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Journal of Peace Research 2005; 42; 131
DOI: 10.1177/0022343305050687

journal of peace RESEARCH

© 2005 Journal of Peace Research,
vol. 42, no. 2, 2005, pp. 131–147
Sage Publications (London, Thousand Oaks, CA and New Delhi) www.sagepublications.com
DOI 10.1177/0022343305050687

Taking Arms Against a Sea of Troubles: Conventional Arms Races During Periods of Rivalry*

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This article revisits the arms race to war relationship with the hope of resolving a lingering debate in international relations over the effects of arms races. Previous empirical studies in this area suffered from a possible selection effect, rendering them unable to differentiate between the escalatory and deterrent effects of arms races. Specifically, earlier quantitative investigations were unable to test deterrence hypotheses, because the unit of analysis (dispute) presupposed that deterrence had already failed in preventing dispute onset. In order to take the possibility of deterrence seriously, a dataset is constructed that identifies arms races independently of dispute occurrence. This article improves on previous studies in that a measure of interdependent arming exogenous to dispute initiation allows for a test of whether arms races actually deter the onset of militarized disputes or contribute to dispute escalation. Both the deterrence and escalation hypotheses are tested using a sample of 'strategic rivals' from 1816 to 1993. The analyses reveal that arms races increase the likelihood of disputes and war. Furthermore, to account for the possibility that the arms race to war relationship may be spurious to dyadic hostilities accounting for both arms races and war, a selection model is employed that differentiates between dispute and war processes. This indicates that arms races do not contribute to deterrence and are instead associated with both disputes and war.

Introduction

Arms Races and Strategic Rivalry

Traditional international relations theory prescribes taking up arms to force revisionist states to back down; a show of strength deters aggression and causes tense but peaceful relations (Morgenthau, 1985: 200–201). Of course, since both rivals are likely to follow these prescriptions, critics argue that intense competition over arms supplies can be fraught with danger as hostilities escalate and potentially spiral out of control (Vasquez, 1993). Anecdotal evidence may support both positions, but more importantly, little conclusive social science evidence exists as to whether arms races deter, escalate, or are spurious to conflict. We wish to change this.

We use this article to develop an empirical study that takes deterrence theory seriously. Specifically, we construct a dataset of conventional arms races that are defined

* Our thanks to Scott Wolford, Rich Fording, and Steve Voss for comments on an earlier draft and to Matt Gabel and Kirk Randazzo for many conversations on the topic. Of course, they are not responsible for the errors that may remain. We provide a Web Appendix for this article with a list of cases meeting the definitions of mutual military buildup and arms race, a description of our coding procedures, and the dataset at http://www.uky.edu/~dgibler/replication.htm. This dataset is for replication purposes only. Any questions or comments should be directed to Doug Gibler at dgibler@uky.edu.

independently of dispute involvement, and thus we are able to test their ability to provide for peace during intense rivalries. By limiting our spatial domain to strategic rivals, we control for the possibility that arms races may be spurious to periods of increased hostility when the likelihood of war is high. Even after these research design changes, we find a positive, statistically significant relationship between arms races, militarized disputes, and war.

The arms race to war relationship is an important unresolved question, for both practice and theory. Using military expenditures to gain an advantage over adversaries is not a thing of the past. As Thompson (2001) shows, 38 strategic rivalries were still active in 1999, and several of these – Israel and its neighbors and India and Pakistan, most notably – have used arms races before, have been involved in deadly conflict, and have nuclear weapons in at least one state. Moreover, the economic and social costs necessary to pursue a program of military spending are enormous, especially if the anticipated results of the bargaining tool are misunderstood.

We begin our argument by reviewing the empirical findings that have tried to uncover the arms race to war relationship. Since indirect mechanisms are often used to theoretically link arms races to either peace or war, we also discuss how other variables may account for both arms races and war. Our basic argument in the next section is that while two theoretically rich and equally plausible claims exist for the arms race/conflict relationship, the empirical literature has largely been divorced from these theories. Instead, as Diehl & Crescenzi (1998) describe, the empirical literature has been mired in methodological controversies obscuring a definitive answer on the effects of arms races. We conclude the next section by outlining a research design that takes each competing claim seriously.

Why the Debate over Arms Races Persists

Quantitative examinations linking arms races to war are greatly underdeveloped compared with formal treatments of the relationship. The formal literature has demonstrated, for example, that arms races can not only cause escalation in the dyad (Kydd, 2000) but also be seen as a bargaining process caused by uncertainty over the relative strength of two rival economies (Kydd, 1997). Models that focus only on deterrence and war show that the nuclear arms race between the Soviet Union and the United States may have contributed to the Cold War peace (Intriligator & Brito, 1989), but differences in risk and changes in the military balance might also lead to failed deterrence (Morrow, 1989).[1]

The wide gulf between the formal and quantitative literatures is a direct result of the inability of empirical studies to differentiate between the escalatory and deterrence effects of arms races. As we demonstrate below, most quantitative investigations of the arms race to war relationship begin with the observation of a militarized dispute between two states. However, this beginning also suggests that any possible deterrent effects of the arms races had already failed, leading to a connection between arms races and war that is possibly spurious (for this argument, see Kydd, 2000: 231). For example, Wallace (1976) provided the first comprehensive empirical examination of arms races. He defined an arms race as a very rapid, simultaneous growth in military expenditures exceeding a certain quantitative threshold for the ten-year period prior to dispute onset

[1] The arms race literature largely began through formal treatments of the relationship. Richardson (1960) was the first to examine competitive arms races and argued that one rival would eventually reach a point of exhaustion, forcing an attack. However, as Bueno de Mesquita (2000) describes, there is no formal link to war in the Richardson arms race model; nothing explains why exhaustion causes the leaders to attack the other state, rather than simply giving up the arms race.

