How does Stalemate Affect Military Spending? Theory and Evidence*

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Abstract

In this study, we propose a game-theoretical model and conduct a number of empirical assessments to examine how stalemate–an important and common outcome of war–affects military spending. In the game, when stalemate becomes a feasible outcome of war, the level of military spending rises in equilibrium. This result is driven by our characterization of stalemate–a substantial destruction of the production and consumption. Furthermore, this study empirically tests if stalemate increases military spending after having controlled for the existing explanations. Based on a number of regressions, it demonstrates that stalemate increases states' spending on the military. The proposed argument makes an important contribution to the rationalist explanations for war. In anticipation of stalemate, states are expected to increase military spending, which implies that states will fight harder and war will be more devastating.

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Introduction

The study of determinants of military spending has attracted a great deal of scholarly attention. One group of explanations focuses on the nature and dynamics of conflict. For example, arms race models investigate how one state's level of military spending reacts to its opponent state's level of spending (e.g., Richardson 1960; Intriligator 1975). Guns and butter models examine the trade-off between guns and butter, assuming that military spending does not directly contribute to utility but is useful in fighting wars (e.g., Hirshleifer 1988; Powell 1999). Another strand of literature centers on the strategic environment. For instance, alliance models assess how allies' expenditures affect one state's calculations of spending on the military (e.g., Smith 1980; Morrow 1993). A third group of studies emphasizes the institutional characteristics of states. Among these studies many examine how regime type influences a state's decision on national defense (e.g., Sprout and Sprout 1968; Albalate, Bel and Elias 2012).

This study introduces a new explanation of military spending. It examines how stalemate–an important and common outcome of war–can affect military spending. Stalemate is characterized by "the lack of any decisive changes in the pre-dispute status quo and is identified when the outcome does not favor either side in the dispute" (Jones, Bremer and Singer 1996, p. 180). The study of stalemate has significant implications for the rationalist explanations for war (e.g., Fearon 1995) and in particular for war termination (e.g., Goemans 2000). As an outcome of failed bargaining, war becomes the last resort to resolve a dispute between states. Stalemate implies that war terminates in such a way that it fails to provide a solution to the dispute. In other words, stalemate is a distinctive war outcome in that an agreement has been reached among the other outcomes of war except stalemate. Therefore, understanding how the anticipation of stalemate will change states fighting wars is expected to make an important contribution to the rationalist explanations for war. Furthermore, stalemate is

a recurring outcome of war. For example, among all the incidents of Militarized Interstate Disputes (MIDs) coded in Maoz (2005), an outcome of stalemate accounts for more than half of the total cases.

To investigate how stalemate affects military spending, we develop a game-theoretical model that incorporates strategic interactions between two states. In this game, stalemate is characterized by a substantial destruction of the production and consumption available to states. Since stalemate implies war fails to provide a solution to the dispute, states will not be able to divide the contested "pie" in stalemate. Put differently, a substantial loss of production and consumption occurs when a war ends in stalemate. Based on this important characterization of stalemate, our game-theoretical model demonstrates that when stalemate becomes a feasible outcome of war, the level of military spending rises in equilibrium. To reiterate, states will increase military spending in anticipation of stalemate. The intuition behind this result is that due to the perceived loss in production and consumption, states will try to avoid the outcome of stalemate. Since the probability of stalemate is an inverse function of their levels of spending on the military, it is expected that states will increase military spending to reduce the probability of stalemate.

In addition, we conduct a number of empirical tests to assess if stalemate increases military spending after controlling for the existing explanations in the literature. Our empirical analysis replicates the regression specifications used in an influential study by Goldsmith (2003). His study shows arguably the most comprehensive empirical investigation of military spending, by including domestic, interstate, and systemic factors from the literature and analyzing all these factors in a unified framework. In other words, his research design especially suits our goal of controlling for all the existing explanations. Furthermore, by employing the research design of an established analysis, this study can minimize the variations in results due to different choices of regression specifications by different researchers. Based

on all the regression specifications and various robustness tests, we find that stalemate induces a higher level of military spending, after having controlled for the existing explanations in the literature.

The rest of this study proceeds in four sections. First, it conducts a brief review of the literature on military spending. Next, this study presents a game-theoretical model to demonstrate how stalemate affects military spending. The empirical tests of the proposed theory are shown in section four. Finally, we provide a concluding remark.

Existing Arguments on Military Spending

In this study, we aim to propose and test an innovative explanation of states' military spending that has not been examined in the literature. Toward this goal, we first conduct a review of the literature. The existing research on military spending can shed light on our research design of the empirical test. Among all the existing studies devoted to explaining military spending, we highlight three of the most important arguments, which include: (i) rivalries and arms races; (ii) alliances; and (iii) state regime types.

Arms race models are arguably the most important and commonly employed explanation of states' military spending (e.g., Richardson 1960; Intriligator 1975; Intriligator and Brito 1984). In his seminal work, Richardson (1960) proposes a simple two-country model to explain the logic of arms races. His key result is that a state's defense spending positively responds to its opponent state's military spending. In addition, when certain conditions are met, an arms race takes place. The Richardson model demonstrates a good prediction of the arms race of 1909-1914. Other scholars have proposed to use rivalry as an alternative conceptualization of arms race for conflict studies (e.g., Goertz and Diehl 1993; Diehl and Crescenzi 1998; Diehl and Goertz 2001).

