

QUANTITATIVE APPROACHES

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OVER the past half-century, there has been a substantial rise in the amount of quantitative research conducted in the field of international relations. The range of issue areas covered in this research has also expanded. Whereas early statistical research in international relations focused primarily on international security—especially the causes and consequences of war—more recent work has addressed a remarkably wide array of topics and has shed considerable light on (as well as generated) some of the most heated debates in the field.

The purpose of this chapter is to survey quantitative research on international relations, tracking its development and assessing the contribution that this body of literature has made. We make no pretense of offering a comprehensive survey of this literature; nor do we attempt to explain particular statistical techniques. Rather, we aim to analyze how quantitative work has informed some key debates in the field of international relations.

1 WHY USE QUANTITATIVE TECHNIQUES TO STUDY INTERNATIONAL RELATIONS?

There are a variety of general reasons why researchers have relied on statistical techniques to study international relations (on these issues see, e.g., Bueno de

Mesquita 1985; Braumoeller and Sartori 2004). First, these techniques are especially useful when analyzing a large number of observations. Many key questions in international relations involve comparisons across the global system at different points in time; others involve comparisons across different regions or countries. Consequently, empirical research in international relations often entails the analysis of large data-sets. Secondly, scholars often wish to make generalizations about global affairs based on a set of cases. Statistical research facilitates these inferences about the broader population through the analysis of representative samples and the laws of probability.

Thirdly, various statistical techniques allow researchers to assess the direction and the strength of relationships. For the purposes of testing theories, it is obviously important to understand whether the key independent variable(s) specified by a theory covary with the dependent variable. Quantitative techniques can help researchers gauge the extent of such covariation. These techniques can also help address the directionality of causation between an independent variable and the dependent variable, ensuring that any observed effect of an independent variable on the dependent variables does not actually stem from the dependent variable's influence on the independent variable. Furthermore, these techniques can shed light on the magnitude of an independent variable's impact on the dependent variable, a very important issue that is often given short shrift. Fourthly, and related, certain quantitative methods are well suited to testing competing explanations of a given outcome. Multivariate models, for example, allow researchers to compare the effects of factors emphasized in competing theories. These models also allow researchers to account for the effects of variables that could be related to both the core independent variable(s) and the dependent variable, thereby reducing the likelihood of observing a spurious correlation between them.

Despite these and other advantages, however, quantitative methods also have well-known limitations. Critics have charged that the variables included in statistical models sometimes lack internal or external validity. They have argued that existing measures of some central concepts—such as political power, conflict, interests, and preferences—are crude at best and inaccurate at worst. Others contend that important variables in certain international relations theories—for example, norms or ideas—cannot be measured at all, thus rendering quantitative tests of these theories impossible. Critics also charge that quantitative tests in the field of international relations sometimes violate key statistical assumptions, thereby casting doubt on the results generated by these tests. Finally, various observers maintain that some quantitative studies are not firmly grounded in international relations theories, and that they focus too heavily on establishing whether variables are correlated without paying enough attention to the underlying causes of any such correlation.

Over time, researchers have paid increasing attention to many of these critiques, attempting to improve measurement techniques, conduct sensitivity analyses, and

better link theory to statistical models. Moreover, while researchers should always be sensitive to measurement issues, these are not concerns relevant only to quantitative research. All empirical analysis, whether quantitative or qualitative, requires the operationalization and measurement of concepts and variables. One advantage of quantitative research is that judgments about measurement tend to be especially transparent and replicable. If a scholar disagrees with a coding or measurement scheme, he or she can readily replicate and adjust that scheme accordingly.

2 QUANTITATIVE RESEARCH ON INTERNATIONAL RELATIONS DURING THE COLD WAR

Quantitative research in the field of international relations has been characterized by a number of trends. First, most of the early quantitative work in the field focused on international security, largely as a result of the discipline's preoccupation with issues involving the cold war. More recently, quantitative research has covered a much broader array of topics, particularly those related to the international political economy and international institutions. Secondly, much of the initial quantitative literature was systemic in orientation: It treated states as unitary actors and paid little attention to domestic politics. Both of these trends began to change near the end of the cold war, an event that contributed to broadening the range of issues that have been analyzed using quantitative techniques.