(Wallace, 1976, 1979). Wallace's (1982) index estimated the smooth time rate of change in military expenditures for each state prior to the dispute and was computed by taking the product of the change for each side; all disputes with a 10% or greater increase in expenditures over the ten-year period were coded as disputes during arms races. Using this measure of arms races, Wallace (1979) found that 23 of 28 arms-racing disputes escalated to war, while only 3 of 71 non-arms-racing disputes escalated to war.

These clear findings on escalation were controversial and began an intense methodological debate. First, Weede (1980) argued that Wallace's sample of disputes was unduly biased in favor of the arms race to war hypothesis, because it disaggregated several multilateral wars into multiple cases of dyadic disputes. World War II, for example, included separate arms-racing disputes for Germany–France, Germany–USSR, Germany–Britain, USSR–Japan, and so on. Weede argued that by including these cases, one event of arms racing was made to look like several, inflating the number of positive escalation cases. Wallace (1982) responded to Weede by eliminating several of the more controversial cases, but the relationship still held, albeit with a reduction of the phi statistic from 0.80 to 0.67.

A more damning problem for Wallace's first studies rested with the index he used to measure arms-racing dyads. As Diehl (1983) argued, the index did not necessarily measure a *mutual* buildup since coincident unilateral growth could deceptively appear in the index as mutual arming. Diehl therefore changed the index to consider mutual arming but reduced the expenditure threshold to an 8% buildup of either personnel or equipment for the period of three years prior to the dispute. Even this new index did not necessarily capture the effects of interdependent arming, according to Diehl, since both states could be arming against other rivals or through bureaucratic competition, while other factors brought them to the dispute. Diehl tested Wallace's finding using the new index and a reduced number of cases, created by merging allies racing against a common enemy as one case, and eliminated the statistically significant relationship between mutual military buildups and escalation to war.[2]

Horn's (1987) measure of mutual military buildup emphasized one of the most important aspects of Richardson's (1960) original conceptualization of arms races, namely, accelerated expenditure growth within the dyad. Horn used two criteria to do this. First, the average growth rate of a country's military expenditures during the time period directly preceding a dispute had to be higher than the historical average; and second, the growth rate in the second half of that period had to exceed the growth rate in the first half. Using this operationalization, Horn confirmed Richardson's expectation that longer arms races were associated with war, while shorter arms races were not related to conflict escalation. However, Horn's focus on operational definition never addressed the debate between Diehl and Wallace over both the influence of the World Wars and the lack of interdependence of spending within the dyad.

In an attempt to resolve the differences among previous studies, Sample (1997) conducted multiple tests with multiple arms race indices employing data used by Wallace, Diehl, and Horn. Evaluating Diehl's criticism of Wallace, Sample found no empirical evidence to support the claim that Wallace's index was capturing unilateral

[2] Vasquez & Henehan (1999: 104) argue that from a normal science perspective, this early debate is important, as Diehl may have unintentionally identified the Wallace cases that were especially prone to escalation. If the eliminated cases were driving the relationship in Wallace's sample, and if these cases mostly involved the World Wars, these research design changes suggest that arms racing is associated with the most deadly wars.

buildups. Sample also eliminated controversial cases from the World Wars in order to ensure independence in Wallace's sample of cases. Using Horn's index, she found a statistically significant relationship between mutual military buildups and escalation. In fact, in all of Sample's tests, using various combinations of the three samples of cases and both Diehl's and Horn's indices, Sample consistently found a positive, statistically significant relationship between mutual military buildups and escalation. Most interesting, Sample found that states involved in arms-racing disputes usually went to war within five years.[3] In a more recent study, Sample (2002) confirmed the findings about the relationship between mutual military buildup and escalation for minor states, but not for mixed status, major–minor dyads.

A Focus on Arms Races Rather than Mutual Military Buildups

While the debate over buildups and escalation has been instructive, it has not produced conclusive evidence on whether arms races are related to war or peace. Each of these research designs focused on the dispute as the unit of analysis, but obviously, a dispute presupposes that general deterrence has already failed (Diehl & Crescenzi, 1998: 112; Sample, 1998, 2000; Fearon, 1994). The observed cases of disputes may actually be a small fraction of the *possible* dispute cases that would have occurred had deterrence not been used, and this selected sample of cases would then provide little knowledge on whether arms races produce peace or war. Simply put, testing arms races based on dispute escalation cannot produce evidence that confirms the effects of arms races.[4]

The rationale for focusing only on dispute escalation probably rests with the difficulty in defining a sample of arms race cases. Although similar in their identifying features, mutual military buildups and arms races are not the same phenomenon. The former indicates a coincidental growth rate within a dyad while the latter represents an interactive phenomenon operating within a rivalry relationship. We focus on arms races and define them as an interactive competition between two rival states using the strength of their armed forces. By defining an arms race in terms of both hostility and competition, this definition corresponds to both early discussions of arms races (Huntington, 1958) and more recent theoretical treatments of the concept (Kydd, 2000). Additionally, our definition echoes those used in earlier quantitative studies but without conflating the arms race with other interstate behavior.[5]

Most important for our definition is establishing interdependence in each mutual military buildup considered an arms race – both states must competitively race against *each other* to be identified as a dyad

[3] The five-year lag revealed different results for each sample, but all were statistically significant. Ninety-three percent of Wallace's cases, 63% of Diehl's cases, and 86% of Horn's cases went to war within the five-year period following a dispute.

