STATE WILLINGNESS TO INITIATE AND MANAGE INTERSTATE RIVER CLAIMS

by

SAMUEL T. DRIGGERS

(Under the Direction of Andrew P. Owsiak)

ABSTRACT

Why do states initiate and manage interstate river claims over some transboundary river basins but not others? Although recent research indicates that geographic and institutional factors render some transboundary river basins more prone to contention or cooperation, few scholars provide a causal mechanism linking transboundary rivers to these outcomes. This analysis addresses the present gap, linking scholarship of domestic institutions with transboundary river research. I argue that states are more willing to initiate interstate river disputes when substantial proportions of a domestic leader's political support reside within a river basin. Additionally, I contend that interstate river disputes are most likely to be unmanaged or negotiated when one disputant is comparatively more willing to protect transboundary river access than the other, while disputes are most likely to result in militarization when both states maintain equal willingness. An empirical analysis of transboundary river dyads from 1900-2001 uncovers substantial support for this argument.

INDEX WORDS: transboundary rivers; interstate river disputes; negotiation; hydropolitics; conflict management; selectorate theory

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CHAPTER 1

INTRODUCTION

Vital to the economic livelihood of riparian states, transboundary rivers are often cited as particularly dangerous flashpoints within the international environment (Petersen-Perlman and Wolf 2017). Yet, although transboundary river basins are quite common (McCracken and Wolf 2019), freshwater access has only developed into a central contention for riparian states within a small percentage of the globe's 310 transboundary river basins. In fact, between 1900 and 2001, data from Hensel and Mitchell (2017) indicates that all 143 cases where a state's leadership initiated an interstate river claim – a scenario where an official representative of one state demands that another state modify its usage of shared, transboundary river resources (Hensel 2013) – occurred in just 14% of all transboundary river basins. What caused these basins to be more prone to interstate river claims than others?

Moreover, even among inherently contentious cases in which interstate river claims exist, some claims are more fiercely contested than others. For instance, between 1900 and 1973, Argentina and Uruguay maintained overlapping claims to jurisdiction and usage of the transboundary La Plata River, a dispute that would ultimately culminate in three separate instances of military confrontation. Yet, between 1941 and 1983, Paraguay and Argentina's dispute over hydroelectric power generation and water usage within the La Plata River Basin was peacefully negotiated, never rising to military action. What caused these claims to be more prone to peaceful or conflictual management?

For the past three decades, scholarship has engaged in a broader theoretic debate through the analysis of transboundary rivers: whether environmental scarcity impels conflict or cooperation (Koubi et al. 2014). Although this academic deliberation produced little understanding of the causal mechanisms at hand in interstate river claim onset and management, scholars weary of the debate have begun to provide novel, theoretically sound, and methodologically rigorous assessments of transboundary river relationships (Bernauer, Bohmelt, and Koubi 2012; Koubi 2019). Linking geographic, institutional, and dyadic factors to outcomes of interest in international relations scholarship (principally conflict and cooperation), their inquiry has provided some understanding of how particular characteristics of transboundary basins increase the likelihood of claim onset and management. Yet, as observed by Brochmann and Gleditsch (2012, p. 520), the varying willingness of states to initiate and manage claims over contentious transboundary rivers "has remained a somewhat more elusive concept." Although previous works assist in identifying *where* interstate river claims are most likely to occur and *how* they are most likely to be managed, scholarship has still been unable to articulate *why* states initiate and manage claims over some contentious transboundary rivers but not others.

Drawing on Most and Starr's (1989) conception of opportunity and willingness, Bueno de Mesquita et al.'s (2003) selectorate theory, and the bargaining model (Blainey 1988; Fearon 1995), I seek to expand upon opportunity-centered analyses of transboundary river relationships, incorporating an understanding of how state willingness to act in the international environment varies as a result of domestic phenomena. First, I argue that the percentage of a state's population residing within a river basin affects the willingness of the state's domestic political leadership to initiate an interstate river claim against another state. Assuming that river basins with larger percentages of the state's total population are more likely to contain larger percentages of a

leader's political support, domestic political leaders are more constrained by the interests of these river basins. Thus, when a river basin experiences some impediment to freshwater access as a result of another riparian state, river basins with larger percentages of the state's total population are more able to wield their influence over domestic political leadership, impelling the leader's initiation of an interstate river claim against the other riparian state.

Second, I contend that the size of a state's winning coalition – the members of the state's total population who maintain political influence over their domestic political leadership (Bueno de Mesquita et al. 2003) – affects the willingness of the state's domestic political leadership to initiate an interstate river claim against another state. As previously noted, all domestic political leaders likely feel pressure from their winning coalition to initiate an interstate river claim if large percentages of the state's populace are negatively impacted by transboundary river issues. I argue, however, that domestic political leaders of large winning coalition states (e.g., democracies) are more likely than domestic political leaders of small winning coalition states (e.g., autocracies or monarchies) to initiate an interstate river claim when small percentages of the state's populace are negatively impacted by transboundary river issues. This divergence in willingness to initiate interstate river claims between large and small winning coalition states would occur because leaders of large winning coalition regimes satisfy their many supporters through provision of public goods such as infrastructure, social programs, and – as is emphasized here – defense of the state's public resources. Meanwhile, leaders of small winning coalition regimes can more easily satisfy their few supporters through the provision of private goods such as direct payments and allowance of graft.

Third, I argue that, once an interstate river claim exists, these same domestic indicators of state willingness to engage over transboundary river issues – the percentage of the state's

population residing within a river basin and the size of the state's winning coalition – play a substantial role in determining how a claim is managed. According to Blainey (1988) and Fearon (1995), the comparative willingness of disputant states to abandon interstate bargaining in favor of conflict determines the bargain that is ultimately struck. In other words, once disputants exchange information about their willingness to abandon bargaining in favor of conflictual action, the more willing disputant will receive a more favorable outcome than the less willing disputant, and conflict is most likely to occur when both disputants maintain equal willingness to engage in conflictual action. Comparing each disputant's willingness to engage over a particular transboundary river basin, I theorize that disputes are most likely to result in the status quo or peaceful negotiations if one disputant state is more willing than the other disputant state to eschew bargaining in favor of militarization; disputes are most likely to result in militarization if both disputant states are equally willing to abandon bargaining in favor of conflictual action.

Empirical analysis of the hypotheses developed within this article primarily receive robust empirical support. As expected, the higher the percent of a state's population residing within a transboundary river basin, the greater the likelihood that a state initiates an interstate river claim over the basin. Additionally, large winning coalition regimes are found to be more likely than small winning coalition regimes to initiate river claims over river basins holding smaller percentages of the state's total population. In my analysis of claim management, I demonstrate that existing interstate river claims are least likely to be managed when the claim's targeted state (the state accused of misuse of disputed freshwater resources) is comparatively less willing to bargain over transboundary river issues than the challenger state (the state disputing usage of freshwater resources). Additionally, empirical analysis indicates that existing interstate river claims are most likely to be managed by negotiation when the claim's challenger state is

comparatively less willing to bargain over transboundary river issues than the targeted state. Unexpectedly, however, empirical analysis provides evidence that militarization is most likely when the claim's challenger state is comparatively less willing to bargain over transboundary river issues than the targeted state, perhaps indicating that the bargaining model of war may lack explanatory power within the context of interstate contentions in which conflict is frequently an economically unviable alternative.

Although findings from the analysis herein do not confirm all expectations presented within this paper, they do provide substantial evidence that the varying willingness among states to initiate and manage interstate river claims is a significant predictor of claim onset and management. Moreover, with the inclusion of state willingness alongside opportunity-related factors, this article offers the first attempt to reach beyond mere correlational linkages between opportunity-related variables and interstate river claim initiation or management. The causal mechanisms specified here – though still deserving of future research – offer a more full, explanatory answer for *why* some rivers develop river claims and *why* some claims are managed peacefully, via conflictual action, or languish unresolved.

CHAPTER 2

LINKING TRANSBOUNDARY RIVERS TO INTERSTATE CONTENTION

Transboundary Rivers as a Threat to International Cooperation

According to Linnerooth-Bayer (1986), no natural resource has as many uses as a river. Beyond human consumption, perhaps the most basic use of freshwater, river water is crucial for agricultural irrigation, industrial processes, urban sanitation, hydroelectric power generation, commercial fishing, recreational activities, the transit of people and goods, and the demarcation of political boundaries. Yet, unlike resources such as timber or metal ores, which may be divided along an international border and managed at the state level, freshwater river resources frequently flow in and out of state borders. Indeed, three-fifths of all freshwater flows across state borders, often forming vast transboundary river basins shared among multiple riparian states (Wolf et al. 1999). As a result, Mandel (1992, p. 25) argues that state "control, jurisdiction, and sovereignty are much more complicated than when dealing with static land resources."

Unlike most interstate interactions over resources, hydropolitics – interstate discourse concerning water allocation, access, and distribution (Mollinga 2008) – remains uniquely regional. Even as globalization increasingly allows for hydrocarbons, coffee, and Coca-Cola to enter worldwide markets, freshwater is typically cost ineffective to transport from one water basin to another, a result of human need for its continual, profuse, and reliable supply. As a result, communities residing within transboundary river basins are frequently reliant on other riparians for adequate access to freshwater resources (Wolf 1998). Furthermore, this reliance is compounded by geographic and climactic factors. Gleick (1993) finds that freshwater is highly

uneven in its global distribution, with significant disparities among states; 97% of Egypt's and 70% of Paraguay's freshwater river flow, for example, originates from outside the two countries, while other states such as Brazil and Switzerland exhibit substantially less reliance on freshwater from beyond their borders. Long-term climactic trends and anthropogenic climate change, too, are increasingly rendering some states more reliant on transboundary river basins than others; globally, climactic variables are upsetting current norms in freshwater allocations by decreasing rates of annual precipitation in dry and arid regions, increasing rates of annual precipitation in tropical regions, increasing the frequency of flood events, and exacerbating the unpredictability of rainfall (Peel, McMahon, and Finlayson 2004; Chou et al. 2009; Dai et al. 2009; Trenberth 2011; Lehmann, Coumou, and Frieler 2015; Donat et al. 2016).[1] In short, transboundary freshwater serves as a crucial and irreplaceable resource for states, and reliance on transboundary waters is often quite extensive.

Within transboundary river basins, many communities' economic livelihood is vulnerable to the actions of other riparian states within the same transboundary river basin. Unfortunately, although there exist Pareto-efficient outcomes in state usage of transboundary freshwater rivers (i.e., sustainable, apportioned, and fair freshwater usage), LeMarquand (1977) contends that riparian states shift toward Pareto-inefficient freshwater usage because of their own, national economic and political interests. And when one riparian state capitulates to these incentives, interstate contentions over freshwater usage and access may arise among riparian states throughout the basin (Gleick 1993; Wolf 1998; Levy and Sidel 2011; Petersen-Perlman, Veilleux, and Wolf 2017).

[1] The role of anthropogenic climate change in modifying river freshwater flow is widely accepted within the scientific community; the role of this change in promoting cooperation or conflict, however, is widely disputed. Broader evidence generally finds that, although anthropogenic climate change may be a factor in promoting conflict, it has a weak or null causal relationship (Gleditsch 2012; Buhaug et al. 2014; Koubi et al. 2014; Mach et al. 2019).

This game-theoretic relationship is commonly observed in the international environment. In the Ebro River Basin, for instance, the government of France attempted to divert and dam freshwater flowing out of Lake Lanoux for hydroelectric power generation despite Spanish claims that the project would negatively impact the country's agricultural interests in the Catalonia region (Kornfeld 2019). In the Colorado River Basin, the United States' discharges of highly saline waters from irrigation and agricultural projects, compounded by an already-constrained river flow reaching Mexico downstream, severely damaged Mexican croplands (Mandel 1992). In the Harirud River Basin, the political leadership of Afghanistan constructed the Afghan-India Friendship Dam (formerly called the Salma Dam) in order to satisfy the country's "growing water demand, economic development, and poverty alleviation [efforts]" whilst simultaneously "improving Afghanistan's current geopolitical position with regard to downstream neighbors" (Nagheeby and Warner 2018, p. 853) – despite Iranian and Turkmen concerns that the dam would hamper the flow of freshwater by between 30 and 80% (Peterson 2013; Nagheeby 2014). Summarily, transboundary river resources, like many shared, interstate resources, suffer from the tragedy of the commons (Hardin 1968).