Until about a half-century ago, quantitative research on international relations was virtually nonexistent. That changed with Karl Deutsch's pioneering work on integration and other topics (e.g. Deutsch et al. 1957) and with the advent of J. David Singer's Correlates of War (COW) Project. The latter research effort was launched in the early 1960s. Since then, it has spawned hundreds of quantitative studies of international relations. During the first few decades of its existence, the COW Project relied on relatively simple bivariate and multivariate techniques to uncover patterns in war, as well as other aspects of international security. The history of this project and its contributions to the study of international relations have been documented elsewhere, so we will not address these issues here (Vasquez 1987; Singer 1990). Nevertheless, it is worth noting that many of the studies we take up in this chapter rely on data generated by the COW Project.

Much of this research project focused on testing hypotheses drawn from realist theories of international relations (on realist theories, see Waltz 1979; Jervis 1999).

In keeping with this realist focus, quantitative research during the cold war was largely systemic in orientation and tended to treat states as unitary actors.¹ Within this literature, analyses of arms racing were particularly influential. Indeed, one of the pioneering quantitative works in the field of international relations addressed the link between arms races and war. In *Statistics of Deadly Quarrels*, Lewis Richardson (1960)—a meteorologist by training—attempted to model the circumstances under which countries engage in arms races that spiral out of control and the conditions under which countries grow weary of such competition, resulting in a peaceful resolution. Spurred by interest in the growing pace and intensity of the cold war arms race, scholars produced a sizeable body of statistical work that adapted Richardson's basic model to investigate military spending as well as more general patterns of conflict and cooperation among the major powers (Goldstein and Freeman 1990).

Many systemic theories argue that patterns of global outcomes are shaped by the structure of the international system and that variations in this structure occur when the global distribution of power changes. Owing in part to the influential work of Kenneth Waltz (1979), quantitative researchers often measure the global distribution of power in terms of polarity—that is, whether one (hegemonic or unipolar), two (bipolar), or more than two (multipolar) particularly powerful states exist. A large portion of the quantitative work on this issue has focused on resolving long-standing debates about whether polarity influences the outbreak of international war. However, quantitative studies have generated no consensus on either the strength or the nature of this relationship (Levy 1984; Hopf 1991; Mansfield 1994). In part, these disagreements stem from differences in how polarity is defined and measured, illustrating why it is important to pay careful attention to whether empirical results are sensitive to the measurement and operationalization of key variables.

Polarity, however, is not the only dimension of the system's structure. Another dimension is the concentration of power in the system, which is determined by the number of major powers and the relative inequality of power among these states (Singer, Bremer, and Stuckey 1972). Focusing on concentration rather than polarity has a number of advantages (Mansfield 1994), and various efforts have been made to assess the relationship between concentration and the outbreak of war. In a review of this literature, Randolph Siverson and Michael Sullivan (1983) suggest that a low level of concentration (that is, a more uniform distribution of power) is associated with more conflict. More recently, Edward Mansfield (1994) has found the relationship to have an inverted

¹ Of course, there were various exceptions to this tendency. For example, a large quantitative literature emerged on internal-external conflict linkages. Partially inspired by an interest in the diversionary theory of war, scholars attempted to determine whether domestic strife gave rise to international conflict and vice versa (Wilkenfeld 1972). The studies, however, found little evidence of this type of relationship.

U-shape: at both low and high levels of concentration, major-power war is least likely to occur. At intermediate levels of concentration, such wars occur most frequently.

In addition to the system's structure, realist theories have placed a heavy emphasis on political–military alliances. Numerous cold war-era quantitative studies attempted to link the creation, operation, cohesiveness, and dissolution of alliances to inter-state conflict. In one of the first studies of this sort, J. David Singer and Melvin Small (1968) concluded that the relationship between alliances and war was conditional on the time period analyzed—increases in the number of alliances correlated with peace in the nineteenth century, but with war in the twentieth century. Later research by Siverson and Sullivan (1983) found that the effects of alliances on war depend on whether the focus is on major or minor powers. In a review of research conducted in the COW Project, John Vasquez (1987) argues that alliances seem to be associated with war, but not causally. The latest wave of quantitative research on this topic has distinguished between different types of alliances. Brett Ashley Leeds (2003), for example, shows that whether the alliance agreement provides for the defense of members, increases an aggressive member's offensive capabilities, or guarantees neutrality in the event of hostilities influences whether it deters or encourages aggression. Defense pacts tend to inhibit conflict, whereas offensive and neutrality agreements tend to promote belligerence.

