Major Powers and Militarized Conflict*

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December 11, 2012

Abstract

This paper attempts to answer the question of why major powers engage in more active foreign policy behaviors than minor powers. It does so by comparing two explanations for the increased conflict propensity of major powers. The first explanation focuses on major powers' observable capabilities, while the second stresses their different behavior. We incorporate both into an ultimatum model of conflict in which a state's cost of conflict consists of both observable and behavioral components. Using data from the period from 1870 to 2001, we empirically illustrate the observable and behavioral differences between major and minor powers. We then utilize a decomposition model to assess the relative significance of the two explanations. The results suggest that most of the difference in conflict propensity between major and minor powers can be attributed to observable differences.

*We thank Songying Fang, Jesse Johnson, Tobias Heinrich, and Victor Marin for comments. Replication materials for the empirical analysis in this article are available electronically at http://hdl.handle.net/1902.1/19559 on the Dataverse Network.

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For decades, scholars have claimed that major powers differed from minor powers. In studies of topics as varied as international conflict, economic sanctions, nuclear proliferation, alliance formation, and conflict mediation, major power status has been used as a control variable. The assumption (either explicit or implicit) behind this choice is that major powers will more often engage in these foreign policy behaviors than would their minor power counterparts. To adjust for the differences between major and minor powers, major power status is a control variable that is used in many studies of international conflict (just to name a few recent examples, Braumoeller and Carson 2011, Dafoe 2011, Kleinberg, Robinson and French 2012). These studies generally agree that major powers are more conflict-prone than minor powers and choose to account for their presence when studying conflict onset.

Most international relations research agrees that major powers are involved in more conflict than other states, yet the question that remains is *why* major powers differ from minor powers. In other words, what about the major powers makes them more likely to become involved in a conflict than a minor power? In the international relations literature, there are two primary explanations for this conflictual behavior. The first explanation focuses on the observable characteristics of major powers. It stresses the fact that major powers have greater material capabilities. These greater capabilities (such as more natural resources, higher GDP, larger militaries) reduce major powers' cost of engaging in conflict and allow them greater opportunity to do so. Major powers are also able to participate in more meaningful alliances and trade with more states, which again would make engaging in conflict less costly. The second explanation is that major powers have a different "major power culture" and an externally-focused definition of security that lead them to have wider interests. This explanation suggests that major powers would behave differently from minor powers, even under the same observable circumstances.

This paper incorporates both explanations into an ultimatum model of conflict in which a state's cost of conflict consists of both an observable and a behavioral component. To test the influence of both components on major powers' conflict propensity, we conduct an empirical analysis that compares the observable differences between major and minor powers for the time period from 1870 to 2001. A decomposition model is used to determine how much of major powers' war proneness can be attributed to differences in the observable variables relative to differences in behavior. The results suggest that most of the variation in conflict propensity of major powers can be attributed to observable characteristics, and not their behavior. This leads to a variety of implications on the "exceptionality" of major powers and the study of conflict onset through a bargaining framework. It seems to be the case that major powers' more active international behavior is determined not by their culture or by being perceived as "part of the club" by other major powers, but rather by their greater capabilities.

The remainder of the paper is organized as follows. The first section reviews the literature on major powers and international conflict, and extract two types of explanations for the observation that major powers are involved in more conflict than other states. The first explanation highlights the observable characteristics of major powers, and the second emphasizes the claim that major powers behave differently than other states. These explanations for major power exceptionalism are formalized with an ultimatum bargaining model that allows for the empirical implications of the two explanations to be separated. The empirical section of the paper follows by describing the differences in observables (i.e., differences in national capabilities, trade, alliance membership, and democracy) and behavioral differences (i.e., differences in coefficients for the observables). Next an empirical strategy for determining the relative importance of the two explanations is developed and implemented. The empirical results show that much of the difference in the rate of conflict between major and minor powers can be attributed to differences in observable characteristics rather than behavior. The manuscript concludes with an overview of the results and offers suggestions for additional research that might expand upon the analysis here.

Major Powers and International Relations

Quantitative studies of international relations typically utilize a country's major power status as a control variable. Studies on topics as varied as international conflict, economic sanctions, military alliance, and international mediation differentiate major powers from other countries in their assessment of these behaviors. Perhaps not surprisingly, in almost all regression models that include major power status as a control variable, the major power variable turns out to be statistically significant. Major powers experience more international conflicts (e.g., Braumoeller and Carson 2011, Dafoe 2011, Kleinberg, Robinson and French 2012, Oneal and Russett 2005, Reed, Clark, Nordstrom and Hwang 2008), impose more economic sanctions (Lektzian and Souva 2003, Lektzian and Sprecher 2007), are more likely to have nuclear weapons (Jo and Gartzke 2007, Montgomery and Sagan 2009), form more military alliances (Gibler and Wolford 2006, Gibler 2008), are more likely to mediate (Greig 2005) or intervene in civil and international conflict (Kathman 2010, Kathman 2011). Overall, major powers are more active internationally, engaging in more foreign policy behaviors that influence the behavior of other states and the way in which the international system functions.

While it is no doubt well established that major powers behave differently from minor powers, we do not know as much about why it is that major powers play this more active role in the international system. Is this simply because major powers have more resources at their disposal that enable them to engage in more foreign policy actions? Or, is there something special about major power states that would make these countries more war-prone than other states?

What we call the "observables" perspective would explain these differences in foreign policy behavior through tangible resources that are available to major powers. Put simply, major powers have more resources at their disposal than do minor powers. More resources will give states the opportunity to be more active, and states will take the opportunity. Palmer and Morgan (2006) discuss how states have a total budget that they can use to produce more foreign policy. As states obtain more resources and this budget grows, they will engage in more foreign policy actions in general. This holds true for every state in the system, whether they are considered a major or minor power. Thus, as states have more resources we should observe them fighting more wars, creating more alliances, and imposing more economic sanctions, all for the simple reason that they have the capacity to do so. It is assumed that states always want to engage in more foreign policy actions, and so major powers are simply the states that have the means to engage in these actions. This "observables" approach does not usually treat states as being either revisionist or status quo oriented, or some states as having more global interests than others (Palmer and Morgan 2006). Rather, states' involvement in the international system is determined by their means to do so, by their resources (Palmer and Morgan 2006, Clark, Nordstrom and Reed 2008). Therefore, the difference in the rate of conflict between major and minor powers can, for the most part, be attributed to the stark differences in capacity and the ability to bring to bear their power globally. Once the observable differences between major and minor powers have been "held constant," one might expect relatively small differences between states that are considered major powers and those that are not.

Many studies of international relations' measurement of major power status reflects this conceptual differentiation of major powers as states with more resources at their disposal. Major power status is often conceptualized using the Composite Index of National Capability (CINC), which is constructed using six indicators of national power that are intended to reflect present and potential power: energy consumption, iron and steel production, military expenditures, military personnel, total population and urban population (Bremer 1980). Nations that rank higher on capability have been found to be involved in and initiate more wars. Thus, the first possibility that we have considered is that major powers' greater involvement in conflict is simply due to the fact that major powers have more resources, making wars relatively less costly than for other states. While one would indeed expect observable characteristics to influence how prone to war a state is, one might also have reasons to believe that there is still some *residual* component to the difference in conflict propensities between major and minor powers. That is, major powers may behave differently from minor powers, even under similar circumstances (Rasler and Thompson 1985, Zakaria 1999). We thus consider the second possibility that there is something about being a major power that leads to behavioral differences across major and minor powers, resulting in different responses to similar environmental conditions. This would be the portion of the difference between major and minor powers that is left unexplained by standard "observables" approaches.

The notion that there are some residual, behavioral differences between major powers and other states is also reflected in the operationalization of major power status in frequently-used datasets. For example, the Correlates of War (COW) Project, in its State System Membership List, makes the claim that observable capabilities alone are not sufficient for categorizing a state as a major power. Rather, "states must behave as major powers, with global interests and reach and must be regarded by the other major powers as 'members of the club' " (Correlates of War Project 2008). The basis of COW's method for defining major powers, accepted by many, is presented in Singer and Small (1972). Singer and Small (1972) define major powers through what they refer to as "inter-coder agreement." That is, major powers are defined as those countries that the majority of coders agree are major powers.[1] What are the characteristics of these particular nations, other than measurable factors, that lead the coders to classify them as major powers?

Scholars have highlighted behavioral differences between major and minor powers that are independent of measurable material capabilities (Wight 1978, Gulick 1955, Organski 1958,

[1] The COW Project lists as major powers, in different time periods, the following nations: Austria-Hungary, China, France, Germany, Great Britain, Italy, Japan, the United States, and the USSR/Russia.