Early Efforts Linking Transboundary Rivers to Conflict and Cooperation

Although scholarship generally agrees that use of transboundary river water is frequently a source of disagreement among states, there exists some debate about the mechanisms that link resource-related contention to the main outcomes of interest in international relations scholarship — namely, conflict and cooperation. On one side of the debate, scholars of the neo-Malthusian school contend that resource scarcity impels conflict in an anarchic international environment (Bernauer, Bohmelt, and Koubi 2012; Koubi 2019). So-named for their association with the

ominous works of Malthus (1798), who theorized that famines, diseases, and conflicts would result from exponential human population growth and consumption, neo-Malthusians found their arguments in the simultaneous trends of an increasing demand for freshwater – the result of human population growth and rising rates of consumption – and a decreasing supply of freshwater – a result of anthropogenic climate change and human abuse of present water supplies (Mandel 1992; Gleick 1993; Homer-Dixon 1994; Suliman 1998). Contending that these trends foster zero-sum disputes over the usage of transboundary freshwater, they predict that actors will protect their resource access through conflictual – though not necessarily violent – engagement in the international environment (Homer-Dixon 1994; 1999). Yet, neo-Malthusian causal linkages between this scarcity-induced conflictual engagement and violent political conflict are frequently vague and varied – if articulated at all (Bernauer, Bohmelt, and Koubi 2012). Gleick (1993, p. 83), for instance, ambiguously contends that whether an interstate contention over scarce freshwater arises to violent conflict is ultimately "affected by the economic, cultural, and sociopolitical factors at work in a given country or region." Kelley et al. (2015), articulating a more specific causal linkage, argues that environmental scarcity induces migration, which in turn impels intra- and inter-state violent political conflict. Homer-Dixon (1994; 1999) argues that environmental scarcities provoke domestic frustration that weakens state institutions, allowing for increased opportunity for inter- and intra-state violent conflict. And, for Mandel (1992, p. 26), freshwater scarcities that develop among neighboring states will only impel violent conflict if the neighboring states have a preexisting "non-cooperative" relationship, because "this condition induces a predisposition to perceive the river basin predicament and other riparian states' motivations in a hostile way." Thus, even when causal mechanisms are explicit in neo-Malthusian works, they maintain little consistency from one study to another.

Disputing neo-Malthusian work, scholars of the cornucopian school contend that resource scarcity is not a determinant factor in violent political conflict (Bernauer, Bohmelt, and Koubi 2012; Koubi 2019). Like neo-Malthusians, cornucopian scholars acknowledge that inverse supply and demand pressures on freshwater resources impel contentions over water use. Yet, cornucopian scholars find that not only has intra- and inter-state conflict rarely occurred as a result of environmental scarcities, but also that cooperation is its predominant outcome (Wolf, Yoffe, and Giordano 2003; Theisen, Holtermann, and Buhaug 2011; Brochmann and Gleditsch 2012; Koubi et al. 2014; Petersen-Perlman and Wolf 2017; Petersen-Perlman, Veilleux, and Wolf 2017). Explaining this relative lack of conflict over scarce resources, some cornucopian scholars contend that resource scarcity engenders human innovation and adaption (Frey and Naff 1985; Boserup and Schultz 1990). For instance, because resource scarcity is a function of supply and demand, Boserup and Schultz (1990) argue that the outcome of increased resource scarcity is an economic one: market incentives for states, individuals, and corporations to develop alternative access to the resource elsewhere or to develop a substitute resource.

Although resource scarcity may encourage innovation and adaption, freshwater is unlike most contentious resources. Whereas disputants can resolve some environmental scarcity-induced contentions through alternative investments, Wolf (1998) contends that, as freshwater access to transboundary rivers cannot be substituted and development of alternative access is typically cost ineffective, this causal logic is inapplicable in the analysis of transboundary rivers. Instead, cornucopian scholars of transboundary rivers generally assert that cooperation occurs because "war is not usually a realistic 'best alternative to a negotiated agreement' … [because] for the price of one week's fighting, you could build five desalination plants" (Petersen-Perlman, Veilleux, and Wolf 2017, p. 107-108).

Notably, while cornucopian scholarship provides some explanation for why states engaged in environmental scarcity-induced resource disputes avoid violent political conflict, most cornucopian works – to include those incorporative of causal logic – stop short of explaining why cooperation occurs.[2] In fact, explicitly stated causal mechanisms linking contentions over transboundary rivers to cooperation are particularly rare within cornucopian work, with most scholarship instead relying on causal explanations for why violent conflict does *not* occur to explain why cooperation *does* occur. Yet, in contending that cooperation occurs because violent conflict does not, cornucopian scholars construct a false dichotomy excluding the possibility that no action is taken in an interstate river dispute. And, as a result, cornucopian scholars oversimplify and minimize the substantial shift that actors must make to move from the contentious status-quo to a negotiated resolution.

Despite their varied and vague causal mechanisms, Bernauer, Bohmelt, and Koubi (2012), Koubi (2019), and Mach et al. (2019) maintain that neo-Malthusian efforts offer evidence that – in some cases – environmental scarcities have a small, yet substantive, effect on inducing conflict. Yet, cornucopian efforts not only demonstrate that cooperation more frequently results from resource scarcity than violent conflict, but also that the causal linkages between resource scarcities and violent conflict are not as simple or deterministic as many neo-Malthusians previously assumed (Bernauer, Bohmelt, and Koubi 2012; Koubi 2019; Mach et al. 2019). Beyond these conclusions, however, significant confusion remains about where, how, and why environmental factors result in conflict and cooperation. Johnson et al.'s (2011, p. 93) review of neo-Malthusian and cornucopian work, for instance, notes that, "despite the growing

[2] This seems to occur – at least in part – as a result of the school's emphasis on Popperian falsification of neo-Malthusian claims. For example, see Theisen (2008), Buhaug et al. (2014), Selby et al. (2017).

number of studies in this field, there is, as yet, no sign of consensus on the expected societal responses to freshwater scarcity."

At least in part, the discrepancies between neo-Malthusian and cornucopian scholarship results from methodological differences (Johnson et al. 2011; Bernauer, Bohmelt, and Koubi 2012; Solow 2013). Solow (2013), for instance, argues that the "battle lines" of the academic debate between neo-Malthusian and cornucopian scholars has generally fallen along methodological divides. Neo-Malthusian scholars, for instance, tend to offer evidence in the form of qualitative and country-specific case study analyses (Mandel 1992; Homer-Dixon 1994, 1999; Kelley et al. 2015). Meanwhile, cornucopian scholarship typically contains large-*N*, quantitative analyses (Yoffe, Wolf, and Giordano 2003; Dinar and Dinar 2005; Brochmann and Gleditsch 2006; Tir and Ackerman 2009).

To offer explanatory models effectively linking transboundary river contentions to outcomes of conflict and cooperation, some scholarship suggests that methodological shifts are essential. Johnson et al. (2011) and Adams et al. (2018), for instance, contend that small-*N* case studies focusing on the effect of environmental scarcities – although certainly valuable to scholarship – suffer severely from a tendency to include only cases supportive of the hypothesized causal relationship (i.e., the "streetlight effect"), allowing an analyst's results to indicate causal significance when true causal factors may be exogenous. And, although broader statistical analyses provide robust evidence, Johnson et al. (2011) argues "they are insufficient for theory building and can often overgeneralize." As has been discussed at length within international relations scholarship, a lack of clear, grounded theory results in scholarly works that merely cite trends (Waltz 2002; Mearsheimer and Walt 2013). Theoretic approaches that lack reality-based micro-foundations and casual mechanisms, however, are frequently overly

abstract, lacking usefulness, accuracy, and explanatory power (Most and Starr 1989; King et al. 1994; Lake 2011; Goertz 2018). If this more narrow research area seeks to offer explanatory models linking freshwater scarcity to conflict and cooperation, a combination of analyses – careful case study design as well as theoretically-based large-*N* scholarship – are of critical importance (Bernauer, Bohmelt, and Koubi 2012; Solow 2013; Koubi 2019).

Grounded Theory in Environmental Scarcity Literature

Intent on carefully elucidating causal mechanisms underlying the relationship between environmental scarcity, cooperation, and conflict, new research has begun to move past neo-Malthusian and cornucopian scholarship. And, in their attempts to incorporate disparate approaches in the formation of empirically assessed causal mechanisms, this scholarship provides novel understanding of *where* transboundary river disputes arise and *how* they are most likely to be managed. Drawing on geography scholarship, Bernauer (2002), Barrett (2003), Gleditsch et al. (2006), and Brochmann and Gleditsch (2012) offer strong evidence that transboundary rivers in which water crosses from an upstream country into a downstream country (as opposed to creating a border between the states or crossing their international border multiple times) are more contentious than other types of rivers, a result of physical geography's bolstering of an asymmetrical power dynamic. Building upon qualitative case studies such as Tiwary (2006), institutional scholarship finds that river basin organizations, river treaties, and international law – allowing for more structured, fair, and trusting agreements – facilitate more peaceful management of transboundary rivers (Hensel, Mitchell, and Sowers 2006; Brochmann and Hensel 2009; Brochmann 2012; Libert and Lipponen 2012; Tir and Stinnet 2012). From the issues approach to international relations, Hensel, Mitchell, and Sowers (2006), Hensel and

Brochmann (2008), and Brochmann and Hensel (2009) provide evidence that regions with lower water availability – which are more strongly impacted by transboundary river issues – are more likely to experience interstate contentions, cooperation, and conflict over transboundary freshwater resources. And, theorists of the bargaining model find that the distribution of non-river resources among states – which can be used as bargaining chips in transboundary river negotiations – can affect the likelihood of cooperative and conflictual outcomes (Lee and Mitchell 2019).

Although this diverse and productive scholarship has increased our understanding of the dynamics at play in interstate contentions over freshwater access, it is not without critique. As argued by Most and Starr (1989), both opportunity – the potential for some international political action – and willingness – a state's interest in undertaking international political action – are necessary conditions for the occurrence of international political phenomena. In other words, even when opportunity for contention exists, states must be willing to take international political action for that contention to occur. Yet, recent scholarship concerning transboundary rivers tends to emphasize only the varying factors that limit or expand potential "opportunities" for interstate contentions to arise (e.g., low water availability or upstream/downstream river orientation), manifest in cooperation (e.g., transboundary institutions or the presence of non-river resources), or result in conflict (e.g., dyadic power disparity).

Even among scholars who recognize the critical role of willingness in causally explaining contentions over transboundary rivers, Brochmann and Gleditsch (2012, p. 520) note that state willingness to initiate and manage contentions over transboundary freshwater access "has remained a somewhat more elusive concept." Linking opportunity for transboundary river contention to state willingness for conflict or cooperation, most scholars rely on the Issue

Correlates of War (ICOW) project's "river salience" index variable, assuming that states will be more likely to initiate and manage contentions over rivers of higher salience (Hensel and Mitchell 2017). Yet, since ICOW's river salience variable is actually an index variable reflecting a river's tangible number of uses (e.g., fishing, power generation, trade; see Hensel 2013), the use of this variable as a measure of state willingness is an inadvertent amalgamation of opportunity and willingness. While contentions may be more common over rivers of many uses (i.e., opportunity), a state's domestic political leadership is not *ipso facto* willing to initiate and manage contentions over transboundary rivers of higher salience. In other words, although the causal mechanism linking opportunity for transboundary river contentions to a state's willingness to initiate and manage those contentions may be predicted by salience, use of the variable – or exclusion of willingness altogether – provides little explanation of the causal mechanism itself. Thus, while analysts increasingly understand *where* transboundary river relationships have a higher probability of contention, scholarship still fails to explain *why* transboundary rivers of varying opportunity result in violent conflict, cooperative action, or ignored interstate contentions.

CHAPTER 3

WILLINGNESS TO ADDRESS RIVER ISSUES

Scholars constructing theories about the onset and management of transboundary river contentions use a variety of state-centric theoretical models (Sprout and Sprout 1971; Mandel 1992; Gleick 1993; Wolf 1998; Hensel, Mitchell, and Sowers 2006; Brochmann 2012). In recent years, however, transboundary river research has largely migrated toward the application of modified bargaining models, a result of increased interest in interstate river disputes among conflict studies scholars (Hensel and Brochmann 2008; Brochmann and Hensel 2009, 2011; Lee and Mitchell 2009). As a result, I begin this section by briefly introducing the bargaining model of war. Second, I discuss current application of the bargaining model within transboundary river research, explaining how usage of a simplified bargaining model within recent scholarship results in incomplete causal linkages. Lastly, I offer my own bargaining model, inclusive of both opportunity and state willingness to initiate and manage interstate river claims.

The Bargaining Model of War

The bargaining model of war, as conceptualized by Blainey (1988) and Fearon (1995), addresses 'war's inefficiency puzzle' — the question of why destructive and costly wars (i.e., Pareto-inefficient outcomes) occur between disputing states while peaceful resolutions of disputes are more cost-effective (i.e., Pareto-efficient outcomes). Assuming states are rational actors, Blainey (1988) and Fearon (1995) suggest that war's high costs and inherently unpredictable outcomes disincentivize disputing states from the use of conflict as a means to

secure preferred dispute outcomes. Yet, achieving a cooperative end to the dispute (a "bargain") is rarely a simple process; while the range of possible dispute outcomes is vast, spanning from one disputant's ideal dispute outcome (e.g., cessation of some abuse of transboundary river freshwater) to their opponent's ideal dispute outcome (e.g., continued abuse of transboundary river freshwater), the number of potential bargains acceptable to both parties varies widely. Fearon (1995) contends that there always exists a range of bargains acceptable to both states as a result of the high costs and unpredictability of war, but the size of this bargaining range is determined by the dyad's varying opportunities for dispute settlement. In other words, differing geographical, institutional, and dyadic factors may render the range of bargains acceptable to disputant states smaller in some disputes and larger in others.