While this review is not meant to be exhaustive, it does suggest some features of the early quantitative literature: acceptance of the unitary actor assumption, an emphasis on structural theories, and a focus on security concerns. Moreover, in each of these areas of research, initial results yielded considerable debate. These disagreements led researchers to refine the measures and tests that were used, and to focus on the particular conditions under which a theory holds. In this way, quantitative analysis has advanced various theoretical debates in the field.

2.1 International Political Economy

While many quantitative studies during the cold war addressed security issues, a handful of studies began to analyze systemic theories of the international political economy. Part of that literature focused on testing hegemonic stability theory, which holds that the relatively liberal international economy that existed during much of the nineteenth century and after the Second World War is attributable to the power preponderance of Great Britain during the former era and the United States during the latter (Kindleberger 1973; Gilpin 1987).

In an effort to test this theory, a number of statistical studies have been conducted, but the results have been far from uniform. John Conybeare (1983), for example, evaluated the relationship between the international distribution of power

and nominal tariff levels on manufactured goods in 1902 and in 1971, controlling for a host of economic, political, and military factors. He found little evidence that power relations affect national tariff levels, and therefore concluded that hegemonic stability theory does not provide an adequate explanation of trade policy. Similarly, Timothy McKeown (1991) conducted a time-series analysis of the relationship between variables associated with hegemony and the ratio of imports to national income for a set of advanced industrial states during the period from 1880 to 1989. Measuring the distribution of power using several variables, McKeown found only a modest influence of these measures on the ratio of imports to national income, leading him to share Conybeare's skepticism about the explanatory power of hegemony stability theory.

Other studies, however, have found more support for the view that hegemony affects the global trading system. For example, Robert Pahre (1999) distinguishes between periods of benevolent and malevolent hegemony. He finds that hegemony generally has a malign effect on the international political economy. In addition, hegemony having more foes than friends tend to be benevolent, but malevolent hegemony can induce cooperative behavior on the part of the remaining states in the international system.

Finally, Mansfield (1994) analyzes the effects of hegemony and the concentration of capabilities on the level of global trade as a percentage of total global production from 1850 to 1965. He finds that whether hegemony promotes global trade depends heavily on how it is defined and measured. Furthermore, there is a U-shaped relationship between the concentration of capabilities and global trade. The ratio of global trade to global production is highest when the level of concentration is both relatively high and relatively low, whereas this ratio is lowest when concentration is at an intermediate level.

In addition to analyzing the effects of hegemony, quantitative research on the international political economy during the cold war and its immediate aftermath also focused on the political economy of national security. One strand of research addressed the influence of political-military alliances on trade patterns. Central to the effects of alliances on trade are the efficiency gains from overseas commerce, which increase each trade partner's national income and can be used to augment each state's military power. Joanne Gowa (1994) argues that states can address the security implications of foreign commerce by trading more freely with their allies than with their (actual or potential) adversaries. To test these arguments, Gowa and Mansfield (1993; Gowa 1994) conducted a statistical analysis of the effects of alliances on trade flows between major powers during the twentieth century. They find strong evidence that allies trade more extensively than other states. A number of subsequent studies have largely confirmed this finding, while covering a wider range of countries and years, and using statistical techniques designed for data that are both cross-sectional and time series (Morrow, Siverson, and Tabares 1998; 1999; Gowa and Mansfield 2004).

A related strand of work centers on the influence of political–military conflict on trade. One set of studies focuses on the effects of political cooperation and conflict on bilateral trade flows. In two influential articles, Brian Pollins (1989*a*; 1989*b*) found that cooperative political relations significantly increased the flow of trade. A second set of studies considers the effects of political–military conflict on trade. Some research finds that wars significantly reduce trade, both globally and between combatants (Gowa 1994; Mansfield 1994). However, other studies have concluded that conflicts—a category that includes wars as well as other less intense political disputes—have little influence on trade patterns, since traders may anticipate conflict and adjust their overseas business relations accordingly (Morrow, Siverson, and Tabares 1998; 1999).

