategically valuable is more likely to become the subject of claims (Huth, 2009). Territorial claims are also more likely to begin over economically valuable territory and land that contain natural resources (Goemans and Schultz, 2016; Huth, 2009).[3] Borders are also more likely to be contested when two states

[3]Goemans and Schultz (2016) find evidence that land containing minerals is more likely to become the subject of claims, but land containing oil is not. Schultz (2017) finds that territory containing oil is not more likely to be contested.

share ethnic ties or partition ethnic groups, particularly if that group has access to political power within one state (Englebert, Tarango, and Carter, 2002; Goemans and Schultz, 2016; Huth, 2009).

3.2.2 Dyadic Factors

Several sets of dyadic factors influence whether potential claims involving these issues are likely to emerge between states. One of the most influential factors regards whether two states are contiguous. All else equal, border territory tends to be more salient than other types of territory due to the fact that it has greater implications for state security and national identity (e.g., Hensel, 2001a; Owsiak, 2012; Vasquez, 2009). Contiguous states are also more likely to find themselves competing over other salient issues. For example, since ethnic groups cluster in space, nearby states are more likely to find themselves competing over the status of ethnic groups. As a result, claims tied to border territory are more likely to be highly salient.

Contiguous states also interact more are more likely to view each other as threats. These states are more likely to find themselves competing over both territorial and non-territorial issues (e.g., regional security) which in turn increases the probability that two states view each other as threats to their security and interests (Vasquez, 2009). This amplifies the commitment problem associated with territory by increasing the value of obtaining an economic or military advantage over the other state. In addition, most states other than major powers will have difficulty successfully waging military campaigns over great distances (Boulding, 1962; Lemke, 2002). This matters insofar as the threat of military force is often used to threaten or coerce opponents into relinquishing territory.

Another important dyadic characteristic relates to whether one or both states are major powers and the relative capabilities of the two states. Major powers have an easier time projecting force at a distance and therefore have an easier time contesting territory held by far-flung states and establishing overseas colonies. Major powers are also more likely to have expansive spheres of influence and therefore more likely to have interests in controlling territory in regions outside their own. Dyads that contain two major powers are

even more likely to find themselves embroiled in territorial claims as they find themselves competing over their relative spheres of influence, including colonial possessions abroad.

A third set of factors involves whether two states view each other as threats or have previously engaged in military competition with each other. Once states engage in hostile interactions, such as militarized disputes, arms races, and alliance-formation, individuals within those states may develop hostile images of the enemy and come to view their competitors as a fundamental threat to their interests. Rivalries thus tend to take on a life of their own; once states have developed hostile images of the enemy, states may come to compete over issues that were not initially salient (Colaresi, Rasler, and Thompson, 2007; Rasler and Thompson, 2006; Dreyer, 2010a; Dreyer, 2010b). Although territorial claims often precipitate rivalries, rivalries may lead states to initiate claims new territorial claims. For example, the claim between India and Pakistan over the Rann of Kutch emerged out of their existing rivalry due to its strategic military value to Pakistan (Colaresi, Rasler, and Thompson, 2007). The tendency of rivalry to beget territorial claims may be particularly likely with respect to economically or strategically valuable territory, as controlling such territory may provide one state a military advantage over the other (e.g., Fearon, 1995).

Other factors that influence the relationship relate to whether one previously held sovereignty over the other. One such factor regards whether one state has previously lost territory to the other. States that have lost territory often issue claims over the lost territory. Claims are also more likely to arise between colonizers and their former colonies over the ownership of other territory held by the colonial power. For example, after gaining independence from the United Kingdom (U.K.), Mauritius issued a claim against the U.K. over control of the Chagos Archipelago, a region formerly considered part of the Mauritian colony. Claims are also more likely to emerge between two colonial powers that have contiguous colonies. For example, multiple claims emerged between Great Britain and France regarding the boundaries of their respective colonies. These include disagreements regarding the boundaries of neighboring Gambia and Senegal, as well as competing claims to the Sudan that eventually led to the militarized Fashoda Incident.

3.2.3 Normative Justifications

Another important set of factors relates to the potential justifications states can use legitimate a claim to domestic and international actors (Abramson and Carter, 2016; Burghardt, 1973; Murphy, 1990; Zartman, 1969). Although contested territory will always be valuable for one reason or another, these explanations are limited insofar as they cannot explain why some valuable pieces of land are contested while others are not. At the international level, such claims are difficult to justify unless they follow international norms regarding the legitimacy of claims and may create the perception that a state is a purely revisionist or expansionist power. Unless states can justify their claims in terms of existing norms, they will often have trouble eliciting support from third parties or will have difficulty convincing actors such as the International Court of Justice that they have a valid claim. At the domestic level, such justifications are highly salient and thus make it easier for leaders to rally support for a claim and convince domestic actors to bear the costs associated with it.

States often attempt to avoid these costs and/or garner support by couching their claims in terms of norms that resonate with domestic and international audiences. These include principles such as self-determination, irredentism, territorial integrity, and historical sovereignty. International and domestic actors tend to view these types of claims as more legitimate and are more likely to side with claimants that have such ties to territory. Moreso than other justifications, claims based on historical ownership tend to be particularly persuasive to international actors (Murphy, 1990).

The fact that states can only credibly appeal to such norms over some territorial claims helps explain why states issue claims over some valuable pieces of territory but not others. In many cases, the presence of valuable territory that both states desire is not sufficient to lead states to issue claims. For example, claims based on historical sovereignty help explain why Ecuador initiated a claim over oil-rich border territory held by Peru but did not contest other oil-rich regions in Peru and Colombia (Murphy, 1990). Although Ecuador claimed territory belonging to Peru, it did not issue claims over additional oil-rich territory in northeastern Peru or on its border with southwestern Colombia. This leads Murphy (1990) to conclude

that Peru chose to contest the particular territory because it could justify that claim based on "questionable circumstances surrounding a 1942 protocol awarding the territory to Peru," (Murphy, 1990, p. 538).

3.2.4 Gaps in the Literature

Although the literature on claim onset has done much to identify the circumstances under which claims could potentially emerge between two states, existing research does little to explain the decision to initiate a claim itself. Assuming that rational actors create policies designed to maximize their expected utility, the choice to avoid initiating a claim implies that the expected utility of doing so is less than that of maintaining the status quo. The decision to initiate a claim thus implies a shift in the expected utility of initiating a claim such that it comes to exceed the expected utility of foregoing a claim. Since most of the structural factors discussed above remain fixed over time, they cannot explain variation in the expected utility of issuing a claim over time. Answering the question of why states issue claims when they do thus requires identifying time-varying factors that lead to changes in the expected utility of issuing a claim.

3.3 The Proximate Causes of Claim Onset

Assuming that two states are structurally predisposed to become involved in territorial claims, what are the triggers that lead a potential challenger state to initiate a claim when they do? Becoming involved in a territorial claim is potentially a very costly prospect, insofar as doing so may lead to a highly militarized rivalrous relationship as well as economic costs (e.g., Lee and Mitchell, 2012; Simmons, 2005; Vasquez, 2009). As such, the decision to initiate a claim often represents a large change in a state's foreign policy that has the potential to have serious consequences. Understanding claim onset thus requires understanding when states make such dramatic changes to their policies.

One model related to the occurrence of dramatic changes in policy is the punctuated equilibrium model of public policymaking (Durant and Diehl, 1989; Baumgartner and Jones, 1993; Diehl and Goertz, 2000; Jones, Baumgartner, and True, 1998). The model holds that large shifts in policymaking rarely occur

as the result of incremental changes to policy; instead, changes in policymaking often occur rapidly, then settle into an equilibrium state that persists for long periods of time. Rapidly changing conditions may be especially conducive to change as they lead to the emergence of a crisis atmosphere, which can, in turn, increase pressure on policymakers and alter the ways in which policymakers think about policy (Jones, Baumgartner, and True, 1998). Similarly, Russett (1990) argues leaders and elites have stable attitudes over time and that such attitudes are only disrupted by dramatic shocks.

In international relations, the punctuated equilibrium model has been used by Diehl and Goertz (2000) to describe enduring rivalries. Contrary to theories that view rivalries as emerging and dying out as the result of long-term, incremental changes in an interstate relationship (e.g., Hensel, 1999; Hensel, 2001b; Vasquez, 2009), Diehl and Goertz (2000) argue that rivalries begin and end during periods of rapid change. The underlying premise is that fundamental changes in the relationships between states often occur as a result of structural breaks or shocks. Generally speaking, interstate relationships exhibit long periods of stasis. States tend to have persistently positive or negative relationships which only change during periods of intense, rapid change that fundamentally alters the nature of their relationship. Applied to rivalry, Diehl and Goertz (2000) argue that rivalries emerge in periods of such rapid change, during which quickly changing circumstances lead to rapidly escalating hostilities. After emerging, rivalries "lock-in" and become entrenched over the long term, until they dissolve in a similar period of rapid change. Because rivalries are entrenched processes, the relationship between rivals should only dissolve as a result of dramatic disruptions to the status quo, as well.

Diehl and Goertz (2000) argue that shocks at both the domestic and international level are capable of producing rivalry. At the domestic level, these shocks tend to be related to changes in leadership or new forms of government. Because different governments have different preferences, large changes in foreign policy such as beginning and ending rivalries are often brought about by changes in those who hold power at the domestic level (see also Bennett, 1997; Vasquez, 2009; Rooney, 2018). Diehl and Goertz (2000) also argue that shocks at the international level, such as world wars and shifts in power polarity, can upset the stability of interstate relationships. Such events may transform the international environment in

which international interactions occur, creating new opportunities for both conflict and compromise. For example, the dissolution of the Soviet Union lead to the end of many patron-client relationships between the Soviet Union and its allies, creating conditions conducive to the realignment of such countries.

Although Diehl and Goertz (2000) focus on the evolution of rivalries, the concept of shocks can be applied to explain other phenomena which entail dramatic changes in the dyadic relationship between two disputants. Initiating a new claim has the potential to produce large changes in the bilateral relationship between states. As noted above, the decision to break with the status quo and initiate a new claim implies that the expected utility of doing so has changed. As with the punctuated equilibrium model of rivalry, I argue that shocks at the domestic and international level increase the probability that states issue claims by leading to fundamental changes in the nature of the actors involved and/or substantially altering the nature of the relationship between two states.

At the domestic level, one cause of changes in the government's preferred policies is a change in the leadership or winning coalition of a state. Various actors compete to influence the direction that state policy takes. Depending on regime type, these actors may include individual voters, businesses, organized interest groups, the military, and government bureaucrats, each of whom has their own policy preferences. The set of societal actors that is able to successfully unify and exert control over the political process is referred to as the winning coalition. In order to gain power, leaders must obtain the support of the winning coalition. Subsequently, they must maintain this support by making policy that aligns with the preferences of the winning coalition or else risk being removed and replaced by someone else. As a result, leaders tend to make foreign policy decisions that align with the interests of their winning coalition (de Mesquita et al., 2003).

Although incumbent leaders and coalition members' preferences may change over time, the fact that the structural causes of territorial claims remain constant over time means that a given leader or ruling coalition is unlikely to change their policy with respect to the issuance of claims, absent major changes in the international environment or dyadic relationship that alter the opportunity or willingness of states to take action. As such, large shifts in the direction of state policy (e.g., issuing a territorial claim) are

most likely to occur due to changes in the domestic actors that control the levers of power (Cox, 1982; Mattes, Leeds, and Carroll, 2015). When a new coalition takes power that values a piece of territory more highly than its predecessor, it is thus possible that the relative valuation of a state's options (i.e., issue a claim or maintain the status quo) changes as well. I posit that coalition changes may be associated with changes in state policy related to territorial claims for two reasons. First, different winning coalitions may have different goals with respect to foreign policy and therefore value the decision to issue a territorial claim more highly. Second, new coalitions may have instrumental reasons for issuing claims as a means of engendering support for and/or suppressing opposition to the new government.

3.3.1 Changes in the Winning Coalition's Preferences

The first reason why new winning coalitions may have an incentive to initiate territorial claims relates to a fundamental change in the preferences of the government's leadership. Because different coalitions have their own distinct interests, coalition changes often entail large changes in the goals and preferences that those with political power wish to pursue (Cox, 1982; de Mesquita et al., 2003; Mattes, Leeds, and Carroll, 2015; Mattes, Leeds, and Matsumura, 2016). For example, a change from a government controlled by ethnic group A to ethnic group B may result in a government that, contrary to their predecessor, cares about unification with group B's ethnic kin in neighboring countries. Similarly, a change in the economic interests that support the government may lead the government to care about controlling territory with certain types of economic value (e.g., resources) more than other economic aims.

The preference change mechanism is exemplified by the claim between the U.S. and Cuba over Guantanamo Bay. Although Cuba was coerced into leasing the territory to the U.S. in 1903, American control of the territory went uncontested by the Cuban government for nearly six decades. This changed following the Cuban Revolution, when the American-backed military government that presided under Fulgencio Batista was overthrown by Fidel Castro on January 1, 1959. By the end of the following year, Castro had repudiated the U.S.' right to maintain control of the occupied territory, initiating a claim that persists until today. What explains the sudden reversal of Cuban policy? The answer lies in a change of the prefer-

ences of the state's winning coalition. The shift from a government controlled by pro-U.S. interests to one that was fundamentally opposed to U.S. foreign policy. Contrary to the military junta, the coalition of supporters that brought Castro to power harbored strong anti-American sentiments (Morley, 1982; Wright, 2000).