Although there exists some range of bargains acceptable to both states, each disputant is unaware of the exact size and extent of the bargaining range (Fearon 1995). For instance, while disputants know the bargains that they would be willing to accept, both disputants have incomplete information about the bargains their opponent would be willing to accept. And, although both disputant states could ensure peaceful resolution of the interstate dispute by offering their opponent an advantageous outcome from their own range of acceptable bargains, both disputants also have incentives to negotiate the most favorable bargain possible for themselves (Fearon 1995). Thus, disputants have incentives to avoid conflict by offering only bargains that are acceptable to both parties, but also to negotiate bargains that are advantageous to their own state.

Because disputants have incomplete information about their opponent's willingness to accept potential bargains, both disputants exchange information through the use of signals – efforts that indicate to their opponent the willingness of a state to abandon bargaining and pursue

a preferred dispute outcome via violent conflict (Schelling 1966; Fearon 1995). These signals, by revealing unacceptable bargaining outcomes that would drive disputant states to pursue their preferred outcomes via violent conflict, indicate to disputants the size of the bargaining range. As a result, states perceived as more willing to abandon bargaining ultimately receive more favorable bargains from their conflict-averse opponents (Blainey 1988). This phenomena, however, results in incentives for each disputant to exaggerate and misrepresent their willingness to abandon bargaining in favor of military action, forcing their opponent to offer more advantageous bargains to avoid a potential conflict (Fearon 1995). Yet, when both states exaggerate and misrepresent their willingness to initiate conflict, both disputants may be unable to discern whether a range of bargains acceptable to both states exists – leading disputant states to perceive conflict as the only way of securing an acceptable dispute outcome (Fearon 1995).

In short, the bargaining model – like Most and Starr's (1989) framework – suggests that outcomes within the international environment are a function of both opportunity (i.e., the number of bargains acceptable to both parties) and willingness (i.e., the willingness of disputant states to abandon bargaining in favor of conflict). When bargaining ranges are large, disputant misrepresentations of their willingness to abandon bargaining exaggerate differences in willingness among disputant states, leading to bargaining outcomes that favor one state over the other. When bargaining ranges are small, disputant misrepresentations of their willingness to abandon bargaining may exaggerate differences in willingness among disputant states, but may also conceal potential bargains acceptable to both states – impelling interstate conflict. Thus, while the size of the bargaining range is critical to understanding interstate disputes, the ultimate selection of a dispute outcome – whether a bargain in favor of one disputant, a bargain in favor

of the other disputant, or interstate conflict – is determined by the varying willingness of states to abandon bargaining and pursue favorable dispute outcomes via conflict.

Application of the Bargaining Model in Transboundary River Research

Scholarship generally applies a simplified bargaining model in transboundary river research. The model begins with two states that share a transboundary river. Both states may choose to undertake actions that limit the other state's access to transboundary river resources (e.g., constructing a dam, implementing navigation controls, using freshwater resources for irrigation, or polluting a river). If one riparian state chooses to take such an action, the other state (the "challenger state") may demand that the state abusing its freshwater access (the "target state") change its freshwater use. Once this demand is made, the target state has the choice of contesting the challenger state's demands (i.e., resulting in an interstate river claim) or complying with the challenger state's demands (i.e., rendering no interstate river claim necessary). According to Hensel and Brochmann (2008) and Brochmann and Hensel (2009), the choice of the target state – whether it contests or complies with the challenger state's initial demands – is a function of the number of potential bargains acceptable to both parties. In other words, if the number of potential bargains acceptable to both the challenger and the target state is large, it is more likely that the challenger state's initial demand (itself a potential bargain) may be immediately acceptable to the target state. If the number of potential bargains acceptable to both the challenger state and the target state is small, however, the challenger state's initial demand may be unacceptable to the target state.

Moving beyond claim onset, scholarly applications of this simplified bargaining model use the same bargaining range mechanism to explain the management of interstate river claims.

When an interstate river claim arises (i.e., the target state rejects the challenger's initial demand), Brochmann and Hensel (2009, 2011) and Lee and Mitchell (2019) suggest that dyads where the bargaining range is large are more likely to be managed peacefully (and successfully), a result of the greater ability of disputants to identify and settle on a bargain in these scenarios.[3] Conversely, Hensel and Brochmann (2008) and Lee and Mitchell (2019) suggest that dyads where the bargaining range is small are more likely to be managed via militarization, a result of the greater inability of disputants to identify and settle on a bargain in these scenarios.

In explaining how the varying size of a dyad's bargaining range affects river claim onset and management, use of this simplified bargaining model offers scholarship improved understanding of state interactions over transboundary rivers. Yet, in the application of this bargaining model to transboundary river research, scholarship emphasizes solely the varying opportunities for claim management – the role of geographic factors (e.g., water-flow rates and river orientation), the presence or absence of international institutions (e.g., intergovernmental organizations and river treaties), and dyadic dynamics (e.g., power and resource disparity) in reducing or expanding the range of acceptable "bargains" that disputants may codify as negotiated agreements. Meanwhile, this scholarship ignores the role of state willingness – a necessary condition for claim onset and management – in determining the outcome of transboundary river contentions. As a result, this scholarship lacks a causal linkage between a dyad's *potential* for interstate river claim onset or management and the dyad's actual *selection* of these outcomes.

[3]One partial exception to this general model is Brochmann and Hensel (2009). Although the authors consider peaceful claim management more likely when institutional factors increase the size of the bargaining range, such as when treaties and shared river basin organizations provide the opportunity for more structured, fair, and trusting agreements, they also consider peaceful claim management more likely when some factors reduce the size of the bargaining range, such as the presence of low water availability.

A Model of Claim Onset and Management

In the onset and management of interstate river claims, as elsewhere in foreign policy, I argue that domestic interests motivate state action. Qualitative and quantitative scholars of political science's institutional literature have long advocated for the inclusion of domestic dynamics within the study of international relations and foreign policy analysis, predicting that domestic factors will explain international political phenomena. Their claims that domestic politics intrinsically link to international politics are not without basis; according to Bueno de Mesquita et al. (2003), some proportion of domestic populaces maintain influence over the actions of governments, regardless of regime type. Using both carrots (e.g., political support) and sticks (e.g., the threat of supporting a rival), the institutionalist literature argues that these influential populaces compete for control over state leadership, directing public discourses, developing interest groups, and forming coalitions (Allison and Halperin 1972; Putnam 1988; Brewster 2004). Shrewd domestic political leadership, tasked with international decision-making yet keenly aware of its domestic political vulnerability, diligently works to satisfy the supporters who help them attain and retain power. Thus, in the international environment, the interests of domestic political support constrain a state's domestic political leadership (Putnam 1988; Fearon 1994; Weeks 2008).

The influence of the domestic populace over foreign policy, however, is not uniform across all states in the interstate environment. According to Bueno de Mesquita et al.'s (2003) selectorate theory, each state's population is composed of three groups: individuals with no political power (hereafter the "disenfranchised" or *D*), individuals with some political influence (hereafter the "selectorate" or *S*), and members of the selectorate supportive of the state's domestic political leadership (hereafter the "winning coalition" or *W*). Although the size of *D*

and *S* have important implications on citizen labor and leisure choices, government expenditures, and a leader's opportunities for kleptocracy, Morrow et al. (2008) contend that the size of *W* is the determinant factor for most state policy decisions – a result of its crucial role in the continued governance of a domestic political leader or their party. For instance, in states where winning coalitions are small (i.e., a monarchy or autocracy), domestic political leadership guarantee their or their party's continued governance by producing private goods (e.g., direct payments, grants of monopolies) for their winning coalition. A larger winning coalition, however, "means more supporters to please, spreading out private benefits, and making public goods a more efficient way for the leader to retain the support of his [winning] coalition" (Morrow et al. 2008, p. 393). Thus, in states where the *W* is large (i.e., a democracy), domestic political leadership guarantee their or their party's continued governance through the provision of state resources on public goods (e.g., roads, social services, popular foreign policies) for their winning coalition. In short, "as the size of *W* increases, leaders will shift … from private benefits and toward public goods" (Morrow et al. 2008, p. 393). As a result, influence of the broader domestic populace over foreign policy is largely determined by the percentage of the state's total population to which the leader must be responsive, with the majority of a large-*W* regime's citizens generally having greater political influence in the international environment than the majority of a small-*W* regime's citizens.

In consideration of this institutional literature, I propose a model of interstate river claim onset and management that begins not with a pair of rational states riparian to a transboundary river, but rather the rationally, self-interested domestic populace of these two riparian states. Importantly, I assume that the members of a state's *W* are distributed similarly to the state's

population.[4] Like prior application of the bargaining model to transboundary river relationships, members of both riparian states may choose to undertake actions that limit the other state's access to transboundary river resources. Yet, if members of one riparian state take such an action, it is the other state's domestic populace residing within the transboundary river basin – not the state as a whole – that is immediately affected by this costly decrease in freshwater access.

When one riparian state's domestic populace residing within a transboundary river basin experiences an interruption to freshwater access, individuals from this basin work through their state's political institutions to raise their concerns, demanding that their domestic political leadership respond to the other riparian state's actions. If significant percentages of the state's total population demand that their domestic political leadership take action over the transboundary river issue (e.g., when the population of the affected transboundary river basin comprises a significant percentage of the state's total population), the state's domestic political leadership must address the populace's concerns to avoid significant political challenges to their leadership (e.g., media scrutiny, poor electoral outcomes, or even riots, secessionist movements, and coup d'états). In these scenarios, the constrained domestic political leadership of the challenger state will be willing to incur costs within the international environment (e.g., increased diplomatic expenditure and worsened interstate relationships) in order to satisfy their domestic populace, demanding that the state abusing its freshwater access – the target state – change its freshwater use. If smaller percentages of the challenger state's total population demand that the state's domestic political leadership take action over some transboundary river issue (e.g., when the population of the affected transboundary river basin comprises a small

[4] I acknowledge that, in some cases, this assumption may be invalid.

percentage of the state's total population), however, the domestic political leadership's inattention to transboundary river issues may not result in the same severity of domestic political challenges (i.e., media scrutiny and worse electoral outcomes may occur, but large-scale riots, secessionist movements, and coup d'états are unlikely). With lower costs of inaction, the challenger state's domestic political leadership will be less willing to incur costs within the international environment. As a result, the challenger state's willingness to demand that the target state change its freshwater use likely falls as the percent of the state's population residing within an affected river basin decreases.

The preceding logic suggests that the domestic political leadership of all states – regardless of the size of their winning coalition – are more willing to make demands concerning another state's freshwater use when transboundary river basin concerns are widely-held among their state's domestic populace. Conversely, this logic also suggests that the domestic political leadership of all states – regardless of the size of their winning coalition – are less willing to make demands concerning another state's freshwater use when transboundary river basin concerns are uncommon among their state's domestic populace. Institutional literature, however, suggests that the size of the challenger state's winning coalition may play a mediating role in the latter scenario. If concerns over transboundary freshwater access arise within a small-*W* state's less populous river basins, the state's domestic political leadership is unlikely to expend resources on transboundary river issues, a result of the winning coalition's preference for the receipt of state resources as private goods. If concerns over transboundary freshwater access arise within a large-*W* state's less populous river basins, however, the state's domestic political leadership – responsible to public goods-oriented members of the winning coalition residing within the river basin – is likely more constrained by the transboundary river concerns of its

citizens. As a result, large-*W* states are likely more willing than small-*W* states to make demands concerning another state's freshwater use when transboundary river basin concerns are uncommon among their state's domestic populace.

If a challenger state's domestic political leadership makes a demand concerning another state's freshwater use, the target state has the choice of contesting the challenger state's demands (i.e., resulting in an interstate river claim) or complying with the challenger state's demands (i.e., rendering no interstate river claim necessary). As in the work of Hensel and Brochmann (2008) and Brochmann and Hensel (2009), the choice of the target state – whether it contests or complies with the challenger state's initial demands – is determined by the number of potential bargains acceptable to both parties. In other words, if the number of potential bargains acceptable to both the challenger state and the target state is large, it is more likely that the challenger state's initial demand – a potential bargain – may be immediately acceptable to the target state. If the number of potential bargains acceptable to both the challenger and target state is small, however, the challenger state's initial demand may be unacceptable to the target state. The preceding discussion of the model, therefore, suggests two expectations relating to the onset of interstate river claims:

> **Hypothesis One:** Interstate river claims are more likely in transboundary river basins in which high percentages of the challenger state's total state population reside, with opportunity for claims held constant.
>
> **Hypothesis Two:** In transboundary river basins home to a small percentage of the challenger state's population, interstate river claims are more likely if the challenger state has a large winning coalition, with opportunity for claims held constant.

If the target state rejects the challenger state's initial demand, the two states begin the process of interstate bargaining to determine the management – or lack thereof – of the new interstate river claim. As in the bargaining model proposed by Blainey (1988) and Fearon (1995),

there always exists some opportunity for a negotiated outcome along the bargaining spectrum, which ranges from the status-quo (where the targeted state continues to benefit from abuse of transboundary river resources) to the targeted state's total compliance with the challenger's claim (cessation of any abuse of the river's freshwater resources perceived by the challenger state). Along this spectrum, there exists some potential bargains that both states would prefer to war, with the size of the bargaining range determined by opportunity-related variables – the dyad's geographical, institutional, and dyadic factors. Yet, while both the challenger and target states know the bargains that they would be willing to accept, neither disputant has complete information about the bargains their opponent would be willing to accept – a factor exacerbated by each disputant's attempts to strengthen their bargaining position through exaggeration and misrepresentation of their willingness to engage in conflict over the dispute.