3 QUANTITATIVE RESEARCH ON INTERNATIONAL RELATIONS SINCE THE MID-1990S

Since the mid-1990s, there have been a number of dramatic changes in quantitative international relations research. First, it has grown more pervasive. A recent survey, for example, found that the portion of articles in the leading international relations journals that rely on statistical analysis rose from about 25 percent in the late 1970s to almost 45 percent by the late 1990s (Sprinz and Wolinsky-Nahmias 2004, 7). Secondly, this work has become increasingly sophisticated, involving a wider range of techniques. Whereas earlier work relied heavily on simple bivariate correlations or ordinary least-squares regression models, recent research has taken advantage of the many innovations that have been made in statistical analysis over the past few decades. Thirdly, contemporary studies cover a much broader array of substantive topics than before. Rather than focusing primarily on testing systemic theories, much of the more recent quantitative work analyzes how domestic politics affects international relations. Furthermore, contemporary statistical research that does focus on systemic theories is often designed to test neoliberal institutional and even constructivist approaches, rather than realist theories. Fourthly, and closely related, recent quantitative studies span a variety of issue areas that received little attention in statistical research during the cold war, including economic sanctions, monetary policy, human rights, and environmental politics.

What explains the rapid proliferation of quantitative research in the field of international relations over the past decade or so? We suspect a handful of forces are at play. An increasing emphasis on quantitative methods training in Ph.D.

programs, the growing amount of quantitative work in other subfields of political science (such as American politics and political economy), the decline in computing costs and the simultaneous rise in computation power to estimate more complex models, and more readily available data-sets (especially over the internet) have each contributed to the proliferation of quantitative work in the field.

Not only has the amount of quantitative research expanded, but the range of methods has expanded too. This development stems from a number of sources. First, important advances have been made in related fields, especially economics and sociology, including improvements in time-series modeling and duration models; the analysis of rare events, simultaneous relationships, endogeneity, and nonrandom selection; and the analysis of data that are both a time series and cross-sectional.

Secondly, the field of international relations underwent an important theoretical shift soon after the end of the cold war, placing less emphasis on realist and neorealist models. Realism, of course, has not been abandoned. There continues to be much research conducted in this theoretical tradition, and much of the statistical research conducted in other traditions is careful to account for variables emphasized by realists. However, the end of the cold war led many observers to question whether realism was the most appropriate theoretical lens through which to view international relations.

Researchers began turning to other approaches with increasing frequency. Among systemic theories, the contemporary era has been marked by the rise of constructivism and by heightened interest in neoliberal institutionalism.² Among alternative approaches, this era has been marked by the rapid growth of work on the links between domestic politics and international relations (Milner 1997). Furthermore, whereas research in the field of international relations—quantitative and qualitative—focused largely on international security during the cold war, the end of this period stimulated rising interest in international political economy, international institutions, and various other substantive issues. These developments have had important implications for statistical research in the field.

3.1 The Liberal Peace

Shifting theoretical tides in the aftermath of the cold war led to the creation of various data-sets that were both cross-sectional and time series. Usually, the cross-sectional units were countries (a “monadic” research design) or pairs of countries (a “dyadic” design). In almost all cases, data on issues of interest to international

² For an overview of constructivism, see Ruggie (1998). For an overview of neoliberal institutionalism, see Keohane and Martin (1995).

relations scholars are reported on an annual basis; as such, the temporal units are generally years. Consider, for example, the voluminous literature that has been produced on the democratic peace. During the late 1980s, scholars displayed growing interest in the proposition that relations between democracies are particularly cooperative and peaceful (Doyle 1986). Indeed, Jack Levy (1989) went so far as to characterize the argument that democracies rarely if ever fight each other as the closest thing that the field of international relations has to a law. Although a few scattered tests of this proposition had been conducted earlier, the 1990s and early 2000s were marked by an enormous amount of research on this topic, most of it statistical (e.g. Russett 1993; Russett and Oneal 2001).

Quantitative studies of the democratic peace typically rely on a dyadic research design. Data are compiled on pairs of states over the longest available period of time, usually the post-Second World War era, but (depending on data availability) sometimes the entire nineteenth and twentieth centuries. The dependent variable in these studies is the outbreak of conflict, usually defined as a militarized inter-state dispute (Jones, Bremer, and Singer 1996), but sometimes defined as war.