Another example involves the claim between Nicaragua and Colombia over the San Andreas and Providencia archipelago. After signing a treaty resolving the dispute in 1928, the dispute remained dormant for over 60 years. In 1979 the Sandinista government took power and declared the old agreement null due to the fact that it had been signed under pressure from the U.S. At the same time, Nicaragua renewed its claims against Colombia to the banks of Quita Suensueno, Serrana, and Roncador. Like the Cuban case, the change in the foreign policy interests of those in control of the government dictated whether they would choose to pursue a territorial claim that had implications for its relationship with other regional actors. An additional example includes Germany's 1933 decision to issue a claim to Austrian territory following the rise of the Nazi party, which campaigned on the issue of reclaiming the Rheinland.

3.3.2 Generating Support Using Territorial Claims

A second reason why coalition changes may be associated with new territorial claims is that new coalitions may attempt to use claims strategically as a means of consolidating their hold on power. Rather than emerging from some underlying preference for obtaining a piece of territory, governments may have instrumental reasons for issuing claims (although this mechanism is not mutually exclusive with the first). Leaders often use foreign policy actions to build support among domestic audiences, especially when they can appeal to nationalist sentiments. When faced with foreign threats, individuals tend to "rally around the flag" and support the government in power (Mueller, 1973). Leaders may thus try to construct or play up threats in the international system as a means of engendering support from domestic audiences. This behavior is exemplified by diversionary theory, which holds that leaders may intentionally involve their states in conflicts as a means of stoking such support (e.g., Russett, 1990; MacKuen, Erikson, and Stimson,

1992; Downs and Rocke, 1994; Meernik, 1994; DeRouen, 1995; Gelpi, 1997; Fordham, 1998; Mitchell and Prins, 2004; Pickering and Kisangani, 2005; Mitchell and Thyne, 2010; Tir, 2010)

Because territorial claims are highly salient and strongly tied to nationalist sentiments, Tir (2010) argues that initiating diversionary conflicts over territory is particularly likely to be effective. This logic can also be applied to the decision to initiate territorial claims. By stoking perceptions that a foreign actor poses a threat to highly salient territory, initiating a claim may help leaders construct a narrative that supporting the government is necessary to oppose a threat to the fundamental interests of the state. This is especially likely to be effective if the incumbent coalition can draw a contrast to their predecessor's foreign policy with respect to a potential territorial claim. Since territorial claims are highly likely to be militarized compared to other issues, issuing new claims is one way in which leaders could hope to provoke a rally around the flag effect.

One example of this mechanism involves a dispute between Nigeria and Cameroon over the Bakassi Peninsula. The roots of the claim lay in a transfer of territory between their colonial parents. In 1913 the United Kingdom and Germany signed an agreement delimiting the border between their respective colonies of Nigeria and Cameroon. In doing so, Britain ceded control over the Bakassi Peninsula to Germany. Although the colonial parents reached a general border agreement, it did not fully demarcate the boundary, and uncertainty over the exact location of the border persisted. Following World War I, Cameroon was split between Britain and France, with the northern portion of Cameroon (including the Bakassi Peninsula) being incorporated into Nigeria. When Britain and France granted the two colonies independence in 1960, there were disagreements over whether British Cameroon should remain part of Nigeria or be reunited with French Cameroon, now the Republic of Cameroon. Separate plebiscites were held in northern and southern British Cameroon, and, as a result, the northern portion of British Cameroon became part of Nigeria, while the southern portion, including the Bakassi Peninsula, became part of the Republic of Cameroon. Notably, the residents of the Bakassi peninsula were ethnic Efiks and therefore were affiliated with groups in southeastern Nigeria rather than those in Cameroon.

Although some disagreement over the exact location of the boundary persisted, the unresolved boundary issues did not become a point of contention between the two states and both worked cooperatively to interpret and implement the terms of the 1961 plebiscites. Following the split, correspondence between the Nigerian and Cameroonian governments affirmed that the Bakassi Peninsula was now part of the Republic of Cameroon (Omeje, 2004). Cameroonian ownership of the Bakassi Peninsula was reaffirmed by General Yakubu Gowon, head of the Nigerian government, in agreements in 1971 and 1975. This changed in 1975 when Murtala Ramat Muhammed led a successful coup within Nigeria's military-led government, removing Gowon from power. In the weeks afterwards, Muhammed repudiated Gowon's actions and claimed the Bakassi Peninsula belonged to Nigeria.

When considering the stakes and relationship between the two governments, the sudden decision to issue a claim over territory that had largely been settled is puzzling. In theory, the territory was salient for both countries: it contains valuable natural resources, constitutes a strategic location, and has ties to ethnic groups in both states. In addition, both states had claims to the territory based on identity, historical ownership, and homeland status. Nonetheless, Nigeria did not issue a claim over the territory until the Muhammed administration took power. Historical evidence and the fact that the other factors that potentially motivated a claim remained fixed support the fact that the claim was motivated by domestic political considerations. With the new regime suffering a "crisis of legitimacy," (Ugwu, 2012, p. 17), the decision to repudiate the recent agreement made by Gowon constituted an attempt by Muhammed to stoke nationalist support and legitimate the seizure of power by characterizing Gowon's actions to reaffirm the previous agreement as an attempt to give away territory that rightfully belonged to Nigeria (Konings, 2005; Ugwu, 2012).

Another reason why coalitions may have instrumental reasons to issue new territorial claims is rooted in the existence of rebel groups opposed to the new regime. Following the seizure of power by a rebel group, opposition groups may continue to attempt to overthrow the government. In doing so, opposition groups often seek sanctuary in neighboring states to avoid state repression (Salehyan, 2007). This has the potential to stoke tensions between the two states, especially if the sanctuary state explicitly supports

the rebel groups. Even when the state does not provide support to rebels, however, the target state may attempt to seize or invade territory that contains rebel groups in order to suppress their activities, provoking concerns over sovereignty and increasing hostility between states (Salehyan, 2008).

One example involves the claim between Uganda and Tanzania over the Kagera Salient, the area in northern Tanzania between the Kagera River and the 1° parallel that formed the boundary between the two. Although the Salient had formerly been under the control of the Bugandan Kingdom within Uganda, the 1° border line established by the United Kingdom and Germany placed it under Tanzanian control. In doing so, it placed members of the Ganda ethnic group on each side of the line. Establishing the boundary at the 1° also forewent the possibility of establishing a boundary along the natural border created by the river. As such, there were historical, ethnic, and geographic concerns that could potentially motivate and justify Ugandan claims to the territory (Griffiths, 1986).

Nonetheless, the border went uncontested for many years. Even after the two states obtained independence in 1961-1962, the border issue did not arise as a point of contention. However, this changed in 1971 following the military coup that brought Idi Amin to power. The Kagera Salient became home to opposition groups that supported the former president, Milton Obote. Having had a close relationship with Obote, Tanzanian president Julius Nyerere welcomed members of the opposition who had been exiled and tacitly supported the activities of rebels in the Kagera region. The fact that opposition groups inhabited the Salient gave Amin an incentive to issue a claim to the region to protect his new regime (Griffiths, 1986; Roberts, 2014). The emergence of the claim was thus a direct consequence of the change in the governing coalition and the interstate divisions it produced (Valeriano, 2011). Although the claim could also be justified in terms of concerns related to ethnic unification, historical control, and creating natural geographic borders, none of these arguments were advanced until Amin took action against the rebel groups residing in the area.

Ultimately, the foregoing discussion shows that the specific reasons that a new coalition may wish to initiate a claim when the previous coalition did not may differ. Nonetheless, the above scenarios all share a common premise–that new coalitions may have an incentive to initiate claims that previous coalitions

did not. This leads to the following hypothesis:

> **Coalition Change Hypothesis**: Dyadic territorial claims are more likely to begin after a dyad member experiences a change in its winning coalition.

3.4 Research Design

I analyze the causes of claim onset by modeling the time until a dyadic territorial claim emerges between two states. The unit of analysis is the dyad-year. The dependent variable is the time until the onset of territorial claims according to the Issue Correlates of War (ICOW) Territorial Claims Dataset, (version 1.01; Frederick, Hensel, and Macaulay, 2017), which contains data on all international territorial claims during the period 1816-2001. Dyads enter the dataset in 1816 or in the first year in which both states are members of the Correlates of War system. Dyads exit the data when a new claim begins and are coded as censored in 2001 or when one state exits the international system.

I code the onset of a claim using a dummy variable for whether a new ICOW claim began between two states in a given year. A territorial claim exists when a high-level official representative of one state officially indicates she regards a specific piece of territory as belonging to their state. Importantly, ICOW does not code the existence of a claim when opposition leaders or other societal groups make claims to land, but the officials governing the state do not.

Most dyads never experience claim onset. It is therefore necessary to use a cure model to distinguish between those dyads that are at risk and those that are not to obtain consistent estimates of the influence of variables that affect the timing of claim onset. My theory provides an explicit distinction between issues that influence the underlying risk of an event (i.e., structural causes that create the motivation or opportunity for claim onset) and those that influence the timing of claim onset. Thus, the use of a cure model is ideal for modeling the process that generates claims and provides greater theoretical insights by indicating *how* each variable influences claim onset. I use the cure equation to model the structural factors that influence claim onset and the hazard component to model the proximate causes.

3.4.1 Specifying the Hazard Equation

To assess the hypothesis regarding how changes in the winning coalition influence claim onset, I use the Change in Source of Leader Support (CHISOLS) dataset (Mattes, Leeds, and Matsumura, 2016). CHISOLS identifies when the societal groups that form the primary base of support for political leaders changes. I use a dummy variable for whether the winning coalition in at least one state within a dyad occurs within a given year (lagged by one year to avoid simultaneity bias). The CHISOLS data begins in 1919. The analysis thus covers the timespan 1919-2001.

I also include three other variables for other domestic level shocks, which may influence both support for the government (and therefore leaders' decision-making regarding costly behaviors) and lead to changes in the relationship between two states (Diehl and Goertz, 2000). First, many claims begin between countries and their neighbors when one country becomes a newly independent state. As new states emerge, claims may emerge between new states and their parent states regarding the territory that belongs to each state. Claims may also emerge with a new state's neighbors. For example, neighboring states may perceive a new state as weak and attempt to prey on them (Maoz, 1989). I code a state as becoming newly independent in the year it enters the Correlates of War (COW) state system (Correlates of War Project, 2017).

Second, I control for civil wars, which may influence the level of support for a government, the probability of coalition changes (i.e., if the government is replaced by its opposition), and a state's ability to dedicate resources to pursuing costly international policies. I code whether a country experiences a civil war in a given year using the COW Intrastate War dataset (Gleditsch et al., 2002). Third, to distinguish between the effects of coalition changes and institutional changes, I include an indicator of regime change (Marshall and Jaggers, 2013; Mattes, Leeds, and Matsumura, 2016). Each of these control variables is lagged by one year.

3.4.2 Specifying the Cure Equation

The cure equation accounts for fundamental characteristics of the dyadic relationship that determine whether two states have incentives to compete over the same piece of land. To model the probability that a piece of territory that both states desire exists, I include several of the structural variables discussed in the literature review. Since contiguous states are more likely to become involved in territorial claims, I include whether two states share a land border using data from Stinnett et al. (2002). Dyads that contain major powers are more likely to become involved in claims, especially when they contain two major powers. I capture this using dummy variables for whether whether a dyad contains one or two major powers, with two minor powers left out as the reference category (Correlates of War Project, 2017).

Since states are more likely to become involved with claims with their former colonizers or parent states, I include a measure of whether one state was ruled by the other prior to independence. The data come from Hensel (2018) and capture whether one state was ruled as "a colony, dependency, League of Nations mandate, UN Trust territory, or other type of possession, as well as states that have seceded from existing states and states that have merged into existing states," immediately prior to independence. As noted above, dyads in which there has been an exchange of territory between two states are more likely to become involved in new claims. I measure this using a dummy variable for whether there has previously been a transfer of territory between the two states (Tir et al., 1998). To account for potential clashes between two colonial powers regarding the boundaries of their respective colonies, I include a dummy variable for whether two states have contiguous colonies using the Correlates of War Colonial Contiguity dataset (Correlates of War Project, 2020).

States that have mutual security interests will pay higher costs from initiating claims. To account for this, I include a dummy variable for whether two states share a defensive alliance (Gibler and Sarkees, 2004). In addition, two states are less likely to become involved in territorial claims once both have become democracies (Gibler, 2012; Gibler and Owsiak, 2018; Owsiak and Vasquez, 2019). I control for this using an indicator for whether both states have a Polity score above five (Marshall and Jaggers, 2013). Since states that view each other as fundamentally hostile powers are more likely to become involved in claims,

I include a dummy variable for whether two states are involved in a rivalry in a given year (Colaresi, Rasler, and Thompson, 2007).