Since disputants have incomplete information about their opponent's willingness to accept potential bargains, each disputant exchanges information with the other through the use of signals (Schelling 1966). By revealing unacceptable bargaining outcomes that would drive disputant states to abandon interstate bargaining in order to pursue more favorable outcomes via conflict, signals expose the size and extent of the disputant's bargaining range (Fearon 1995). Yet, as disputants are incentivized to misrepresent their willingness to eschew interstate bargaining in favor of military action, domestic political leaders may communicate false signals to their opponents. According to Hall and Yarhi-Milo (2012), most international relations scholars consider only costly signals – those which risk a domestic leader's political or military assets – as sincere indicators of a state's intentions. Jervis (1989, p. 26), however, notes that while costly signals are valuable indicators of a disputant's willingness to abandon interstate bargaining in favor of military action, it is signals "beyond the ability of an actor to control" that

are most credible. One such signal is the passive communication of a domestic political leader's bargaining constraints. According to Schultz (1988), the very nature of a disputant state's political institutions confer a baseline, unmanipulated understanding of a leader's domestic political constraints to the disputant's opponent, and thus provides some information on the size and extent of the dispute's bargaining range. And, although nearly all domestic political leaders can manipulate their political constraints in order to generate audience costs (a costly signal) that ultimately secures more favorable interstate bargains (Fearon 1994; Weeks 2008), this baseline understanding of a domestic political leader's constraints is a reliable signal of the type of bargains that would drive a disputant to abandon interstate bargaining and pursue a preferred outcome via military action.

As shown previously, it is the interests of domestic political support that constrain a state's domestic political leadership in the international environment. Once an interstate river claim arises over a transboundary river basin, the domestic populaces of both riparian states residing within the river basin work through their state's political institutions, demanding that their domestic political leadership receive a favorable dispute outcome. The more widely-held the demands that a state's domestic political leadership receive a favorable dispute outcome are among a state's total population, the more constrained the state's domestic political leader is within interstate bargaining. As a result, the domestic political leadership of states with large percentages of their total population residing within transboundary river basins are likely more willing to abandon interstate bargaining in order to pursue the domestic populace's preferred outcome via military action. Meanwhile, the domestic political leadership of states with only small percentages of their population residing within transboundary river basins will be more

able to offer their opponent bargaining concessions, ensuring that neither state engages in military action.

The interests of a state's political support, however, is not uniform across all states in the interstate environment. In addition to the percentage of the state's total population residing within the transboundary river basin under dispute, the size of a state's winning coalition likely plays a role in whether constraints are placed on the domestic political leadership's interstate bargaining. In large-*W* states, for instance, the state's domestic political leadership is responsible to public goods-oriented members of the winning coalition. To ensure continued governance of the domestic political leadership, therefore, the winning coalition's concerns about transboundary river issues – a public good – must be addressed. As a result, the domestic political leadership of large-*W* states are likely more willing to abandon interstate bargaining in order to pursue the domestic populace's preferred outcome via military action. In small-*W* states, however, the state's domestic political leadership is held responsible to only the private-goods oriented members of the winning coalition. To ensure continued governance of the domestic political leadership, therefore, the domestic population's interests in transboundary river issues – a public good – are subservient to the private goods interests of the winning coalition. As a result, the domestic political leadership of small-*W* states are likely more able to offer their opponents bargaining concessions, ensuring neither state engages in military action.

Holding opportunity-related variables constant, this logic collectively suggests that states with greater domestic political constraints ultimately receive more favorable bargains from their conflict-averse opponents. If the targeted state is comparatively more constrained in interstate bargaining by its domestic populace than the challenger state, therefore, the willingness of the targeted state to engage in diplomatic or military conflict over the interstate river claim is greater

than that of its opponent; as a result, the bargain offered by the challenger state will be nearest to the target state's ideal bargaining outcome – the status quo. In this scenario, it is likely that claims are temporarily, if not indefinitely, ignored by the target state, as diplomatic and military backlash from the challenger state is unlikely and abuse of transboundary river water economically beneficial to the populace of the target state.

> **Hypothesis Three (a):** Dyads in which the target state has comparatively greater percentages of its population residing within the transboundary river basin than the challenger state will be more likely to remain unmanaged than other types of dyads.
>
> **Hypothesis Three (b):** Dyads in which the target state has a comparatively larger *W* than the challenger state will be more likely to remain unmanaged than other types of dyads.

If a claim's challenger state is comparatively more constrained in interstate bargaining by its domestic populace than the target state, the willingness of the challenger state to engage in diplomatic or military conflict over the interstate river claim is greater than that of its opponent; as a result, the bargain offered by the target state will be nearest to the challenger state's ideal bargaining outcome – cessation of any transboundary river abuse by the target state. In this scenario, it is likely that claims are ultimately negotiated by the disputants, as continued abuse of transboundary water access is more likely to spur diplomatic and military backlash from the challenger state.

> **Hypothesis Four (a):** Dyads in which the challenger state has comparatively greater percentages of its population residing within the transboundary river basin than the target state will be more likely to be managed via negotiation than other types of dyads.
>
> **Hypothesis Four (b):** Dyads in which the challenger state has a comparatively larger *W* than the target state will be more likely to be managed via negotiation than other types of dyads.

If both a claim's challenger state and target state have significant domestic political constraints on interstate bargaining, both states maintain similar willingness to engage in diplomatic or military conflict over the interstate river claim; as a result, each state has an

incentive to exaggerate and misrepresent their willingness to engage in conflict over the claim, attempting to secure better terms of freshwater access and usage for themselves. In this scenario, misrepresentation of each state's willingness to engage in diplomatic or military conflict over the claim may prevent the disputants from discerning whether a range of bargains acceptable to both states exists – leading disputant states to perceive conflict as the only way of securing an acceptable dispute outcome despite its high costs.

> **Hypothesis Five (a):** Dyads in which both states have similar percentages of their population residing within the transboundary river basin will be more likely to be managed via militarization than other types of dyads.

> **Hypothesis Five (b):** Dyads in which both states have similar *W*-sizes will be more likely to be managed via militarization than other types of dyads.

CHAPTER 4

RESEARCH DESIGN

I test these hypotheses within two separate statistical analyses, drawing upon both new data and a variety of common geography and international relations datasets. Due to the varying spatial and temporal domains of these datasets, both analyses are limited to interstate transboundary river basins within the Western Hemisphere, Western Europe, and the Middle East between 1900 and 2001. Additionally, both analyses exclude transboundary basins existing (in whole or in part) within colonies, territories, or non-state entities.[5] For the analysis of claim onset, I use directed dyad-years as my unit of analysis. As a result, this analysis' dataset includes two dyads for each year that a pair of states were riparian to the same transboundary river basin (one in which each state is a potential challenger). For the analysis of claim management, I use the same unit of analysis, but exclude all dyads in which an interstate river claim did not occur.

The first analysis, relating to Hypotheses 1-2, assesses the effect of domestic political constraints on the likelihood that a challenger state initiates an interstate river claim. As previously noted, interstate river claims rarely occur. Although this frequent absence of claim initiation may result from the low willingness of a state's domestic political leadership to initiate a claim, it may also result from an unknown external factor. For instance, a significant number of dyads may experience no claims not because of public disinterest in initiating an interstate river

[5] Notably, these prohibitions exclude a number of pre-1920 dyadic records between the United States and the United Kingdom (then the colonial ruler of Canada), pre-1949 dyadic records between Suriname/Brazil and France (pre-departmentalization colonial ruler of French Guiana), pre-1959 dyadic records between the United States and Canada concerning various Alaska-Yukon river basins, and dyadic records between Israel and Palestine (currently a non-state entity).

claim, but rather the absence of a contention over transboundary river resources that concerns the state's domestic populations. As a result, infrequent occurrence of claims within the dataset may lead traditional regression modeling to misrepresent the true effect of included variables on the onset of interstate river claims. To account for the likely inflation of non-claim dyads within the dataset, I use a zero-inflated negative binomial (ZINB) model. ZINB models allow for overdispersion of the dependent variable by assuming that a subset of the sample data is unable to generate a count (Fox 2016; Ward and Ahlquist 2018). As a result, ZINB models artificially "deflate" the effect of non-claim dyads within the dataset, parsing them from the potentially count generating dyads (Fox 2016).

The second analysis, relating to Hypotheses 3-5, assesses the effect of varying dyadic interest in river basin concerns on the likelihood that a dyad manages an existing interstate river claim. For this analysis, I group the management of claims into three outcome categories: no management, peaceful management, and militarization. In order to determine the effect of comparative state interest on dyadic determination of claim management strategies, each unordered category must appear within the same model. As a result, I use a generalized multinomial logistic (GML) model. GML models assess covariate effects through the use of simultaneous logistic regression models, which estimate the likelihood that each record returns one of two outcomes (Long 1997; So and Kuhfeld 2010; Ward and Ahlquist 2018; Fox and Weisberg 2019). Analysts employing GML models must select a baseline category of the dependent variable to be used in each simultaneous logistic regression, allowing for simpler interpretation while not impacting model fit or prediction (Fox and Weisberg 2019). As "no management" was the most frequent outcome within the dataset, I use this category as a baseline from which to compare outcomes of negotiation and militarization.

Dependent Variables

In analyzing the onset of interstate river claims, this study employs the presence or absence of an interstate river claim – scenarios where at least one official representative of a state's government makes explicit demands concerning another state's river usage (Hensel 2013) – as its dependent variable. Denoted as "Claim," the variable is coded as 0 if no claim occurred in a given dyad-year and 1 if a claim occurred. To determine all possible cases in which an interstate river claim could occur, I used the Transboundary Freshwater Dispute Database (TFDD), a spatial, vector-format dataset, to identify river basins shared by more than one state (McCracken and Wolf 2019). From this data, I created two dyads for each pair of riparian states sharing a transboundary river basin, with each state coded in one dyad as a potential challenger state and in the other dyad as a potential target state. I then merged TFDD-derived dyads with the Issue Correlates of War (ICOW) river claims dataset, which includes all cases within the spatial and temporal domain when an interstate river claim occurred (Hensel et al. 2008).[6] Once merged, the dataset included 34,090 dyad-year records, with claims only occurring in 2.19% of these dyads.

To analyze the management of interstate river claims, this study employs the type of management (no management, negotiation, or militarization) of yearly-coded interstate river claims as its dependent variable. This data comes from the ICOW river claims dataset, which maintains thorough, annual assessments of claim management attempts (Hensel et al. 2008). For

[6] ICOW river claim data codes claims over individual transboundary rivers. Although this allows for particularly nuanced analyses, most datasets used in the study of transboundary rivers (including TFDD) group numerous rivers into broader transboundary river basins. In order to draw on both datasets, therefore, analysts must either assign TFDD's less-specific river basin data to ICOW's more-specific river data, or ICOW's more-specific river data to TFDD's less-specific river basin data. I have performed the latter data transformation, adhering to the common practice in geographic data management of converting all data to the lowest resolution dataset needed in an analysis. This strategy better preserves the internal validity of statistical analysis as it prevents data extrapolation.

ease of analysis, claim management attempts were recoded into a single categorical variable denoted "Management."[7] Excluding all dyads in which an interstate river claim did not occur, the dataset includes a total of 746 dyad-year records, with no management, negotiation, and militarization occurring on 78%, 18%, and 3% of dyad-years, respectively.

Independent Variables

In arguing that domestic politics impel interstate action, this analysis recognizes that domestic political influence is a function of both the percent of a state's population maintaining a grievance and the responsiveness of the state's political system. As a result, analyses within this article use two proxy variables for the influence of river basin populaces (as well as their interaction term) as independent variables. Importantly, as the theory of claim onset proposed herein argues that the domestic dynamics within the challenger state impel claim onset or lack thereof, independent variables for the challenger state alone are included in the first empirical model.[8] Yet, the analysis of claim management must take into account multi-state dynamics at play in international bargaining. As a result, independent variables for both states are transformed to non-zero values and included in the model as challenger-to-target ratios. As use

[7] ICOW dyad-year claims in which no management attempts occurred were coded as lacking management. ICOW dyad-year claims in which at least one militarized interstate dispute (MID) occurred were coded as being managed by militarization, as it is likely that any negotiations occurred as a direct result of military confrontation. All ICOW dyad-year claims in which negotiation occurred, but no militarization, were coded as being managed by negotiation. Additionally, all ICOW dyad-year claims in which negotiation occurred within three years of a MID were coded as being managed by militarization, as it is likely that these negotiations occurred as a direct result of military confrontation.