Mearsheimer 2001, Levy 1983). One plausible explanation for this residual difference is that major powers have different goals than do minor powers. That is, major powers will be driven to fight more wars, not only because they have greater capabilities to do so but also because they have different goals that they want to achieve with their greater capabilities other than to secure their own survival. This means that major power states would sometimes be willing to engage in wars that are too costly for minor power counterparts. This argument can be traced back to earlier work that theorized about the unique qualities of states considered major powers and the difference between major power political behavior and the less relevant political interactions of minor power states (Wight 1978, Gulick 1955, Organski 1958). According to Wight (1978), major powers have wider (world-wide) interests than do minor powers, therefore "they wish to monopolize the right to create international conflict." Their leaders have inherently different agendas from those of minor powers (Lemke 2003). Hegemons, according to Wight (1978), all aspire to some sort of global empire that can reconstitute the world. In doing this, they will be more concerned with their relative standing in the international system than minor powers would be, as only the leading major powers are truly able to reconstitute the world to their liking (Rasler and Thompson 1985).

Other possible sources of the residual difference are cultural and/or cognitive differences. Many of the countries that have been classified as great powers have been European. It may be the case that the culture of these nations has made them more war-prone than other nations under equivalent circumstances (Lemke 2002, Ayoob 1991). Beyond regional and circumstantial differences, scholars have argued that there are distinct minor and major power cultures that lead to the two groups behaving differently, even under the same circumstances (Ayoob 1991). Moreover, Thomas (1987) argues that the concept of security is not the same for major and minor powers. On the one hand, considering how secure they are, major powers are primarily concerned about external threats. On the other hand, minor powers will also take into account factors that are taken for granted by major powers, such as the internal security of the state and the provision of basic goods such as food and health care (Thomas 1987). This means that major powers are more responsive to changes in the external conditions that encourage states to fight, such as increases in their military capabilities relative to other states. In contrast, minor powers are less responsive to such conditions because they are more constrained in terms of their ability to take advantage of military opportunities.

These two types of explanations, one based on observable characteristics and the other based on behavioral heterogeneity, generate different expectations about the conflict propensities of major and minor powers, which in turn have different implications for our understanding of international politics. If, as suggested by the "observables" perspective, the difference between major powers and other states can be mostly attributed to differences in observable factors such as national capabilities, etc., then we should expect that a minor power that has obtained more resources would begin to act more like a major power. This means that the empirical findings obtained by analyzing major power behaviors can be, at least in principle, generalized to explain the behaviors of those minor powers that have gained sufficient resources. However, previous empirical studies that focus only on major power behaviors are rather cautious about generalizing their theories and empirical findings outside the major power behaviors. In fact, most of these studies carefully limit their scope of generalizability to major powers, arguing that one must await future research that directly analyzes minor power behaviors before one can begin to assess the generality of their findings (e.g., Rasler and Thompson 2000). This cautious view on generalizability is based partially on the perspective that there are important intangible differences in major and minor powers' goals, cultures, or views on security, which lead major powers to behave differently than minor powers even under similar circumstances.

It is thus important to be able to disaggregate the effects of both the observable and unobservable characteristics of major and minor powers. To distinguish between these two different categories of explanations, the remainder of the paper begins by introducing a simple bargaining model of conflict that illustrates how observable and unobservable characteristics associated with the cost of fighting influence the probability of conflict. The model allows us to *conceptually* differentiate observable and behavioral explanations in a precise way. Following the discussion of the bargaining model, we conduct a series of empirical analyses to explore the relative importance of the two explanations.

Contrasting Observable and Behavioral Explanations

Bargaining theory has proved to be a powerful lens through which to view international relations (Fearon 1995, Powell 2006). Below we introduce a simple bargaining model of conflict that shows that the probability of conflict is a function of the costs of conflict. Consistent with the "observables" perspective discussed above, we assume that major powers incur lower costs of conflict than minor powers due to their superior military capabilities and rich resources. Furthermore, consistent with the behavioral perspective, we also allow major and minor power states to have different "saliency" parameters. This allows major and minor power states to behave differently depending on their evaluation of the observable cost of conflict. The model shows that major powers will experience a higher probability of conflict because of their greater capabilities and lower sensitivity. This model also enables us to differentiate the two perspectives in a precise way.

To sketch this dynamic out, consider the following ultimatum model adopted from Fearon (1995). Two states, A and B, are in a dispute over the possession of a good worth 1 for both sides. The proposer (A) makes a demand $x \in [0, 1]$, which the responder (B) can either accept or reject. If the demand is rejected by B, a violent conflict ensues where A and B pay costs for fighting, c_A, and c_B, respectively. The proposer (A) wins the conflict with probability p, and the responder (B) wins with the complementary probability $1 - p$. If B accepts the demand, the payoffs are x for A and $1 - x$ for B. We first solve the complete information version of the game via backwards induction. At the last node of the game, B will accept any demand that gives B at least as much as $1 - p - c_B$ and will reject otherwise because this is the amount B can get from fighting. Given this, A can maximize its payoff if it makes the largest demand that B will accept. So, A's optimal demand is the one that makes B indifferent between accepting and rejecting, such that $1 - x = 1 - p - c_B$ or $x^\star = p + c_B$. In equilibrium, A demands $x^\star$, which B accepts. As long as both A and B are fully informed about their own utilities and those of their rival, there will be no conflict in equilibrium. This leads to the well-known result that because conflict is costly, there is always a negotiated settlement that both A and B prefer to conflict.

However, if it is assumed that A does not know B's costs of fighting, it can be shown that major powers tend to make larger demands, which can result in a higher probability of conflict. To illustrate this point, assume that c_B is drawn from some continuous probability distribution with the associated cumulative distribution function $H(\cdot)$ and the density function $h(\cdot)$. Under this assumption B's with $c_B < x^\star - p$ reject A's demand and B's with $c_B \geq x^\star - p$ accept A's demand. Therefore, the *ex ante* probability of conflict is just the probability that B rejects the demand, or $\Pr(c_B < x - p) = H(x - p)$. Given this, we now consider A's optimal offer under uncertainty.

We assume that A's cost of conflict c_A consists of observable component $\bar{c}_j$ and unobservable behavioral component ζ_j, such that $c_A = \zeta_M \ \bar{c}_M$ for major powers and $c_A = \zeta_m \ \bar{c}_m$ for minor powers. $\bar{c}_j$ captures tangible resources such as military capabilities and resources available to the state. This component is multiplied by the saliency parameter ζ_j, which captures how states respond to these observables. Consistent with the "observables" perspective, we assume that major powers have greater material capabilities, richer resources, and are less constrained by geography in deploying their forces abroad, so that $\bar{c}_j$ is lower for major powers than for minor powers, or $\bar{c}_M < \bar{c}_m$. To accommodate the behavioral perspective, we allow that $\zeta_M \neq \zeta_m$. That is, the behavioral perspective implies that major powers are, on average, more willing to bear the cost of conflict than minor powers if they are put under similar circumstances. Put differently, the cost of conflict is more salient for minor powers than for major powers because minor powers have more narrowly defined goals and/or are primarily concerned about internal security. Thus, the behavioral perspective suggests that $\zeta_M \ll \zeta_m$ whereas the "observables" perspective implies $\zeta_M \simeq \zeta_m$.

Using this information, the expected value function for any demand made by A can be constructed:

$$V(x|\text{Major}) = H(x-p)(p-\zeta_M\bar{c}_M) + \big[1 - H(x-p)\big]x$$
$$V(x|\text{Minor}) = H(x-p)(p-\zeta_m\bar{c}_m) + \big[1 - H(x-p)\big]x$$

where $H(x-p)$ is the *ex ante* probability of conflict. A's optimal demand $x^\star$ maximizes the above expected value function. Assuming that c_B is drawn from a uniform distribution with a lower bound of 0 and an upper bound of 1, $H(x) = x$ and $h(x) = 1$. Setting the derivative of the expected value function equal to zero and solving for $x^\star$ gives the optimal demand. If A is a major power, this is

$$\frac{\partial V(x|\text{Major})}{\partial x} = 1 - H(x-p) + h(x-p)(p - \zeta_M\bar{c}_M - x) = 0$$
$$x^\star = \frac{1}{2}(1 + 2p - \zeta_M\bar{c}_M).$$

Similarly, for a minor power, the optimal demand is $x^\star = \frac{1}{2}(1 + 2p - \zeta_m\bar{c}_m)$. Plugging this optimal demand into the expression for the *ex ante* probability of conflict, we obtain the probability of conflict in equilibrium.

$$\Pr(\text{Conflict}|\text{Major})^\star = \frac{1}{2}(1 - \zeta_M \bar{c}_M) \tag{1}$$
$$\Pr(\text{Conflict}|\text{Minor})^\star = \frac{1}{2}(1 - \zeta_m \bar{c}_m). \tag{2}$$

Both the "observables" and the behavioral perspectives suggest that c_A is smaller for major powers, or $\zeta_M \bar{c}_M < \zeta_m \bar{c}_m$. This causes major powers to make larger demands. In addition, if there is uncertainty about the cost of fighting, as illustrated above, major powers with lower costs of fighting relative to other states will make larger demands that are more likely to be rejected. Thus, both perspectives suggest that the probability of conflict is higher for major powers than for minor powers. However, they differ sharply in terms of how much of this difference is attributed to the difference in $\bar{c}_j$ or the difference in ζ_j.