3.5 Results

Table 3.1 presents the results of the analysis. The first column presents the estimates for the variables included in the hazard equation. The values presented are hazard coefficients. Positive coefficient estimates are thus associated with an increased probability of failure and a decreased survival time. Hypothesis 1 posits that dyads that are susceptible to territorial claims are more likely to become involved in such claims following a coalition change in one of the dyad members. The estimated coefficient for coalition change is positive and significant, which indicates that coalition changes are associated with an increased hazard rate among the set of susceptible observations. Put otherwise, dyads that are likely to become involved in claims often experience claim onset in the wake of a coalition change. Exponentiating the estimated coefficient of 0.22 produces a hazard ratio of 1.25, which indicates that coalition changes are associated with a 25 percent increase in the hazard rate among susceptible cases.

To further assess the substantive effects of coalition change, Figure 3.1 plots the conditional survival function (i.e., the survival function for dyads that are susceptible) when the coalition change variable is equal to zero and one (with all other variables held constant at their medians). The vertical distance between the survivor curves can be interpreted as the difference in the probability of survival curves at a particular time point t. From this plot, it can be seen that the substantive effects of coalition change are relatively small. At its maximum, the difference between a median case that experiences a coalition change and one that does not at the same time point is about 8 percent.

The relatively small substantive effect may be due to the fact that there are frequent coalition changes but only a small subset of those actually precipitate conflict. Based on my theory, coalition changes are associated with claim onset because the particular coalition in power has specific interests in initiating a claim. However, in many cases, it is to be expected that there will be a continuity of preferences between a new and old government. There are thus many more instances in which a coalition change does not

Table 3.1: Model of the Onset of Territorial Claims, 1918-2001

	Hazard Coef.	Logit Coef.
Coalition Change	0.22*	
	(0.08)	
Civil War	0.09	
	(0.08)	
Independence	0.7	
	(1.71)	
Regime Transition	-0.24	
	(0.35)	
Contiguity		1.27*
		(0.24)
Major-Minor Dyad		1.8*
		(0.18)
Major-Major Dyad		2.19*
		(0.49)
Previous Territorial Change		0.18
		(0.27)
Former Colony		0.49
		(0.33)
Colonial Contiguity		2.86*
		(0.32)
Defensive Alliance		-0.03
		(0.12)
Joint Democracy		-0.79*
		(0.3)
Rivalry		2.04*
		(0.21)
Intercept		-9.72*
		(0.11)
Number of Observations	729557	
Number of Failures	186	
AIC	5330	
BIC	5169	

Note: Standard errors in parentheses. * $p < 0.05$.

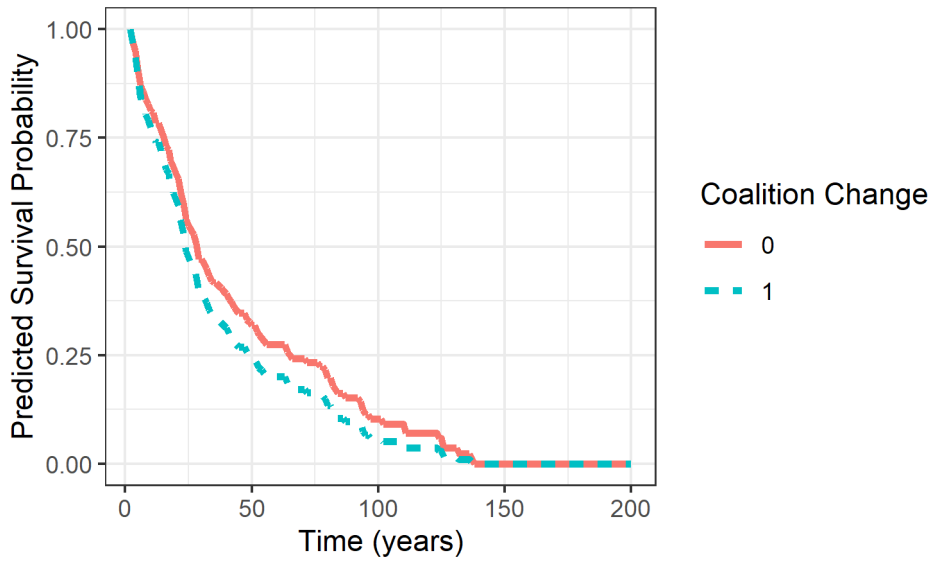

Figure 3.1: Conditional Survival Curves for Coalition Changes

produce claim onset than there are those that do. Moreover, coalition changes are not necessary conditions for claim onset, as other events in the domestic or international realms may help precipitate claims. Nonetheless, the results indicate that some coalition changes are associated with claim onset and thus support the probabilistic hypothesis that coalition changes increase the risk of claim onset among susceptible dyads. The additional variables included in the hazard equation (civil war, independence, and regime transition) are all insignificant. This suggests that the primary reason why states may issue new claims at the domestic level is changes in those who hold control of the levers of power, rather than other domestic factors.

The results for the variables included in the cure equation are presented in the second column of coefficients in Table 3.1. The estimated coefficients in the cure equation are logistic regression coefficients. Positive values indicate that, all else equal, higher values of a variable are associated with an increased likelihood that a dyad is susceptible to becoming involved in a territorial claim. Negative coefficient estimates indicate that higher levels of a variable are associated with a lower degree of susceptibility.

Table 3.2: Percent Change in Predicted Probability of Territorial Claim Onset

	Percent Change
Contiguity	256
Major-Minor Dyad	505
Major-Major Dyad	792
Colonial Contiguity	1640
Joint Democracy	-54
Rivalry	669

Note: Predicted probabilities calculated with all other variables held at their medians.

The variables included in the cure equation generally behave as expected. The results indicate that the effect of contiguity is significant. The positive coefficient of 1.27 indicates that the log-odds of being susceptible to territorial claims are greater in contiguous states than noncontiguous states. To assess the substantive effects of each significant variable in the cure equation, Table 3.2 presents the percent change in the predicted probabilities when each variable is set to zero and one, with all other variables held constant at their medians. Contiguity is associated with a 256 percent change in the probability that states are susceptible to territorial claims.

Notably, the substantive effect of contiguity is among the lowest in the table. This is somewhat surprising, given that contiguous states might be expected to be much more likely to become involved in claims. This indicates that many other factors play a more important role in determining susceptibility than contiguity. This is important when considering the possibility of using only contiguous dyads or politically relevant dyads in an analysis. Although these dyads are more susceptible to claim onset, there are many claims between noncontiguous states that are not captured by using such case selection techniques. This provides evidence that using techniques that model the underlying probability of claim susceptibility, such as cure models, are a better approach to accounting for the heterogeneous susceptibility between dyads.

As expected, major power status has a positive and significant effect on a dyad's susceptibility to territorial claims. The estimated coefficient for mixed dyads (i.e., those that contain one major and one

minor power) is 1.80. Table 3.2 indicates that mixed dyads are 505 percent more susceptible to claims than those that contain two minor powers. The coefficient estimate for dyads that contain two major dyads is also positive and significant, indicating that these dyads are more susceptible to territorial claims than dyads composed of two minor powers. The coefficient estimate of 2.19 is even greater than that for mixed dyads, indicating that these dyads are even more susceptible. Dyads that contain two major powers are 792 percent more likely to be susceptible to territorial claims than those containing two minor powers.

Contrary to Huth (2009)'s findings, whether two countries have previously exchanged territory is not significantly associated with susceptibility to claim onset. This may indicate that states fully delineate territorial transfers when they occur and that subsequent disputes are not likely to emerge between them. Alternatively, it may reflect the fact that states that lose territory to another state rarely initiate new claims against the previous challenger. Whether one state was formerly a dependent territory or colony of the other is also not significantly associated with susceptibility to claim onset. Thus, the example of the Chagos Islands disputes between the United Kingdom and Mauritania discussed above is likely to be an aberration and prior dependency status is unlikely to be a generalizable cause of territorial claims. This may indicate that newly independent states tend to establish relatively well-defined boundaries with their parent states upon gaining independence. In addition, this measure only accounts for whether a state that gains independence was a possession of their parent state immediately prior to independence. If that territory was formerly ruled by other countries besides the immediate parent, these relationships are not captured by the data used.

Colonial contiguity has a large, significant relationship with susceptibility to claim onset. The coefficient of 2.86 indicates that states which have colonies next to each other are more likely to become involved in territorial claims. Somewhat suprisingly, colonial contiguity has the largest substantive effect of any of the variables included in the cure equation. Table 3.2 shows that the probability that two states with contiguous colonies are 1,640 percent more likely to become involved in a territorial claim. Notably, this relationship holds when controlling for both contiguity and the presence of major powers within the dyad. This suggests that colonial contiguity has an additional effect on territorial claims and is not simply

picking up on the large amount of colonial activity conducted by major powers. This may be due to the fact that other players in the international system that are not considered major powers still engage in a great deal of colonial activity (e.g., Portugal and Spain).

Whether two states possess a defensive alliance was not found to be significantly associated with susceptibility to claim onset. This likely indicates that alliance ties are not sufficient to deter one state from claiming territory possessed by the other when the domestic coalition values it highly enough to issue a claim. The estimated coefficient for joint democracy is negative and significant, indicating that dyads containing two democracies are less susceptible to experiencing territorial claims than dyads containing at least one non-democracy. Although the relationship holds, it is unclear whether there is a causal connection between democracy and the onset of territorial disputes. On the one hand, since democratic leaders are more accountable to their constituents, they may be less willing to take potentially controversial actions like issuing claims. However, this assumes that the winning coalition does not support issuing a claim, which runs contrary to the theory laid out above. Alternatively, the size of the selectorate may matter. Whereas issuing territorial claims may benefit narrow interest groups (e.g., ethnic groups), they may be unpopular with the public as a whole. Since democratic leaders are more susceptible to experiencing coalition changes, they may therefore be more constrained from pursuing claims that would benefit a small portion of the selectorate. However, the literature on the territorial peace suggests that democracy does not have a causal effect on territorial claims. Instead, the correlation between democracy and claim onset is likely merely an artifact of the timing of events. Scholars have argued that the sequence of events typically occurs such that states resolve their most salient territorial claims (i.e., those involving borders) prior to becoming democracies (Gibler, 2012; Gibler and Owsiak, 2018; Owsiak and Vasquez, 2019). The observed correlation may thus be due to a selection effect, namely, that jointly democratic states are thus less likely to find themselves competing over territory to begin with.

Finally, the coefficient estimate for rivalry of 2.04 has a positive and significant relationship with the onset of territorial claims. The percent change in the predicted probability of claim onset is 669, which indicates that rivals are much more susceptible to territorial claims. This implies that states that view each

other as fundamental threats to their security or interests are more likely to become involved in territorial claims. This may be because territory with potential strategic or military value takes on heightened importance when engaged in prolonged hostile confrontations with an enemy, as in the example of the Rann of Kutch discussed above.

3.6 Discussion and Conclusion

In this chapter I seek to answer the question of why leaders begin territorial claims when they do. Although existing studies demonstrate that a variety of dyadic factors and territorial attributes predict claim onset, they do not consider the question of timing. I propose that states issue claims when there are changes in the winning coalition of one of the disputants. Since different coalitions have different preferences and incentives to issue claims, such changes may bring a government to power that has an incentive to issue a claim where the previous government did not.

The findings of my study are consistent with the idea that changes at the domestic level influence the timing of claim onset. The analysis indicates that changes in a state's leader or winning coalition are associated with an increased probability of claim onset. Although the substantive effects are relatively small, they indicate that susceptible dyads are more likely to experience claim onset in years in which there is a coalition change. Previous research indicates that territory that is highly salient to domestic audiences is more likely to become the subject of dispute. My findings complement this research by suggesting that changes in the preferences of the governing elite, and thus the salience of the territory to high-level decisionmakers, affects whether or not states choose to initiate claims over valuable territory. These findings are robust to the inclusion of a large array of structural variables that predict the potential for claims to emerge between states, thus alleviating the problem associated with the inclusion of many dyads that are not at risk of claim onset.

Generally speaking, the results of the cure equation indicate that the structural factors that influence the potential for claims to arise have effects consistent with previous research. The results of the cure equation highlight the importance of using a cure model or other mixture-type model to model the sus-

ceptibility of states to claim onset, rather than using case selection devices such as politically-relevant dyads to eliminate cases from the sample. While contiguity and major power status influence whether claims may emerge, other variables also have a major influence on the probability of claim onset. For example, colonial contiguity has the largest substantive effect of any of the variables in the cure equation. However, limiting the sample to politically relevant dyads would effectively eliminate dyads between colonizers such as Spain and Portugal and their former colonial possessions. Likewise, my findings indicate that rivalries (which often emerge over territorial claims) increase the probability that states become involved in additional territorial claims in the future. Using politically relevant dyads has the potential to eliminate some rivalrous dyads from consideration. I discuss potential ways to extend the theory and findings in this chapter in the concluding chapter.

