
Indicators of Deterrence Success

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PAPER 4

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Abstract: My paper seeks to determine the factors explaining the likelihood of successful deterrence. I form a set of hypothesis based on four game-theoretical models that incorporate factors of resolve and soft power. Based on these models, I hypothesize that challenger resolve will have a negative effect on deterrence success and that defending state resolve and the use of soft power will have no effect. The results of binary logistic regression models indicate that there is an overall negative relationship between challenger resolve and deterrence success, a potentially positive relationship between defender resolve and deterrence success, and no statistically significant relationship between soft power and deterrence success.

Indicators of Deterrence Success

The Development of Deterrence

Influenced by the threat of nuclear annihilation during the Cold War, mid-twentieth century strategists increasingly sought to avoid conflicts rather than win victories. This espoused deterrence, a strategy based on avoiding the initiation of conflict. Deterrence was heavily influenced by the presence of nuclear weapons and by the bilateral relationship between the former Soviet Union and the United States. On the most basic level, deterrence addresses situations in which one state (the challenger) threatens to commit an action, and another state (the defender) seeks to deter the challenger from committing that action. In international relations, defenders typically hold positions of power and therefore benefit from a continuation of the status quo. As such, they seek to deter actions that would disrupt the status quo by maximizing the costs of action, maximizing the benefits of restraint, minimizing the benefits of action, and minimizing the costs of restraint (Kilgour and Zagare 2000). They can attempt to accomplish this by issuing threats or making promises. Threats generally refer to threats of military intervention or of harsh political and economic sanctions. Promises include peaceful and friendly tools such as state aid, diplomatic engagement, and economic involvement. Different approaches to deterrence use different combinations of threats and promises.

Classical deterrence is one approach. Many thinkers, including Thomas Schelling, Herman Kan, and William Kaufmann, contributed to classical deterrence theory. The basic principle behind classical deterrence theory is that of a balance of power. If power is equally distributed across actors, no single actor will be able to upset the status quo (Zagare 1996). Classical deterrence argues that a balance of power achieved through a balance of threats leads to successful deterrence. Each side makes it clear to the other that it will impose unacceptable costs

on its adversary in the case of aggression. In Cold War terms, the balance of power referred to the nuclear parity relationship between the U.S.S.R. and U.S. (Schelling 1960). The United States and the Soviet Union had each developed the ability to challenge the other with devastating nuclear attacks. Accordingly, each state threatened that any attack against itself or its allies would be returned in kind. Classical deterrence theory holds that this mutual threat led to a high level of stability and deterred each side from using nuclear weapons. Whether or not the lack of open conflict between the superpowers during the Cold War can be attributed by deterrence, the situation which mutually assured destruction sought to address no longer existed. With the fall of the U.S.S.R and the end of the Cold War, the structure of global power became more complex. Deterrence theorists could no longer think primarily of the Warsaw Pact and NATO, but had to take into account a vast number of individual actors with varied alliances. New deterrence challenges had arisen; challenges with an asymmetry of power and an asymmetry of stakes that do not fit into the framework of mutually assured destruction. A new approach to deterrence was required to address these new challenges.

In an effort to provide such an approach, D. Marc Kilgour and Frank C. Zagare developed Perfect Deterrence Theory. Perfect Deterrence shifts the focus of deterrence to include non-nuclear disputes as well as nuclear deterrence, ranging from low-stakes territorial disputes to all-out war. In such situations, the initiation of an undesired action would not necessarily lead to uncontrolled escalation. Moreover, the bilateral structure of deterrence theory is adjusted to include a greater number of actors of varying degrees of commitment and power, and a greater emphasis is placed on the credibility of the defender's threats and the resolve of the challenger. The dimension of promises is also introduced, in order to complement threats in

deterrence. However, promises are not a focal point. They remain on the periphery, and as such do not have a great impact on Perfect Deterrence Theory.

In part to emphasize the dimension of promises in deterrence, Joseph Nye put forward the idea of smart power. Smart power focuses on the use of soft power promises to complement hard power threats. As defined by the Center for Strategic International Studies, soft power refers to the non-confrontational tools that states can use to deter undesired actions from other states. It includes alliances, global development, public diplomacy, economic integration, and technology and innovation (Armitage and Nye 2007). Instruments of soft power can be used in order to make the initiation of undesired action less desirable than restraint by shifting the benefits and costs associated with restraint and initiation.