To illustrate this, the difference in probability of conflict between major and minor power states is obtained by subtracting (2) from (1):

$$\begin{aligned} D &\equiv \Pr(\text{Conflict}|\text{Major})^\star - \Pr(\text{Conflict}|\text{Minor})^\star \\ &= \frac{1}{2}(1 - \zeta_M \bar{c}_M) - \frac{1}{2}(1 - \zeta_m \bar{c}_m) \\ &= \zeta_m \bar{c}_m - \zeta_M \bar{c}_M. \end{aligned}$$

Adding and subtracting $\zeta_m \bar{c}_M$ from the right-hand side of this and rearranging the terms, we obtain

$$D = \zeta_m(\bar{c}_m - \bar{c}_M) + (\zeta_m - \zeta_M)\bar{c}_M \tag{3}$$

The "observables" perspective assumes that $\bar{c}_M < \bar{c}_m$ and $\zeta_M \simeq \zeta_m$. Thus, the expectation is that most of the difference in the rate of conflict between major and minor power states can be understood in terms of the differences in their *observable characteristics* rather than the differences in how major and minor powers *respond* to similar circumstances. That is, the first part of (3), $\zeta_m(\bar{c}_m - \bar{c}_M)$, should be much greater than the second part, $(\zeta_m - \zeta_M)\bar{c}_M$. On the other hand, the behavioral perspective assumes that $\zeta_M \ll \zeta_m$, implying that much of the difference is explained by the second part, or how responsive major and minor power states are to the observable characteristics such as material capabilities. Now that we have conceptually differentiated the observable and behavioral explanations, the goal of the statistical analyses that follow is to empirically assess the relative importance of the two explanations.

Empirical Analysis

We conduct a series of statistical analyses in three steps. As an empirical first cut, we initially examine the differences between major powers and other states with respect to the observable factors including national capabilities, trade, alliance membership, democracy, and past dispute involvement. Following that, we also examine differences between major powers and other states in terms of how these states respond to these observables (i.e., differences in coefficients). Finally, we introduce an empirical strategy that enables us to determine the relative importance of the observable and behavioral differences.

An Empirical First Cut

The analyses use data that span the time frame of 1870–2001 and contain 10,736 observations. The full sample includes 789 major power country-years and 9,947 minor power country-years. The outcome variable, MID Initiation, is recorded as 1 if the state initiated a militarized interstate dispute (MID) against another state in the observation year; 0 otherwise. To identify initiation of an MID, we focus on MIDs involving principal initiators and principal targets and exclude joiners. Data are from Maoz's (2005) refined version of the data. To differentiate between major and minor powers we use the COW Project's classification of major powers, where a coding of 1 reflects a major power and a 0 a minor power. In addition, we include a set of variables known to correlate with militarized conflict. State capability is measured using the state's military capability score in the year, as operationalized by COW. We rescale this measure by multiplying the `cinc` score by 10. A state's level of democracy is recorded as 1 if the state has a democracy score greater than or equal to 6; 0 otherwise. We use the `polity2` (Democracy minus Autocracy score) variable from the Polity IV dataset. To measure the level of trade we use the natural logarithm of the sum of the state's exports and imports in a given year. Trade data are from the COW Project. We also include a variable for the number of alliance partners a state had in a given year. Alliance data are from the ATOP dataset. Finally, we include a variable for the number of peace years that have passed since the last initiation of a MID by the state.

Figure 1 About Here

The primary empirical difference of interest between major powers and other states is the significantly higher rate of conflict experienced by major powers. In Figure 1, the top-left panel shows the observed rate of militarized conflict for major powers (to the left) and minor powers (to the right). This difference in the rate of militarized conflict between major powers and other states is recognized by most quantitative studies of international conflict. Many studies justify their focus on major powers precisely because major powers are involved in militarized conflict more often than other states. In fact, many of the minor powers are never involved in any meaningful level of militarized conflict.

How much of this difference in conflict probability can be attributed to the observable differences between major and minor powers, as suggested by the "observables" perspective? To illustrate the differences in observable characteristics of major powers and other states,

Figure 1 also shows the average differences between these two groups. In this figure, the heights of the bars show the mean values of each variable for two samples: major power states (to the left) and minor power states (to the right). Error bars on top of the rectangular bars show the 95 % confidence intervals for the mean estimates. We can see that there are important and interesting differences between major powers and other states in terms of observable variables that are found to correlate with militarized conflict. As mentioned previously, major powers are involved in much more conflict than other states and, as expected, have much greater economic and military power that is indicated by the capability variable. The political institutions in major powers are more democratic on average, and major powers engage in more trade than do other states. Finally, major powers have more alliance ties than other states, and they experience much shorter spans of peace than other states.

These differences in observable correlates of conflict are largely consistent with the "observables" explanation for the difference in the rate of conflict between major power and other states. Based on the distribution of these variables and the fact that there are many more minor powers than major powers, major powers should be expected to make larger demands and experience more conflict than other states because of their strong bargaining position and optimism about the outcome of a militarized conflict. However, it is possible that there are also important differences in ways that major and minor power states respond to these observable correlates of conflict. For example, Reed and Chiba (2010) demonstrate that, although there are important observable differences between contiguous and noncontiguous dyads, much of the difference in their conflict propensity can be attributed to differences in how neighbors and nonneighbors behave. Is it also the case that major powers behave differently from minor powers, just as neighbors and nonneighbors behave differently? To explore this question, we regress our outcome variable (conflict initiation) on the observable covariates discussed above.

Table 1 About Here

Table 1 shows the results of regression analyses on major and minor power states. These logit coefficients show the estimated marginal changes in conflict propensities in response to the changes in observable variables. To see how major powers differ from other states, separate models are estimated for three samples: the sample of major power states (Model 1), sample of minor power states (Model 2), and the sample of all states (Model 3).[2] Interestingly, all of the coefficients share the same sign across three models. Military capabilities, trade, and alliance membership are all positively correlated with militarized conflict. Democracy and spans of peace are negatively correlated with militarized conflict. However, compared to other states, major powers appear to be less sensitive to the effect of democracy and trade. This may be because there is more variation in democracy and trade in the sample of minor powers. Most major powers are democratic and fully engaged in the international political economy. In short, although there are interesting differences between major powers and other states in terms of how they respond to observable factors, to a great extent major powers and other states appear to respond to the observable factors described in Figure 1 in a similar fashion.

Figure 2 About Here

Figure 2 shows the estimated mean probability of conflict for major powers relative to other states. In this figure, kernel density plots (smoothed histograms) represent the distribution of the expected probabilities of conflict obtained from two samples. [3]

[2] Running separate models for sub-samples of the data is mathematically equivalent to estimating the pooled sample by interacting all the covariates with the variable that separates the sample (i.e., the Major Power variable). In other words, logit coefficients reported under Models 1 and 2 are the implied coefficients from such fully interacted model.

[3] Uncertainty estimates are obtained by bootstrapping. That is, we first draw 1000 sets of samples from major and minor power observations, respectively. We then estimate logit models shown in Table 1 for each set, and obtain mean predicted probabilities for major and minor power observations. Plotted in Figure 2 are the 1000 values of the mean predicted probabilities for major and minor power observations.

Decomposition Method

The analyses in the preceding section provide some evidence for the claim that the primary difference between major powers and other states is caused by the distribution of observable factors. That is, major powers are involved in more conflict because they are more powerful than minor powers. However, there is also some evidence to support the claim that major powers behave differently than do minor powers in addition to the descriptive differences in observables. It is not yet clear how much of the gap in conflict probability between major and minor powers is explained by the differences in observables relative to the behavioral heterogeneity. This section outlines an empirical strategy that is able to do exactly this.

To determine the power of "observable" explanation relative to the behavioral explanation, it must be determined how much of the difference is due to differences in observable characteristics between major and minor powers, and how much is due to differences in the coefficients of separately estimated models of conflict for the major and minor powers. A more precise definition of the quantities of interest is needed in order to decompose these two effects. The microeconometrics literature on wage discrimination (Oaxaca 1971, Oaxaca 1973, Blinder 1973) offers a useful guide to decomposing these effects. This literature attempts to decompose the wage gap between males and females into differences in observable characteristics, such as education and experience, from behavioral differences between the two groups.[4] This research seeks to answer the following counterfactual question: How would the distribution of wages look for women if they were operating under the behavioral regime of males? That is, is the difference in wages caused by differences in coefficients between the two groups or by differences in the values of observable variables between the two groups?