During the course of the 1990s, interest in the democratic peace grew broader. Bruce Russett and John Oneal (2001), for example, analyzed whether there was a more general liberal peace. Drawing on long-standing arguments by Immanuel Kant and others, they hypothesized that democracy, high levels of economic interdependence, and participation in international organizations combine to inhibit inter-state conflict. These developments led to models of conflict in which the key independent variables were not just regime type, but also the flow of trade between the states in each dyad (usually normalized by their national incomes to construct a measure of interdependence) and the extent to which they participated in intergovernmental organizations (Russett and Oneal 2001; Pevehouse and Russett 2006).

Initial statistical studies provided considerable support for the democratic peace and for a more general liberal peace, yet these studies also provoked various criticisms. Some observers questioned whether the democratic peace might be a function of chance alone (Spiro 1994), while others charged that the effects of democracy grew out of the similar interests and preferences that democracies share about international affairs (Gartzke 1998; Gowa 1999). Still others challenged the statistical techniques that were being used to test the liberal peace. What should be done to address the temporal dependence that exists in these data-sets (Beck, Katz, and Tucker 1998), the fact that there may be unmeasured heterogeneity in the data stemming from factors such as history or culture that are specific to a particular country or dyad (Green, Kim, and Yoon 1998), or the fact that inter-state conflict is a rare event (King and Zeng 2001)? These concerns have led researchers to use a variety of different techniques and have cast doubt on some aspects of the liberal

peace, although most studies confirm that democratic dyads are less likely to fight than other country pairs.³

One key issue in research on the liberal peace is whether international trade affects the outbreak of political–military conflict. The bulk of the available evidence indicates that heightened interdependence inhibits conflict (Russett and Oneal 2001), a result that accords with arguments advanced by commercial liberals. Most of these studies use the ratio of international trade to national income as a measure of interdependence. However, a number of studies using alternative measures of interdependence have found little support for the liberal position (e.g. Barbieri 2005). Equally, while most studies of this topic treat interdependence as exogenous, some recent research argues that it is endogenous. When interdependence is treated in this way, the evidence that it is inversely related to conflict is far weaker (Keshk, Pollins, and Reuveny 2004).

Partially as a result of these inconclusive findings, some scholars have investigated the particular conditions under which heightened interdependence inhibits hostilities. For example, Mansfield and Pevehouse (2000) argue that extensive trade ties dampen conflict only when the trade partners belong to the same preferential trading arrangement. Joseph Grieco and Christopher Gelpi (2003) contend that the relationship is mediated by the regime type of the states involved: Because democratic governments are more sensitive than other governments to political pressure exerted by private traders, the pacific influence of heightened trade will be felt more strongly in democratic than in nondemocratic states. Thus, the effects of interdependence may be more complex than suggested by earlier theoretical or empirical work.

The links between domestic politics and international security have also been studied in the quantitative literature on the use of military force by the United States. Although this literature emerged in the latter part of the cold war (Ostrom and Job 1986), the bulk of this research has been conducted more recently and has focused on how domestic processes influence the incentives of US presidents to use force. As with nearly every area of literature reviewed here, disagreements and discontinuities have emerged. Initial contributors to this literature suggested that domestic economic conditions directly shaped a leader's incentives to engage in conflict (Ostrom and Job 1986). More recently, however, some contributors have argued that the domestic environment influences only perceptions of threat (Fordham 1998); others have argued that domestic factors play no role in the process (Gowa 1998). In addition, debates have emerged as to whether particular domestic institutions, such as Congress, directly influence the propensity to use force (Howell and Pevehouse 2005). Methodological debates have ensued as well, including a suggestion that existing models suffer from selection on the dependent variable

³ Furthermore, these modeling issues have influenced related work on democratic transitions and the outbreak of conflict (Mansfield and Snyder 2005).

(Meernik 1994) and pay insufficient attention to time-series dynamics (Mitchell and Moore 2002).

In each of these newer research areas, debates over measurement, boundary conditions, and estimation techniques have both theoretical and empirical implications. In essence, these debates are more about what a theory predicts, the conditions under which we expect the theory to hold, and whether competing theories offer more compelling accounts of the evidence. While it might be easy to dismiss debates in these literatures as solely statistical in nature, they are essential to how we reformulate theories in light of evidence, a topic we return to in the conclusion.