[4] One notable exception to the focus on escalation is Sample's (2000) study of dispute occurrence. Unfortunately, even in this study, the independent variable is still mutual military buildups rather than arms races, and this may lead to biased inferences. For example, Sample's (2002) data include several cases of mutual military buildups that lack even face validity – in 1939 alone, the Netherlands had buildups 'against' Britain, Finland, and Hungary, while in 1941, Japan was building 'against' South Africa.

[5] Many early quantitative studies elevated the importance of 'rapid' or 'abnormal' rates of military growth as defining features of arms races (Richardson, 1960; Wallace, 1979, 1982; Smith, 1980; Horn, 1987). However, Kydd (2000) notes that there is no necessity for an arms race to be defined by continuous increases in armed forces from a theoretical perspective. He echoes Huntington (1958) and other early arms race scholars when he argues that the competitive dynamic of an arms race does not need to be limited to the 'size' of the militaries alone but could also encompass 'racing' over technological supremacy and other related considerations.

experiencing an arms race. Given the large number of states undertaking military buildups during the past two centuries, this task would at first seem overwhelming, but Diehl & Crescenzi (1998) hint at one way of simplifying this task, although they do so in a slightly different context. They argue that arms races might be spurious to other causes of conflict (1998: 113) – a point we will return to shortly – and believe that enduring rivalries may be the principal cause. Whether or not this is the case, rivalries provide an excellent method of narrowing the possible cases of arms races, since the competition that is inherent in them constitutes one of the defining criteria for an arms race.[6]

In the next section, we detail a dataset of arms races constructed using Thompson's (2001) list of strategic rivalries. By examining a population of mutual military buildups during these strategic rivalries, we are able to isolate a manageable number of cases in which to establish interdependent arming. The prime advantage provided by our dataset is that we are now able to assess the ability of arms races to deter conflict onset. Since our arms race data were gathered independently of dispute data, we suffer no bias in analyzing the ability of arms races to either deter or provoke the outbreak of disputes. This is true at least in the context of rivalry, but as we will also argue, Thompson's definition of rivalry leads us to believe that we have identified the total population of arms races.

A second advantage of our arms race dataset is that it is dyadic. By selecting on disputes, previous studies were unable to agree on the proper sample of cases. In the debate between Diehl (1983) and Wallace (1979), for example, 17 conflict escalations were considered questionable cases, since several large wars, like World War I and World War II, would constitute the bulk of the dyadic cases of arms races and escalation.[7] Our dataset begins with the dyad, and hence, we will be able to test whether dyadic, interdependent arming results in the outbreak of conflict within that dyad. We measure interdependence at both the arms race and the conflict stages, and therefore we can think of no suspect cases for these analyses.

Using our new sample of arms race cases, we wish to test each of the following two competing claims from the existing literature on arms races:

H1: Arms races decrease the likelihood of both disputes and war.

H2: Arms races increase the likelihood of both disputes and war.

Hypothesis 1 assumes that a deterrence process controls the majority of possible dispute cases. The dispute cases observed in previous empirical studies represent only a small fraction of the total cases of possible disputes, making wars infrequent as well. Hypothesis 2 assumes that the previous literature is correct and arms races escalate disputes to war, even after controlling for the possibility of failed deterrence. Consistent with the hypothesized escalation process, arms races also expose contentious issues, increasing the overall number of disputes.

As Diehl & Crescenzi (1998) point out, it could be the case that neither of these hypotheses is empirically correct or, worse for our purposes, the escalation model could be correct but underspecified owing to omitted variable bias. For example, they divide Sample's (1997) set of cases between enduring rival and non-enduring rival dyads

[6] We present arguments from both sets of the rivalry literature – the literature that defines rivalry in terms of dispute density (Diehl & Goertz, 2000) and also the literature that concentrates on strategic rivals (Thompson, 2001). However, as we discuss in the next section, our operational definition of rivalry is based upon Thompson's identification of competition and interdependence within dyads.

[7] See Vasquez & Henehan (1999: 103–108) for a discussion of these cases.

and find that most of the escalation cases took place during enduring rivalries; this was especially true using Horn's index of military buildup (Diehl & Crescenzi, 1998: 113–114). Further examination of the non-rival cases showed that all but one of the escalations were cases of contagion as the disputants joined an existing war, while most of the enduring rival cases were initiators. They believe this evidence may indicate that the relationship between arms races and war (1) is 'completely spurious' to enduring rivalry, (2) exists in interaction with rivalry, remaining an important cause for war but only in rivalry, or (3) exists only in rivalry, and arming disputes outside of this context are misclassified (1998: 114).[8] The first possibility is obviously the most damning for the arms race literature; evidence showing a strong connection between arming, conflict onset, and eventual escalation might just as well constitute evidence that the causes of war also cause arms races. We control for this argument by selecting our sample of arms races solely from strategic rival dyads. By doing this, we constrain rivalry such that it will not vary in any of our tests; positive results for arms races in this context would demonstrate that arms races cause conflict, even when controlling for the presence of rivalry.

We turn now to discuss the dataset used for testing our hypotheses. In the next section, we begin by describing the procedures used to identify our sample of arms race cases and continue with a summary description of the data.