This paper poses a similar question: How would the distribution of conflict look for

[4] Recent applications of the Blinder–Oaxaca decomposition analysis in political science include Dow's (2009) analysis of the gender gap in political knowledge and Reed and Chiba's (2010) analysis of the gap in conflict probability between neighbors and nonneighbors.

major powers if they were interacting under the behavioral regime of the less conflict-prone sample of minor powers? Standard analyses assume that major and minor power dyads respond identically to variables such as democracy, trade, and military capabilities. The decomposition model to be described allows the responses to these other variables to differ across the two groups. To answer the counterfactual question and to study the differences between major and minor powers in a more flexible framework, the generalized decomposition specification detailed in Fairlie (2005) is followed. Starting with the standard regression model, where for major powers, j = majors, and for minor powers, j = minors:

$$Y_j = X_j \beta_j + \epsilon_j, \quad E(\epsilon_j) = 0.$$

The mean outcome difference between the two groups is:

$$R = \bar{Y}_{\text{majors}} - \bar{Y}_{\text{minors}} = \bar{X}_{\text{majors}} \hat{\beta}_{\text{majors}} - \bar{X}_{\text{minors}} \hat{\beta}_{\text{minors}}. \tag{4}$$

This mean difference can be rewritten by adding and subtracting $\bar{X}_{\text{majors}} \hat{\beta}_{\text{minors}}$ from the right-hand side and gathering the relevant terms together.

$$R = \underbrace{\left[(\bar{X}_{\text{majors}} - \bar{X}_{\text{minors}}) \hat{\beta}_{\text{minors}} \right]}_{\text{Observables}} + \underbrace{\left[\bar{X}_{\text{majors}} (\hat{\beta}_{\text{majors}} - \hat{\beta}_{\text{minors}}) \right]}_{\text{Behavior}}. \tag{5}$$

The first part of equation (5), "Observables," is the difference in the conflict probability between major and minor powers that can be explained by differences in measurable variables. The difference between major and minor powers is illustrated in Figure 1. If no differences existed between the two groups, $\bar{X}_{\text{majors}} = \bar{X}_{\text{minors}}$, all of the difference in the conflict probability between major powers and minor power states would be attributed to behavioral differences. However, the descriptive statistics in Figure 1 show this is not the case. Some of the difference in the conflict probability is explained by differences in the X's from each group, and the decomposition allows a specific statement to be provided about the magnitude of this effect on the whole and for each observable variable.

The second part of equation (5) represents the difference in the conflict probability that can be explained by behavioral differences between the two groups (i.e., differences in how major and minor powers respond to values of the observable variables). This is simply the difference in the logit coefficients shown in Table 1. The coefficients from the sample of minor powers are used for the vector of benchmark coefficients drawn from the group that is not expected to experience more conflict. This follows the convention in labor economics of using the sample of males as the benchmark because this group is not expected to experience wage discrimination. The coefficients from the sample of minor powers are used based on an expectation that their conflict behavior will be unaffected by the behavioral effect of being a major power.[5] When $\hat{\beta}_{\text{majors}} = \hat{\beta}_{\text{minors}}$, all of the difference in the conflict probability between major and minor powers is a function of differences in observable variables. Again, Table 1 shows that $\hat{\beta}_{\text{majors}} \neq \hat{\beta}_{\text{minors}}$; the decomposition enables a precise statement to be made about how differences in the coefficients between the two groups affect the difference in the conflict probability. This method enables an assessment of the relative merit of both explanations regarding the difference in the conflict probability between the two groups. This decomposition is relatively straightforward in the context of least squares. However, a slight modification is necessary to study these quantities of interest in the context of maximum likelihood estimation (Jann 2006). Setting the superscripts for major powers to T and for

[5] An alternative approach is to use the coefficients from the pooled model as the benchmark (Oaxaca and Ransom 1994, Neumark 1988). The decomposition equation (5) for such specification is written as

$$R = \underbrace{\left[(\bar{X}_{\text{majors}} - \bar{X}_{\text{minors}})\hat{\beta}_{\text{pooled}}\right]}_{\text{Observables}} + \underbrace{\left[\bar{X}_{\text{majors}}(\hat{\beta}_{\text{majors}} - \hat{\beta}_{\text{pooled}}) - \bar{X}_{\text{minors}}(\hat{\beta}_{\text{minors}} - \hat{\beta}_{\text{pooled}})\right]}_{\text{Behavior}}. \quad (6)$$

minor powers to C, the nonlinear transformation is (Fairlie 2005):

$$R = \left[\sum_{i=1}^{N^T} \frac{F(\boldsymbol{X_i^T} \hat{\boldsymbol{\beta}}^{\boldsymbol{C}})}{N^T} - \sum_{i=1}^{N^C} \frac{F(\boldsymbol{X_i^C} \hat{\boldsymbol{\beta}}^{\boldsymbol{C}})}{N^C} \right] + \left[\sum_{i=1}^{N^T} \frac{F(\boldsymbol{X_i^T} \hat{\boldsymbol{\beta}}^{\boldsymbol{T}})}{N^T} - \sum_{i=1}^{N^T} \frac{F(\boldsymbol{X_i^T} \hat{\boldsymbol{\beta}}^{\boldsymbol{C}})}{N^T} \right], \quad (7)$$

where, $F(\cdot)$ is the logit link function and N is the number of observations in each sample.[6]

Decomposition Results

The aggregate results of the decomposition analysis are shown in Figure 3. The dark kernel density function to the right of the figure shows the mean probability of conflict for major powers, or $\bar{Y}_{\text{majors}} = \bar{X}_{\text{majors}} \hat{\beta}_{\text{majors}}$ in equation (4).[7] To the far left of the figure is the kernel density function that shows the probability of conflict for the average minor power, or $\bar{Y}_{\text{minors}} = \bar{X}_{\text{minors}} \hat{\beta}_{\text{minors}}$ in equation (4). These are the same two density functions shown in Figure 2.

*** Figure 3 About Here ***

The goal of the decomposition analysis is to understand the gap between these two density functions in terms of observable variables and responses to changes in the observable factors. To this end, the kernel density in between the major and minor power kernel densities is a counterfactual kernel density function. This counterfactual density is calculated by matching the observable characteristics of the major power states ($\bar{X}_{\text{majors}}$) with the behavioral characteristics of the minor power states ($\hat{\beta}_{\text{minors}}$).[8] Put differently, the counterfactual density function represents states that have the average observable characteristics of major

[6] Technically, it is necessary for the two groups to have the same number of observations. Following convention, this is accomplished by sampling observations from the group with the larger number of observations in the data to match the number of observations in the smaller group. See the appendix for a description of the exact procedure we use.

[7] Since this is a non-linear model, a more technically accurate expression is $\bar{Y}_{\text{majors}} = \sum \frac{F(X_{\text{majors}} \hat{\beta}_{\text{majors}})}{N}$

[8] We follow the bootstrapping procedure described in footnote 3 to calculate uncertainty estimates for the counterfactual probabilities.

powers but behave like minor powers. Notice that the counterfactual $\bar{X}_{\text{majors}}\hat{\beta}_{\text{minors}}$ is precisely the quantity that we added and subtracted from equation (4) in order to decompose the difference in conflict probability as shown in equation (5). In this sense, Figure 3 is a graphical representation of equation (5).

The difference between the major power density $\bar{X}_{\text{majors}}\hat{\beta}_{\text{majors}}$ and the counterfactual density $\bar{X}_{\text{majors}}\hat{\beta}_{\text{minors}}$ is labeled the "Behavioral Effect" in the figure because $\bar{X}_{\text{majors}}\hat{\beta}_{\text{majors}} - \bar{X}_{\text{majors}}\hat{\beta}_{\text{minors}} = \bar{X}_{\text{majors}}(\hat{\beta}_{\text{majors}} - \hat{\beta}_{\text{minors}})$, which is precisely the second part of equation (5). This difference represents the portion of the gap in the rate of conflict between major powers and other states that can be explained by different responses to similar environmental situations. Comparing the major power density function with the counterfactual density function, we can see that if the average major power were to respond to changes in observable variables as if it were a minor power, the probability of conflict would be lower. However, the difference in how major powers respond to changes in observable factors does not seem to be especially strong. In fact, the reduction in the probability of conflict is from 0.478 to 0.407. This is merely 19.7 % ($\simeq \frac{0.478-0.407}{0.478-0.121}$) of the gap in conflict between the two groups.