3.2 Domestic Politics, International Institutions, and International Political Economy

Interest in how domestic politics affects international affairs has not been limited to the study of international security. On the contrary, there is a burgeoning quantitative literature on the influence of domestic factors on trade and monetary relations, foreign direct investment (FDI), foreign aid, and economic sanctions. William Bernhard and David Leblang (2006), for example, study the links between domestic politics and market behavior, placing particular emphasis on how democratic competition promotes change in currency, bond, and equity markets, and on how such change influences the ability of democratic politicians to retain office. Equally, a sizable number of quantitative studies have analyzed how partisanship, the number of “veto points” in government, a country’s regime type, and other domestic political factors influence foreign trade relations (Lohmann and O’Halloran 1994; Mansfield, Milner, and Rosendorff 2000; 2002; Milner and Judkins 2004; Henisz and Mansfield 2006).

In addition, recent statistical work has addressed the effects of domestic politics on FDI. Quan Li and Adam Resnick (2003), for example, find that democracy has a mixed effect on FDI in developing countries. Strong property rights promote FDI and these rights are stronger in democracies than other countries. However, the direct effect of democracy is different: Holding constant the strength of property rights, democracies received less FDI than other countries during the last few decades of the twentieth century. Conversely, Nathan Jensen (2006) finds that democracies attract more FDI than other states, based on an analysis of both developed and developing countries covering roughly the same period of time. Additional quantitative research on the links between domestic institutions and FDI is likely to refine these findings and to specify the conditions under which these empirical relationships hold.

Quantitative work on the domestic politics of foreign economic relations has also focused on sanctions. Lisa Martin (2000, ch. 4) examines how partisanship affects

the decision to impose sanctions. She finds that, in the United States, the executive branch typically takes the lead in wielding sanctions when the government is "unified" (that is, when the executive and legislative branches are controlled by the same party), whereas Congress typically does so when the government is "divided" (that is, when these branches are controlled by different parties).

A number of other quantitative studies of economic sanctions have considered the impact of nonrandom selection, an issue that has attracted attention throughout the field of international relations. In one study, T. Clifton Morgan and Valerie Schwebach (1997) examine the conditions under which sanctions lead a target country to change policy without the state sending the sanctions resorting to force. They use Gary Hufbauer, Jeffrey Schott, and Kimberly Ann Elliott's data (1990) on sanctions to test their argument, but recognize that relying solely on these data could introduce a selection bias if the same factors that affect whether states become involved in sanctions also influence the outcome of sanctions. For this reason, they supplement the sanctions data with a set of inter-state crises in which sanctions were not imposed. Morgan and Schwebach find that sanctions have neither a statistically significant nor a substantively large effect on the outcome of such disputes; nor do they influence which crises escalate to war.

In a related study, Daniel Drezner (2000) argues that many observers fail to appreciate the usefulness of sanctions, because a selection bias is at work. The most successful sanctions, Drezner argues, are the ones that are threatened but never implemented, since sanctions impose costs on both the sending country and the target state. Drezner uses statistical methods to show that a large number of sanctions attempts end when sanctions are threatened and before they are imposed, because the targets of these actions comply with the senders' demands. Equally, these cases generate more concessions on the part of targets than cases in which sanctions are actually imposed, providing evidence of a selection effect to which researchers need to pay careful attention.

Selection effects are hardly limited to economic sanctions. James Vreeland (2003), for example, analyzes whether International Monetary Fund (IMF) programs succeed in promoting growth, a topic of considerable importance and one marked by substantial disagreement. He argues that existing empirical studies of this topic are flawed because they fail to account for both the factors prompting governments to enter into agreements with the IMF and the subsequent effects of these agreements on growth. Vreeland develops a model to account for nonrandom selection and then uses it to assess the effects of IMF agreements. He finds that governments turn to the IMF when their foreign reserve position is weak, but also to help offset domestic opposition to reform programs. Moreover, Vreeland finds that, when controlling for conditions that drive states to the Fund, IMF programs reduce economic growth and that participation in these programs exacerbates income inequalities within states.