Chapter 4

Domestic Politics, Contentious Issue Claims, and Economic Interdependence[1]

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Abstract: Does economic interdependence influence how states manage claims over contentious issues? A vast literature explores whether interdependence is associated with a decrease in militarized conflict. However, existing research does not pay much attention to whether interdependence facilitates the peaceful management of claims. I argue that the existence of claims themselves create economic opportunity costs for disputants. This provides domestic groups with an interest in bilateral trade with an incentive to pressure leaders to resolve the issues that states compete over peacefully. I find some evidence that states resolve claims over contentious issues more quickly when the actors involved are dependent on each other for their economic well-being.

4.1 Introduction

Does economic interdependence promote the peaceful settlement of contentious issue claims between states? An extensive body of research argues that states engaged in high levels of bilateral economic activity are less likely to fight militarized disputes. Because military conflict reduces economic activity between states, the prospect of fighting threatens the interests of powerful actors dependent on trade. As a result, these actors have an incentive to pressure leaders to avoid military conflict (e.g., Choi, 2011; Doyle, 1997; Li and Sacko, 2002; Gartzke, Li, and Boehmer, 2001; Gartzke, 2007; Hegre, Oneal, and Russett, 2010; Keshk, Pollins, and Reuveny, 2004; Kim and Rousseau, 2005; Mansfield, 1994; Morrow, 1999; Polachek, 1980; Pollins, 1989a; Reuveny and Kang, 1996; Rosecrance, 1986; Russett and Oneal, 2001; Oneal and Russet, 2002).

Despite the extensive body of literature on trade and military disputes, few studies consider the possibility that interdependence facilitates the resolution of the issues over which states compete (exceptions include Espey and Towfique, 2004; Lee and Mitchell, 2012; Schultz, 2015; Tir and Ackerman, 2009; Zawahri and Mitchell, 2011). Even in the absence of militarized conflict, issue claims can reduce the extent of economic activity between states by influencing individuals' expectations about the future likelihood of military and diplomatic conflict and by creating uncertainty about who possesses jurisdiction over the issue claim. This hinders bilateral cooperation over infrastructure and development projects and obstructs the flow of goods and services between states. As a result, economic actors may be forced to forego potentially lucrative opportunities in favor of less profitable ventures (e.g. Carter and Goemans, 2018; Lee and Mitchell, 2012; Simmons, 2005; "Introduction"). To the extent that they do so, domestic audiences have incentives to pressure leaders to pursue the peaceful settlement of issue claims.

In developing this argument, I focus on three particular issues that the Issue Correlates of War dataset covers; territorial, river, and maritime claims. Since each of these issues is salient to domestic audiences, leaders who wish to remain in office must therefore pay careful attention to the preferences of the domestic supporters who sustain them in office (i.e., the winning coalition). As a result, domestic politics constrain

the range of terms that leaders can accept and narrow the bargaining range between disputants (Fearon, 1994; Putnam, 1988). Because claims over these three issues are highly salient to domestic audiences, leaders who attempt to pursue settlements that contradict the preferences of these supporters risk being removed from power and replaced by leaders who will pursue alternative policies (de Mesquita et al., 2003; Chiozza and Goemans, 2011; Colaresi, 2004; Vasquez, 2009). Competition over these issues also creates the shadow of armed conflict and hinders the flow of economic goods between states (Simmons, 2005). I argue that the economic opportunity costs associated with these claims creates Incentives for domestic interest groups that have a stake in trading with another disputant to support the settlement of these claims. In doing so, it expands the win-sets of leaders and their ability to find mutually acceptable compromises with their opponents (Putnam, 1988).

To test my argument, I analyze how economic interdependence influences states' propensity to peacefully terminate claims using the Issue Correlates of War dataset (Hensel et al., 2008). Controlling for other factors related to the salience of the issue claim, previous conflict management attempts, and the relationship between two states, I find some evidence that economic interdependence is associated with a decreased time until peaceful resolution using a cure model. Overall, this suggests that leaders consider the potential costs and benefits to their constituents when making decisions about whether to pursue peaceful settlement. I discuss the implications of this in the conclusion.

4.2 Economic Interdependence and International Conflict

A vast literature explores the potential pacifying effects of economic interdependence on interstate relations. Scholars advance multiple potential mechanisms to explain this relationship. At the dyadic level, the most common mechanism involves the opportunity costs associated with fighting (e.g., Crescenzi, 2003; Doyle, 1997; Polachek, 1980; Rosecrance, 1986; Russett and Oneal, 2001). Since militarized conflict will likely disrupt trade relations between two states that fight, the possibility of fighting threatens the profits of businesses that engage in trade. These businesses thus have incentives to pressure leaders into avoiding conflict.

Fighting another state threatens the interests of traders in three ways (Anderton and Carter, 2001; Glick and Taylor, 2010; Keshk, Pollins, and Reuveny, 2004; Kim and Rousseau, 2005; Long, 2008; Polachek, 1980). First, fighting directly damages property and infrastructure, threatens individuals' lives, and hinders the transportation of goods across borders. As a result, traders may choose to forego trade with their adversary in favor of trading with other countries or operating solely in domestic markets. In addition, the economic costs of war may hinder the growth of the claimants and thereby lead to reduced demand from domestic buyers.[2]

Second, beyond the direct effects of fighting, states may implement policies that reduce bilateral trade. States often use trade policy to impose costs on their opponents through various means. One way of doing this is by implementing sanctions and confiscating goods and assets as a means of reducing their opponent's gains from trade. In doing so, states hope to hinder their opponent's growth, which potentially diminishes their war fighting capabilities and foments domestic opposition to continued fighting. States may also implement restrictions to deny opponents access to militarily valuable goods and resources (Gowa, 1994). Since reducing trade also harms domestic businesses, states may also resort to implementing trade restrictions as a costly signal of resolve (Gartzke, Li, and Boehmer, 2001; Morrow, 1999).

Third, military conflict may reduce commercial interactions with third parties, creating "second-order" threats to profits. Just as fighting directly threatens the interests of businesses trading between the two disputants, the physical destruction and barriers created by conflict threaten the interests of businesses in third party countries. This, in turn, may deter actors in third parties from conducting business with the disputant states while conflict is ongoing. In addition, states allied with one of the disputants may curtail trade with their ally's opponent as a means of imposing costs on them.

In addition to the opportunity costs that conflict directly produces, the potential for conflict alone can lead firms to curtail trade with another state (Li and Sacko, 2002; Long, 2008; Morrow, Siverson, and Tabares, 1998; Morrow, 1999). Rational firms who anticipate the possibility of future conflict will consider

[2]Military conflict may not eliminate all trade between disputants. Levy and Barbieri (2004) demonstrate that disputants sometimes maintain some level of trade during war. Nonetheless, military conflict is likely to dampen the overall level of trade between two countries.

this when making decisions about who to trade with. As such, firms may choose to forego potentially lucrative relationships in favor of forging safer (but less valuable) relationships with businesses in other states. Even businesses that do not quit trading with the enemy may realize losses. These businesses are likely to increase their prices to compensate for the risks of doing so, which threatens to lower demand for their goods. As a result, they will still realize losses relative to their potential for gains in the absence of the threat of conflict.

For businesses that engage in trade, the opportunity costs associated with conflict can be quite large. Since rational, profit-maximizing businesses pursue the most lucrative arrangements possible, abrogating existing relationships requires businesses to trade with suboptimal partners, especially when the elasticity of supply and demand for traded goods is low (Polachek and McDonald, 1992). Moreover, finding new partners to trade with entails high transaction costs. The process of acquiring suppliers and customers requires a substantial investment of time and resources, particularly when businesses depend on "complex production chains that cross national boundaries many times," (Chaney, 2013, p. 29). As a result, "disrupting existing trade linkages can potentially entail large aggregate welfare and efficiency costs," over the long run (Chaney, 2013, p. 28).

Empirically, the evidence for trade's ability to prevent militarized disputes is mixed. On the one hand, various studies find that higher levels of bilateral economic interdependence are associated with decreases in the probability of violent disputes (e.g., Choi, 2011; Gartzke and Li, 2003c; Gartzke, 2007; Russett and Oneal, 2001; Oneal and Russet, 2002). On the other hand, other studies support the argument that interdependence is associated with an increased probability of conflict (e.g., Barbieri, 2002; Crescenzi, 2003), while others produce mixed or null results (e.g., Choi, 2011; Gartzke, Li, and Boehmer, 2001; Gartzke and Li, 2003c; Gartzke, 2007; Green, Kim, and Yoon, 2001). In short, there is no consensus on whether or how economic interdependence influences conflict. The fact that conflict (or the shadow of conflict) may reduce trade hinders empirical tests of this relationship. Although several studies have tried to model this simultaneous relationship explicitly, they also produce mixed results (Hegre, Oneal, and Russett, 2010;

Keshk, Pollins, and Reuveny, 2004; Kim, 1998; Kim and Rousseau, 2005; Mansfield, 1994; Pollins, 1989a; Pollins, 1989b; Reuveny and Kang, 1996).

4.3 Domestic Politics and the Management of Territorial Claims

Although political leaders are ultimately responsible for making foreign policy decisions, an extensive body of scholarship demonstrates that the preferences of domestic audiences influence which policies leaders are able and willing to pursue. Regardless of regime type, all leaders are beholden to powerful constituencies that have the power to retain or remove them from office, a group known as the winning coalition (de Mesquita et al., 2003). Leaders remain in office by providing coalition members with benefits (in the form of public or private goods) that exceed those which a challenger can offer. Those who pursue policies that conflict with the preferences of the winning coalition will lose support and may ultimately risk being removed and replaced by challengers who promise to pursue alternative policies (see also Chiozza and Choi, 2003; Colaresi, 2004).

As a result, leaders must consider the preferences of the winning coalition when making decisions about how to manage highly salient claims issue claims. Territory, rivers, and maritime zones are three issues that domestic audiences find highly salient, for economic, security, and psychological reasons (e.g., Hensel et al., 2008). First, all these issues have economic value for disputant states. For example, land that contains valuable natural resources, has the potential to sustain large populations, or otherwise constitutes a source of industrial or agricultural value provides domestic audiences with the opportunity to realize substantial economic gains. Rivers affect various economic activities as well, since freshwater is a vital input for a diverse array of economic activities including agriculture, industry, fishing, hydroelectric power generation, mining, sanitation, and commercial navigation. Maritime claims often involve disputes over navigation, fishing, and access to natural resources.

Second, these issues relate to the sovereignty and national security of the state. Attacks on homeland territory constitute a direct threat to citizens and their interests. States often rely on contested border territory as a buffer zone to protect the core of the state. Maritime and river disputes often have strategic

value insofar as they facilitate the movement of naval vessels or provide access to strategic choke points. River borders also protect the state by creating an obstacle for potential invaders, and control of maritime zones is necessary to defend attacks on the coast.

Third, individuals often hold strong emotional and psychological attachments to contested issues. Ethnic, cultural, national, and other identity groups often have historical ties to territory and believe control of this territory is necessary for preserving their identity. This is particularly true when it is part of the homeland or contains ethnic or religious groups linked to domestic audiences (Gibler, Hutchison, and Miller, 2012; Miller, 2013). Rivers and maritime disputes may also carry intangible salience related to national identity, sovereignty, and status, although not to the extent that territorial claims do (Hensel et al., 2008; Sadoff and Grey, 2002). A prime example is the claim between Iran and Iraq over the Shatt-al-Arab. As noted by Swearingen (1988, p. 415):

> …nationalism bestowed a highly charged significance to the disputed lands along the Iran-Iraq border. None has acquired greater symbolic value than the Shatt al-Arab. The progressive diminishment of Iraqi control there by treaty had little actual economic effect, but its psychological importance was large.… Loss of the territory represented a tangible symbol of subjugation and humiliation by imperial powers and an ancient rival. The territorial loss in 1975 was also an embarrassing display of Iraq's failure to become the preeminent regional power and the leader of the Arab world."

Besides the values of the contested issues themselves, the history of interactions between two states with each other conditions whether domestic audiences prefer conflict or cooperation. States with a repeated history of cooperation are more likely to trust each other to adhere to commitments and therefore more likely to cooperate in the future (e.g., Axelrod, 1984). In contrast, when two states share a history of mutual hostile interactions (e.g., militarized disputes, arms races, and forming counter-alliances), domestic audiences develop psychological images of the enemy as fundamentally opposed to their interests (Colaresi, Rasler, and Thompson, 2007; Senese and Vasquez, 2008; Vasquez, 2009). Once these images develop,

domestic actors will be distrustful of the opposing state and wary of compromise, making it difficult for leaders to negotiate with the opposing state.

Due to the salience of territorial, river, and maritime claims, survival-minded leaders pay careful attention to the preferences of their supporters when managing these claims. Any settlement necessarily requires one or both states to relinquish a portion of their claim. Such concessions are thus likely to be opposed by domestic audiences within at least one disputant. The linkages between domestic politics and the management of issue claims can be seen by conceptualizing claims as two-level games (Putnam, 1988). Claims themselves constitute a bargaining problem at the international level, wherein both states compete to obtain some distribution of the contested good. A state and its government may have an inherent interest in controlling these goods for reasons related to security, sovereignty, status, and influence. In order for a claim to be resolved, states must identify a distribution that both prefer over leaving the claim unresolved. When states can identify an agreement that is acceptable to both, the two have an incentive to settle and end the costs associated with the ongoing claim.