Furthermore, many studies have empirically tested how rivalries affect military spending. Williams and McGinnis (1992) use a time series model to examine the defense expenditures of the U.S. and the Soviet Union during the Cold War period. They show that "a shared dynamic structure of the rivalry system" increases both states' defense budgets (p. 91). Employing a causality methodology, Kollias and Paleologou (2002) demonstrate that during 1950-1999 the Greek-Turkish rivalry has led to an arms race between these two countries. Based on a cross-sectional and time-series analysis that includes a sample of all states from 1886 to 1989, Goldsmith (2003) also finds a positive effect of enduring rivalry on defense spending.

Another often-cited explanation of military spending is participation in alliances. A state can strengthen its military power through two different means: internally by increasing defense spending, and externally through forming alliances. Trade-offs exist between these two methods. For example, Morrow (1993) examines how political costs affect this trade-off. He argues that to achieve security, arms-building is slower but more reliable while alliance formation is faster but less reliable. Domestic opposition arises in both methods. Arms-building requires extracting greater resources, and alliance formation requires abandoning some domestic policies. Therefore, a state needs to weigh the benefits and costs of arms versus allies.

Many scholars have theoretically and empirically assessed how allies' expenditures affect a state's military spending. Based on the assumption that social welfare is determined by civilian output and security, Smith (1980) uses the example of the United Kingdom to examine a state's demand for military spending. He hypothesizes that being a member of NATO can have two different effects on the UK's military spending: "in the 'follower' case an increase in US military expenditure signals an increase in threat requiring more British military expenditure; while in the 'free rider' case it signals an increase in protection (for

a given Soviet share) allowing reductions in expenditure" (p. 814). His data analysis supports the hypothesis that the UK was a free rider. Many follow-up studies have investigated this interdependence between one state's military spending and its allies' military expenditures (e.g., Murdoch and Sandler 1984; Smith 1989; Sandler and Murdoch 1990; Dunne and Perlo-Freeman 2003; Caruso and Di Domizio 2016). For example, in a recent study Caruso and Di Domizio (2016) find a positive interdependence between US and European military expenditures.

Finally, a great deal of research has stressed the importance of regime type. It is generally agreed that democracies tend to spend less on the military. This argument emphasizes the existence of a keener competition for resources between different interest groups in democracies (e.g., Armijo, Biersteker and Lowenthal 1994). For example, Sprout and Sprout (1968) illustrate the competition between social welfare and military spending in Britain between 1890 and 1966. They show that after excluding war years, the share of military spending as percent of GNP has been decreasing over time when compared to social service expenditures. Their explanation is that Britain is a trade-dependent economy and its deteriorating balance-of-payment results in the government's reducing military expenditures.

A large number of articles have empirically examined whether democracy reduces military spending in a global setting. Using the data from 1967 to 1989, Garfinkel (1994) shows that military spending as percent of GDP is significantly smaller for democratic countries, due to the preferences of median voters. In a study that analyzes various categories of public spending, Alesina and Wacziarg (1998) show that public expenditures on defense are negatively associated with democracy. Based on a much longer time period from 1816 to 1997, Fordham and Walker (2005) similarly demonstrate that democratic states are likely to spend less on their militaries. In a more recent study, Albalate, Bel and Elias (2012) examine military spending in 157 countries for the period 1988-2006, and once again find that

democracies on average spend less. Furthermore, they show that presidential democracies tend to spend more on defense than parliamentary systems.

As previously mentioned, this study proposes and tests a novel explanation of military spending. Here it is useful to point out that our proposed explanation is fundamentally different than the existing argument that an occurrence of war or conflict increases states' military spending. This existing argument is intuitive: when states are involved in a war or conflict, they are likely to devote more resources to national defense. Once the war or conflict is over, states will cut their military expenditures. However, we instead argue that a particular outcome of war–stalemate–increases military spending. That is, our argument predicts that when compared to other war outcomes, the outcome of stalemate induces more military spending. In other words, the prediction of our argument is not an increase in military spending for every war or conflict, but only for the ones that end in stalemate. In the following theory section, we provide a detailed discussion of this novel argument.

A Theory of How Stalemate Affects Military Spending

The Game-Theoretical Model

In this article, we propose an original explanation of states' levels of military spending. It argues that stalemate–an important and common outcome of war–has a causal effect on military spending by increasing states' investments in the military. This argument demonstrates how stalemate can affect military spending, which makes an important contribution to the literature on military spending. In addition, it makes an important contribution to the rationalist explanations of war (e.g., Fearon 1995), and in particular to our understanding of war termination (e.g., Goemans 2000). As an outcome of failed bargaining, war becomes

the last resort to resolve a dispute between states. Stalemate implies that war terminates in such a way that it fails to provide a solution to the dispute. In anticipation of stalemate, states will increase military spending, which suggests that states will fight harder and war will be more devastating.