Research Design

Identifying Arms Races

An arms race is an interactive competition between two rival states using the strength of their armed forces. The competition takes place over specific issues, as both states seek resolution of a territorial, regime, or policy claim. Competitions over territory involve specific pieces of land; competitions for regime change are launched by revisionist states, attempting to overthrow the leadership of their rival; and arms races advocate policy changes that do not directly target the leadership of the rival but instead seek to alter their policy goals. This issue can be, and probably often is, distinct from the issues that dominate the rivalry.[9]

As Diehl & Crescenzi (1998) point out, the most obvious place to look for competition is in the rivalry literature. Unfortunately for our purposes, most definitions of rivalry are based upon dispute density (Diehl & Goertz, 2000; Bennett, 1996, 1997a,b, 1998). Using the Militarized Interstate Dispute (MID) dataset from the Correlates of War project (Gochman & Maoz, 1984; Jones, Bremer & Singer, 1996), rivalries are often defined as a minimum number of MIDs within a certain period of time. The duration of the rivalry is wholly determined by the initiation and termination of these disputes. For our purposes, these defining criteria pose a significant problem because inferences regarding deterrence will be highly biased. Just as in the studies by Wallace (1979, 1982) and Diehl (1983), a dispute has already occurred, suggesting that deterrence may have already failed.

Rivalries are by nature conflictual, and we would expect disputes to be an integral part of the relationship. However, we agree with Thompson (1995, 2001) that disputes provide only a partial understanding of the

[8] It is important to note that all of these possibilities presuppose that the deterrence model of arms races is incorrect and that conflict is more likely when states are arming.

[9] We should note that this definition of arms races, though perhaps restrictive, does not preclude competitions over relative position or prestige as these are often tied to specific issues – prior to World War I, for example, Germany and the United Kingdom raced following differences over the distribution of colonies and other territorial claims, and this race evolved into a competition for primacy (Kennedy, 1984).

rivalry relationship. Rivals can compete for trade, alliances, or power in the international system without ever experiencing an armed encounter, and using disputes to establish the rivalry periods biases the sample of dyads. The competitive relationship might exist long before the onset of the first dispute and end long after resolution of the last dispute. And again, this is especially true if the deterrence model is correct.

To compensate for these problems of endogeneity, Thompson (2001) operationalizes a definition of rivalry that is based not on conflict but on the qualitative analysis of historical records. There are three basic criteria for identifying dyads that are strategic rivals – both states must view the other as (1) a competitor, (2) a source of actual or latent threats that pose some possibility of becoming militarized, and (3) an enemy (Thompson, 2001: 560). Conceptually, mutual recognition of competitiveness is central when establishing two states as potential rivals and is used by or suggested as important in several studies (Kuenne, 1989; McGinnis & Williams, 1989; McGinnis, 1990; Vasquez, 1993; Thompson, 1995; Levy & Ali, 1998; Levy, 1999; Rapkin, 1999), and intuitively, the standard of mutual recognition is fundamental because for two states to truly compete, they need to recognize the other as the target of that competition.

Thompson (2001: 562–568) does not employ *a priori* duration criteria – the rivalry exists as long as the two states view each other as rivals. Each rivalry is independent, and the duration is dictated by the policy aims of the rival states. Since domestic constituencies may disagree about who the target rival state should be, only the opinions of the leaders in control of the government are considered. A rivalry that develops during a war is not included unless the rivalry outlasted the war. Finally, Thompson assumes a rivalry continues until there is an explicit indication that threat perceptions and hostility levels have decreased considerably; government policy statements must give clear evidence that the competitive atmosphere ceased to exist.

The weakness of this qualitative approach to rivalry is that it is somewhat subjective and difficult to replicate. But while there are many possible ways to define rivalry relations, we feel that Thompson's data represent the best attempt to separate the concepts of competition and interdependence from the more reliable, but also more problematic, identification of dispute behavior. We therefore use Thompson's identification of strategic rivals to delimit the list of states that have the potential to be engaged in an arms race. In the end, the main advantage of this approach is that we will finally be able to adequately test deterrence theory hypotheses.

Arms Race Criteria

We use two indicators to identify whether an arms race has occurred during a strategic rivalry. First, both rivals must have increased their military spending or personnel by 8% or more in every year of a three-year period; we use the two military components – personnel and expenditures – of the Composite Index of National Capabilities (CINC) from the Correlates of War project (Singer, Bremer & Stuckey, 1972) to identify these states. The 8% figure is chosen to prevent the capture of gradual increases in expenditures due to inflation and mirrors the most widely used measure in the field (Diehl, 1983). The three-year temporal criterion is long enough to avoid temporary expenditure anomalies, possibly aimed at equipment upgrades, and short enough to exclude multiple cases of arming. We do not assume that 8% has any particular significance, but we believe that, along with the rivalry criterion, this level allows for a sample size that is reasonably large for inference but still

small enough to establish interdependence.[10]

For the second indicator, we completed a qualitative evaluation of historical accounts, examining the relationship of the rival states during the time periods when mutual military buildups occurred.[11] We consulted government documents, historical accounts, and contemporary news sources (where available) to establish the nature of the rival relationship during the mutual military buildups. We looked for specific indications that (1) states were buying or building armaments or increasing the number of their military (personnel), and (2) this buildup involved a competitive dynamic within the rival dyad. In several cases, we were able to eliminate buildups due to non-specific regional unrest, domestic turbulence, and even cooperative arming against other states. We also eliminated cases in which our definition of arms races was met but the interdependence was the result of an ongoing war.[12]