On the other hand, the difference between the counterfactual density $\bar{X}_{\text{majors}}\hat{\beta}_{\text{minors}}$ and the minor power density $\bar{X}_{\text{minors}}\hat{\beta}_{\text{minors}}$ is labeled the "Observable Effect" in the figure because this difference is $\bar{X}_{\text{majors}}\hat{\beta}_{\text{minors}} - \bar{X}_{\text{minors}}\hat{\beta}_{\text{minors}} = (\bar{X}_{\text{majors}} - \bar{X}_{\text{minors}})\hat{\beta}_{\text{minors}}$, which is just the first part of equation (5). This is the portion of the gap in the rate of conflict that can be explained by differences in average observable variables (e.g., military capabilities, democracy, trade, etc). This effect is much larger than the "Behavioral Effect." Changing a minor power's observable factors to reflect the average major power increases the probability of conflict from 0.121 to 0.407. This amounts to 80.3 % ($\simeq \frac{0.407-0.121}{0.478-0.121}$) of the gap in conflict between the two groups. Put differently, the effect of this change in observable variables results in almost a 236 % ($= \frac{0.407-0.121}{0.121}$) increase in the probability of conflict, compared to about a 15% ($= \frac{0.407-0.478}{0.478}$) decrease in the probability of conflict that is associated with major powers behaving as if they were minor powers.[9]

Besides describing the aggregate differences in the probability of conflict between major powers, other states, and the counterfactual states, it is also possible to calculate the explanatory power of each independent variable. The goal of this analysis is to further disaggregate the aggregate "observable" effect (80.3% of the gap) into individual contributions by each covariate. We follow Fairlie's (2005) generalization of the nonlinear decomposition method that extends the Blinder–Oaxaca linear decomposition analysis (Oaxaca 1971, Oaxaca 1973, Blinder 1973). [10]

*** Figure 4 About Here ***

*** Table 2 About Here ***

Figure 4 reports these results. Solid circles show the estimated contributions from the explanatory variables expressed as percentage points, and the horizontal line segments associated with them show the 95 % confidence interval of the estimates. In other words, each estimate shows the percentage of the gap in the conflict probability that can be attributed to each observable variable. Positive estimates suggest that the variable has a positive contribution to the gap, meaning that increases in the value of the observable variable increase the gap in the probability of conflict. On the other hand, observable variables with negative estimates decrease the gap. Note that if we add up all the individual contributions, the result is 80.3 %, which corresponds to the "observable" effect discussed above. The remaining gap in the probability of conflict (19.7%) is attributed to the behavioral difference between major and minor power states.

[9] As a robustness check, we also performed a decomposition analysis using the pooled coefficients as the benchmark (See equation (6) in footnote 5). The results suggest that 89 % of the gap is attributed to the observables and 11 % is behavioral, lending greater support for the "observables" perspective. The results are included in the replication package.

[10] Since the logit model is a nonlinear model, we can no longer use $\bar{X}$ to calculate the counterfactual for each covariate. Instead, we calculate $\boldsymbol{X_i}\hat{\boldsymbol{\beta}}$ for each observation in the sample and aggregate them to obtain $\sum_i^N \boldsymbol{X_i}\hat{\boldsymbol{\beta}}$. We iterate this process 1,000 times to approximate the nonlinear model equivalent of $\bar{X}\hat{\beta}$. See Appendix for more details.

Individual contributions differ interestingly both in size and in magnitude. The observable variables contributing the most to the gap in the conflict rate between the two groups are those that measure military capabilities, whereas the difference in the average years of peace also explains a substantial amount of the gap. Variables measuring trade and alliances also make positive contributions to the gap. On the other hand, the contribution of democracy is negative, suggesting that democracy decreases the probability difference between major and minor power states. It is useful to illustrate how we calculate these quantities in the context of linear models and to discuss the interpretation of the effects of the variables.

To obtain individual contribution for a variable x in linear models, we first take the difference between the average value of the variable in the major power sample and the average value in the minor power sample, $\bar{x}_{\text{majors}} - \bar{x}_{\text{minors}}$, and then multiply this difference by the benchmark coefficient (i.e., coefficient from minor power sample), β_{minors}. Therefore, when a variable exhibits a positive contribution it is because the signs of β_{minors} and $\bar{x}_{\text{majors}} - \bar{x}_{\text{minors}}$ are the same. If the variable exhibits a negative contribution, it is because the signs of β_{minors} and $\bar{x}_{\text{majors}} - \bar{x}_{\text{minors}}$ are different.[11] For example, the contributions of capabilities, trade, and alliances are positive because major powers are both more likely to have greater capabilities, levels of trade, and alliances, and these variables are positively correlated with militarized conflict in this sample. The contribution of peace years is positive because major powers have shorter spans of peace that are negatively correlated with militarized conflict. On the other hand, the contribution of democracy is negative because major powers are more democratic than minor powers, on average, and democracy is negatively correlated with conflict.

[11] In the context of nonlinear models, the marginal effect of one covariate depends on the values of the other covariates. For this reason, calculations of the individual contribution cannot rely on the average value of x but rather use the actual values while controlling for the other covariates at the observed values. See the appendix for the detail.

Percentage contributions reported in Figure 4 and the last column of Table 2 are obtained by dividing the individual contribution for each variable by the raw difference (0.356) in conflict probabilities between major and minor powers. As we see, the observable variables contributing the most to the gap in the conflict rate between the two groups are those that measure military capabilities and the years of peace.

Discussion and Conclusions

The goal of this paper is to study the difference between major powers and other states in terms of their conflict behavior and to use these results to make an evidence-based statement about the differences between major and minor powers. In addition, the results from this manuscript provide some evidence about the ability of bargaining theory to explain how major powers and hegemonic states may differ from minor powers. The empirical evidence strongly suggests that most of the difference in the rate of conflict between major powers and other states is due to differences in observable variables between the two groups such as military capabilities, democracy, alliance membership, trade, and spans of peace. In terms of generalizability, this is good news for studies that limit their data to a sample of major powers. Although variables typically associated with militarized conflict have different relative effects in the two groups (i.e., major powers and other states), the direction of the effects is consistent across groups. This means that insomuch as unobservable factors correlate in the same way that these observable factors do with conflict onset, the results from papers that focus only on major powers can be expected to be generally similar to results in a sample of all states or just minor powers. Since the explanatory variables in the sample of major powers have similar effects in a sample of minor powers, choosing major powers as the criteria of case selection amounts to selecting observations based on a value of an independent variable that is uncorrelated with unmeasured factors (i.e., the error term).

The tendency for major powers and other states to have similar responses to changes in observable factors has some interesting theoretical implications as well. The analysis here is supportive of the claim that there are general dynamics that can lead to the onset of militarized conflict and that these dynamics hold across heterogenous units. Moreover, these results from the empirical analysis are consistent with the logic of bargaining theory. Variables that might make a state optimistic and willing to make larger demands, such as military capabilities and alliances, are positively correlated with major powers and conflict onset. There is some evidence here for major powers making larger demands because of their favorable bargaining position relative to other states. Moreover, major powers are unlikely to back down when their demands are unmet. This relative imbalance in resolve, favoring major powers, is consistent with the imbalance of observable variables between major powers and other states.

Overall, the empirical evidence seems to support the dynamic sketched out in the bargaining model. There does not appear to be anything exceptional about major powers aside from the fact that major powers have more capacity to become involved in international interactions and tend to have greater bargaining leverage. Despite the fact that previous research posits that being a major power contains an intangible, behavioral element that goes beyond capabilities, it appears to be the case that if there is such an effect, it is rather small.

The results point to an interesting similarity between measures of political relevance and major power status. Insomuch as measures of political relevance attempt to capture a latent capacity to become involved in international interactions these measures are similar to the major power status. One can think about political relevance as selecting on a positive value of an unmeasured variable one might call "capacity." Likewise, major power status also selects on positive values of "capacity." Based on this logic, results from studies using politically relevant dyads and studies using major powers should both generalize to other samples of all dyads and all states.

Finally, the results show that while scholars may often conceptualize major powers as states that have global agendas and are willing to interact differently from other states in the system, in actuality this behavior is simply determined by the capacity of states to behave in this more active manner. That is to say, the bargaining behavior of states is not defined by whether others see them as “part of the club” or whether they are innately more globally engaged. Rather, their bargaining behavior will change to look more like the behavior associated with major powers (making larger demands, being more likely to become involved in conflict) as their observable variables (such as capabilities) change. Future research may carefully explore the differences between major powers and other states in terms of their expected and observed bargaining behavior.