To demonstrate how stalemate affects military spending, we employ a game-theoretical model that incorporates strategic interactions between states. One important consideration of the proposed game is to deliver an intuitive explanation of how stalemate affects military spending. As a result, we choose to set up a game that is concise and maintains realistic assumptions. Toward this goal, the proposed game-theoretical model is grounded in the well-known class of general equilibrium models developed to explaining conflict (e.g., Hirshleifer 1988; Grossman 1991; Skaperdas 1992; Neary 1997; Baker 2003; Caruso 2007; Garfinkel and Skaperdas 2007). In the following, we introduce the setup of the proposed game and show the solution of equilibrium.[1]

It is a typical Hirshleifer-style model (i.e., a general equilibrium model of conflict), where two rival states i and j play a one-shot game. It is a simultaneous and non-cooperative game in which each state makes a decision on the allocation of its initial resources (r) between guns (g) and butter (y). It is understood that military spending (g) does not generate any direct utility. Instead, military spending determines the probability of winning a war for state i, which is given by the Contest Success Function (CSF) $\frac{g_i}{g_i+g_j}$.[2] That is, the more state i spends on the military, the more likely it will win a war. Furthermore, given the commonly assumed risk-neutral preferences, the CSF also dictates how the contested pie (i.e., $r_i + r_j - g_i - g_j$) is split between the two states. Alternatively, we can assume that the

[1]Caruso (2007) develops a simple game to show that stalemate can lead to a higher degree of violence. Our proposed model modifies and generalizes his model in a number of important directions. As a result, the similarities between his game and our game–including the solution of equilibrium–are to a large degree minimized.

[2]For example, see Skaperdas (1996) for a detailed discussion of contest success functions.

winning state takes everything (i.e., $r_i + r_j - g_i - g_j$) while the losing state acquires nothing, which nonetheless will lead to the same expected utility calculations as suggested by the CSF.

Based on this model setup, it is expected that state i maximizes the following utility function

$$u_i = \frac{g_i}{g_i + g_j}(r_i + r_j - g_i - g_j) \tag{1}$$

Taking the first-order derivative w.r.t g_i, we have

$$\frac{du_i}{dg_i} = \frac{-g_i^2 - 2g_j g_i + (r_i + r_j - g_j)g_j}{(g_i + g_j)^2} \tag{2}$$

Let equation (2) equal to zero and solve for g_i, we obtain the optimal level of military spending for states i and j[3]

$$g_i^* = g_j^* = \frac{r_i + r_j}{4} \tag{3}$$

Thus far, this study has shown the optimal level of military spending for the case where stalemate is precluded. This is our baseline case. In the next step, we introduce stalemate as a possible outcome of war, and show how stalemate can affect the level of military spending in equilibrium. In doing so, we first modify the previous CSF to accommodate stalemate, and adopt the CSF introduced in Blavatskyy (2010). In this modified CSF, the probability of winning a war for state i becomes $\frac{g_i}{1+g_i+g_j}$. That is, in addition to either state i or state j winning, there is a probability of stalemate indicated by $\frac{1}{1+g_i+g_j}$. Here the probability of stalemate has been normalized to $\frac{1}{1+g_i+g_j}$. However, since g_i and g_j can be either greater than or less than 1, the probability of stalemate can still vary between 0 and 1.

The second important assumption that we make for the case with stalemate is that when

[3]The solution for g_j is obtained by symmetry of the game.

stalemate occurs, only a portion of $r_i + r_j - g_i - g_j$ becomes available to each state and this proportion is denoted by a parameter λ. This turns out to be a crucial assumption, and this assumption indeed captures our interpretation of stalemate. As previously mentioned, after peaceful bargaining fails, war becomes arguably the last resort to resolve a dispute (e.g., a division of resources such as a piece of territory). When a war ends in stalemate, it means that war fails to resolve the dispute, which suggests that states will not be able to move any further. Put differently, states will not be able to divide the contested "pie," and in such cases neither side acquires anything in stalemate. To be more general, we allow λ to be either 0 where none of the $r_i + r_j - g_i - g_j$ becomes available to states or a small positive number to indicate a small fraction is still available. For example, when two states dispute over a mine located in a war zone, the occurrence of stalemate can significantly reduce the normal production. Similarly, stalemate can hinder states from resuming normal trade after a war terminates. In both examples, it is demonstrated that at most only a very small portion of $r_i + r_j - g_i - g_j$ will be available to either side when stalemate occurs.

The introduction of stalemate to the game leads to the following revised utility function for state i

$$u_i' = \frac{g_i}{1 + g_i + g_j}(r_i + r_j - g_i - g_j) + \frac{1}{1 + g_i + g_j}\lambda(r_i + r_j - g_i - g_j) \tag{4}$$

Once again, taking the first-order derivative w.r.t. g_i

$$\frac{du_i'}{dg_i} = \frac{-g_i^2 - (2 + 2g_j)g_i + (r_i + r_j - g_j)(1 + g_j - \lambda) - \lambda(1 + g_j)}{(1 + g_i + g_j)^2} \tag{5}$$

Let the first-order derivative be equal to 0 and solve for g_i

$$g_i^* = g_j^* = \frac{(r_i + r_j - 3) + \sqrt{(r_i + r_j - 3)^2 + 16(1 - \lambda)(r_i + r_j) - 16\lambda}}{8} \tag{6}$$

In conclusion, equation (6) shows the optimal level of military spending for each state when stalemate is a possible outcome of war.[4]

Since our goal is to compare military spending between two cases, we calculate the difference between the two equilibrium levels of military spending by subtracting equation (3) from equation (6)

$$\begin{aligned} &\frac{(r_i+r_j-3)+\sqrt{(r_i+r_j-3)^2+16(1-\lambda)(r_i+r_j)-16\lambda}}{8}-\frac{r_i+r_j}{4} \\ =&\frac{\sqrt{(r_i+r_j+3)^2+(4-16\lambda)(r_i+r_j)-16\lambda}-(r_i+r_j+3)}{8} \end{aligned} \tag{7}$$

The result given by equation (7) shows the prediction of the proposed game-theoretical model of stalemate. We summarize this most important equilibrium result in **Proposition 1**.