Two Examples of Case Coding

The rivalry between North and South Korea during the 1960s and 1970s offers an excellent example of several coding criteria we used for this dataset. In the late 1960s, the North Korean government began dramatically increasing its military forces (personnel and expenditures), and in 1968, the North Korean army sent special operations troops to conduct a raid against South Korea's presidential palace (Hamm, 1999). Two days later, the North Koreans conducted another raid, seizing the USS Pueblo. These two crises led to an overall increase in the levels of fear, hostility, and tension within the dyad. South Korea responded by dramatically increasing its arms purchases from the United States and continued these purchases throughout the 1970s. The increased military expenditures made South Korea competitive with ever-growing North Korean capabilities, even without United States military support. North Korea's economy suffered during the mid-1970s, largely in response to the efforts made to increase their armed forces, and this precipitated a stall in the buildup during 1977. However, by the next year, North Korea recovered and continued its buildup, overtaking South Korea in personnel by 1979. Of course, North Korea only reversed the earlier personnel/expenditure balance through the arms race; originally, North Korea outspent South Korea but had fewer personnel, but by 1976, South Korea had begun outspending its northern rival.

Since South Korea did not match the

[10] If promising results are found, we can then justify relaxing these measurements and, time and resources allowing, undertake a larger data-collection effort. We should note, however, that we did experiment with relaxing both criteria. First, we randomly chose 20 mutual military buildups between states that were not strategic rivals. In none of these cases were we able to substantiate interdependent arming leading to an arms race. Second, we relaxed the 8% criterion to a 6% increase in military expenditures or personnel for strategic rival dyads. Two possible cases of arms races would be added by doing this, but in neither case was interdependent arming substantiated.

The 8% measure could bias our sample against finding arms race cases in smaller states, as arms expenditures and personnel increases of this magnitude are often difficult to maintain. However, we have reason to believe that this bias is not serious. First, a majority of our arms race cases are between minor states. This, combined with the addition of only two cases of mutual buildup when the threshold is lowered to 6%, suggests that we are capturing a significant number of smaller-state cases.

[11] An advantage of qualitative distinctions is that we can compensate for potentially unreliable CINC data. Diehl & Crescenzi (1998: 116) note a point made by Stuart Bremer, one of the original authors of the CINC data: 'There is serious doubt now on whether the Correlates of War Project capability data should be used to make the kind of nuanced distinctions in high versus medium level increases in military expenditures that are the cornerstone of most arms race indices.' By using the lower threshold of 8% per annum increases (as opposed to 10% in Wallace's studies), we are able to capture most (if not all) of the medium-level arms increases. Historical judgment, rather than expenditure data, is then relied upon to confirm that an arms race was in fact taking place.

[12] Obviously, ongoing war cases have to be treated differently from other types of arms races. Later in the article, we discuss how we deal with this source of bias.

buildup above the 8% threshold until 1973, the buildup begun by North Korea in the mid-1960s is coded as unilateral and is not considered an arms race. When South Korea matched the personnel and expenditure increases, and when it did so in response to North Korean actions, we code the beginning of the arms race. We code the end of the arms race in 1976, since North Korea discontinued its buildup in 1977; we code a new arms race beginning the following year and ending in 1981, when both sides failed to increase their military expenditures.[13]

Conversely, the mutual military buildup between long-time rivals Iran and Egypt in the 1960s is an example of how we use qualitative evaluations of historical records to eliminate some cases that fail to meet the interdependency criterion. Between 1964 and 1970, both Iran and Egypt were rapidly building up their militaries at a rate that exceeded the 8% threshold of military spending or personnel increases. While Iran and Egypt certainly both continued to view the other as a rival, the military buildup itself was the result of pressures outside their rivalry dynamic. In the case of Iran, it was encouraged by the United States to use its oil revenues to purchase and develop large quantities of arms and military equipment, aimed at hindering the growing regional presence of the Soviet Union (Cleveland, 1999). Egypt, however, fought two wars with Israel during this period and increased its expenditures and personnel while targeting Israel, not Iran (see Leng, 2000, for a nice description of this case). We eliminate this case from our dataset because of the disconfirming historical evidence suggesting that the military buildups during this time period were not directed at the other state. Without interdependence, there was no arms race.

[13] The North Korea/South Korea dyad is the only example of an arms race beginning less than five years before the end of the previous arms race. Neither of these arms races was followed by a war in our analyses.

In summary, we identified all rivals engaged in mutual military expenditure or personnel buildups greater than 8% over three-year periods, isolating 108 instances of strategic rivals engaged in mutual military buildups over three-year periods between 1815 and 1992. We then investigated the historical record for each of these cases to determine whether the buildup was due to an arms race. Our qualitative investigations narrowed these cases to 71 instances of buildups that were competitive and interdependent, and we coded these cases as arms races; the remaining 37 cases were cases of coincidental arming not directed at the other rival in the dyad. Arms races last a mean of 4.2 years in our dataset, ranging from 3 years (our arbitrary minimum duration) to 9 years. In total, we found 289 dyad-years of arms races during 6,293 dyad-years of strategic rivalry.

Control Variables and Rival Explanations

As we noted earlier, Diehl & Crescenzi (1998: 112–113) suggest two strong possibilities for an indirect relationship between arms races and war. We control for the first possibility, the presence of rivalry, partially through sample selection. If rivalries drive arms expenditures and conflict, eliminating the effects of arms races independently, then we should witness no direct effects from arms races during rivalry years. The second possibility, according to Diehl & Crescenzi, is that arms races are mechanisms for creating changes in the ratio of capabilities within the rival dyad, and this echoes some previous arguments in the literature.