However, because leaders are beholden to domestic actors, any agreement must also be acceptable to the winning coalition in both states. Strong opposition to settlement can thus substantially constrain the range of agreements that leaders are willing to pursue. This limits the bargaining space between two disputants, as negotiators will have more difficulty identifying agreements that are acceptable to the leaders of both states and their respective domestic audiences (Fearon, 1994; Putnam, 1988). This can make it difficult for leaders to engage in accommodationist policies at all stages of the process (i.e. engaging in settlement attempts, making agreements, and achieving domestic ratification and compliance). Because claims are salient, leaders' decisions about which policies to pursue against their opponents are heavily influenced by the preferences of domestic groups (Vasquez, 2009).

Generally speaking, leaders tend to engage in more peaceful settlements over highly salient claims, but have a harder time actually reaching enduring agreements over such claims. On the one hand, leaders tend to engage in more peaceful settlement attempts over highly salient claims in an effort to successfully resolve an issue that is valued by domestic audiences (**mitchell2007a**; Allee and Huth, 2006; Hensel,

2001a; Hensel et al., 2008). However, this general trend does not always hold. When opposition to compromise is strong enough, leaders may avoid engaging in peaceful settlement attempts altogether. Particularly in the context of hostile rivalries, even attempting to reach a peaceful settlement can elicit domestic opposition. Leaders who agree to do so are often perceived as weak, caving to enemy pressure, and demonstrating a willingness to make concessions. For example, resistance to settling border claims with China prevented Indian Prime Minister Jawaharlal Nehru from even holding serious talks with Chou En-lai. Unless China agreed to cede the entirety of the contested territory, public opinion favored the use of force over any peaceful settlement. As Maxwell (1970) notes, " It was certain that his agreeing to meet Chou En-lai would be seen and as a surrender to Chinese pressure, a gesture towards appeasement…" (64). When he eventually agreed to meet with Chou in February 1960, Nehru refused to discuss the prospect of any concessions. Although he carefully conveyed that fact to domestic audiences, he still faced increased opposition as a result of the meeting. [3] Domestic opposition can also influence the types of conflict management techniques that states engage in. When engaging in peaceful settlement attempts over highly salient issues, leaders are more likely to use third-party mechanisms such as mediation, arbitration, and adjudication as a means of deflecting the blame for unpopular settlements on international actors (Allee and Huth, 2006; Huth, Croco, and Appel, 2011; Simmons, 2002).

On the other hand, states have a more difficult time actually reaching an agreement over highly salient claims. Prior research shows that states are less likely to make concessions, reach agreements, and comply with the terms of the settlement over highly salient claims (Allee and Huth, 2006; Mitchell and Hensel, 2007; Simmons, 2002; Vasquez, 2009). Moreover, domestic audiences may be more willing to support the use of military force as an alternative to peaceful compromise when claims are highly salient (Hensel, 2001a; Hensel et al., 2008; Huth, 2009; Mansbach and Vasquez, 1981; Vasquez, 2009). This is particularly true when claims are imbued with high intangible salience, since they evoke strong emotional reactions and are often functionally indivisible.

[3] By contrast, when claims are lowly salient, leaders may settle claims in order to focus their attention and resources on other domestic and foreign policy issues (Fravel, 2008).

Beyond making it harder for leaders to reach agreements, the interests of the winning coalition also play a role in determining whether any agreement reached actually resolves the claim, since domestic actors have the power to implicitly or explicitly ratify agreements (Putnam, 1988). [4] The successful implementation of any agreement requires the cooperation of at least some domestic actors who have the power to stymie its entry into force. In democratic states this may take the form of an explicit ratification process wherein certain political leaders must approve the terms of an agreement before it enters into force. Even in nondemocracies, however, leaders may require the cooperation of certain actors, such as the military, in order to implement an agreement.

Since the implementation of agreements is contingent on the approval and ratification of domestic actors, reaching an agreement is not sufficient to ensure that both states actually adhere to its terms. Leaders may be unable to convince domestic audiences that a particular agreement is beneficial and may therefore be unable to convince them to ratify agreements after they have been established. Moreover, if the winning coalition chooses to replace a leader who agrees to an unpopular settlement, their replacements are unlikely to comply. As such, all else equal, states are less likely to adhere to negotiated settlements as the salience of the claim (**mitchell2007a**; e.g., Simmons, 2002; Vasquez, 2009), although the involvement of third parties may help create stronger incentives for states to adhere to these agreements (Fearon, 1995; Walter, 2002).

Although previous literature has explored the conditions that constrain leaders from pursuing accommodationist policies, less has been said about the factors that may encourage domestic audiences to support them. In spite of the factors that may create opposition to a settlement, it is also feasible that there are factors that encourage domestic audiences to support settlement. Where these factors exist, the winning coalition may value cultivating or maintaining a cooperative relationship with another state, which may foster a willingness to compromise over settlements in order to promote such a relationship.

[4] Following Putnam (1988), I use the term "ratification" to refer broadly to any process at the domestic level that is necessary to implement international agreements. This includes formal processes required for a treaty to enter into force, such as approval by a legislature, or informal processes by which other powerful veto players (e.g., the military, bureaucracies, or administration officials) must approve of an agreement in order for it to be implemented effectively.

Drawing on the literature connecting economic interdependence and militarized disputes, I argue that significant economic linkages are one such factor that can engender support for settlement. Existing research partially speaks to the question of whether interdependent states are more likely to cooperate over contentious issues. Lee and Mitchell (2012) find that interdependent states are more likely to engage in peaceful settlement attempts over territorial claims. Espey and Towfique (2004), Tir and Ackerman (2009), and Zawahri and Mitchell (2011) show that economic interdependence increases the probability of agreements over river management. However, these studies focus on whether any agreement is signed, not necessarily those that occur in the context of contentious issue claims. After all, states can cooperate over river management without having disputes over the river itself. None of these studies demonstrate that states are ultimately more likely to resolve their claims peacefully when states depend on each other for their economic well-being.

4.4 Territorial Claims, Opportunity Costs, and Peaceful Conflict Management

Although the existing literature on interdependence focuses on the opportunity costs of fighting, even the existence of an issue claim can create real and potential economic opportunity costs through two mechanisms. First, since each of these issues has the potential to produce militarized conflict, the existence of a claim itself creates the shadow of armed conflict between the two states. In doing so, the existence of claims increases the potential risk to economic actors who conduct business with the other claimant, and thereby increases the incentives for these actors to support the peaceful settlement of the dispute (Lee and Mitchell, 2012; Schultz, 2015; Simmons, 2005). Moreover, as noted above, businesses that anticipate this possibility may alter their expectations about the profitability of trade and forego potentially lucrative relationships with the opposing country, and states may pursue protectionist policies to diminish their opponent's military capacity.

Second, independent of the potential for armed conflict, the mere existence of claims may create opportunity costs by hindering the ability of actors to engage in economic activity with the other state. Issue claims can create opportunity costs by preventing states from building infrastructure and undertaking development projects (individually or jointly) that would facilitate the flow of goods into or across contested areas (Carter and Goemans, 2018; Gavrilis, 2008; Simmons, 2005; Toset, Gleditsch, and Hegre, 2000). Settlement also fosters the development of institutions that are necessary to regulate and facilitate the flow of trade across borders (Carter and Signorino, 2010; Carter and Goemans, 2014; Simmons, 2005). The lack of regulations may also lead states to implement protectionist policies to control the flow of smugglers, traffickers, rebels, and refugees across borders, as well as the various goods they may bring with them (e.g., drugs and weapons) (e.g., Carter and Poast, 2017; Gavrilis, 2008; Simmons, 2005). The empirical research on this relationship has primarily examined territorial claims (e.g., Carter and Goemans, 2018; Schultz, 2015; Simmons, 1999; Simmons, 2002; Simmons, 2005; Simmons, 2006), although river and maritime claims are also likely to produce opportunity costs via similar mechanisms (e.g., by hindering navigation).

Because claims create real and potential opportunity costs for domestic actors, domestic audiences have an incentive to support claim settlement when the potential for economic losses or gains is high (Lee and Mitchell, 2012; Schultz, 2015). The extent to which resolving issue claims stands to increase trade between two countries depends in part on the extent to which the two states trade in the status quo. The more two states depend on trade with each other, the greater incentive domestic actors have to push leaders to resolve claims amicably.

An illustrative case involves the claim between the United States (U.S.) and the United Kingdom (U.K.) over the territory of Oregon.[5] As discussed by McDonald (2009), the ultimate resolution of the claim was shaped by competing domestic factions with differing economic interests within each country. The claim between the two countries dated back to the 1700s, with both countries claiming it based on exploration expeditions and settlements established in the area. Following the War of 1812, the two states made repeated attempts to resolve the dispute by partitioning the territory. However, these attempts only

[5] This section draws heavily on the discussion in McDonald (2009).

resulted in an agreement to jointly occupy the territory while a final agreement was reached. One detail that was of particular concern was whether to partition the territory at the 49th parallel. Although the U.S. indicated a willingness to partition the territory at this line, the U.K. was only willing to accept this line east of the Colombia River, which would allow them to control the territory between the River and the Pacific Ocean.

The situation escalated after the election of James K. Polk as president. In an attempt to unify the party following the contentious proceedings of the Democratic National Convention, the party platform called for the full annexation of both Oregon and Texas in order to unify western and southern members of the party. As a result, Polk found himself forced into taking a hardline position with respect to Oregon. Although the British government indicated a willingness to make concessions in the early 1940s, this new hardline position stymied Polk's ability to accept compromises that did not include the entirety of the territory.

During this period, divisions within the Democratic Party threatened to inflame the dispute. In particular, there was growing pressure by western senators within the party to retain the entire territory and to annex it by force if necessary. This included an attempt to issue a Congressional proclamation that the U.S. owned the entirety of the territory. In spite of this, attempts to push for a more expansive policy were thwarted by opposition from southern and northeastern politicians. In particular, southern Democrats opposed any move that could damage trade ties with Britain, which constituted the largest export market for cotton. Likewise, the Whig Party drew support from northeastern merchants and financiers who also highly valued trade ties with Britain. The economic concerns of these politicians' constituents was their prime motivation for creating opposition to the expansionist pressures of western politicians and created space for Polk to compromise over the territory. Polk and the U.K. government were eventually able to agree to a partition of the territory along the 49th parallel and the cession of the entirety of Vancouver Island to the U.K.

Support for expanded trade between the U.S. and Britain also played a role in Britain's decision to make concessions. As part of a broader free-trade policy agenda, Conservative British Prime Minister

Robert Peel, along with his foreign secretary, Lord Aberdeen, sought to bring the claim over Oregon to a close. In doing so, they hoped to lay the groundwork for expanded trade with the U.S. However, support for expanding free trade within their own party was limited, with the party split between those loyal to Peel and others who favored protectionist policies. As McDonald (2009, p. 154) notes, "Peel and Aberdeen were concerned about the domestic political costs of conceding too much to the United States....The precarious nature of their governing coalition compounded such worries." Ultimately, Peel was able to find support for his free-trade agenda and the settlement of the Oregon claim among the opposition. This provided them with the political leeway necessary to make concessions to the U.S.

The above scenario demonstrates that free trade interests had an integral part in bringing about the resolution of the Oregon claim. Importantly, the debate within both countries did not simply center on whether or not to go to war. Although there was some debate in both countries about whether to use war as a means of extracting concessions (particularly in the U.S.), pro-trade factions also supported making concessions as a means of resolving the underlying claim and expanding the trade relationship between the two states. This enabled the leadership of both states to make concessions. In both cases, the opportunity costs associated with the claim and the potential for the expansion of economic ties following its resolution of the claim shaped the stances that policymakers took with respect to resolving the claim.

Since economic interdependence should increase the pressure on policymakers to settle claims in a peaceful manner, leaders should be more willing to engage in potentially controversial accommodationist policies that facilitate the peaceful resolution of claims when they are highly dependent on trade with another state. In particular, leaders should have greater incentives to resolve claims expediently in order to limit the ongoing costs of continuing a claim. This results in the following hypothesis:

> **Peaceful Resolution Hypothesis**: As the level of economic interdependence between two states increases, the time until two states achieve a peaceful resolution of a claim should decrease.

4.5 Research Design

I test my argument using data on issue claims from the Issue Correlates War Dataset (ICOW), which includes data on territorial claims, river claims, and maritime claims (Hensel et al., 2008). Claims consist of a disagreement between two states over the ownership or use of the contested issue. An official representative of at least one state must make explicit, public statements on behalf of the government regarding the disagreements to be considered a claim. The occurrence of a claim does not depend on whether the states take any particular actions to manage a claim, including militarized disputes and peaceful settlement attempts. The spatial and temporal coverage of the ICOW data varies by issue type. Data on territorial claims is available for the Americas and Western Europe from 1816-2001. Data on river claims is available for the Americas, Western Europe, and the Middle East from 1990-2001. Data on maritime claims is available for the Americas and all of Europe from 1900-2001.