Proposition 1: *If $\lambda = 0$, the existence of stalemate as a possible outcome of war increases the level of military spending in equilibrium. More generally, when $(4-16\lambda)(r_i+r_j)-16\lambda > 0$, which holds true if λ is a very small number, stalemate increases the level of military spending in equilibrium.*

It is useful to have a discussion of this important equilibrium result. Note that our conclusion that stalemate increases military spending is not driven by states increasing their military expenditures after observing the occurrence of stalemate. Their decisions to allocate resources are made before an outcome of war is realized. That is, states cannot invest additional resources in the military after a war ends in stalemate. Instead, the intuition for our equilibrium result is that states lose a significant portion of $r_i + r_j - g_i - g_j$ in the case of stalemate, and therefore states will try to avoid the outcome of stalemate by reducing the probability of stalemate $\frac{1}{1+g_i+g_j}$. When states increase g_i and g_j, the probability of stalemate

[4]Since λ is a very small number, it implies that $16(1-\lambda)(r_i+r_j)-16\lambda > 0$. As a result, we rule out the other possible case $\frac{(r_i+r_j-3)-\sqrt{(r_i+r_j-3)^2+16(1-\lambda)(r_i+r_j)-16\lambda}}{8}$ as a solution.

decreases. As a result, our conclusion is primarily driven by the proposed interpretation of stalemate.

Illustrative Cases

As demonstrated in the previous discussion of the proposed game-theoretical model, our assumption that only a small portion of $r_i + r_j - g_i - g_j$ will still be available when stalemate occurs is essential to the model prediction stated in **Proposition 1**. Therefore, it is useful to show this important assumption indeed often holds true using real world examples. In what follows this study discusses two short illustrative cases to demonstrate that stalemate destroys normal production and consumption. In addition, we show in these cases that stalemate increases states' levels of military spending as predicted by **Proposition 1**.

The Greek-Turkish rivalry has been extensively investigated in the literature (e.g., Kollias 1996; Kollias and Paleologou 2002; Dunne, Nikolaidou and Smith 2005). Many military confrontations occurred between Greece and Turkey, and a number of these militarized conflicts have turned into stalemate. For instance, one significant case of stalemate took place after the Turkish invasion of Cyprus in 1974, and another important case occurred in the aftermath of the Imia/Kardak crisis in 1996. It has been shown that stalemate has led to substantial economic losses. Again, take the case of stalemate that resulted from the Turkish invasion of Cyprus in 1974. Stalemate has significantly undermined the economy of the Turkish Republic of Northern Cyprus, a sovereign administrative unit that is located in the occupied northern part of Cyprus and declared its independence in 1983. In particular, the tourism industry–which is the main local economic activity–has been severely impacted in this disputed northern part of the island. For example, Altinay and Bowen (2006) show that North Cyprus held only one-third of South Cyprus's GNP per capita and attracted as few as one-eighth of tourists when compared to South Cyprus in 2003. Therefore, stalemate

has disrupted the ordinary business activities and caused enormous economic losses in this contested region. Furthermore, military expenditures in Greece and Turkey have grown rapidly due to stalemate. For example, based on the World Bank data, Greece increased its arms imports by 118% and Turkey by 39% in 1975 following the case of stalemate occurred in 1974.

Our second illustrative case examines the rivalry between Armenia and Azerbaijan. These two neighboring states fought a war between 1992 and 1994 to claim the control of Nagorno-Karabakh–a landlocked region within Azerbaijan inhabited by Armenian population. A ceasefire was signed in May 1994 and the war ended in stalemate. Based on MIDs data, a number of new conflicts occurred between Armenia and Azerbaijan from 1995 to 2001, and again all of these conflicts ended in stalemate. The Nagorno-Karabakh war and the ensuing stalemate have dramatically changed the economic landscape in the war affected areas. Baumann et al. (2015), for example, investigate the impact on the land use. They show that a substantial portion of the land in the conflict zone–more than 60%–was abandoned during the Nagorno-Karabakh war, and only 17% of the abandoned land was re-cultivated after the ceasefire agreement. This example of land use once again shows that stalemate can bring significant economic losses as has been hypothesized. Meanwhile, both Armenia and Azerbaijan have raised their military spending in the aftermath of the war. Based on SIPRI military expenditure data (constant 2011 USD), Armenia's annual military spending on average increased by 3% between 1996 and 2001, with a spike of 27.7% increase in 1997.[5] Likewise, military spending of Azerbaijan on average increased by 11% during the same time period with a peak of 30.5% in 1999.

[5]The military spending data is missing for Armenia in 1995.

Empirical Analysis

Research Design

Based on a game-theoretical model, the previous theory section demonstrates that stalemate induces a higher level of military spending. In this section, we conduct a large-N empirical assessment of this important theoretical prediction. Our goal is to empirically test if stalemate indeed increases military spending after we control for other important explanations from the existing research. Toward this goal, this study chooses to replicate the regression specifications used in an influential study of military spending by Goldsmith (2003). His article shows arguably the most comprehensive empirical investigation of military spending, by including domestic, interstate, and systemic factors from the military spending literature and analyzing all these factors in a unified framework. An additional significant advantage of employing an established analysis and introducing our new variable of stalemate is that we can minimize the variations in results due to different choices of regression specifications by different researchers. Put differently, replicating a well-received published article to a large degree can make our research design sound more objective.