Over the past decade, the issue of nonrandom selection has also generated increasing attention outside the area of international political economy. Studies of international security, for example, began emphasizing the distinction between the onset of conflict and the escalation of conflict. Moreover, scholars recognized that some of the same factors would probably influence both outcomes, creating a source of potential bias. To address this issue, William Reed (2000), Paul Huth and Todd Allee (2003), and others have used selection models that account for the possibility that factors affecting whether countries become embroiled in a dispute might also affect whether the dispute escalates. In some cases, the effects of variables when these two stages of conflict are modeled independently change when these stages are analyzed using a unified selection model. For example, Reed (2000, 88) finds that regime type has a statistically significant impact on the escalation of hostilities until one controls for its influence on the onset of conflict. This avenue of inquiry has contributed to a broader methodological argument concerning the need to account for selection processes in the field of international relations.⁴

Most recently, researchers have analyzed whether there are selection effects in the formation and implementation of international agreements. Inspired by theoretical debates in the literature on compliance with international institutions (Downs, Rocke, and Barsoom 1996), scholars started examining whether the states that choose to enter international agreements do so because they intend to comply with those agreements. If so, then the agreements may have little independent effect on compliance or other aspects of state behavior. In a recent quantitative study, Jana von Stein (2005) finds that the states that enter into IMF agreements are predisposed to take steps that are in accord with these agreements. In her view, this evidence suggests that international institutions help to distinguish “compliant” from “noncompliant” types of states. As such, participating in an international institution helps a state to signal its willingness to abide by its overseas commitments.⁵

More generally, there has been considerable debate in the field of international relations over whether international institutions are endogenous. There are various well-known statistical techniques (including instrumental variables regression and other related two-stage estimators) that can be used to examine whether institutions are actually endogenous and, if so, to model institutions as endogenous when assessing their impact on international relations. The methodological concerns discussed in this section are more than worries over statistical nuance. In fact, they are central to the theoretical debates in the field, reflecting a concern about exactly what theories predict and how to test those predictions adequately.

⁴ For a review of selection models and instances where alternatives to these models may be superior, see Signorino (2002).

⁵ Recently, Koremenos (2005) has linked questions of regime design and flexibility to issues of enforcement, opening a new avenue of quantitative research on international organizations.

4 CONCLUSIONS

In this chapter, we have reviewed some of the burgeoning literature in the field of international relations that utilizes quantitative techniques. We conclude with three observations about the use of these methods. First, as is obvious even to the casual observer, quantitative analyses are now increasingly common in the field. The use of statistical techniques started during the cold war, but the end of the superpower rivalry corresponded with a sharp increase in both the amount of quantitative research and the topics on which this research focused. Both trends seem likely to persist.

Secondly, concomitant to the general rise of statistical approaches in the discipline and the end of the cold war, researchers became increasingly interested in the roles of domestic politics and international institutions in shaping global outcomes. Also, the scope of questions analyzed with quantitative analyses has continued to expand. Recent quantitative work on international security, for example, has placed considerable emphasis on state failure (Goldstone et al. 2002), civil wars and genocide (Valentino, Huth, and Balch-Lindsay 2004; Doyle and Sambanis 2006), human rights (Poe and Tate 1994; Poe, Tate, and Keith 1999; Hafner-Burton and Tsutsui 2005), and the environment (Midlarsky 1998; Neumayer 2002).

Thirdly, and most importantly, while some continue to criticize quantitative approaches as atheoretical, statistical work in the field of international relations has advanced our empirical understanding and has pushed theoretical boundaries. It is difficult to imagine current theorizing regarding liberalism, neoclassical realism, or human security without taking into account the knowledge generated by large-*n* studies. More than simply confirming preconceived notions about the relationship posited by theory, quantitative studies have generated new insights while helping to specify conditions under which relationships hold.

The rise in quantitative work has had important implications for the field of international relations. Some critics of quantitative analysis point to inconsistent findings, measurement problems, and problems of operationalization as weaknesses of statistical approaches. However, while empirical investigation (quantitative or qualitative) must be informed by theory, debates over measurement, operationalization, and method force scholars to think about theory. Exactly what does a given theory predict? What variables are crucial to the theory's prediction? Is the predicted relationship direct or conditional? Good theory informs good empirical analysis, but good empirical analysis is needed to update and refine theories. Quantitative techniques are powerful and valuable tools of empirical analysis, and the field of international relations is far richer for their heightened use.

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