Morrow (1989), for example, found limited support for a 'window of opportunity' caused by dynamic changes in the ratio of capabilities between arming nations. Similarly, Werner & Kugler (1996) argued that dissatisfied states undertook arms races to alter the status quo distribution of

capabilities to their favor, possibly hastening the transition to a war. Finally, Diehl (1985) showed that major states with high defense burdens were most likely to escalate their disputes to war. All of this suggests that rather than increasing hostility within the dyad, arms races may create instability in the capability ratio between the rivals. This instability would cause disputes, as one rival fears the overtaking of another or as uncertainty over the capability levels of both states changes, prompting one or both leaders to begin a bargaining process over the status quo.[14]

To determine whether capability changes have an impact on the arms race to dispute and war relationship, we measure the overall CINC score for both rivals and use the disaggregated indicators of personnel and expenditure levels. We coded a military capability change whenever the stronger state switched positions with the weaker state in the rival dyad. For example, in the North Korea versus South Korea case described earlier, North Korea began the arms race by outspending South Korea, while South Korea had more military personnel. At the end of the arms race, North Korea had more military personnel but was spending less than South Korea. Therefore, this race would be coded as experiencing ratio changes in both personnel and expenditures; these changes were coded only for the exact year in which the dominant state changed.[15]

Using our arms race dataset, we find that arms races increase the likelihood of changes in the personnel and overall capability score ratio for strategic rival dyads. However, arms races are not the only explanation of these changes, since only 8% of personnel and expenditure ratio changes and only 10% of capability score changes occur during arms race years.

We use this article to test the effects of conventional arms races, but conventional arms races do not exist in isolation. It is possible, for example, that the presence of nuclear weapons could affect the overall likelihood of rival dyads engaging in or escalating conflicts. Indeed, Sample (2000, 2002) cites the presence of nuclear weapons as one possible explanation for Cold War arms races being less war-prone than the rest of her cases. Therefore, we control for the possible effects of nuclear deterrence by including a dummy variable for all strategic rival dyad-years in which both states possessed nuclear weapons. This variable is coded as 1 for five strategic rivals: USA–USSR after 1949; USA–China after 1964; UK–USSR after 1952; China–USSR after 1964; and China–India after 1974.

Finally, we control for several variables demonstrated to be predictors of conflict in a dyad. We code each rival dyad for contiguity (advanced, allied, and parity), and we follow Bremer (1992) in defining these variables. Advanced states have world shares of economic capabilities that are greater than their world shares of population, using CINC scores to calculate each component. The presence of an alliance is measured within the dyad, alliances with states outside the dyad are ignored, and we use Version 3.0 of the Correlates of War alliance dataset to code our cases. Parity is defined as dyads with a ratio of CINC scores between 0.80 and 1.20, and contiguity is coded as 1 if direct land contiguity is present in the dyad and 0 otherwise. Our measure of joint democracy follows convention, labeling as democratic states with combined Polity IV scores (democracy plus autocracy) greater than 5. We label a dyad jointly democratic if both states had Polity scores of 6 or greater. Much of the literature since 1992 supports Bremer's findings that contiguity and parity increase

[14] See Vasquez (1993: 181) for how sudden capability changes can sometimes drive increases in hostility, rather than exposing a new bargaining environment.

[15] We present analyses using these exact year data. However, results using one-, two-, or three-year lags of this variable produce substantively similar results.

the likelihood of conflict, while joint democracy, alliances, and wealth exhibit pacifying effects. We see no reason to deviate from these expectations in our sample of cases.

Sample Selection

To determine whether arms races increase the likelihood of conflict onset, we construct an annual dataset of Thompson's (2001: Table 1) 'strategic rivals' between 1815 and 1993.[16] Our dependent variable is the presence of a Militarized Interstate Dispute (MID) from Version 2.0 of the Correlates of War project (Jones, Bremer & Singer, 1996), as amended into dyadic form by Maoz (1999). We code only originators on day 1 of the dispute as experiencing a MID and find a total of 834 MIDs occurring during our sample of strategic rivalry. Of these MIDs, 92 reach the level of war within the dyad. Since the dependent variable is always dichotomous – MID/no MID and war/no war – regression techniques that assume a continuous dependent variable are inappropriate. Therefore, we use probit analysis to estimate the effects of buildups on the likelihood of a strategic rival experiencing a MID.

Testing the Relationship Between Arms Races and War

To uncover the relationship between arms races and war, we use multivariate probit analyses with the occurrence of a MID or a war as the dependent variable, and these results are presented in Table I.[17] As Column 1 shows, the presence of an arms race is positively related to the occurrence of a dispute, even after adding the conflict control variables. These control variables also demonstrate some interesting characteristics. First, neither the presence of two advanced economies, nor joint democracy, nor rough parity is related to dispute onset at any reasonable level of significance. This is probably due to the relative paucity (joint advanced and joint democracy) or overabundance (parity) of these cases in the sample of strategic rivals, since rivalry itself is related to parity and lack of democracy and may contribute to a depressed economy in at least one of the rivals; in other words, though our sample provides leverage for understanding the effects of arms races, the other independent variables affect rivalry development and not necessarily MID occurrence (Lemke & Reed, 2001). Second, the capability change variables do not significantly affect the likelihood of a dispute; changes in which state leads the military personnel or expenditures ratio of the dyad do not lead to dispute onset. Finally, three other control variables have statistically significant effects on MID onset – the presence of an alliance (negative), contiguity (positive), and the joint presence of nuclear weapons (positive). The coefficients for alliance presence and contiguity seem congruent with the literature, but nuclear weapons are generally thought to pacify rival dyads.