As a result, all the regression variables except for stalemate are taken from Goldsmith (2003), and this study closely follows his article to describe these variables and the regression specifications. The unit of analysis is state-year, and the sample of analysis includes all states from 1886 to 1989. As explained in Goldsmith (2003), his empirical analysis ends in the year of 1989 since the data for several important independent variables are not available after 1989. The dependent variable is a state's level of military spending, constructed as a percentage of GDP. In our theoretical model, the amount of resources available for allocation (r) is fixed, and military spending (g) is competing with other forms of spending (y). Therefore, using GDP to measure the amount of available resources and normalizing military spending

as a percentage are indeed consistent with the theoretical model.[6] The data for military expenditures is taken from the Correlates of War (COW) project (Singer and Small 1993), and the GDP data is from Russett and Oneal (2001). To better approximate linearity, a log transformation is employed for this variable in Goldsmith (2003).

Stalemate is our key independent variable, and it is the only new variable that we introduce. This study relies on the MIDs data coded by Maoz (2005) to construct this variable. The definition of stalemate is given on the page of 180 in Jones, Bremer and Singer (1996):

> A stalemate is defined by the lack of any decisive changes in the pre-dispute status quo and is identified when the outcome does not favor either side in the dispute. Stalemates usually are produced when there was no alteration of the status quo. However, they can occur even if the status quo has changed so long as net balance results in a draw.

In addition to stalemate, MIDs outcomes are coded as victory, yield, compromise, and released (Jones, Bremer and Singer 1996). Among all the incidents of MIDs coded in Maoz (2005), an outcome of stalemate accounts for more than half of the cases. The variable of stalemate is coded one if a state experiences a stalemate outcome in a given year, and zero otherwise. This operationalization does not make any further differentiation among the other MIDs outcomes, and here the underlying rationale is that when compared to stalemate, an agreement is reached among these other outcomes. Put differently, stalemate is the only outcome in which war fails to resolve a dispute, and this distinctive feature of stalemate defines our interpretation of stalemate in the theoretical model.

The other independent variables are *GDP Per Capita, Economic Growth, Regime Type,*

[6]This argument suggests that alternative measures, such as military spending normalized by state population or military spending without any normalization, are inappropriate for the purpose of testing our theoretical model.

Civil War, Interstate War, Extrastate War, Defense Pact, Enduring Rivalry, Major Power, Capability Change in PRIE, Regional Dummies, Systemic Hegemony Index, and *Bipolarity*, all of which are taken from Goldsmith (2003). The first four variables measure domestic factors that can influence military spending. The definitions of GDP Per Capita and Economic Growth are self-explanatory. Regime Type is measured by the Polity2 variable (Jaggers and Gurr 1995), which ranges from -10 (full autocracy) to 10 (full democracy). Civil War is based on the COW Intrastate Wars data. It is coded one if a state is involved in a civil war with 1,000 or more battle deaths, and zero otherwise. The next seven variables are devoted to measuring interstate factors. Similar to Civil War, Interstate War and Extrastate War are taken from the COW project, and adopt 1,000 battle deaths as the threshold. Defense Pact is another dummy variable, equal to one if a state has a defense pact in a given year, and zero otherwise. Enduring Rivalry is based on the list of rivals complied by Wayman (2000). Major Power indicates whether a state is coded as a major power by the COW project. PRIE abbreviates for the Politically Relevant International Environment, and the variable Capability Change in PRIE is taken from Maoz (1996). In addition, Goldsmith (2003) includes a set of regional dummies (i.e., Africa, Asia, Europe, Middle East, North America, and South America). The last two variables capture systemic factors. Systemic Hegemony Index employs the COW Composite Index of National Capability (CINC) scores of the United Kingdom and the United States. Finally, Bipolarity equals to one for the years between 1945 and 1989, and zero otherwise. The summary statistics of all the variables employed in this study are shown in Online Appendix Table A1.

To reiterate, we replicate the regression specifications used in Goldsmith (2003) to empirically test our hypothesis. That being said, we need to make one modification to his research design by dropping the lagged dependent variable from the regression analysis. Goldsmith (2003) employs the lagged dependent variable based on the incremental argument, which

proposes that "budgetary and bureaucratic inertia affect the defense burden by perpetuating existing funding levels, discouraging significant reductions in spending even if threats diminish" (p. 555). However, in a widely cited article, Achen (2000) seriously challenges this incremental argument. He argues that when "the political environment is stable," "fully rational players will misleadingly appear to be merely boundedly rational" and "lagged budgets will falsely appear to be the sole cause of future budgets" (p. 10). Put differently, incrementalist effects are seriously exaggerated, and the lagged dependent variable can destroy the effect of other variables or even reverse the sign of other coefficients.[7] Therefore, we follow Achen's (2000) suggestion by not including the lagged defense budget in our regression analysis.

Empirical Results

In Goldsmith (2003), five different regression specifications are employed to show the robustness of his results. The first regression uses state fixed effects, and regressions 2-5 are all based on panel-corrected standard errors (Beck and Katz 1995) but with different combinations of the independent variables. We follow Goldsmith and run these five regression specifications–named models 1 through 5–in Table 1. In addition, following the original analysis, several independent variables are lagged by one year to reduce the potential endogeneity problem.[8]

[Table 1 about here.]