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Table 1: Estimated Logit Coefficients:DV = MID Initiation, 1870–2001

	Model 1 Major Powers	Model 2 Minor Powers	Model 3 Pooled
Major Power			0.450^{***}
			(0.123)
Capability	0.546^{***}	0.729^{***}	0.601^{***}
	(0.114)	(0.158)	(0.093)
Democracy	$-0.346^{\dagger}$	-0.403^{***}	-0.406^{***}
	(0.184)	(0.083)	(0.075)
Log Trade	0.036	0.111^{***}	0.105^{***}
	(0.049)	(0.016)	(0.015)
N(Alliance)	0.044^{**}	0.030^{*}	0.032^{***}
	(0.015)	(0.012)	(0.009)
Peace Years	-0.273^{***}	-0.217^{***}	-0.218^{***}
	(0.060)	(0.013)	(0.013)
Peace Years^2	0.015^{*}	0.006^{***}	0.006^{***}
	(0.006)	(0.001)	(0.001)
Peace Years^3	$-0.0002^{\dagger}$	-0.00005^{***}	-0.00005^{***}
	(0.0001)	(0.000006)	(0.00006)
Intercept	-0.738^{*}	-1.813^{***}	-1.764^{***}
	(0.372)	(0.110)	(0.105)
N	789	9947	10736
Log likelihood	−499	−3285	−3787

Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 2: Nonlinear Decomposition: Individual Contributions[a]

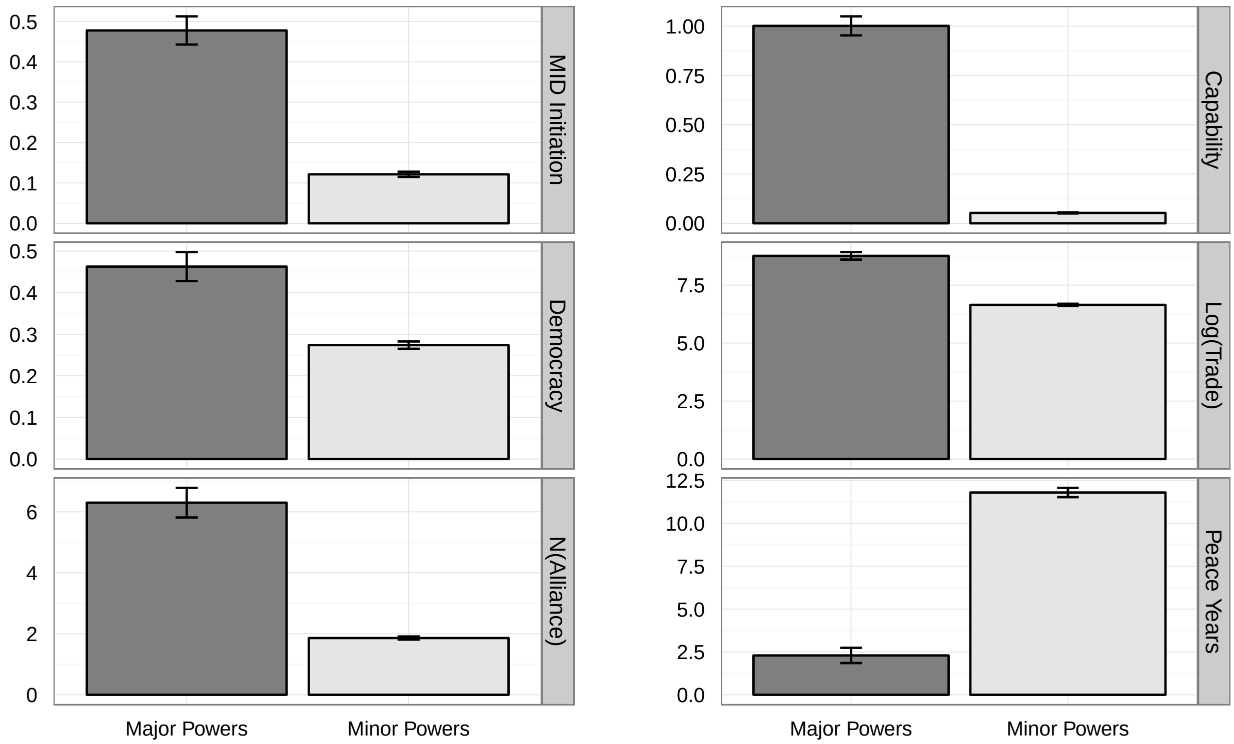
Variable	Individual Contribution (Std. Error)	Percentage Contribution
Capability	0.128*** (0.029)	35.8 %
Democracy	−0.012*** (0.003)	−3.4 %
Trade	0.037*** (0.005)	10.3 %
N(Alliance)	0.024* (0.010)	6.8 %
Peace Years[b]	0.110*** (0.006)	30.9 %
Difference in the rate of conflict (R)	0.356	
Difference Attributable to Observables (R_O)	0.286	80.3 %
Difference Attributable to Behavior (R_B)	0.071	19.7 %
Sample Size of the Reference Group (Minor-power countries)	9,947	

[a] This is a nonlinear decomposition of the observable and behavioral effects of major power on militarized conflict. Minor-power sample is used as a benchmark group in decomposition.

[b] Cubic polynomials are also included in the model. Reported contributions for Peace Years are the total contribution from the Peace Years variable and its square and cubic terms.

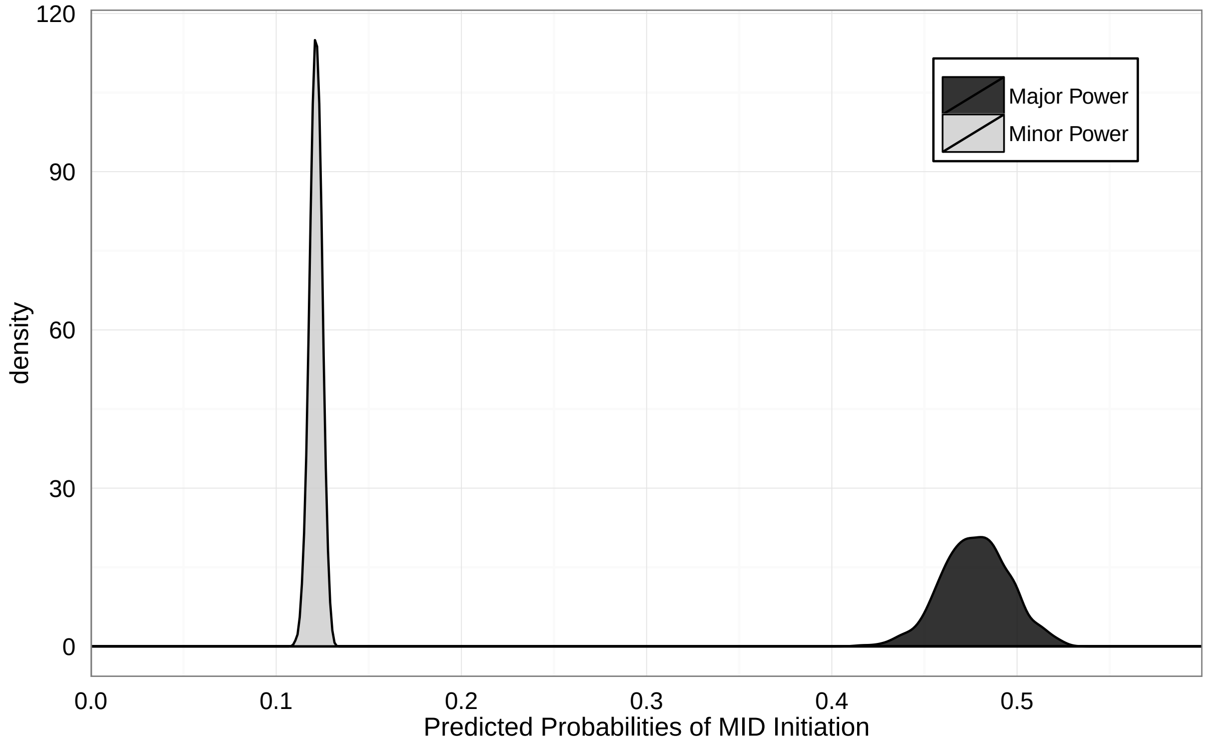
† significant at $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Figure 1: Differences in Observable Variables