Using war onset as the dependent variable alters few of the findings. Arms races (positive) and alliances (negative) remain strong predictors of war onset in a rival dyad, and the effects of nuclear weapons are strong enough to prevent estimation of this coefficient, since no war has occurred in a dyad where both states possessed nuclear weapons (we therefore omit the nuclear weapons variable from this model). Contiguity is no longer statistically significant in this model, but a more interesting change regards personnel ratio changes; in the war model, a change in which state leads

[16] We believe that we have come close to identifying the entire population of arms races and can therefore estimate the effects of arms races on the entire population of dyad-years, 1816 to 1993. However, since strategic rivalry plays such a large part in our definition of arms races, we limit the analyses to this set of cases to avoid bias. Scholars wishing to employ our data in larger samples of dyads could treat the arms race variable as an interaction between rivalry and interdependent arming.

[17] For all analyses in this article, we report coefficients using robust standard errors, clustered on the dyad. All estimations were performed using Stata 8.0.

Table I. Probit Analyses of the Effects of Arms Races on MIDs and War

	Model 1	*Model 2*	*Model 3*
Dependent variable:	MID onset	War onset	War onset
Selection variable:			MID onset
Arms race present	.661(.093)***		.656(.093)***
Capability-related control variables			
Changes in personnel ratio	.094(.107)		.095(.107)
Changes in expenditure ratio	–.020(.105)		–.015(.105)
Both nuclear powers	1.069(.147)***		1.094(.145)***
Parity	.064(.088)		.060(.088)
Other control variables			
Contiguity	.240(.061)***		.243(.061)***
Joint democracy	.127(.118)		.132(.118)
Alliance	–.341(.061)***		–.343(.062)***
Both advanced	–.095(.094)		–.099(.094)
Constant	–1.119(.056)***		–1.122(.056)***
Arms race present		.654(.163)***	.667(.164)***
Capability-related control variables			
Change in personnel dominance		.350(.189)*	.342(.191)*
Change in expenditure dominance		.178(.206)	.183(.204)
Both nuclear powers		–	–
Parity		.241(.171)	.264(.174)
Other control variables			
Contiguity		.070(.137)	.029(.138)
Joint democracy		–.058(.287)	–.063(.289)
Alliance		–.322(.149)**	–.308(.148)**
Both advanced		–.049(.204)	–.026(.208)
Constant		–2.335(.127)***	2.316(.124)***
Rho			.984(.858)
N uncensored	3,279	3,279	3,279
N censored	–	–	562
LR X^2	96.15***	26.26***	27.95***

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
Standard errors in parentheses.

in total military personnel is positively related to war onset. However, neither the presence of this variable nor an interaction of personnel changes with arms races affects the positive, statistically significant relationship between arms races and war.[18] This suggests that the arms race to war relationship is not spurious to changes in overall personnel capability changes in the dyad.

The results presented thus far demonstrate that arms races are related to the onset of MIDs and wars in a strategic rival dyad, confirming Hypothesis 2, and the effects of arms races are not likely to be spurious to other factors. To check the overall robustness of our results, we emulate Sample (1997) and estimate the same models with yearly lags for the arms race variable. We estimate

[18] Models with interactions for all capability change variables are available from the authors. Arms races retain a positive, statistically significant effect in each of these models. We also controlled for the speed of the armament increases by including several different rates of armament and personnel change variables. None of these results was statistically significant, however.

models with one-, two-, and three-year lags, and in each model, the arms race coefficient remains statistically significant and in the same direction as the model reported in Table I.[19] This suggests that arms races have an immediate and prolonged impact on the likelihood of a rival dyad experiencing either a militarized dispute or a war.

The two models analyzed thus far have assumed the impact of arms races to be consistent across disputes and wars. Our next analysis relaxes this assumption and tests whether arms races also contribute to war escalation once a dispute has occurred. We do this by estimating a bivariate probit with selection where a dyadic MID is the selection variable for all possible cases of dyadic war. As Column 3 of Table I shows, the rho of this model, though positive, is not significant. An insignificant rho suggests that the selection process and the model predicting war are independent (Reed, 2000). Put another way, no variable omitted from these models has an impact on dispute escalation to war for strategic rivals, and since the selection model introduces no bias into the escalation process, the coefficients in both the MID and war portions of the model remain substantively similar to the probit models without selection. Indeed, as a comparison of Columns 1 and 2 with Column 3 shows, none of the statistically significant coefficients changes in either sign or impact.[20]

These findings obviously confirm Hypothesis 2, linking arms races to disputes and wars. While arms races are often thought to be spurious to some unmeasured variable that drives both increased and interdependent arming as well as conflict – the underlying hostility or tension in the dyad resulting from rivalry – we follow the advice of Diehl & Crescenzi (1998) and control for this possibility by selecting only rival relationships for our sample of cases. Even in this set of cases, arms races increase the likelihood of both disputes and wars.