[7]In his criticism of the use of lagged dependent variables, Achen (2000) shows an important example where the lagged dependent variable has a coefficient close to 1 and a t-value larger than 100. The results of the lagged dependent variable in Goldsmith (2003) show exactly the same pattern: the coefficient is usually more than .9 and the t-value is always larger than 100. This strong similarity demonstrates that the use of lagged defense budget in Goldsmith (2003) falls right under Achen's criticism.

[8]These variables are labeled with subscript $t-1$. In other words, the variables without any subscript are concurrent with the dependent variable.

As clearly demonstrated in Table 1, across all the five different model specifications, stalemate–our variable of interest–uniformly increases states' military spending levels. The size of coefficient ranges from around .1 to nearly .4, and this variable is statistically significant at the 1% level for all the cases. As a result, our theoretical prediction that stalemate induces a higher level of military spending is strongly supported by the data, after having controlled for the important explanations from the existing research.

It is worth to take a look at the other independent variables in Table 1. First, between model 1 and the other four models–in particular model 4 that uses the same variables as model 1, two variables–GDP Per Capita and Defense Pact–demonstrate the opposite predictions. The existing research suggests that the effect of GDP Per Capita or Defense Pact on military spending can go either direction. One explanation of the observed discrepancy in Table 1 is that these two variables are highly correlated with the estimated state-specific effects in model 1.[9] Most of the findings in Table 1 are intuitive. Democracies are less likely to spend on the military, while states that are involved in some form of war (i.e., civil, interstate, or extrastate war) are likely to spend more. Furthermore, states that are major power or involved in rivalry tend to have a larger defense budget. Finally, states are likely to have a higher level of military spending during the Cold War, whereas hegemonic dominance reduces other states' defense spending. As a final note, the regional dummies suggest that compared to the states in Europe and Middle East, the states in Africa, Asia, North America, and South America on average spend less on national defense.

In addition, as a robustness test, we add a control for ongoing MIDs and rerun the five regression models in Table 1. This new variable *MIDs* is a dummy variable that equals one if a MID is ongoing for a state in a given year, and zero otherwise. Although Goldsmith (2003)

[9]Many variables in Goldsmith (2003), including Defense Pact, fail to show statistical significance due to his inclusion of the lagged dependent variable.

already includes a control for interstate wars, our stalemate variable is constructed based on militarized interstate disputes, and there is only a weak-to-moderate positive correlation between interstate wars and MIDs (i.e., the correlation coefficient is .3). The new regression results are shown in Online Appendix Table A2. In summary, the findings of stalemate are unchanged: stalemate causes a higher level of military spending after having controlled for the effect of ongoing MIDs, and the sizes of coefficients remain essentially the same when compared to Table 1. Not surprisingly, the new variable MIDs demonstrates a positive effect on military spending. Furthermore, the remaining independent variables show largely the same results as their counterparts in Table 1.

The analysis in Table 1 and Table A2 has demonstrated that an occurrence of stalemate increases states' military spending. However, a scrutiny of our theoretical model and empirical analysis suggests that a discrepancy might exist. In the proposed game-theoretical model it is assumed that states allocate the resources before a war outcome is realized, while in the empirical test this decision is made after observing a war outcome. First, we need to emphasize that any game is an abstraction of the real world, and as a result it is common to observe some form of gap between a theory and an empirical test when conducting empirical tests of theoretical models. In our game, whether stalemate is a possible outcome of war is formed in expectation, and it is understood that expectation cannot be *directly* operationalized. That being said, we propose an approach to *indirectly* operationalize this expectation. We argue that since rival states interact with each other continuously, a past stalemate outcome can inform rival states to realistically form their expectation of a future war outcome. Therefore, we perform an additional analysis that examines how stalemate affects military spending among rival states only. A further advantage of the proposed analysis is that militarized interstate disputes among rival states are generally significant enough to influence states' decisions on the defense budget.

To empirically investigate the effect of stalemate among rival states, we propose two different methods to show the robustness of our results. The first approach still includes all states in the sample of analysis, but it only counts stalemate occurred among rival states. That is, the new stalemate variable–Stalemate, rivalry–is coded one if a state experiences a stalemate outcome from a militarized interstate dispute with its rival in a given year, and zero otherwise. Put differently, if a stalemate outcome is from a MID *not* with its rival, this new stalemate variable will be coded as zero. The other approach adopts the same stalemate variable (i.e., Stalemate, rivalry), but it further restricts the sample of analysis to rival states only. Since non-rival states are excluded from the sample, the dummy variable Enduring Rivalry is dropped from the analysis based on the second approach. The data to identify rivalry is taken from Gibler, Rider and Hutchison (2005). The regressions results of these two new analyses are presented in Table 2 and Table 3, respectively.

[Table 2 about here.]

[Table 3 about here.]

The results from Table 2 and Table 3 clearly demonstrate that among rival states, stalemate increases states' military spending. All the coefficients are positive and statistically significant at the 1% level. Furthermore, as expected, the sizes of these coefficients are larger than their counterparts shown in Table 1. In short, our regression analyses from all the tables have lent strong empirical support to the prediction of our theoretical model that stalemate increases military spending. For the other independent variables, these new tables (in particular Table 2) show very similar results as Table 1. There are a few exceptions. For example, in Table 3, Economic Growth gains statistical significance. One explanation of this negative effect is proposed by the Keynesian model. When economic decline occurs, the

government reacts by expanding its budget, including the defense budget (Russett 1990).[10]