4.5.1 Dependent Variables and Model Specification

The unit of analysis is the claim-year. To test my hypothesis regarding claim resolution, I code a dummy variable for whether a claim ends via nonviolent means in a given year. This variable captures whether the claim was resolved because one disputant threatened or used organized violence to bring about the termination of the claim. This includes cases where settlements were reached through "peaceful" means such as negotiations or third party mediation, but was brought about by the threat or use of force. This variable also captures cases where a state unsuccessfully uses force to attempt to obtain the territory and subsequently drops its claim. This variable is coded one if a peaceful resolution is achieved and 0 otherwise. Cases are coded as censored if a claim is resolved via violent means or is ongoing at the end of 2001.

To model the duration until claim termination, I use a cure model. Figure 4.1 displays the Kaplan-Meier estimates of claim termination. As can be seen, the survival curve has a long tail on the right-hand side starting around year 100. This indicates that roughly 10 percent of claims will never experience peaceful resolution. The cure equation thus models whether a claim could potentially be resolved via peaceful

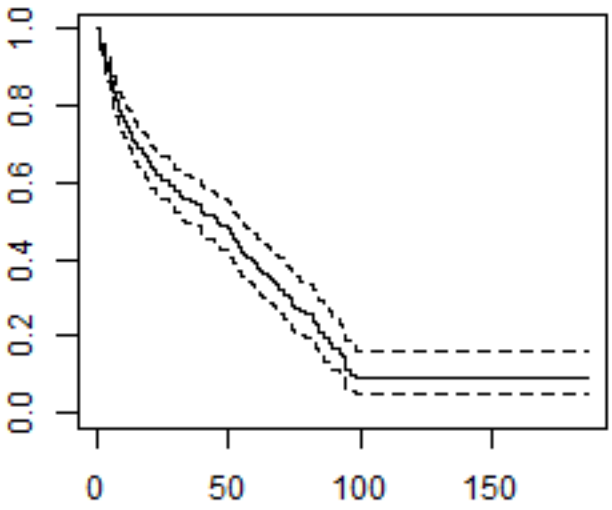

Figure 4.1: Kaplan-Meier Plot of Nonviolent Claim Resolution

means, while the hazard equation models the time until peaceful resolution occurs among those claims which can potentially be resolved.

4.5.2 Primary Independent Variable

Testing my argument requires a measure of the extent to which states depend on bilateral trade for their own economic well-being. States that engage in high levels of bilateral trade in the status quo should generally have more to lose if claims produce diplomatic or military conflict and more to gain by resolving their claims. The extent to which the opportunity costs of fighting influence leaders' decisionmaking depends on the relative political strength of pro and anti-trade groups within the winning coalition. Whether these groups have political influence depends, in turn, on the types of goods and services that dominate a particular country (Hiscox, 2002). Generally speaking, pro-trade groups will have greater economic

power in societies that are already engaged in high levels of trade. The greater the economic power of these groups, the more resources they have to organize and mobilize opposition to policies and the greater influence they have to lobby politicians to resolve claims (Levy, 2009; Rogowski, 1989; Solingen, 1989). As such, I measure economic interdependence using the existing level of trade between two countries.

The appropriate measure used to test theories related to economic interdependence depends on the specific mechanism that relates trade to decisions regarding foreign policy (see, e.g., Barbieri, 2002; Barbieri and Peters, 2003; Boehmer, Jungblut, and Stoll, 2011; Gartzke and Li, 2003b; Gartzke and Li, 2003a; Oneal, 2003; Simmons, 2009, for a discussion of different measures). Since my theory focuses on whether economic actors stand to experience substantial economic harm if bilateral trade with an opposing state is disrupted, I measure the extent to which each dyad member's economic wellbeing is dependent on the other by taking the ratio of bilateral trade to gross domestic product (GDP). Following Barbieri (2002), I then obtain the average level of trade dependence within each dyad by taking the geometric mean of the two countries' dependence measures.[6] Compared to the arithmetic mean, the geometric mean accounts for the fact that dependence scores may be highly asymmetric for two countries. I rescale this variable between zero and one for ease of interpretation. Both trade and GDP are measured in millions of US dollars. Trade data come from the Correlates of War Trade Dataset, Version 4.0 (Barbieri, Keshk, and Pollins, 2009). GDP data come from the Maddison Project (Bolt et al., Maddison Project, version 2018). This measure is lagged by one year to avoid simultaneity bias, which should address concerns about whether any association between claim resolution and trade is due to an increase in trade after the fact.

4.5.3 Control Variables

To control for potential confounding factors, I include control variables for characteristics of the issue claim and characteristics of the dyadic relationship. With respect to the issue claim itself, I control for four factors. First, since the claim management strategies states choose depends on the issue at stake (Hensel et al., 2008; Owsiak and Mitchell, 2019), I control for the type of issue each claim concerns by including

[6] The geometric mean is equal to the square root of the product of the two variables.

dummy variables for river and maritime claims (with territorial claims left out of as a reference group). Second, I control for the salience of each claim using the ICOW salience index. This measure ranges from 0 to 12 based on the characteristics that each claim possesses.[7] Since the bargaining range should be narrower when highly salient claims are involved, I include each of these variables in the cure equation. Third, I control for the history of claim management attempts between disputants by including separate variables for whether states have recently engaged in militarized interstate disputes (MIDs), unsuccessful peaceful settlement attempts, and successful peaceful settlement attempts (Hensel, 2001a; Hensel et al., 2008). Each of these variables constitutes a weighted moving average of the number of conflict management attempts within the previous ten years, with more recent attempts weighted more heavily. In addition, since trade may be depressed by militarized conflict, I include a dummy variable for whether two disputants are engaged in an ongoing MID in a given year (Gibler, Miller, and Little, 2016).

I also control for several dyadic variables thought to influence both the frequency with which states sign agreements and the extent to which they trade. First, I control for differences in power between disputants by including the ratio of the military capabilities of the weaker state to the total capabilities of the two disputants (Singer, Bremer, and Stuckey, 1972; Singer, 1987). Second, I control for whether two states are contiguous (i.e., share a land or river border) (Stinnett et al., 2002). Third, since states with similar regime types overcome commitment problems more easily, I control for whether both states in a dyad are democratic or autocratic (Leeds, 1999). Dyads are coded jointly democratic if both states have a Polity score above 5 and jointly autocratic if both have a score below -5 (Marshall and Jaggers, 2002).

[7] The territory index includes measures of whether it contains natural resources, constitutes a strategic location, is highly populated, is considered part of either state's homeland, , is associated with an identity claim, or has historically been controlled by either state.). Rivers' salience are coded based on whether it contains natural resources, serves highly populated areas, is located in either state's homeland, or is used for navigation, used for hydroelectric power generation, or used for irrigation. The maritime salience index contains indicators for whether it is associated with the state's homeland, constitutes a strategic location, is used for fishing, contains migratory fish stocks, contains oil, or contains other natural resources.

4.6 Analysis

Table 4.1 presents the results of the analysis. Model 1 is a standard Cox proportional hazards model of the time until peaceful claim termination. Positive coefficients indicate that a variable is associated with an increased hazard rate, and thus, a decreased survival time. The estimated coefficient for average trade dependence is positive and significant, indicating that states with higher levels of trade resolve their claims faster than those with lower level of trade. This supports the proposition that the leaders of states with high levels of bilateral trade have greater incentives to facilitate the quick resolution of claims. Exponentiating the coefficient of 1.96 provides a hazard ratio of 7.1, indicating that claims between the most interdependent states are (average trade = 1) have a 610 percent greater hazard rate than the least interdependent states (average trade = 0). The coefficient estimate is the largest of any other coefficient in the model, indicating that the effect of trade is very large compared to other important factors that explain the speed with which states resolve claims.

Model 2 presents the results of a proportional hazards cure model of claim resolution. The second column consists of the hazard coefficients for those variables included in the hazard equation. As with Model 1, positive coefficients indicate that a variable is positively associated with a higher hazard rate. Model 2 provides some evidence that trade is associated with quicker nonviolent claim resolution, although the evidence is not as strong as that produced by Model 1. The estimated coefficient for trade dependence is positive, but is only significant at 0.10 level. The lower significance level may be the result of the fact that the cure model controls for the unobserved heterogeneity between claims that are cured and those that are not. However, the use of a lower threshold of statistical significance may be justified given the data and model used. One issue with cure models is that they tend to be highly demanding on the data. Since only 97 events occur, the cure model may have trouble identifying significant relationships due to a lack of data. Moreover, due to the directional nature of the hypothesis, the use of a one-tailed test is arguably justified, which results in a p-value below 0.05.

Table 4.1: Models of Nonviolent Claim Resolution

	Model 1	Model 2	
	Hazard Coef.	Logit Coef.	Hazard Coef.
Average Trade Dependence	1.438*		0.556*
	(0.746)		(0.324)
Recent MIDs	0.199		0.057
	(0.188)		(0.175)
Recent Failed CM Attempts	-0.384**		-0.118
	(0.129)		(0.08)
Recent Successful CM Attempts	0.941**		0.404**
	(0.107)		(0.089)
Ongoing MID			-0.135
			(0.359)
Issue Salience	-0.04	-0.006	
	(0.052)	(0.053)	
River Claim	0.834**	1.054**	
	(0.318)	(0.272)	
Maritime Claim	-0.692**	-0.54**	
	(0.294)	(0.252)	
Joint Democracy	0.375	0.732**	
	(0.267)	(0.233)	
Joint Autocracy	1.197**	1.137**	
	(0.412)	(0.38)	
Contiguity	-0.299	0.025	
	(0.278)	(0.278)	
Capability Ratio	0.413	1.252*	
	(0.827)	(0.752)	
Intercept		-4.516**	
		(0.382)	
Number of Observations	5227		5227
Number of Failures	97		97
AIC	717		2203
BIC	745		2288

Note: Standard errors in parentheses. Standard errors for Model 2 were estimated using 500 bootstrap replications. ** $p < 0.05$, * $p < 0.10$.

Regardless, the cure model does provide some evidence that there is an association between economic interdependence and claim resolution. Exponentiating the coefficient of 0.56 produces a hazard ratio of 1.74, indicating that the hazard rate among those observations that may potentially experience claim resolution is 74 percent greater for those with the highest level of interdependence than for those with the lowest. Figure 4.2 plots the predicted survival curves across the range of trade dependence, with all other variables held constant at their medians. At the greatest vertical distance between the two curves, the probability that a claim has been resolved is 15 percent greater for a dyad with high levels of interdependence.

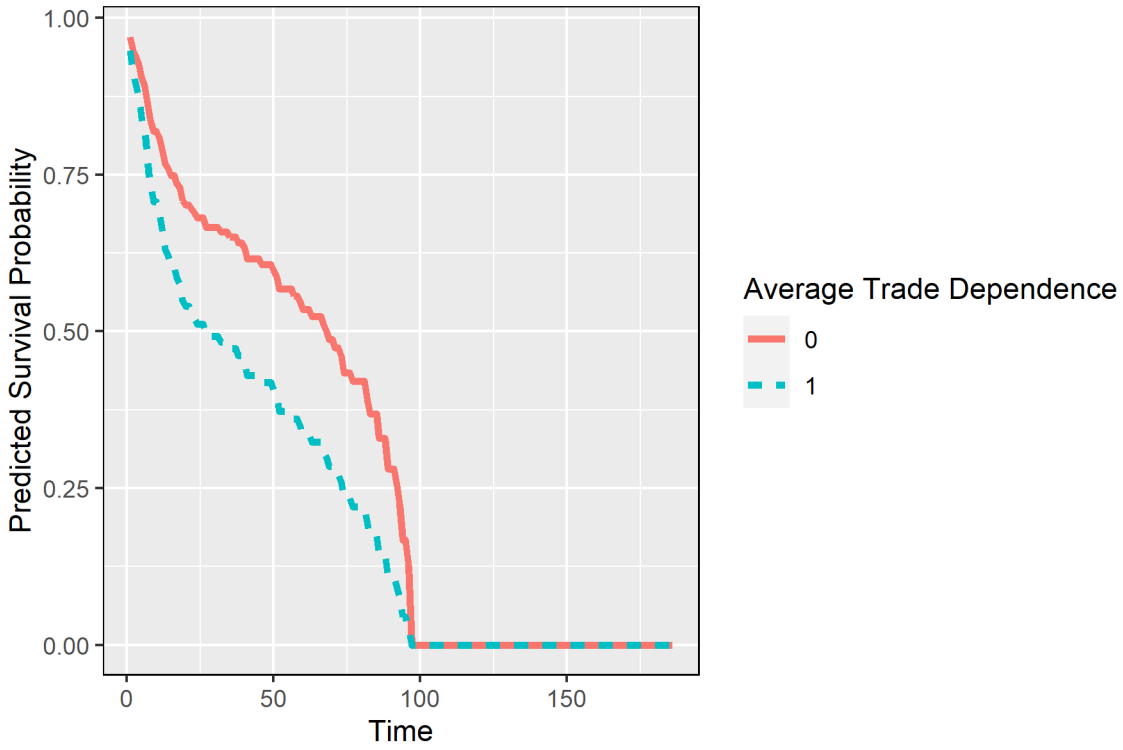

Figure 4.2: Effect of Trade on Claim Resolution

The control variables generally behave as expected, although there are some differences across the two models. Recent militarized interstate disputes are not found to be associated with the probability of peaceful claim termination in either model. Recent failed conflict management attempts are found to be negatively associated with claim termination in Model 1, but not in Model 2, while successful conflict management attempts are found to be positively associated with an increased hazard of claim termination across both models. This implies that the strongest predictor of successful settlements is whether states

have been successfully negotiating in the recent past, rather than whether they have attempted to reach an agreement and failed. This may provide evidence that piecemeal conflict resolution tactics have an important role in facilitating claim resolution (see also Mattes, 2018). Ongoing MIDs are found to be negatively associated with the probability of claim resolution in Model 1, but not in Model 2.