[8] Although the ICOW dataset is dyadic, I contend that it is not irresponsible to use the dataset for analysis concerning only one side of the dyad (the challenger) as long as the analysis is limited to the *onset* of claims. As the ICOW river claims dataset codes dyadic claims with a "challenger" (specifically defined as the state initiating the river claim) and a "target" (the state accused of transboundary river misuse), the onset of interstate river claims can be understood to be directed (Hensel 2013). Other dyadic information included in the dataset, however, cannot be assumed to be directed from the challenger state to the targeted state (or vice versa). As a result, the analysis of claim management herein assesses the likelihood that no claim management, negotiation, or militarization occur *on the dyad* rather than as the result of one dyadic state alone.

of ratios create data asymmetry, however, these variables are logarithmically transformed prior to analysis.[9]

To measure population distributions within each state's river basins, I create a "percent in basin" (denoted "PIB") variable that measures the percentage (0-100) of a state's total population residing within each separate transboundary river basin. This variable comes from the Global Human Settlement (GHS) database, a spatial, raster-format dataset measuring the distribution of the Earth's population in 1975, 1990, and 2000 (Schiavina, Freire, MacManus 2019).[10] To calculate PIB, I perform zonal sums of GHS data in reference to state boundaries from the CShapes vector dataset (Weidmann, Kuse, and Gleditsch 2010) and river basin boundaries from TFDD's vector dataset (McCracken and Wolf 2019) within a geographic information system. Zonal sums for river basin population were then divided by zonal sums for state population and associated with dyad-year records.

The influence of state populations within a political system is determined in part by the size of a state's winning coalition, with domestic political leaders of large-*W* regimes needing the support of greater numbers of citizens than domestic political leaders of small-*W* regimes. As a result, I include the "*W*" variable from Bueno de Mesquita et al.'s (2003) selectorate theory, which quantifies the size of the state's winning coalition on a four point scale ranging from zero

[9] Negative values of a logarithmic ratio indicate that the numerator's (i.e., the challenger) value was smaller than the denominator's (i.e., the target) value. Positive values indicate that the numerator's value was higher than the denominator's. Values close to zero indicate that the numerator's and denominator's values were similar, while more extreme values indicate that one value was significantly larger than the other.

[10] Although the use of only three population distribution assessments will overgeneralize changes in population distribution occurring between 1900 and 2001 – particularly as the 1975 assessment is used to calculate population distributions for all included river basins and states between 1900 and 1982 – the GHS dataset is the most comprehensive global, subnational population distribution dataset available for the period covered by this analysis. As the percentage of state populations residing within each river basin has seemingly shifted little between 1975 and 2000, I expect this generalization will not significantly impact results. When required datasets are eventually expanded beyond 2001, however, satellite-derived population distribution data such as CIESIN's Gridded Population of the World (2018) will provide improved assessments of the percentage of state population residing within river basins.

to one. Larger values of this variable indicate that a government maintains a larger winning coalition (and therefore must be more responsive to broader citizenry), whereas smaller values indicate that a government maintains a smaller winning coalition (and therefore must be responsive to comparatively fewer supporters).

Control Variables

Both analyses also control for six opportunity-related factors thought to affect interstate river claim onset and management. First, this study controls for the effect of water availability, a factor shown by Hensel and Brochmann (2008) and Brochmann and Hensel (2009; 2011) to be highly correlated with increased onset, militarization, and negotiation of interstate river claims. The proxy variable for water availability used in this analysis – a 29-year average of annual river basin runoff found within TFDD (McCracken and Wolf 2019) – captures the general water availability in each river basin. The variable, denoted "Runoff," is power transformed in order to reduce its skew. Assuming that transboundary river misuse is held constant, river basins with low rates of runoff – where freshwater misuse affects a greater percentage of water available – may be more likely to result in interstate contention.

Second, this analysis controls for river orientation. Analyses of interstate river claims indicate that the geographical orientation of a river plays a large role in determining the level of contention of an interstate river claim (Hensel and Brochmann 2008; Brochmann and Hensel 2009, 2011; Brochmann and Gleditsch 2012; Lee and Mitchell 2019). Among three broad types of river orientations, rivers forming state borders and U-shaped rivers (i.e., those that cross from an upstream state to a downstream state before crossing back into the upstream state) prove to be less contentious, likely a result of a shared interest in maintaining and protecting freshwater

resources (Brochmann and Hensel 2011). Upstream-downstream river configurations (i.e., those that flow from one upstream state into another downstream state), in contrast, tend to be the most contentious, as upstream states have little incentive to maintain and protect freshwater resources beyond their own borders (Brochmann and Hensel 2011). Because prior analyses only code transboundary river basins for geographical orientation if they are part of an interstate river claim, the majority of river basins within this study's spatial domain (i.e., basins not part of an interstate river claim) required coding for use in the empirical analysis of claim onset. As a result, I binarily coded all transboundary river basin dyads within the Western Hemisphere, Western Europe, and the Middle East for the presence or absence of upstream-downstream river orientation. This data was compiled into a variable denoted "Downstream" where a 1 indicates that the challenger state is downstream from the targeted state and a 0 indicates another type river orientation.[11]

A third control variable considers the distribution of military power between the challenger and target states. Comparatively stronger riparian states may be more willing to initiate or manage a river claim than comparatively weaker riparians (Hensel and Brochmann 2008; Brochmann and Hensel 2009). This variable is drawn from the Correlates of War Project's Composite Index of National Capabilities (CINC) score (Singer, Bremer, and Stuckey 1972). For use in the analysis of both claim onset and management, I divide the challenger state's CINC scores by the target state's CINC scores. As use of a ratio creates data asymmetry, I then logarithmically transformed the data. This data normalization resulted in a measure denoted

[11] As U-shaped rivers and rivers forming the border between two states are each shown to have no significant effect on claim management, I have chosen – like Hensel and Brochmann (2008), Brochmann and Hensel (2009; 2011), Brochmann and Gleditsch (2012), and Lee and Mitchell (2019) – not to include these orientations as separate categories. Additional information on the coding of this variable can be found within Appendix A.

"Comparative Power," where negative values indicate that the dyad's potential challenger is comparatively weaker than the potential target state and positive values indicate the reverse.

A vast literature concerning interstate treaties and intergovernmental organizations (IGO) contends that rule-based agreements and institutions standardize expectations for the management of interstate contentions and increase the opportunity for dialogue among states. Indeed, the presence of shared IGOs and bilateral river treaties are shown to increase the likelihood of interstate river claim onset and management, likely as a result of the potential challenger state's expectation that target states will cooperate in transboundary river management (Brochmann and Hensel 2011; Brochmann, Hensel, and Tir 2012).[12] For this reason, I include a fourth control variable summing the number of IGOs that the challenger and target state share, drawn from Pevehouse et al. (2019).[13] I normalize skew within this variable, denoted "Shared IGOs," through a power transformation. Fifth, I include a binary control variable indicating the presence or absence of a river treaty that is lagged 5 years, a variable borrowed from Brochmann's (2012) study on river treaty effectiveness. Denoted as "River Treaty," a 1 in this variable indicates the presence of a river treaty while a zero indicates the absence of a river treaty. Sixth, I include a binarily-coded control variable for "Joint Democracy." Joint democracy, like membership in shared IGOs and river treaties, is predicted to standardize intergovernmental expectations for the management of interstate contentions.[14] Following standard practice in conflict research, joint democracy is coded as a 1 when both of a

[12] The positive, statistically significant effect of river treaties on interstate river claim onset may be spurious, as rivers having prior river treaties are likely to also be those where there already exists some contention over river usage. Although I welcome inquiry into this potentially spurious relationship, it is not addressed within this article.
[13] Although this variable is a fairly indirect measure of interstate interaction within IGOs, it is a commonly used measure within the study of transboundary rivers (see, for instance, Hensel and Brochmann 2008; Brochmann and Hensel 2009; 2011). As a result, I have chosen to replicate its use within this study for the sake of continuity with other academic literature.
[14] Despite the predictions included here, some evidence indicates that joint democracy significantly decreases the likelihood of river claim onset (Hensel and Brochmann 2008; Brochmann and Hensel 2009).

dyad's riparian states maintain a six or greater on the POLITY2 index and 0 otherwise (Polity IV 2011).

CHAPTER 5

EMPIRICAL ANALYSES

Empirical Analysis of Claim Onset

I begin the empirical analysis of claim onset with a brief description of the dataset used in developing the statistical models. Spanning from 1900 to 2001 in the Western Hemisphere, the Middle East, and Western Europe, the dataset used in the analysis of claim onset includes a total of 34,090 possible dyad-years in which a claim could occur. In total, claims occurred in a mere 746 dyads (2.19%), supporting prior findings that claim onset is an altogether rare occurrence. The dataset's summary statistics appear in Table 1 below. Summary statistics reveal that, in the median dyad-year observation, the challenger state has a low percentage of its state population residing within the basin at hand (1.51%) and a fairly large winning coalition (.75 out of 1). Thus, while most observations within the dataset concern larger-*W* states, most of the included river basins contain only a small percentage of the state's politically influential populace.

Table 1: Claim Onset Summary Statistics

Statistic	N	Mean	Median	St. Dev.	Minimum	Maximum
Claim	34,090	0.02	0	0.15	0	1
Percent in Basin	34,009	14.48	1.51	26.43	0	100
Winning Coalition	33,173	0.62	0.75	0.31	0	1
Downstream	32,061	0.34	0	0.46	0	1
Runoff (sqrt)	32,086	18.88	19.83	13.14	0	52.61
Comparative Power (log ratio)	34,086	0.04	0.05	2.22	-10.27	10.27
Shared IGOs (sqrt)	34,086	5.43	5.39	1.80	0	10.30
Joint Democracy	33,652	0.31	0	0.46	0	1
River Treaty (lagged)	31,763	0.04	0	0.20	0	1

Table 2 presents a ZINB regression analysis of interstate river claim onset.[15] As previously noted, the ZINB model produces two outputs: a zero model and a count model. In this analysis, the zero model assesses the likelihood that a state is structurally unable to develop an interstate river claim, such as when a state's populace has no reason to believe that their access to a transboundary river's resources is threatened by another state. For instance, although the United States and Canada share the Firth River Basin, the United States is unlikely to initiate an interstate river claim over the river; with its headwaters in the Alaska Arctic National Wildlife Refuge and its mouth discharging into the Beaufort Sea, navigation on the river is rare and Canadian environmental damages – already unlikely to occur within the Yukon Ivvavik National Park – could not flow upstream into the United States. The ZINB regression's count model, in contrast, assesses the likelihood that an interstate river claim is initiated over a potentially count-producing observation. Dyadic observations including river basins such as the Rhine, for example, may produce an interstate river claim – a result of the river's basin's significantly more complicated physical and political geography. Since interstate river claims can only occur in potentially count-producing observations, state willingness to initiate an interstate river claim could only have the hypothesized effect in the count model. As a result, the count model is of greater importance for the evaluation of hypotheses and theories proposed herein.

[15] The ZINB model provides a good fit for the claim onset dataset, as measured by an evaluation of the Akaike Information Criterion in comparison with various generalized linear models and a Wald test against the null (intercept-only) model ($p < 0.00$).

Table 2: Claim Onset ZINB Regression Summary

Coefficient	Zero	Count
Percent in Basin (PIB)	-0.02 (0.01) *** 0.98	0.02 (0.00) *** 1.02
Winning Coalition (*W*)	1.10 (0.62) * 2.99	1.20 (0.31) *** 3.32
PIB x W	-0.02 (0.02) 0.98	-0.02 (0.01) *** 0.98
Downstream	-5.39 (0.53) *** 0.00	-0.95 (0.15) *** 0.39
Runoff (sqrt)	-0.14 (0.02) *** 0.87	-0.12 (0.01) *** 0.89
Comparative Power (log ratio)	-0.48 (0.08) *** 0.62	-0.31 (0.03) *** .74
Shared IGOs (sqrt)	0.44 (0.11) *** 1.55	0.22 (0.04) *** 1.24
Joint Democracy	0.57 (0.46) 1.77	-0.64 (0.19) *** 0.53
River Treaty (lagged)	-2.16 (0.52) *** 0.11	-0.13 (0.21) 0.88
Constant	0.48 (0.60) 1.62	-2.64 (0.28) *** 0.07
N	28,196	28,196
Log Likelihood	-2,823.556	-2,823.556

(Note: Exponentiated coefficients reported under coefficients and standard errors.)
* p < .1; ** p < .05; *** p < .01

Of the variables shown to have a statistically significant effect within the zero model, higher values of PIB, presence of downstream river orientation, higher rates of freshwater runoff, greater military strength of a potential challenger, and the presence of river treaties result in a significantly decreased likelihood that a state is structurally unable to raise a claim. The direction of these effects are not especially surprising; many of the variables with negative effects in the zero model indicate a potential for increased stress on limited transboundary river resources, such as increased populations and disadvantaged orientation along a river's flow. Meanwhile, the zero model also indicates that states with larger winning coalitions, that participate in the same IGOs as their riparian neighbors, and that are jointly democratic with their riparian neighbors are more likely to be structurally unable to initiate a claim, though the effect of joint democracy was shown to be nonsignificant. These variables may have a positive effect on the likelihood that an

observation is unable to initiate an interstate river claim because they decrease the willingness of the potential target riparian to abuse transboundary river resources. For instance, target states may be less likely abuse freshwater access if they expect diplomatic backlash in IGOs that are shared among both riparian states.