As a final note, we address the concern that duration instead of stalemate induces a higher level of military spending. One argument proposes a positive relationship between MIDs duration and outcome of stalemate, arguing that MIDs that end in stalemate tend to last longer and as a result states will spend more on the military. However, an investigation of MIDs data does not support this conclusion. Based on Maoz's (2005) MIDs data that covers the years from 1816 to 2001, we calculate the correlation between MID duration and outcome for each MID. Here MID duration is computed as the difference between its start date and end date, and MID outcome denotes whether it ends in stalemate. The resulting correlation coefficient indicates a weak negative relationship between MIDs duration and outcome of stalemate, with a coefficient equal to $-.116$.[11] We do not conduct a regression analysis to assess this argument since it is ill-suited in this case. Contrary to the correlation analysis that is performed at the MID level, the regression analysis in this study uses state-year as the unit of analysis. Since the dependent variable measures a state's *annual* defense budget instead of its *cumulative* budget for each MID, it suggests that it would be a mismatch between the dependent variable and a measure of duration at the MID level. Therefore, such a regression analysis would be inappropriate.[12] Nevertheless, our correlation analysis provides some useful evidence to show that a strong positive relationship between MIDs duration and outcome of stalemate is not warranted.

[10]Another different finding is from Extrastate War, which shows a negative coefficient in two regressions in Table 3. This result, however, is somehow puzzling, and we do not have a satisfactory explanation.

[11]When MID duration is calculated by the number of years, the resulting correlation coefficient remains essentially the same, which is equal to $-.104$.

[12]Even if we are willing to change our unit of analysis to the MID level to accommodate the measure of duration, it would be unrealistic to construct a dependent variable that measures a cumulative budget for each MID.

Conclusion

In this study, we propose a game-theoretical model and conduct a number of empirical tests to demonstrate that stalemate induces a higher level of military spending. In the game, when stalemate becomes a feasible outcome of war, the level of military spending rises in equilibrium. This result is driven by our characterization of stalemate that a substantial loss of production and consumption occurs in stalemate. Due to this perceived loss, states will try to increase military spending to reduce the probability of stalemate. In addition, we empirically test if stalemate increases military spending after having controlled for the existing explanations. This study replicates the regression specifications used in an influential study by Goldsmith (2003), which shows arguably the most comprehensive empirical investigation of military spending in the literature. Based on a number of regressions that include all states from 1886 to 1989, it demonstrates that stalemate increases states' spending on the military.

The proposed explanation of military spending makes a significant contribution to the literature on military spending. Furthermore, it makes an important contribution to the rationalist explanations for war. In anticipation of stalemate, states are expected to increase military spending, which suggests that states will fight harder and war will be more devastating. This result has many useful implications. For example, it provides a different explanation of why wars between rival states are much more costly. Finally, note that the proposed explanation is fundamentally different than the existing argument that an occurrence of war or conflict increases states' military spending. Here we argue that a particular outcome of war, instead of war itself, increases military spending.

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Table 1: Stalemate and Military Spending

	Model 1	Model 2	Model 3	Model 4	Model 5
Stalemate$_{(t-1)}$	.092***	.258***	.280***	.317***	.375***
	(.025)	(.041)	(.043)	(.051)	(.045)
GDP per capita$_{(t-1)}$	−.308***	.007	−.006	.249***	.199***
	(.045)	(.036)	(.036)	(.038)	(.033)
Economic growth$_{(t-1)}$	−.091	−.184	−.229	−.252	−.149
	(.113)	(.187)	(.189)	(.214)	(.181)
Regime type$_{(t-1)}$	−.014***	−.019***	−.019***	−.030***	−.027***
	(.002)	(.003)	(.003)	(.004)	(.003)
Civil war	.263***	.224***		.141***	.267***
	(.047)	(.045)		(.051)	(.052)
Interstate war	.521***	.523***		.496***	.751***
	(.050)	(.067)		(.075)	(.082)
Extrastate war	.201***	.044		.268***	−.007
	(.059)	(.067)		(.060)	(.073)
Defense pact$_{(t-1)}$	−.087***	.017	.009	.254***	
	(.033)	(.034)	(.034)	(.040)	
Enduring rivalry$_{(t-1)}$	.388***	.301***	.351***	.365***	.212***
	(.045)	(.033)	(.033)	(.033)	(.033)
Major power	1.083***	.609***	.633***	.311***	.563***
	(.085)	(.080)	(.082)	(.090)	(.072)
Capability change in PRIE$_{(t-1)}$	−.153	.175	.153	.660***	
	(.172)	(.159)	(.156)	(.196)	
Africa		−1.048***	−1.055***		−.604***
		(.058)	(.060)		(.059)
Asia		−.957***	−.917***		−.642***
		(.049)	(.049)		(.045)
Middle East		.031	.059		.209***
		(.042)	(.045)		(.044)
North America		−1.184***	−1.167***		−1.025***
		(.048)	(.046)		(.049)
South America		−.736***	−.744***		−.598***
		(.053)	(.054)		(.054)
Systemic hegemony index$_{(t-1)}$	−2.518***	−.829*	−.995**	.339	
	(.389)	(.503)	(.496)	(.579)	
Bipolarity	1.356***	.746***	.763***	.251***	
	(.090)	(.076)	(.075)	(.069)	
Constant	−2.481***	−4.407***	−4.275***	−7.067***	−5.601***
	(.358)	(.293)	(.294)	(.271)	(.256)
State fixed effects	yes				
Panel-corrected standard errors		yes	yes	yes	yes
Number of observations	4,426	4,426	4,426	4,426	4,525

Notes: Standard errors are in parentheses. $^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$. Europe is omitted as the reference group.