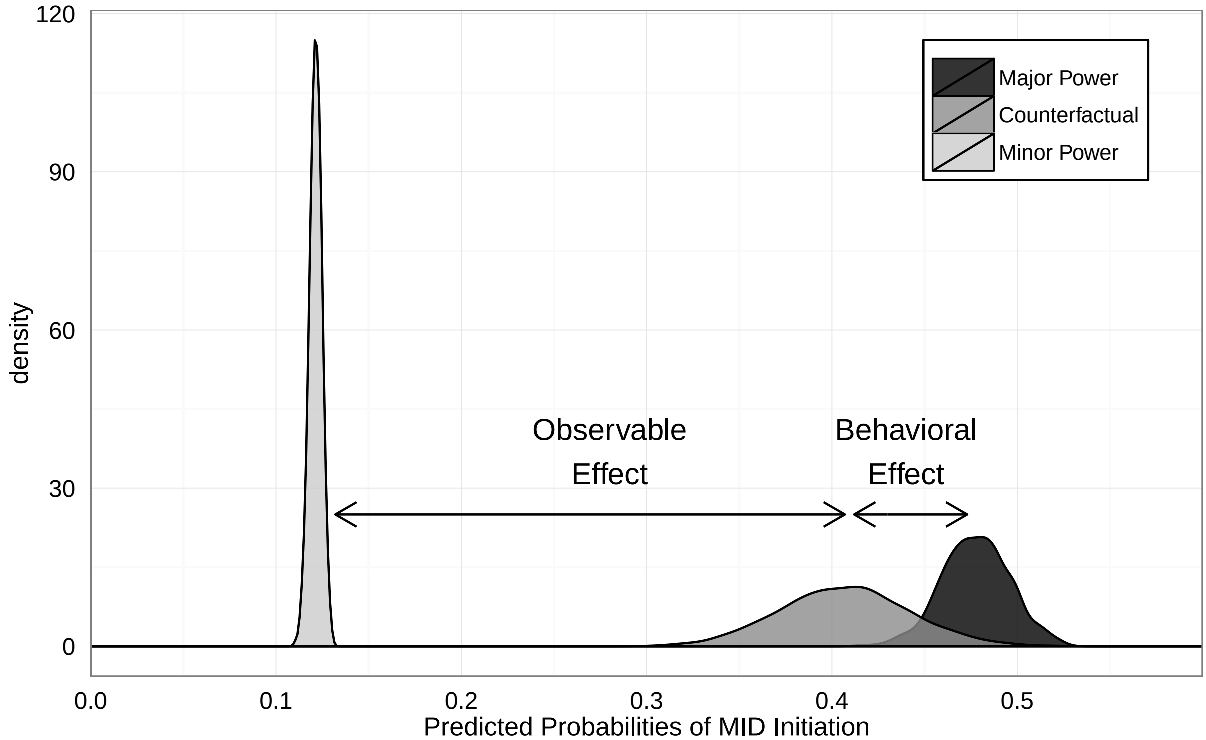
In each panel, mean values are shown for two sub-samples: major power observations (to the left, $n = 789$) and minor power observations (to the right, $n = 9,947$). The error bars on top of the rectangular bars show the 95 % confidence intervals of the mean values.

Figure 2: Densities for the Conflict Probability



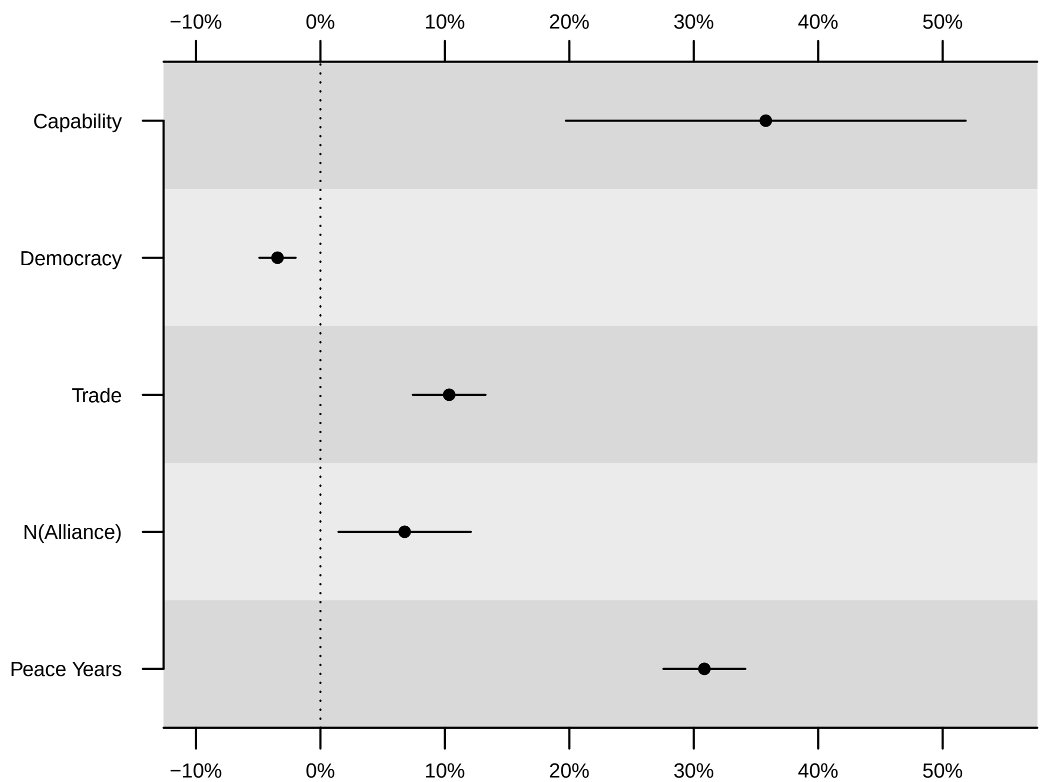
This figure shows the density plot (smoothed histogram) of predicted probabilities of conflict initiation in the two samples. The horizontal axis shows the predicted probability of conflict initiation, and the vertical axis shows the density estimates for the major power sample (to the right) and the minor power sample (to the left). Each of the two densities in the figure is centered around the observed rate of conflict for major (0.478) and minor power (0.121) samples, respectively. The difference between the means is 0.356, which is statistically significant, with a p-value of $< 1e - 15$. See footnote 3 for further details.

Figure 3: Nonlinear Decomposition of Observable and Behavioral Effects



This figure shows the density plot (smoothed histogram) that illustrates the decomposition analysis. The two density estimates plotted on the left and right sides replicate the density estimate shown in Figure 2. The gray density in the middle, which has a mean value of 0.407, shows the counterfactual conflict probability for country-years with observable characteristics of major powers and behavioral characteristics of minor powers. The difference in probabilities between the counterfactual and the minor power sample is 0.286 , which corresponds to the observable effect (80.3% of the gap). The difference in probabilities between the counterfactual and the major power sample is 0.071, which corresponds to the behavioral effect (19.7% of the gap).

Figure 4: Nonlinear Decomposition: Individual Contributions



This graph presents the results of the nonlinear decomposition of major power and minor power states shown in Table 2. Individual contributions from explanatory variables are shown with circles (point estimates) and horizontal lines (95% confidence intervals). Total contributions from the observable variables are obtained by summing all the individual contributions, which yields 80.3% with a confidence interval of (61.4%, 98.9%). The remaining difference in the outcome differential (19.7% of the gap) is attributed to the behavioral effect. Standard errors are approximated with the delta method.

Appendix: Nonlinear decomposition procedure

In this section we explain the procedure to perform a nonlinear decomposition analysis based on simulation. We use this procedure to calculate individual contributions of each covariate that are shown in Table 2. Once we have individual contributions, the observable effect is obtained by summing up the contributions of all the covariates in the model. Then, the behavioral effect is obtained by subtracting the observable effect from the raw difference in conflict probabilities between major and minor power samples. The procedure we describe here is based on the Blinder-Oaxaca decomposition method for linear models and Fairlie's (2005) generalization for nonlinear models.

The Set-up

Suppose there are three covariates of interests, X_1, X_2, and X_3, that explain the outcome variable, militarized conflict. Using the logit link function, the probability of militarized conflict for the ith observation, Y_i is given as:

$$Y_i = F(\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i}) \tag{8}$$

where F is the logit CDF, β_0 is the intercept, and β_m is the coefficient parameter for X_m. Using the matrix notation, the right hand side of (8) is expressed as $F(\boldsymbol{X_i \beta})$ where $\boldsymbol{X_i} = \{1, X_{1i}, X_{2i}, X_{3i}\}$ and $\boldsymbol{\beta_i} = \{\beta_0, \beta_1, \beta_2, \beta_3\}$.