In moving to the count model, we can assume that all observations within the model can develop an interstate river claim. The first hypothesis proposed within this paper suggests that states are more likely to initiate interstate river claims over a river basin if high percentages of the state's total population reside within the basin, a result of increased pressure on domestic political leadership. According to Table 2, evidence in support of this hypothesis is ample. Exponentiated coefficients indicate that a one percent increase in the challenger state's PIB results in a two percent increase in the expected probability of claim onset, assuming the observation is within the "non-zero" group and the size of the state's *W* is held at zero.

Figures 1 and 2 provide further evidence in support of this hypothesis. Figure 1 shows the model's predicted probability of interstate river claim onset across all possible values of the challenger's *W*, with PIB presented at its 25th percentile and 75th percentile values (0.02% and 14.45%, respectively) and all other variables held constant at their median values. Each group of predictions – the group with PIB at its 25th percentile and the group with PIB at its 75th percentile – is associated with a prediction interval. Importantly, this interval should be used primarily for assessing where predictions are most accurate (e.g., where intervals are most narrow) rather than the evaluation of statistical significance, as overlap in prediction intervals "may or may not indicate that the group difference is nonsignificant across independent groups" (Mize 2018). Figure 2, provided alongside Figure 1, shows the marginal effect of a shift from the 25th to 75th percentile of PIB across all possible values of *W*, assuming all other variables are held constant

at their median values. Here, the average marginal effect of a shift from the 25th to 75th percentile of PIB is associated with a confidence interval. In contrast to the prediction intervals in Figure 1, the confidence interval in Figure 2 can be used for evaluation of a marginal effect's significance.

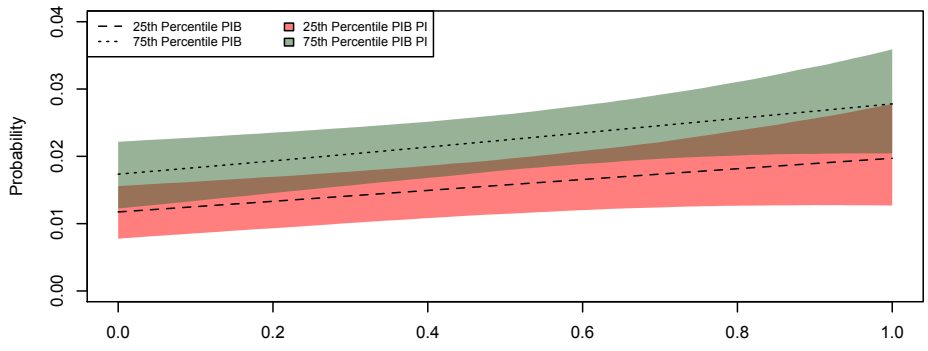

Figure 1: Probability of Claim Across W

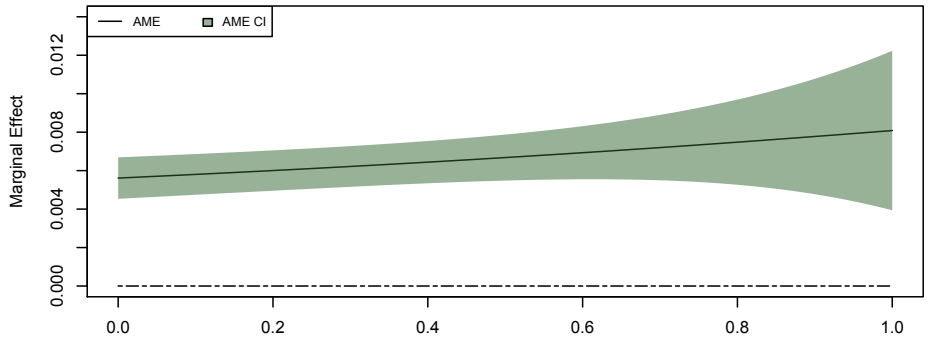

Figure 2: Average Marginal Effect of PIB Across W

Analysis of the ZINB count model's predicted probabilities depicted in Figure 1 indicates that the hypothesized effect of PIB on claim onset is supported, with increased values of PIB resulting in an increased probability of interstate river claim onset across all values of *W*. For instance, assuming *W* is held at its median value of .75 out of 1, a shift from the 25th percentile of PIB to the 75th percentile of PIB has a significant, positive marginal effect on claim onset of 0.7%. And, although this marginal effect may seem insubstantial, it is actually quite large –

resulting in a nearly 39% increase in the probability that the observation initiates an interstate river claim.

As values of PIB increase beyond the 75th percentile, the predicted probability of interstate river claim onset continues to rise substantially. For instance, assuming *W* is held at its median value (0.75 out of 1), the predicted probability of interstate river claim onset at PIB's 75th percentile is 2.51%. Yet, when PIB rises to 51% (i.e., when a slight majority of the state resides within the river basin), the predicted probability of interstate river claim onset climbs to nearly 4.5% – a 79% increase from the predicted probability of interstate river claim onset when PIB is held at the 75th percentile. In short, the model supports the expectation that challenger states are more willing to initiate interstate river claims over basins in which larger percentages of their populations reside.

The second hypothesis proposed within this paper suggests that large-*W* regimes are more likely to initiate interstate river claims over less populated river basins – a result of their comparatively larger need to satisfy minority communities to maintain power. Figure 3 shows the model's predicted probability of interstate river claim onset across all possible values of the challenger's PIB, with *W* presented at representative 25th percentile and 75th percentile values (.5 and 1, respectively) and all other variables held constant at their median values. Each group of predictions – the group with *W* at its 25th percentile and the group with *W* at its 75th percentile – is associated with a prediction interval. As noted previously, these intervals should be used primarily for assessing where predictions are most accurate rather than for the evaluation of statistical significance. Figure 4, provided alongside Figure 3, shows the marginal effect of a shift from the 25th to 75th percentile of *W* across all possible values of PIB, assuming all other variables are held constant at their median values. Additionally, the average marginal effect of a

shift from the 25th to 75th percentile of *W* is depicted with a confidence interval, which can be used for evaluation of a marginal effect's significance.

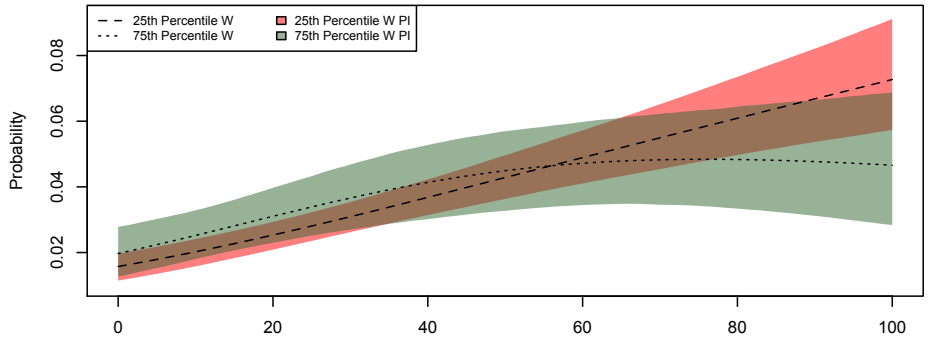

Figure 3: Probability of Claim Across PIB

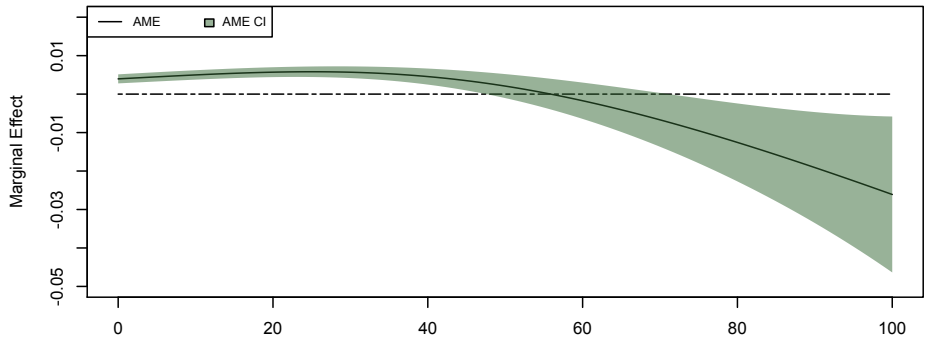

Figure 4: Average Marginal Effect of W Across PIB

Analysis of the ZINB count model's predicted probabilities in Figure 3 indicates that the hypothesized effect of *W* on claim onset at low values of the challenger's PIB is supported. As nearly 80% of the dataset's values for the challenger's PIB fall below 20%, the predicted probabilities and marginal effects indicate that, in the vast majority of cases, larger-*W* regimes are significantly more likely to initiate a claim than smaller-*W* regimes. For instance, at the dataset's median value for the challenger's PIB (1.5%), large-*W* regimes are 0.4% more likely to initiate an interstate river claim than smaller-*W* regimes, a statistically significant effect. And,

although this marginal effect may seem insubstantial, it is actually quite large – with a shift from *W*'s 25th percentile to its 75th percentile resulting in a 24% increase in the probability that the observation initiates an interstate river claim. In short, expectations that large-*W* regimes will have comparatively greater willingness to initiate interstate river claims over river basins with low values of PIB than small-*W* regimes is supported by the model.

Unexpectedly, Figures 3 and 4 also indicate that the effect of *W* on claim onset reverses as PIB reaches higher (and particularily extreme) values, with large winning coalitions actually decreasing the probability of claim onset. Although further analysis into this phenomena is neccesary, I suspect that this interactive effect results from a tendancy of large-*W* states to prioritize some public goods provisions over others. For instance, when PIB is high, the domestic political leadership of large-*W* states may prioritize dispensation of more manageable public goods (i.e. domestic infastructure and service improvements) over potentially costly and intractable, multi-state river claims, seeking to guarentee the leader's or party's reselection through the accomplishment of other constituent concerns. Meanwhile, when the challenger's PIB affected by river issues is small, large-*W* domestic political leadership may choose to initiate interstate river claims as a sort of virtue-signal, seeking to gain minority support while having little intention of ensuring that the claim is managed quickly or effectively.

Empirical Analysis of Claim Management

Limiting the dataset used in the prior analysis to the 746 dyad-years in which a claim occurred, the dataset includes 584 observations where no claim management occurred, 137 observations where negotiation occurred, and 25 observations where militarization occurred. Although these three claim management types have rarely been analyzed alongside one another,

the frequency with which dyads fail to manage claims, negotiate over claims, and militarize claims is similar to prior analyses that focus on interstate river claim management (Hensel and Brochmann 2008; Brochmann and Hensel 2011). The consolidated dataset's summary statistics appear in Table 3.

As discussed within the prior section, use of log ratios correct data asymmetries resulting from taking a ratio. Yet, interpretation of log ratios can be particularly challenging given this transformation. Although values are converted to percentages wherever possible,[16] readers should note that negative values of a log ratio indicate that the challenger's PIB or *W* value was smaller than the target's respective PIB or *W* value when the ratio was assessed. Thus, a dyad with a negative PIB log ratio indicates that the target state has a greater PIB than the challenger state. In contrast, positive values of a log ratio indicate that the target's PIB or *W* value was smaller than the challenger's respective PIB or *W* value when the ratio was assessed. A dyad with a positive *W* log ratio, therefore, indicates that challenger has a higher *W* than the target state. Lastly, values close to zero indicate that both state's PIB or *W* values are similar. Since Table 3 shows mean and median values for the PIB log ratio and *W* log ratio are close to zero, therefore, interstate river claims typically occur in dyads where both states have similar PIB and *W*-sizes.

[16] To convert log ratios to percentage comparisons, the log ratio should be exponentiated and multiplied by 100. This results in the percent difference in size between the challenger and target. For instance, a log ratio of 1 results in a value of 2.72 when exponentiated. This indicates that the challenger's initial variable value was 272% the size of the target's initial variable value. Meanwhile, a log ratio of -0.5 results in a value of 0.61 when exponentiated, indicating that the challenger's initial variable value was only 61% of the size of the target's initial variable value.

Table 3: Claim Management Summary Statistics

Statistic	N	Mean	Median	St. Dev.	Minimum	Maximum
Management Type	746	1.251	1	0.51	1	3
Percent in Basin (log ratio)	746	0.30	0.40	2.43	-7.46	13.14
Winning Coalition (log ratio)	719	-0.18	-0.22	0.54	-1.61	1.61
Downstream	746	0.51	1	0.50	0	1
Runoff (sqrt)	746	13.19	11.71	8.59	0	43.42
Comparative Power (log ratio)	746	-0.72	-1.04	1.87	-4.33	4.13
Shared IGOs (sqrt)	746	5.48	5.48	1.43	2.24	9.70
Joint Democracy	744	0.21	0	0.41	0	1
River Treaty (lagged)	699	0.06	0	0.24	0	1

Table 4 presents a GML regression analysis of interstate river claim management.[17] The GML model presents separate coefficients for possible outcomes, as measured against a baseline outcome. As "no management" is the most frequent outcome within the dataset, I use this category as the baseline from which to compare the other outcomes. Yet, as noted by Fox (2016, p. 394) and Ward and Ahlquist (2018), the analysis of GML regression summaries and coefficients is somewhat nebulous, requiring "mental gymnastics" by the interpreter. As a result, I briefly discuss the model summary before offering graphic representations of the model's output.