Table 2: Stalemate and Military Spending, Stalemate among Rival States Only

	Model 1	Model 2	Model 3	Model 4	Model 5
Stalemate, rivalry$_{(t-1)}$	.161***	.313***	.345***	.381***	.399***
	(.032)	(.051)	(.052)	(.061)	(.055)
GDP per capita$_{(t-1)}$	−.307***	.011	−.0009	.256***	.210***
	(.045)	(.036)	(.036)	(.039)	(.034)
Economic growth$_{(t-1)}$	−.088	−.176	−.222	−.240	−.130
	(.113)	(.188)	(.190)	(.215)	(.183)
Regime type$_{(t-1)}$	−.014***	−.019***	−.019***	−.030***	−.027***
	(.002)	(.003)	(.003)	(.004)	(.003)
Civil war	.267***	.239***		.160***	.291***
	(.047)	(.046)		(.051)	(.053)
Interstate war	.512***	.507***		.478***	.752***
	(.050)	(.066)		(.075)	(.083)
Extrastate war	.196***	.059		.287***	.022
	(.059)	(.067)		(.060)	(.073)
Defense pact$_{(t-1)}$	−.094***	.009	−.00005	.244***	
	(.033)	(.034)	(.034)	(.041)	
Enduring rivalry$_{(t-1)}$	.374***	.283***	.328***	.346***	.197***
	(.045)	(.035)	(.035)	(.036)	(.035)
Major power	1.053***	.606***	.632***	.304***	.597***
	(.085)	(.079)	(.081)	(.089)	(.073)
Capability change in PRIE$_{(t-1)}$	−.150	.276*	.264*	.792***	
	(.171)	(.158)	(.155)	(.190)	
Africa		−1.048***	−1.056***		−.596***
		(.057)	(.059)		(.059)
Asia		−.952***	−.913***		−.605***
		(.049)	(.049)		(.044)
Middle East		.040	.067		.230***
		(.043)	(.046)		(.046)
North America		−1.184***	−1.167***		−1.030***
		(.048)	(.046)		(.050)
South America		−.736***	−.743***		−.602***
		(.054)	(.055)		(.055)
Systemic hegemony index$_{(t-1)}$	−2.491***	−.811	−.975**	.350	
	(.389)	(.506)	(.497)	(.582)	
Bipolarity	1.361***	.776***	.796***	.291***	
	(.090)	(.075)	(.074)	(.067)	
Constant	−2.490***	−4.501***	−4.373***	−7.190***	−5.666***
	(.357)	(.300)	(.301)	(.282)	(.263)
State fixed effects	yes				
Panel-corrected standard errors		yes	yes	yes	yes
Number of observations	4,426	4,426	4,426	4,426	4,525

Notes: Standard errors are in parentheses. $^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$. Europe is omitted as the reference group.

Table 3: Stalemate and Military Spending, Subsample for Rival States

	Model 1	Model 2	Model 3	Model 4	Model 5
Stalemate, rivalry$_{(t-1)}$	.184***	.335***	.379***	.444***	.347***
	(.033)	(.048)	(.052)	(.062)	(.049)
GDP per capita$_{(t-1)}$	−.163**	.040	.018	.190***	.237***
	(.063)	(.042)	(.043)	(.039)	(.029)
Economic growth$_{(t-1)}$	−.443***	−.441**	−.488**	−.252	−.363*
	(.164)	(.199)	(.202)	(.236)	(.210)
Regime type$_{(t-1)}$	−.015***	.00008	−.0002	−.025***	−.003
	(.003)	(.003)	(.003)	(.004)	(.003)
Civil war	.326***	.279***		.262***	.263***
	(.059)	(.070)		(.075)	(.073)
Interstate war	.552***	.606***		.643***	.828***
	(.054)	(.078)		(.086)	(.090)
Extrastate war	.041	−.285***		.010	−.332***
	(.075)	(.071)		(.063)	(.075)
Defense pact$_{(t-1)}$	−.133***	−.065	−.072	.134**	
	(.052)	(.044)	(.046)	(.060)	
Major power	1.421***	.868***	.897***	.589***	.725***
	(.117)	(.085)	(.085)	(.095)	(.082)
Capability change in PRIE$_{(t-1)}$	−.483*	.181	.161	.549***	
	(.249)	(.197)	(.202)	(.183)	
Africa		−.515***	−.480***		−.078
		(.090)	(.095)		(.078)
Asia		−.708***	−.566***		−.404***
		(.068)	(.066)		(.067)
Middle East		.464***	.560***		.570***
		(.067)	(.065)		(.057)
North America		−1.113***	−1.038***		−.996***
		(.081)	(.086)		(.072)
South America		−.499***	−.445***		−.478***
		(.060)	(.060)		(.050)
Systemic hegemony index$_{(t-1)}$	−1.877***	−.912	−1.313**	−.392	
	(.548)	(.625)	(.623)	(.685)	
Bipolarity	1.004***	.639***	.664***	.393***	
	(.129)	(.091)	(.092)	(.089)	
Constant	−3.176***	−4.633***	−4.424***	−6.350***	−5.916***
	(.487)	(.360)	(.373)	(.289)	(.228)
State fixed effects	yes				
Panel-corrected standard errors		yes	yes	yes	yes
Number of observations	2,238	2,238	2,238	2,238	2,374

Notes: Standard errors are in parentheses. $^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$. Europe is omitted as the reference group.