Surprisingly, issue salience is not associated with an increased potential for claim resolution. This may reflect the fact that issue salience has competing effects on whether leaders have an incentive to engage in the peaceful management of claims. On the one hand, the incentives to resolve highly salient claims are greater, which tends to lead to more peaceful settlement attempts, as discussed above. However, highly salient claims may also be more difficult to actually reach agreements over. In this case, the two effects may wash each other out when it comes to the overall duration of a claim, as leaders attempt to settle highly salient claims more but do not have as much success doing so

River and maritime claims are both found to differ significantly from territorial claims across both models. River claims are positively associated with an increased potential for claim termination, suggesting that river claims are easier to resolve via nonviolent means that territorial claims. By contrast, maritime claims are negatively associated with the potential for claim termination. Thus, while territorial claims tend to produce more frequent and more intense violent conflict, these results suggest that maritime claims may be more difficult to ultimately resolve by peaceful means.

With respect to the dyadic variables, only joint autocracy is statistically significant in Model 1. The positive coefficient estimate indicates that dyads consisting of two autocracies have a greater potential to engage in nonviolent claim resolution than mixed dyads. This is consistent with research that shows that jointly autocratic dyads are less likely to experience militarized conflict than mixed dyads (e.g., Weeks, 2012). In Model 2 however, jointly democratic dyads are also found to be better at resolving their claims via nonviolent means than mixed dyads, consistent with democratic peace theory. Contiguity is not found to have a significant effect in either model. Thus, while contiguous states may be more likely to fight over issue claims (especially territory), there is no evidence that these states have a more difficult time reaching a nonviolent resolution to a claim.

Finally, the capability ratio between two disputants is not significant in Model 1 but is significant at the 0.10 level in Model 2. The capability ratio variable ranges between 0 and 0.5, where 0.5 indicates perfectly symmetric capabilities. The positive coefficient indicates that two states are more likely to reach a nonviolent claim resolution the more symmetric the balance of power between them is. This suggests that states are more likely to work cooperatively when the two have relative parity, while they are more likely to experience a violent resolution, or none at all, when capabilities are highly asymmetric. This may be because highly asymmetric dyads provide the stronger state with an advantage when trying to coerce an opponent to relinquish their claims, or because weaker opponents cannot successfully force the resolution of claims against stronger opponents.

4.7 Conclusion

When do states resolve issue claims peacefully? I have argued that the nonviolent resolution of claims may be influenced by the level of economic exchange between two states. Because claims bring with them the possibility of militarization and hinder the ability of states to cooperate over economic policy, domestic groups with an interest in trading with their opponent stand to benefit by resolving claims as quickly as possible. I suggest that economic interdependence provides leaders with domestic incentives to resolve the underlying issue claims that threaten the economic interests of traders.

The results above provide some support for the argument that states which are highly dependent on each other are more likely to pursue and reach peaceful settlements over issue claims. Specifically, the analysis demonstrates that states are more likely to resolve issue claims quickly when they are highly dependent on the other state. Although the association between trade and claim resolution does not reach conventional levels of statistical significance when using a cure model, the results still suggest that there is a fairly high likelihood of a relationship between the two.

These findings have several implications for scholarly research and policymaking. First, economic interdependence has implications for state behavior beyond reducing armed conflict. Specifically, states may be more likely to use peaceful conflict management strategies to resolve disputes between actors that

are highly interdependent. Resolving the underlying issue claim thus eliminates the chance of fighting over the disputed issue. Moreover, this helps shed light on why states resolve issue claims even when the potential for militarization is low.

Second, it contributes to the literature on contentious issues by suggesting that the management of these claims is influenced by trade. While previous research has focused primarily on characteristics of the issues themselves, my findings suggest that states consider the externalities of a claim when attempting to resolve these claims. In particular, when resolving a claim carries economic benefits, leaders may find space to bargain even over highly salient claims.

Third, my findings suggest that policymakers interested in encouraging the settlement of contentious claims may benefit from increasing bilateral economic activity between states. This is relevant to contemporary policy discussions of whether increased trade can lead to more peaceful relations between states. This has implications, for example, for the debate over whether trade ties can help usher in the rise of China peacefully. For example, my findings suggest that policies designed to increase economic integration, such as regional trade organizations, may play a role in promoting international stability.

Chapter 5

Conclusion

Although survival analysis has become a mainstay of quantitative political science, scholars often use it without regard to one of the fundamental assumptions that these models make: that all subjects will eventually experience the event of interest. In many cases, not all observed subjects are susceptible to experiencing the event of interest and, as such, this assumption does not hold. In order to deal with these problems, scholars in biostatistics and related fields have developed cure models, a class of models that relax this assumption. By allowing scholars to jointly model the probability that a subject is susceptible to failure and the timing of failure among those subjects that are susceptible, cure models correct for the presence of cured observations and provide scholars with increased confidence that their results are statistically and substantively sound.

The primary goal of this dissertation has been to show that cure models have the potential to improve research in international relations and political science more generally. Chapter 2 introduced the concept of cured observations and discussed the reasons why including cured observations in a standard duration model can potentially lead to biased and inconsistent coefficient estimates. I also introduced the proportional hazards cure model (PHCM) to political science. Compared to parametric models, the PHCM offers a flexible, semiparametric alternative that does not rely on making parametric assumptions about the shape of the baseline hazard. To facilitate the use of the PHCM, I introduced software in the form of the **tvcure** R package. This software expands the range of data that can be analyzed using the

PHCM by allowing for the incorporation of time-varying covariates. Using a replication study of civil conflict recurrence, I demonstrated that the results obtained from a Cox model and cure model can differ substantially.

It is worth noting that cure models are somewhat niche models intended for use in very particular circumstances. For the majority of phenomena that scholars of political science study, the assumption that all subjects will eventually fail is justified. In these cases, the use of a cure model would needlessly complicate the analysis and should not produce substantially different results from a standard model. Moreover, it is worth noting that the need for a cure model is contingent on the degree to which there are cured subjects in the data. When the number of cured observations is low, the probability that the results will differ substantially decreases.

For this reason, it is important that scholars investigate their data before estimating models in order to determine whether a cure model is necessary. Cure models should only be considered when there is a substantial portion of subjects in the data that are not expected to fail. Moreover, even in the presence of heavy censoring, a cure model is not always appropriate or necessary. As noted in Chapter 2, heavy censoring may result because most of the subjects have simply not experienced the event yet. Whether the presence of a large number of censored observations is due to the presence of cured observations or not is ultimately a theoretical question. If there is reason to believe that all subjects will fail within a time reasonably close to the end of the censoring period, the use of a cure model is not necessary. However, where there is reason to suspect that this is not the case, cure models should be employed instead.

Even when cure models are appropriate, it is not necessarily the case that the results of a standard Cox proportional hazards model will substantially differ from those of the PHCM or another form of cure the model. However, researchers cannot know whether this will be the case before estimating a cure model and comparing the results of the two models. In these cases, the results should be regarded as suspect unless a cure model is used. If nothing else, scholars seeking to make accurate inferences regarding the subject matter they study ought to use these models, where appropriate, out of an abundance of caution.

One issue that has arisen throughout this dissertation is the question of model fit. On the one hand, in Chapters 2-4, the AIC and BIC for the Cox model tended to outperform the cure model. This is surprising given that the cure model matches the theoretical data-generating process that underlies each of these processes much better than that of the Cox model. Ultimately, the question of which model relies on a choice of whether to use a model whose assumptions are clearly violated, or one which seems to fit the data better. Assuming that the goal of an analysis is inference and not prediction, however, it generally makes more sense to choose a model which matches the theoretical nature of the process being examined. Future research should also focus on developing measures of predictive performance for the PHCM, such as an area under the curve (AUC) statistic, which would allow a more rigorous test of the predictive validity of the two models.

One reason why the model fit statistics do not favor the cure model may be related to the rare events nature of the data used. Because the number of subjects that eventually fail is low for the applications in Chapters 3 and 4, it may be that the model has difficulty identifying the susceptible observations. Monte Carlo simulations show that the performance of cure models declines when there are not enough failures in the data and when the overall number of susceptible observations is low (see, e.g., Sy and Taylor, 2000). One avenue for future research is to use simulation studies to examine how these models perform in the context of rare events and how their performance might be improved. For example, the use of undersampling to balance the number of susceptible and nonsusceptible subjects in the data may make it easier for the model to separate susceptible and nonsusceptible subjects.

To further illustrate the usefulness of cure models, Chapters 3 and 4 presented novel theoretical arguments using data that contained cured observations. Chapter 3 assessed the onset of territorial claims. Since most dyads never experience territorial claims, it is thus necessary to account for this fact when modeling their occurrence. In particular, I distinguished between the structural and proximate causes of claim onset. Structural factors, such as fixed dyadic factors, structurally predispose some dyads to experience claim onset. However, the timing of the onset of these claims cannot be explained by such time-invariant factors. To understand why states issue claims when they do, it is necessary to consider

the proximate triggers that can precipitate claims among states. As discussed in Chapter 2, the logic of structural and proximate causes maps well onto the cure model. Structural causes influence whether a subject is susceptible or not, while proximate causes influence when the event occurs to a susceptible subject.

Chapter 4 analyzed the influence of economic interdependence on the peaceful management of territorial claims. Among other things, I examined whether claims are likely to be resolved via nonviolent means using a cure model. bb

5.0.1 Future Directions for Research on Territorial Claim Onset

In Chapter 3, I argued that scholars should pay greater attention to the proximate causes of territorial claims. In doing so, I focused on potential domestic shocks that would disrupt the status quo and lead states to initiate new claims. However, as discussed briefly in Chapter 3, shocks at the international level may also disrupt dyadic relationships in such a way that the expected utility of issuing a territorial claim may increase. Future research may thus consider what kinds of international shocks could potentially lead to the onset of new claims.

One factor that may increase the willingness of states to initiate territorial claims is the occurrence of international crises or conflicts between states. By increasing perceptions of hostility and threat, the occurrence of these events may heighten the extent to which states value strategically or economically valuable territory. The literature on issue salience tends to assume that territory is equally valuable to all actors and that the value of those stakes remains constant over time. In fact, the subjective value of territory may change over time as changes in a state's environment lead them to value certain goods more or less (Mansbach and Vasquez, 1981). In this case, the subjective value of territory that is a potential source of military power can change over time as the security situation of a state changes. This could occur, for example, when tension between a state and its neighbors arises or escalates, producing diplomatic or military crises and/or conflict. Even if such crises do not lead directly to conflict, hostile interactions between states condition their expectations about the future behavior of their opponent and heighten the

probability of future hostile interactions (Vasquez, 2009). By increasing the states' expectations regarding the potential need to use force in the future, crises or conflicts can lead states to place an increased emphasis on controlling potential sources of power than they previously did.

A similar implication of this is that changes in a state's external security environment could lead to changes in its subjective valuation of issuing territorial claims over economically or strategically valuable territory. For example, a state that is highly secure (e.g., one that does not have any significant military threats to its interests) has less use for militarily valuable territory than a state that faces a high degree of insecurity (e.g., if they are embroiled in multiple rivalries with neighboring states). Thus, changes in this state's dyadic relationship with other powers may increase or decrease the subjective utility of pursuing new claims over such territory as their security situation changes. For example, the termination of rivalries with other states, may free up resources for that state to pursue other territorial claims and therefore provide them with incentives to

5.0.2 Future Directions for Research on Economic Interdependence and Issue Claim Management

The findings in Chapter 4 suggest three avenues for future research. First, researchers may wish to examine whether the effects of economic interdependence are contingent on the salience of claims. It is possible that the increased incentives for domestic audiences are more important in the context of highly salient claims which are more likely to face opposition. On the other hand, the effects of economic interdependence may be weaker in the context of highly salient claims due to the fact that it is more difficult for trade to overcome opposition to the settlement.

Second, it may be of interest to examine whether the size of the effects of interdependence vary based on issue types. For example, since territorial claims are generally regarded as more salient than other issues, the effects of interdependence may be stronger or weaker over these claims (for the same reasons as overall claim salience). Likewise, the extent to which claims over different issues create opportunity costs may

differ. As a result, economic interdependence may increase support for some issue claims more than others.