The Impact of Arms Races

We have demonstrated that arms races increase the likelihood of disputes and the probability that these disputes will end in war, but what are the effects of arms races compared to other causes of conflict? For example, are arms races associated with most wars? The answer to the second question is 'No' – few wars are actually associated with arms races. Only 13 of the 79 wars identified by the Correlates of War project as occurring between 1816 and 1992 have been preceded by an arms race using our sample of cases, and only 25 of 174 strategic rivals identified by Thompson (2001) had arms races before one of their wars.[21] Nevertheless, arms races do seem to have an impact on the major wars as over half (17 of 30) of our cases are related to the two World Wars, and most of the high-fatality dyadic wars occur in the presence of an arms race. This suggests to us that the escalatory effects of arms races not only exist at the level of dispute to war but also escalate the severity of wars.

In addition to escalation, arms races seem to have an important substantive impact on the likelihood of conflict, especially in comparison with the other

[19] The results are summarized here; the details of the models are available from the authors.

[20] Our criterion of 8% increases in either military personnel or expenditures might bias against finding minor-state dyadic arms races; this criterion might also impact our results for major-state dyads by including only the most heavily racing minor states. We partially control for this possibility by including continuous capability-change measures in our analyses. To further control for these biases, we also ran separate analyses using only major-state dyads. The results for major-state dyads are completely consistent with the results for the full sample of dyads reported herein.

[21] This excludes two wars that preceded arms races – the Crimean War (1853) had Britain and Russia arming in 1854, and the Sino-Japanese War (1937) had China and Japan arming in 1941. We count only one case of arms race preceding war for each strategic rival, even though several rival dyads had more than one arms race that preceded a war.

Table II. Assessing Probabilities of Conflict in the Presence of Arms Races

	Prob. y = 1	*% change*
The probability of disputes in strategic rival dyads per year		
An average strategic rival dispute onset	0.16	
The probability of dispute onset for a strategic rival dyad that . . .		
is engaged in an arms race	0.35	116.2
is contiguous	0.20	23.5
has an alliance	0.08	–51.2
is contiguous, has no alliance, and is engaged in an arms race	0.43	165.6
The probability of war in strategic rival dyads per year		
An average strategic rival war onset	0.01	
The probability of dispute onset for a strategic rival dyad that . . .		
is engaged in an arms race	0.05	400.0
is contiguous	0.01	23.9
has an alliance	0.01	–53.2
is contiguous, has no alliance, and is engaged in an arms race	0.06	450.5

The marginal effects are computed holding all statistical insignificant variables at their mean and all other variables at 0 for absent. Only significant coefficients are reported.

variables in our models. For example, as Table II shows, the chance of a MID for strategic rivals more than doubles, from 16% on average to 35% during an arms race year, and the chance of war changes from 1 in 100 to 1 in 20 during arms race years. These results are especially dramatic in comparison with the two other variables that are statistically significant across both models – contiguity increases the probability of both types of conflict by just over 23%, and an alliance decreases these probabilities by more than half.[22]

Concluding Remarks

We believe there are several ways to build upon the research we begin here, without necessarily becoming mired in the methodological debates that have plagued the arms race literature. First, our dataset of arms races was arbitrarily restricted to those dyads racing at 8% in each year of a three-year period, using either military expenditures or personnel. An obvious extension of these data would lower the 8% threshold and perhaps vary the buildup criteria, relaxing the three-year period criterion. We focused on the more intense buildups in this study, because the rapid buildups seem to us to be more credible commitments to deter rivals, and these criteria also provided a more manageable set of cases for qualitative investigations of interdependent arming. Nevertheless, it could still be the case that lower-level, less intense buildups might not instigate the processes that lead to disputes and wars, and an expanded dataset using lower thresholds for arming would answer this question. Our dataset may also favor the inclusion of wealthier and more populous states, as they are more likely to be able to increase their expenditures and personnel at rapid rates. Relaxing the quantitative thresholds for arming would lessen this concern as well.

Our criteria were applied only to

[22] While both contiguity and alliances have a noticeably smaller impact in the models, it is likely that other variables – capability ratios and regime type, most notably – have been kept constant by our selection process, rendering their effects statistically meaningless in the models. This selection process was necessary to demonstrate that arms races are not spurious to the many other possible causes of conflict.

Thompson's (2001) list of strategic rivals, and a natural, though possibly time-consuming, extension of our dataset would apply our criteria to all dyadic cases, from 1816 onward. Given Thompson's criteria for establishing strategic rivalries, we suspect that we have identified most cases of interdependent arming that meet our quantitative threshold, but this should be confirmed empirically, and the added investigations would add leverage to whether rivalry selection processes also impact upon the effects of arms races (Lemke & Reed, 2001).

In summary, our analysis of strategic rival dyads suggests, first, that arms races do not deter conflict. Our dataset takes the possibility of deterrence seriously as we identify arms races independently of whether a dispute has actually occurred, but our results still demonstrate that engaging in an arms race increases the likelihood of both disputes and wars. Second, by analyzing the potential selection effects between dispute onset and escalation, we are able to say with some measure of confidence that we have accounted for the variables that could potentially lead strategic rivals to escalate their disputes to war. Since only contiguity increases the chance of dispute escalation in our model in any statistically significant way, we are left with the conclusion that arms races do not provide for deterrence and contribute to dispute escalation to war among strategic rival dyads. Third, we control for the possibility of spuriousness by selecting a sample of dyads with high perceptions of mutual threat – the existence of rivalry. In this sample of cases, we conclude that the arms race to war findings are not spurious to factors inherent in rival relationships. We hope our research resolves some of the discrepancies found in the arms race literature, allowing future studies to develop a clearer understanding of the relationship between arms races and war.

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