The data are divided into two samples, T (major powers) and C (minor powers). The number of observations for each sample is N^T and N^C, respectively. As shown in the first part of equation (7), the aggregate observable effect, R_O, is

$$\sum_{i=1}^{N^T} \frac{F(\boldsymbol{X_i^T \hat{\beta}^C})}{N^T} - \sum_{i=1}^{N^C} \frac{F(\boldsymbol{X_i^C \hat{\beta}^C})}{N^C} \equiv R_O,$$

where $\hat{\boldsymbol{\beta}}_{\boldsymbol{m}}^{\boldsymbol{C}}$ is a vector of estimated benchmark coefficients.[12] In the scalar representation, this is

$$R_O = \sum_{i=1}^{N^T} \frac{F(\hat{\beta}_0^C + \hat{\beta}_1^C X_{1i}^T + \hat{\beta}_2^C X_{2i}^T + \hat{\beta}_3^C X_{3i}^T)}{N^T} - \sum_{i=1}^{N^C} \frac{F(\hat{\beta}_0^C + \hat{\beta}_1^C X_{1i}^C + \hat{\beta}_2^C X_{2i}^C + \hat{\beta}_3^C X_{3i}^C)}{N^C}.$$

Put differently, the aggregate observable effect, R_O, is the portion of the probability difference R that is attributed to observable covariates, X_1, X_2, and X_3. Our goal here is to disaggregate this further and determine how much of R_O is attributed to each of the three X_m's. In order to calculate the contribution of X_1, for example, we take the difference between $\sum \frac{F(\cdot)}{N}$ evaluated with $\hat{\beta}_1^C X_1^T$ and $\sum \frac{F(\cdot)}{N}$ evaluated with $\hat{\beta}_1^C X_1^C$ while holding $\hat{\beta}_2 X_2$ and $\hat{\beta}_3 X_3$ constant. The challenge is that, in nonlinear models, the marginal change in $\sum \frac{F(\cdot)}{N}$ due to a change in X_m depends on the values of the other covariates. We circumvent this issue by calculating $\sum \frac{F(\hat{\beta}_m^C X_m^T,\ \boldsymbol{X}_{-m}\hat{\boldsymbol{\beta}}_{-m})}{N} - \sum \frac{F(\hat{\beta}_m^C X_m^C,\ \boldsymbol{X}_{-m}\hat{\boldsymbol{\beta}}_{-m})}{N}$ for all the observed values of $\boldsymbol{X}_{-m}$. Another issue is that the number of observations is different for the two samples ($N^T < N^C$). This issue is addressed by sampling (with replacement) observations from the smaller group (T) so that we have equal number of observations for the two samples. To adjust for the sampling error, we iterate this procedure a sufficiently large number of times.

Each round of iteration consists of two steps: (1) drawing a random sample from the smaller group, and (2) calculating $\sum \frac{F(\hat{\beta}_m^C X_m^T,\ \boldsymbol{X}_{-m}\hat{\boldsymbol{\beta}}_{-m})}{N} - \sum \frac{F(\hat{\beta}_m^C X_m^C,\ \boldsymbol{X}_{-m}\hat{\boldsymbol{\beta}}_{-m})}{N}$ for each observation and for each covariate. We explain these two steps below.

Step 1: Sampling from T group

In each iteration of the simulation, we first draw a random sample from the smaller group (T) with replacement, while using all the observations in the larger group (C). Then the sampled observations in the T group are matched with the C group. The resulting data set

[12] We use the minor power sample as the benchmark group for reasons discussed in the text.

looks like the following.

Observation	C group			T group		
1	X_{11}^C	X_{21}^C	X_{31}^C	X_{11}^T	X_{21}^T	X_{31}^T
2	X_{12}^C	X_{22}^C	X_{32}^C	X_{12}^T	X_{22}^T	X_{32}^T
3	X_{13}^C	X_{23}^C	X_{33}^C	X_{13}^T	X_{23}^T	X_{33}^T
$\vdots$		$\vdots$			$\vdots$	
i	X_{1i}^C	X_{2i}^C	X_{3i}^C	X_{1i}^T	X_{2i}^T	X_{3i}^T
$\vdots$		$\vdots$			$\vdots$	
N^C	$X_{1N^C}^C$	$X_{2N^C}^C$	$X_{3N^C}^C$	$X_{1N^C}^T$	$X_{2N^C}^T$	$X_{3N^C}^T$

In each row, we have observations from the C group (X_{1i}^C, X_{2i}^C, X_{3i}^C for the ith row) paired with the observations randomly sampled from the T group (X_{1i}^T, X_{2i}^T, X_{3i}^T for the ith row). Each iteration of simulation generates slightly different results because of the differences in pairing of observations from both groups. We smooth out the differences by taking the mean value of all iterations.

Step 2: Calculating individual contributions

For the sampled observations, we calculate the following quantities in order to obtain the individual contributions:

$$R_{O1} = \frac{1}{N^C} \sum_{i=1}^{N^C} \Big[F(\hat{\beta}_0^C + \underline{\hat{\beta}_1^C X_{1i}^T} + \hat{\beta}_2^C X_{2i}^C + \hat{\beta}_3^C X_{3i}^C) - F(\hat{\beta}_0^C + \underline{\hat{\beta}_1^C X_{1i}^C} + \hat{\beta}_2^C X_{2i}^C + \hat{\beta}_3^C X_{3i}^C) \Big] \tag{9}$$

$$R_{O2} = \frac{1}{N^C} \sum_{i=1}^{N^C} \Big[F(\hat{\beta}_0^C + \hat{\beta}_1^C X_{1i}^T + \underline{\hat{\beta}_2^C X_{2i}^T} + \hat{\beta}_3^C X_{3i}^C) - F(\hat{\beta}_0^C + \hat{\beta}_1^C X_{1i}^T + \underline{\hat{\beta}_2^C X_{2i}^C} + \hat{\beta}_3^C X_{3i}^C) \Big] \tag{10}$$

$$R_{O3} = \frac{1}{N^C} \sum_{i=1}^{N^C} \Big[F(\hat{\beta}_0^C + \hat{\beta}_1^C X_{1i}^T + \hat{\beta}_2^C X_{2i}^T + \underline{\hat{\beta}_3^C X_{3i}^T}) - F(\hat{\beta}_0^C + \hat{\beta}_1^C X_{1i}^T + \hat{\beta}_2^C X_{2i}^T + \underline{\hat{\beta}_3^C X_{3i}^C}) \Big], \tag{11}$$

where R_{Om} is the portion of R_O that is attributed to the observable covariate X_m.

In equation (9), notice that the only difference between the first $F(\cdot)$ and the second $F(\cdot)$ is the underlined terms, $\underline{\hat{\beta}_1^C X_{1i}^T}$ and $\underline{\hat{\beta}_1^C X_{1i}^C}$. Notice also that the second $F(\cdot)$ is precisely the predicted probability of conflict for the ith observation in the C group. The first $F(\cdot)$ in (9) represents the counterfactual probability of conflict for the ith observation in the T group. That is, we replace X_{1i}^C with X_{1i}^T in the second term to obtain the first term. Then, the difference between the first $F(\cdot)$ and the second $F(\cdot)$ is the observable effect that is attributed to covariate X_1 for the ith observation. R_{O1}, or the individual contribution of X_1, is the mean difference of the first and the second $F(\cdot)$ for all the observations. In equation (10), observe that the first $F(\cdot)$ in (9) becomes the second $F(\cdot)$ in (10). Then, to obtain the first $F(\cdot)$ in (10), we replace X_{2i}^C with X_{2i}^T in the second $F(\cdot)$. Likewise, the first $F(\cdot)$ in (10) becomes the second $F(\cdot)$ in (11), and the first $F(\cdot)$ in (11) is obtained by replacing X_{3i}^C with X_{3i}^T.

It can be seen from equations (9)–(11) that the estimates of individual contributions can be sensitive to the orderings of the covariates. The contribution of X_2 is calculated by utilizing the "leftover" from the calculation of X_1, and the contribution of X_3 is calculated by utilizing the "leftover" from the calculations of X_1 and X_2. If we calculate the contributions of X_1, X_2, and X_3 in different orders, the results may differ. This is because, in nonlinear models, the marginal changes in $F(\cdot)$ due to X_m depend on the values of the other covariates. We circumvent this problem by randomizing the ordering of the covariates in each iteration of the simulations, approximating the mean estimates from all possible orderings.

Summarizing the quantities of interests

The results reported in this paper are based on 1,000 simulations. The point estimates reported in Table 2 are obtained by taking the mean of the estimates from the 1,000 replications. Uncertainty estimates can be obtained either by a linear approximation (the delta method), or by the quasi-Bayesian simulation methods. The delta method is computationally less demanding, though it requires a stronger distributional assumption. The quasi-Bayesian computation is more flexible (i.e., it does not rely on the linear additivity assumption), but it is computationally more expensive. For the quasi-Bayesian computation of the uncertainty estimates, we use 1,000 simulated β_k^C drawn from the multivariate Normal distribution (King, Tomz, and Wittenberg 2000). In our particular example, both methods lead to identical inference.