Third, future research could examine whether economic interdependence has disparate effects on different types of conflict management. For example previous literature suggests that leaders are more likely to choose arbitration and adjudication when domestic opposition to settlement is high (e.g., Allee and Huth, 2006). This suggests that dyads with low levels of interdependence may be more prone to resort to these strategies, since support for settlement in these states will be lower.

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Appendix A

Supplementary Materials for Chapter 2

A.1 Estimating Semiparametric Cure Models using Expectation Maximization

Since the distribution of S_u is left unspecified, maximizing the full likelihood of the semiparametric cure model using standard Newton-Raphson type algorithms is not possible. Standard Cox proportional hazards models make use of the partial likelihood method to eliminate S_u from the likelihood. However, due to the more complex form of the semiparametric PH cure model, this is not possible.

As such, semiparametric cure models require an estimation technique that can maximize the full-likelihood and provide estimates of S_u. Peng and Dear (2000) and Sy and Taylor (2000) suggest using an expectation-maximization (EM) algorithm.[1] The complete data log-likelihood is given by

$$\mathcal{L}_C(\boldsymbol{\beta}, \boldsymbol{\gamma}, H_0) = \prod_{i=1}^{n} p_i^{y_i}(1-p_i)^{1-y_i} \prod_{i=1}^{n} \{h_u(t_i)^{\delta_i y_i} S_u(t_i)^{y_i}\}, \tag{A.1}$$

[1] Alternatively, the PHMC can be estimated using Markov Chain Monte Carlo simulations (Kuk and Chen, 1992), multiple imputation (Lam, Fong, and Tang, 2005), and Bayesian techniques.

where the first product term contains the parameters related to the incidence component of the model and the second contains the parameters related to the latency component. The log of Equation A.1 can be expressed as the sum of two likelihood functions:

$$\mathcal{L}_1(\boldsymbol{\beta}) = \sum_{i=1}^{n} \Big\{ y_i \log(p_i) + (1 - y_i) \log[1 - p_i] \Big\}, \tag{A.2}$$

$$\mathcal{L}_2(\boldsymbol{\gamma}, S_u) = \sum_{i=1}^{n} \Big\{ y_i \delta_i \log h_u(t_i) + y_i \log[S_u(t_i)] \Big\}. \tag{A.3}$$

The E-Step of the EM algorithm takes the conditional expectation of the complete log-likelihood function with respect to the unobserved y_i values for the given current estimates of $\boldsymbol{\beta}$, $\boldsymbol{\gamma}$, and S_{u0}.[2] Although y_i is not observed, the expectation of y_i conditional on the observed data and current parameter estimates is sufficient to conduct this step since Equations A.2 and A.3 are linear functions of y_i. Let $w_i^{\{m\}}$ denote the conditional expectation of y_i given the current parameter estimates $\Theta^{\{m\}} = (\boldsymbol{\beta}^{\{m\}})$, given by

$$w_i^{\{m\}} = E(y_i | \delta_i, t_i, \mathbf{x}_i, \mathbf{z}_i) = \delta_i + (1 - \delta_i) \left(\frac{p_i S_u 0(t_i)}{1 - p_i + p_i S_u 0(t_i)} \right). \tag{A.4}$$

For uncensored individuals ($\delta_i = 1$), the value of y_i is known and $w_i^{\{m\}}$ reduces to 1. For censored individuals, $w_i^{\{m\}}$ reduces to the probability of the i^{th} censored individual being uncured. Put otherwise, for censored individuals, $w_i^{\{m\}}$ "represents a fractional allocation to the susceptible group," (Sy and Taylor, 2000, p. 229). Substituting $w_i^{\{m\}}$ for y_i in Equation A.2 and Equation A.3 produces

$$\mathcal{L}_1(\boldsymbol{\beta}) = \sum_{i=1}^{n} \Big\{ w_i^{\{m\}} \log(p_i) + (1 - w_i^{\{m\}}) \log[1 - p_i] \Big\}, \tag{A.5}$$

$$\mathcal{L}_2(\boldsymbol{\gamma}, S_u) = \sum_{i=1}^{n} \Big\{ w_i^{\{m\}} \delta_i \log h_u(t_i) + w_i^{\{m\}} \log[S_u(t_i)] \Big\}. \tag{A.6}$$

The M-step involves maximizing the log-likelihood functions of Equation A.5 and Equation A.6 with respect to the unknown parameters $\boldsymbol{\beta}$, $\boldsymbol{\gamma}$, and S_{u0} using the current values of $w_i^{\{m\}}$. Since Equation

[2] Initial estimates for w_i are derived by setting all censored cases to 0 and all uncensored cases to 1.

A.5 does not depend on the value of $\boldsymbol{\beta}$ or S_{u0}, estimates of $\boldsymbol{\gamma}$ can be obtained by maximizing Equation A.5 using standard binomial regression routines. Similarly, since Equation A.6 does not depend on the value of $\boldsymbol{\gamma}$, estimates of $\boldsymbol{\beta}$ and S_{u0} can be obtained by maximizing Equation A.6 using standard Cox PH routines (Peng, 2003; Cai et al., 2012), where S_{u0} is estimated using Breslow (1972)'s version of the Cox PH model, given by

$$\hat{S}_0(t|Y=1) = \exp\left(- \sum_{j:t_{(j)} \leq t} \frac{d_{t_{(j)}}}{\sum_{i \epsilon R(t_{(j)})} w_i^{\{m\}} \exp(\mathbf{x}_i' \hat{\boldsymbol{\beta}})} \right), \tag{A.7}$$

where $d_{t_{(j)}}$ is the number of events at time $t_{(j)}$ and $R(t_{(j)})$ is the set of observations that are at risk of failure at $t_{(j)}$.[3]

Once estimates of $\boldsymbol{\beta}$ have been obtained, estimates of the conditional baseline survival function, S_{u0}, are obtained using profile likelihood methods. This typically involves using a modification of Breslow (1972)'s likelihood for the Cox PH model.[4] Once the estimates of $\boldsymbol{\beta}$, $\boldsymbol{\gamma}$, and S_{u0} are obtained, the E-step is repeated using the newly obtained estimates to re-estimate the value of $w_i^{\{m\}}$. Estimation proceeds by iterating between the E and M steps until the values of the parameters converge. Fang, Li, and Sun (2005) demonstrate that the maximum likelihood estimates of S_u are consistent and asymptotically normally distributed.

The estimator defined in Equation A.7 may not approach zero for t greater than the maximum observed failure time, $t_{(k)}$. Taylor (1995) characterizes this as an identifiability problem in which the tail of the S_u distribution is difficult to estimate. Taylor (1995) suggested imposing the constraint that $S_{u0} = 0$ for $t > t_{(k)}$. This constraint is achieved by setting $w_i^{\{m\}} = 0$ for observations where $t > t_{(k)}$ in the E-step. This effectively eliminates the identifiability problem and leads to more stable parameter estimates and faster convergence (Taylor, 1995). In addition, this constraint may lead to less biased estimates of $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ in the presence of high levels of censoring. Substantively, this constraint implies that most of the subjects

[3] This constitutes using a modified version of the Nelson-Aalen estimator to estimate the baseline cumulative hazard and then estimating the survivor function using $S_{u0} = \exp - H_0(t|\hat{Y} = 1)$.

[4] Sy and Taylor (2000) demonstrate that S_u can also be estimated using the nonparametric full likelihood method of Kalbfleisch and Prentice (1980).

left at the end of the observation period are members of the cured group and are unlikely to fail in the future. Put otherwise, the use of the semiparametric PH mixture cure model may not be appropriate when the follow-up period of a study is not long enough for most of the susceptible individuals to have already failed.

Because cure models tend to be demanding on the data, they are prone to issues of non-convergence or unstable coefficient estimates in small samples or in samples in which there are very few failures or very few cured observations (although the constraint on the survivor function discussed above improves the performance of the cure model in this regard (Taylor, 1995; Sy and Taylor, 2000)). In addition, cure models may be prone to complete or quasicomplete separation (i.e. infinite coefficient and variance estimates) in either the incidence or latency components. This is particularly likely in small samples and when there are very few failures or very few cured subjects (Sy and Taylor, 2000). Although this is difficult to deal with without omitting covariates from the model, the use of Bayesian priors to ameliorate these issues is an area of active research (Han, Zhang, and Shao, 2017).

Since estimates of the variance of the estimated parameters are not directly available from the EM algorithm, alternate methods of estimating the standard errors are necessary for hypothesis testing. [5] As such the standard errors of the coefficients are typically estimated using a nonparametric bootstrap with replacement to (e.g. Peng, 2003; Cai et al., 2012).

[5] Although scholars have derived analytical approximations of the standard errors, including Peng and Dear (2000), Sy and Taylor (2000), Fang, Li, and Sun (2005), and Xu, Baines, and Wang (2014), these estimates tend to be unstable and are difficult to estimate when more than a few covariates are included. In addition, these formulas cannot be easily be adapted to accommodate variations or extensions of the semiparametric PH mixture cure model.

A.2 Descriptive Statistics for Replication Analysis

Table A.1: Descriptive Statistics for Replication Analysis

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Duration	3931	14.38	13.06	1.00	4.00	21.00	59.00
Civil war Recurrence	3931	0.04	0.19	0.00	0.00	0.00	1.00
Motivation-Decreasing PCJ	4288	0.32	0.53	0	0	1	3
Opportunity-Decreasing PCJ	4288	0.50	0.69	0	0	1	3
Power Sharing	4288	0.06	0.24	0	0	0	1
Military Personnel	4114	5.68	1.06	4.61	4.82	6.16	8.68
GDP/Capita Growth	3978	0.02	0.10	−0.69	−0.01	0.05	1.90
GDP/Capita	3985	21.66	1.00	18.95	20.79	22.40	24.28
Ethnic Conflict	4288	0.39	0.49	0	0	1	1
Democracy	4288	0.21	0.40	0	0	0	1
Conflict Duration	4288	0.78	0.93	0	0	1.4	4
Battle Deaths/Capita	4108	−10.14	2.73	−17.60	−12.04	−8.04	−2.88
Victory	4288	0.49	0.50	0	0	1	1
Peace Agreement	4288	0.10	0.30	0	0	0	1
Number of Rebel Groups	4288	1.30	0.56	1	1	2	4
Peacekeeping Operations	4288	0.10	0.30	0	0	0	1
Post-Cold War	4288	0.56	0.50	0	0	1	1

A.3 Fully Specified Cure Model

For the sake of comparison, Table A.2 presents the results of a cure model that includes all variables used in Models 1 and 2 from Chapter 2 in both equations of the cure model. Three differences from the model specified based on my theoretical expectations are apparent. First, the peacekeeping variable, which was significant in Model 1 and insignificant in Model 2, becomes significant again.

Second, military personnel remains significant, but becomes significant in a different equation. Whereas it was previously negative and significant in the hazard equation, in the fully specified model, it is significant in the cure model but not the hazard model when included in both equations. This suggests a different interpretation regarding the effect of military personnel. Instead of merely reducing the time until conflict recurrence, the fully specified model suggests that states with stronger militaries are altogether less likely to experience a repeat civil war. Third, GDP per capita becomes insignificant in the fully specified model. This is somewhat puzzling, given the well-established effect of economic well-being on the probability of civil war in the literature.

The AIC for the fully specified model is 2959, while the AIC for Chapter 2, Model 2 is 2977. The BIC for the fully specified model is 3152, while the BIC for Chapter 2, Model 2 is 3101. The AIC is thus higher for the theoretically specified model, indicating that the fully specified model performs better. However, contrary to the AIC, the BIC is higher for the fully specified model. It is thus inconclusive whether the theoretically or fully specified model fits the data better. For the sake of parsimony, and to demonstrate the process of selecting which variables to place in each equation, I chose to present the results of the theoretically specified model in the body of the main text.

Table A.2: Cure Model with All Independent Variables Included in Both Equations

	Logit Coef.	Hazard Coef.
Motivation Post-conflict Justice	-0.371	-0.168*
	(0.221)	(0.055)
Opportunity Post-conflict Justice	-0.137	0.007
	(0.173)	(0.06)
Power Sharing	-0.451	-0.058
	(0.454)	(0.673)
Peacekeeping	-0.888*	-0.083
	(0.443)	(0.085)
Military Personnel	-0.425*	-0.012
	(0.115)	(0.043)
GDP Growth	-0.577	-0.217
	(0.888)	(0.299)
ln GDP per Capita	-0.211	0.06
	(0.108)	(0.042)
Ethnic War	0.063	0.031
	(0.222)	(0.063)
Democracy	-0.078	0.02
	(0.225)	(0.076)
Conflict Duration	-0.032	-0.054
	(0.121)	(0.032)
Battle Deaths per Capita	-0.07	0.02
	(0.046)	(0.014)
Victory	-0.949*	-0.008
	(0.214)	(0.095)
Peace Agreement	0.181	0.007
	(0.443)	(0.083)
Number of Rebel Groups	1.036*	0.066
	(0.12)	(0.035)
Post-Cold War	0.377*	-0.012
	(0.181)	(0.087)
Intercept	1.982	
	(2.393)	
Number of Observations	3773	
Number of Failures	154	
AIC	2959	
BIC	3152	

Note: Standard errors in parentheses. * $p < 0.05$.