[17] The GML model provides a good fit for the claim management data, as measured by evaluation of Akaike information criterion in comparison with various generalized linear models.

Table 4: Claim Management GML Regression Summary

Coefficient	Outcome: Negotiation	Outcome: Militarization
PIB (log ratio)	0.08 (0.05) 1.08	0.11 (0.11) 1.12
W (log ratio)	0.51 (0.25) ** 1.66	-0.13 (0.46) 0.88
PIB (log ratio) x W (log ratio)	0.03 (0.11) 1.03	-0.04 (0.19) 0.96
Downstream	-0.48 (0.24) ** 0.62	-0.16 (0.49) 0.85
Runoff (sqrt)	-0.05 (0.02) *** 0.95	0.06 (0.04) * 1.07
Comparative Power (log ratio)	-0.08 (0.07) 0.92	0.22 (0.15) 1.24
Shared IGOs (sqrt)	0.22 (0.08) *** 1.25	-0.41 (0.20) ** 0.67
Joint Democracy	0.90 (0.33) *** 2.47	-0.70 (0.90) 0.50
River Treaty (lagged)	-0.15 (0.42) 0.86	0.06 (1.09) 1.06
Constant	-2.08 (0.48) *** 0.13	-1.89 (0.94) 0.15

(Note: Exponentiated coefficents reported under coefficients and standard errors.)
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

The model produces four main conclusions. First, negotiation is more likely to occur when the challenger state has a higher proportion of its population residing within the river basin than its target state, although this effect is statistically insignificant. Second, negotiation is significantly more likely to occur when the challenger state's *W*-size is larger than its target state's. Third, militarization is more likely to occur when the challenger state has a higher proportion of its population residing within the river basin than the target state, although this effect is statistically insignificant. Lastly, militarization is more likely to occur when the challenger state's *W*-size is smaller than its target state's, although this effect is not statistically significant. Importantly, however, these findings are revealed only in respect to the likelihood of no management occuring. As a result, the log-odds structure of the GML (i.e., each outcome as

measured against the baseline) "makes it difficult to formulate a general understanding of the results" (Fox 2016).

Presented graphically, Figure 5 illustrates the model's predicted probability of interstate river claim management across all possible values of the challenger-to-target PIB log ratio, with the *W* log ratio and all control variables within the model held at their median values.[18] For instance, with a dyad's PIB log ratio value set at zero – indicating that both the challenger and the target state have exactly the same PIB – and all other variables held at their median values, the probability of no management, negotiation, and militarization occuring on a dyad is 85%, 12%, and 3%, respectively. Additionally, prediction lines for each outcome – no management, negotiation, or militarization – are associated with a prediction interval. As in previous figures, prediction intervals should be used primarily for assessing where predictions are most accurate rather than evaluation of statistical significance.

[18] Analysis of marginal effects indicated that predicted probabilities were insignificantly different when the *W* log ratio was held at its 25th percentile and 75th percentile values. As a result, the *W* log ratio is depicted – like control variables – at its median value.

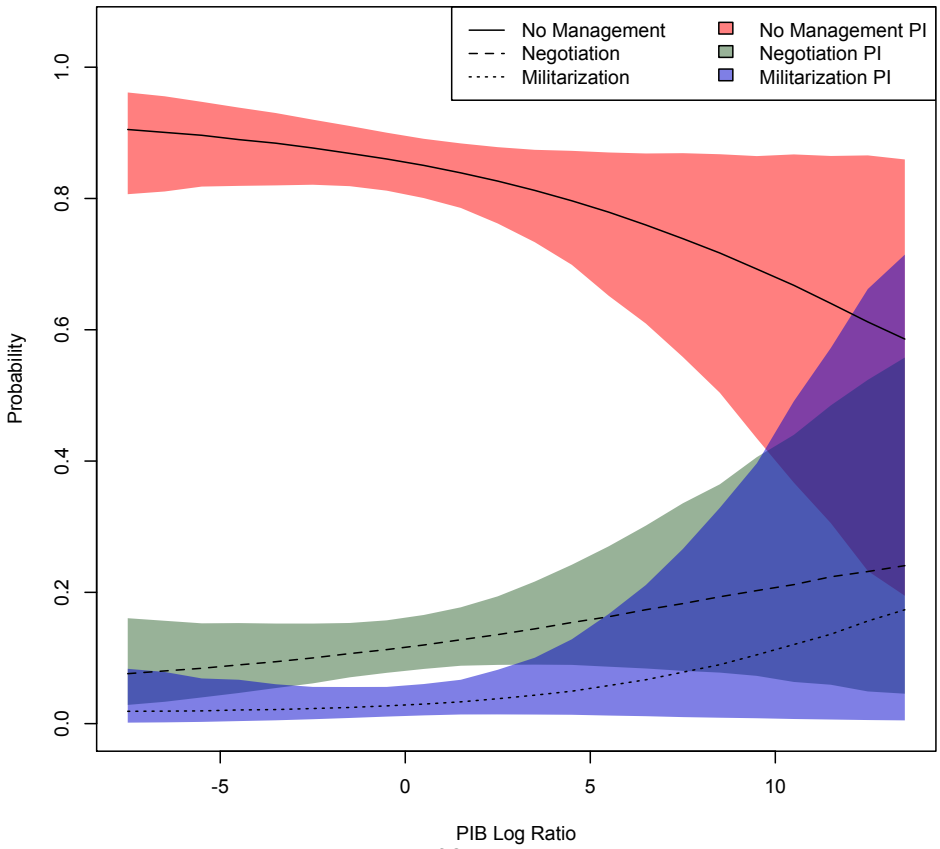

Figure 5: Probability of Claim Management Across PIB Ratios

Figure 6 illustrates the model's predicted probability of interstate river claim management across all possible values of the challenger-to-target *W* log ratio, with the PIB log ratio and all control variables within the model held constant at their median values.[19] For example, with a dyad's *W* log ratio value set at 0.70 – indicating that the challenger has twice the *W* of the target state – and all other variables held at their median values, the probability of no management, negotiation, and militarization, is 79%, 18%, and 3%, respectively. Additionally,

[19] Analysis of marginal effects indicated that predicted probabilities were insignificantly different when the PIB log ratio was held at its 25th percentile and 75th percentile values. As a result, the PIB log ratio is depicted – like control variables – at its median value.

prediction lines for each outcome are associated with a prediction interval for indication of projection accuracy.

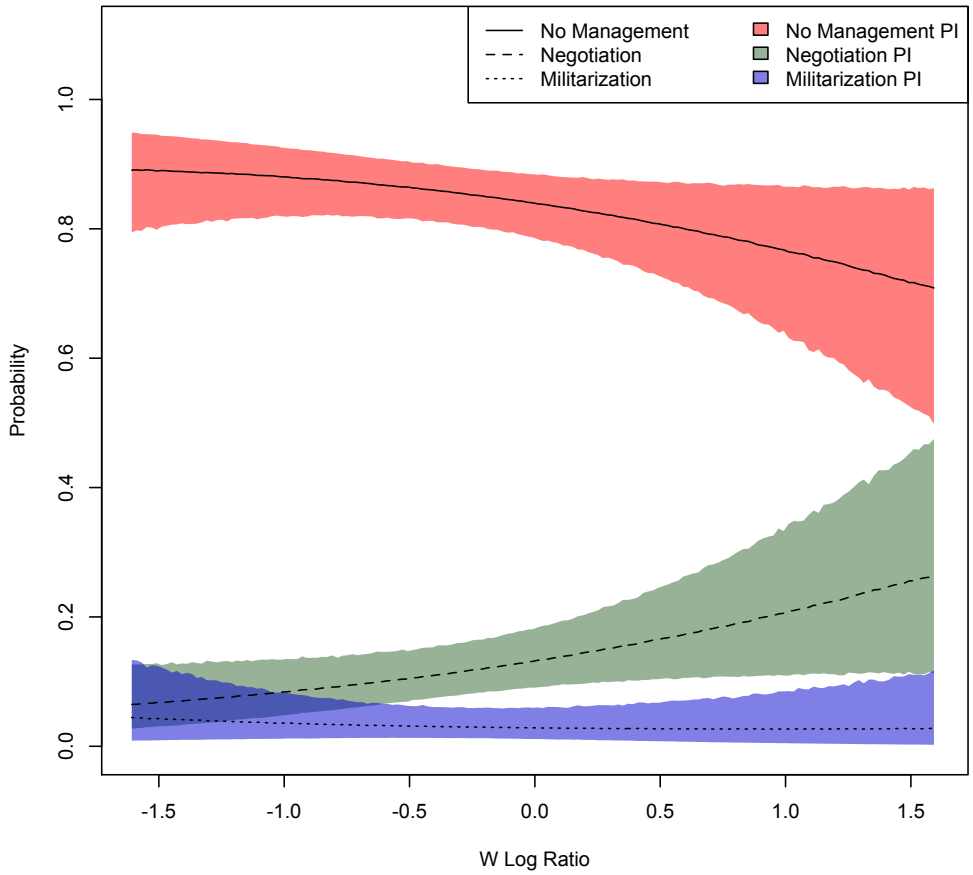

Figure 6: Probability of Claim Management Across W Ratios

Hypothesis Three (A) proposes that dyads in which the targeted state has a greater percentage of its population residing within the transboundary river basin than the challenger state will be more likely to remain unmanaged than other types of dyads. The model offers substantial support for this expectation. A one-unit decrease in a record's PIB log ratio – equating to a relative increase in the target state's PIB – results in an 8% decrease in the relative odds of negotiation or a 12% decrease in the relative risk of militarization, as compared to the likelihood of no claim management. Figure 5 graphically depicts this relationship, with the

probability of no claim management at its highest when values for the PIB log ratio are at their most negative. For instance, when the PIB log ratio is set at its minimum value (i.e., -7.5) – indicating that the challenger has less than 1% of the PIB of the target state – no claim management occurs on a massive 90% of dyads. The probability of no management occuring, however, notably falls from this maximum as the target state's PIB decreases in relation to the challenger's. For instance, when both the target and challenger share the exact same PIB, the probability of no claim management drops from 90% to 85%. And, when the PIB log ratio is held at its maximum value (i.e., 13) – indicating that the target state's PIB is less than 0.01% of the challenger state's PIB – the probability of no claim management plunges to just 59%. In short, the model herein suggests that the probability of no claim management occuring is indeed higher when the targeted state has larger percentages of its population residing within the river basin than the challenger state.

Hypothesis Three (B) suggests that dyads in which the targeted state has a comparatively larger *W*-size than the challenger state will be more likely to remain unmanaged than other types of dyads. The model provides ample support for this expectation as well. A one-unit decrease in a dyad's *W* log ratio – equating to a relative increase in the target state's *W* – results in a 66% decrease in the relative odds of negotiation, as compared to the likelihood of no claim management. Unexpectedly, however, a one-unit decrease in a record's *W* log ratio also results in a 12% increase in relative risk of militarization, as compared to the likelihood of no claim management. Predicted probabilities shed some light on this seemingly peculiar outcome. Figure 6 indicates that, although militarization is more likely at low values of the PIB log ratio than at other values, this increase in probability has no effect on the outcome most predominant at these values: no claim management. In fact, Figure 6 reveals that the probability of no claim

management is highest when values for the *W* log ratio are at their most negative. For instance, when the *W* log ratio is held at its minimum value (i.e., -1.61) – indicating that the target state has 5 times the *W* of the challenger state – the probability of no claim management is 89%. Yet, as the *W* log ratio increases, the probability of no claim management falls. For example, at the *W* log ratio's median value (i.e., -0.22) – indicating that the target state has 125% of the challenger state's *W* – the probability of no claim management falls to 85%. When the *W* log ratio is increased to its maximum value (i.e., 1.61) – indicating that the target state has just 20% of the *W* of the challenger state – the probability of no claim management sinks further to 71%. The model, thereofore, suggests that the probability of no claim management is indeed higher when the targeted state has comparatively larger *W*-size than the challenger state.

Hypothesis Four (A) suggests that the likelihood of negotiation will be highest in dyads in which the challenger state has a comparatively greater percentage of its population residing within the transboundary river basin than the targeted state. Despite insignificant coorelation of the PIB log ratio and negotiation, the model provides some support for this expectation. For instance, exponentiated coefficients reveal that a one-unit increase in the PIB log ratio – equating to a relative increase in the challenger's PIB – results in an 8% increase in relative odds of negotiation, as compared to the likelihood of no claim management. Figure 5, too, shows that negotiation is most likely to occur when the PIB log ratio is at its highest values. For instance, when the PIB log ratio is at its maximum value (i.e., 13) – indicating that the challenger's PIB is more than 100,000 times greater than the target's – the probability of negotiation is 24%. As the PIB log ratio decreases in value, however, the probability of negotiation decreases in tandem. For instance, at the markedly less-extreme PIB log ratio median value of 0.40 – indicating that the challenger's PIB is just 1.5 times larger than the target's – the probability of negotiation sinks

to just 12%. Thus, the model provides substantial evidence that the probability of negotiation is highest when the challenger state has a higher PIB than the target state. Moreover, negotiation is particularily likely when the challenger state's PIB is considerably higher than the target state's.

Hypothesis Four (B) proposes that the likelihood of negotiation will be higher on dyads where the challenger state has a comparatively larger *W* than the targeted state. The model provides generous support for this expectation. Positively and significantly coorelated with the likelihood of negotiation, a one-unit increase in a dyads's *W* log ratio – equating to a relative increase in the challenger's *W* – results in a 66% increase in the relative odds of negotiation, as compared to the likelihood of no claim management occuring. Moreover, Figure 6 shows that negotiation is most likely when the *W* log ratio is at its highest values. For instance, when the *W* log ratio is held at its maximum value (i.e., 1.61) – indicating that the challenger state's *W* is 5 times the target state's – the probability of negotiation is 26%. As the *W* log ratio decreases, however, so too does the probability of negotiation. For example, at the *W* log ratio's median value of -0.22 – indicating that the target state has 125% of the *W* of the challenger state – the probability of negotiation falls to 12%. And, when the *W* log ratio sinks to its minimum value (i.e., -1.61) – indicating that the target state's *W* is 5 times the challenger state's – the probability of negotiation sinks to just 3%. The model, therefore, suggests that the probability of negotiation occuring is indeed higher when the challenger state has larger *W* than the target state.

Lastly, Hypothesis Five suggested that dyads will be most likely to be militarized when both the challenger and target state have similar PIB (A) and *W* (B), as indicated by log ratios close to zero. Since the effect theorized within this hypothesis is non-linear, the regression model's summary and exponentiated coefficients are of little use for their empirical assessment. The model's predicted probabilities, however, offer support against these hypotheses. Figure 5,

for instance, shows that the probability of militarization is greatest not when the PIB log ratio is close to zero, but rather when the PIB log ratio reaches its highest values. For instance, when the PIB log ratio is set at its maximum value (i.e., 13) – indicating that the challenger state's PIB is more than 100,000 times greater than the target state's – the probability of militarization is 17%. Yet, when the PIB log ratio is held at 0 – indicating that both the challenger state and target state have the exact same PIB – the probability of militarization sinks to just 3%. Moreover, Figure 6 indicates that the probability of militarization is greatest not when the *W* log ratio is close to zero, but rather when the *W* log ratio it is at its lowest values. For example, when the *W* log ratio is held at its minimum (i.e., -1.61) – indicating that the target state's *W* is five times the challenger state's – the probability of militarization is 4%. Yet, when the *W* log ratio is held at 0 – indicating that both the challenger state and target state have the exact same *W* – the probability of militarization sinks to just 3%. In short, the expectation that militarization will be most likely when the PIB log ratio and *W* log ratio are close to zero is unsupported by the model.[20]

Although this outcome was unexpected, it provides an exciting opportunity for further scholastic inquiry. The bargaining model of war, the foundational theory at the basis of predictions herein regarding claim management, is traditionally applied to serious contentions among states, with grave consequences for dispute irresolution (Mitchell 2017). Yet, in the context of interstate river disputes, Petersen-Perlman and Wolf (2017) contend that the best, rational alternative to a negotiated agreement is infrequently militarization. After all, "for the price of one week's fighting, you could build five deslination plants … [with] no loss of life, no

[20] Shifts above and below the median value of the logged comparative power ratio used in generating predicted probabilities – a particularly relevant variable for the understanding of militarization – only serve to dampen or exaggerate the effects presented in Figures 6 and 7. In other words, dyads with high PIB log ratios and low *W* log ratios are the most likely to be militarized, regardless of whether the challenger state or target state is militarily more powerful.

international pressure, and a reliable [freshwater] supply you don't have to defend in hostile territory" (Petersen-Perlman and Wolf 2017). Thus, in scenarios when both disputant states maintain equal willingness to fight over the use of a transboundary river, management of interstate river claims may not yeild significant enough benefit to outweigh the substantial costs of militarization. As state willingness to militarize a claim shifts in favor of the challenger state, however, militarization may increasingly be seen by the challenger state as a means to motivate negotiation on the dyad, expecting that the targeted state lacks the willingness to fight and will ultimately negotiate following a militarization. Thus, in this scenario, militrization may occur not from uncertainty about the outcome of conflict as is theorized by Blainey (1988) and Fearon (1995), but rather the certainty that militarization will not arise to a costly war.[21]

[21] Although unassessed within this article, I welcome further inquiry into this prediction. A causal linkage between low-value interstate contentions and low-level militarization may explain broader occurrences of interstate violence.

CHAPTER 6

DISCUSSION AND CONCLUSION

At the outset of this study, I asked why some transboundary river basins are more prone to the initiation of interstate river claims than others, and – once a claim arises – why some claims are more prone to peaceful or conflictual management. In shedding its neo-Malthusian and cornucopian past, recent transboundary river research drawing on geographic, institutional, and international relations scholarship has begun to provide some understanding of varying opportunities for claim onset and management among riparian dyads. In other words, the academe increasingly understands *where* contentions over transboundary rivers are most likely and *how* these contentions are most likely to be managed. Yet, this work has thus far emphasized only one of two necessary conditions for interstate river claim onset and management (i.e., opportunity), omitting a causal understanding of *why* states are willing to initiate and manage claims over some transboundary rivers but not others.

I confront this lacuna, advancing a theoretical argument that draws upon selectorate theory and the bargaining model of war. According to this argument, when a state's domestic populations residing within a transboundary river basin encounter a threat to their freshwater access as a result of another riparian state, these individuals work within their state's political system to raise their concerns among domestic political leadership. If transboundary river concerns are widely-held among the domestic populace – regardless of the state's particular institutions – the state's domestic political leadership will be more willing to initiate an interstate river claim, avoiding political consequences of leaving river concerns unaddressed. Yet, I

contend that, if transboundary river concerns are held by only a small percentage of the domestic populace, the willingness of a state's domestic political leadership to initiate an interstate river claim diverges based on the size of the state's winning coalition. In small-*W* states where only low percentages of the state's domestic populace are concerned about transboundary freshwater access, the domestic political leadership has little incentive to expend resources otherwise provided to their few supporters as private benefits on the protection of a public good. In large-*W* states where only low percentages of the state's domestic populace are concerned about transboundary freshwater access, however, the domestic political leadership will be more willing to initiate or manage an interstate river claim as a result of their need to maintain political support through the provision of public goods.

Once an interstate river claim is initiated by one state (the "challenger") against another (the "target"), interstate bargaining begins. At this point, both state's domestic populations residing within the transboundary river basin work within their state's political system to demand that their domestic political leadership receive a favorable dispute outcome – whether cessation of freshwater abuse by the target (sought by the challenger state) or a cessation of demands by the challenger (sought by the target state). The more widely-held transboundary river concerns are among the state's domestic populace – regardless of the state's particular institutions – the more likely it is that the state's domestic political leadership will face political consequences if the dispute's resolution is unfavorable. Moreover, the larger the winning coalition of a state (and thus the lower a leader's ability to satisfy their supporters via provision of private goods), the more likely it is that the domestic political leadership will face political consequences if the dispute's resolution is unfavorable. Thus, the domestic political leadership of states will be more willing to commit resources to the favorable resolution of interstate river claims if large

proportions of the state's population reside within the basin under dispute and if the state has a large winning coalition.

According to the bargaining model, if one disputant state is more willing than the other disputant state to commit resources toward securing a better bargain – such as through diplomatic pressure or military action – their opposing disputant is more likely to offer a better bargain to avoid costly diplomatic or military confrontation. As a result, I argue that dyads will be most likely to be unmanaged – a favorable outcome for the target state – when the target state has a comparatively higher percentage of its population residing within the disputed basin or a comparatively larger winning coalition than the dyad's challenger state. Similarly, I argue that negotiation – a favorable outcome for the challenger state – is most likely to occur on dyads where the challenger state has a comparatively higher percentage of its population residing within the disputed basin or a comparatively larger winning coalition than the targeted state.

Finally, the bargaining model indicates that, if both disputant states are similarly willing to commit resources toward securing a better bargain, both states have an incentive to exaggerate and misrepresent their willingness to engage in diplomatic and military conflict over the claim in an attempt to secure better terms of freshwater access and usage for themselves. This, however, may lead to informational asymmetry about each state's actual capabilities and willingness to engage in conflict, leading one or both states to undertake military confrontation despite its high costs. As a result, I argue that dyads will be most likely to be militarized when both the challenger state and target state have similar percentages of their population residing within the disputed basin or have a similar sized winning coalition.

Empirical evidence generally supports the logic of this argument. A quantitative analysis of the period 1900-2001 reveals that states are significantly more likely to initiate interstate river

claims over transboundary river basins comprising higher percentages of their domestic population. Moreover, this analysis also indicates that, when the percentage of the state population residing within a transboundary river basin is small, large-W states are significantly more likely to initiate an interstate river claim. These findings suggest that interstate river claim onset is a function of not only geographic factors, but also the willingness of a state's domestic political leadership to undertake international bargaining. Moreover, my analysis indicates that domestic political leaders initiate interstate river claims because their state's residents demand it, with more vulnerable leaders – those held most responsible to transboundary river basin residents – most likely to undertake initiation of an interstate river claim.

For dyads in which an interstate river claim exists, the empirical analysis herein suggests that dyads are most likely to remain unmanaged if the target state has a larger percentage of its population residing within the disputed transboundary river basin or a larger winning coalition than the challenger state. Conversely, negotiation is shown to be most likely to occur on a dyad when the challenger state has a larger percentage of its population residing within the disputed transboundary river basin or a larger winning coalition than the target state. Unexpectedly, however, quantitative analysis also indicates that militarization is not most likely to occur when both disputants have a similar percentage of state population within the disputed transboundary river basin or a similar size winning coalition. Collectively, these findings suggest that interstate river claim management is strongly informed by not only geographic and institutional factors, but also the comparative willingness of states to eschew interstate bargaining in favor of diplomatic or military conflict. Importantly, the analysis indicates that a dyad's domestic political leaders are constrained by the demands of their state's residents, with the dyad's more vulnerable leadership – the leader held most responsible to their respective transboundary river

basin residents – less likely to compromise favorable management of the interstate river claim. Yet, this analysis also indicates that, in the study of low-value interstate contentions such as those over transboundary freshwater access, the bargaining model of war may not accurately predict interstate conflict.

Prior scholarship has adeptly offered understanding of *where* interstate river claims are most likely to occur and *how* they are most likely to be managed. This study, however, represents the first attempt to incorporate the willingness of states – the reason *why* states act in the international environment – into the study of interstate river claim onset and management. This study, however, only incorporates two measures of state willingness within its theoretical development. With immense understanding of state motivations within the international arena found within political science's institutional and behavioral literature, further exploration of these dynamics will vastly improve academic understanding and policymaking foresight in transboundary river management and resource-related interstate contentions.

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APPENDIX A: CODING OF THE DOWNSTREAM CONTROL VARIABLE

Previous studies of interstate river claims have only coded geographical orientation for non-directed dyads in which interstate river claims occurred. Yet, as this study requires data on geographical orientation for all river basins in which a claim could theoretically occur, it was necessary to perform manual coding of each river basin within the spatial and temporal domain of the study. Moreover, as this study uses a directed-dyad format for the analysis of claim onset, this analysis was able to code for "downstream" river orientation (i.e., the challenger state is downstream from the targeted state) rather than the less-nuanced "upstream-downstream" coding that prior analyses have used to denote geographical orientation in non-directed dyads. Coding of this variable relied on careful analysis of various atlases, maps, and satellite imagery, although Macmillan's *Planet Earth* world atlas (1st edition), the *National Geographic Atlas of the World* (5th edition), and Google Earth's third-party imagery served as particularly vital resources.

All transboundary river basins within the Western Hemisphere, Western Europe, and the Middle East were manually coded for the presence or absence of downstream river basin orientation, here defined as whether the potential challenger state is downstream from the potential targeted state. In coding for this variable, a 1 denotes the presence of downstream river orientation while a 0 denotes the absence of downstream river orientation. An example of this sort of river alignment would include the Colorado River, which – as a transboundary river basin comprising part of two states – would result in two dyads for every year included within the dataset. In the dyad-years where Mexico is the potential challenger, the dyads would be coded

with a 1 as Mexico's Colorado river basin is downstream from the United States' Colorado river basin. The other dyad, where the potential challenger is the United States, would be coded as a 0.

Coding of some river basins, however, were slightly more complicated. For instance, take a U-shaped river basin such as the Erne river basin, which winds from the Republic of Ireland to Northern Ireland before returning to the Republic of Ireland. Here, each dyad with the Republic of Ireland as a potential challenger would be coded as a 1 as it is at least partially downstream from the United Kingdom. Yet, a potential challenger United Kingdom would be coded as a 0 despite the fact that it is downstream from Ireland, as it is unlikely that the Republic of Ireland would take an action that would ultimately have a negative impact on itself once the water flows back into the Republic. Lastly, all dyads in which a river basin completely forms an international border are coded as a 0, as neither bordering state could be understood to have an incentive to negatively affect water flow or freshwater access that is shared by both parties throughout the length of the river.