Soft power in is not a new concept by any means. For centuries, states have used trade and diplomacy to assert their influence over other states. However, it has only recently been applied to deterrence. As such, the effects of soft power on deterrence success have not yet been tested. If soft power can effectively play a part in deterrence by denying benefits for the initiation of undesired actions or providing alternative benefits for restraint, smart power theory can be integrated into existing deterrence theory in order to provide better deterrence strategies which lead to greater deterrence success in a large variety of situations.

The goal of this paper is to determine what factors influence the success of deterrence and what specific effects those factors have on deterrence success. I ask: *What accounts for variance in the likelihood of successful deterrence?*

There are 74 cases in my model. The cases span a variety of different situations. The dependent variable, deterrence success, is tested on the variable of interest and other independent variables using a binary logistic regression model. In situations which end either in non-

aggression or concession of the challenger, deterrence is successful. Deterrence success is derived from historical events. Resolve will be measured through two variables: military personnel (ratio of military personnel to total population) and battlefield deaths (ratio of battlefield deaths suffered to total population.) Soft power will be measured through another set of variables: trade and diplomacy. Four game theoretic models, each tailored to a different combination of challenger and defender resolve, are used to predict the effects of resolve and soft power on deterrence success. Resolve ranges from soft to hard. Players with hard resolve tend to be less averse to conflict and more averse to defeat (in terms of military personnel and battlefield deaths, harder resolve equates to higher ratios.) Players with soft resolve tend to be less averse to defeat and more averse to conflict. Based on the outcome predictions of the games, I predict that challenger military personnel and challenger battlefield deaths will be the variables of interest with a negative effect on deterrence success. I test this prediction with a binary logistic regression model including the following variables: challenger military personnel, challenger battlefield deaths, defender military personnel, defender battlefield deaths, and measures of soft power in the form levels of bilateral trade and the presence or absence of diplomatic engagement. I predict that: *Challenger resolve (challenger military personnel and challenger battlefield deaths) will have a negative effect on deterrence success, trade and diplomacy will have no effect on deterrence success, and defender resolve (defender military personnel and defender battlefield deaths) will have no effect on deterrence success.*

Shifting Approaches to Deterrence

As power structures have shifted over time, the types of situations that deterrence has been required to address have changed greatly. In response to these changes, approaches to deterrence have changed as well. Classical deterrence was the first approach, including both

structural deterrence and decision-theoretic deterrence. Perfect deterrence followed, with smart power being the most recent approach.

Classical deterrence was developed during the Cold War and as such was heavily influenced by the bilateral nuclear power relationship between the United States and the Soviet Union. Classical deterrence was developed to address situations where the challenger and the defender mutually threaten to use nuclear weapons (Kilgour and Zagare 1993). The defender is limited in its deterrence options in this situation because the perceived benefit of action for the challenger comes from the effects created by the use of nuclear weapons. Because action and benefit are inseparable in this situation, defenders cannot effectively minimize the challenger's benefits of action or costs of restraint. Moreover, classical deterrence fails to examine the role of soft power in deterrence, removing the potential to maximize the benefits of restraint. Therefore, the defender can only seek to maximize the costs of action.

There are two categories of classical deterrence, each of which uses a different approach. The first category is structural deterrence, which relies on a balance of power in the form of threats and on high costs for action (Kilgour and Zagare 2000). Under structural deterrence, relationships are stable when there is parity between challenger and defender and the cost of action is high for both (Zagare 1996). Lower costs for actions and non-parity relationships lead to instability (Zagare 1996). Perceptions of threat credibility are derived from the distribution of power and from the high level of stakes in a situation. If each state is equivalently powerful and the costs of action would be high for each, threats are perceived to be credible. Therefore, a balance of power translates into a balance of credible threats (Zagare 1996).

The prototypical model of structural deterrence is a conflict situation between two nuclear powers. Both states threaten to use nuclear weapons, and both threaten a nuclear

response in the event of a nuclear attack. Due to the destructive capabilities of nuclear weapons, each state effectively holds the other's population hostage. Threats in such a situation are credible. This concept is referred to as mutually assured destruction (Schelling 1960).

Structural deterrence explains the mechanisms that lead to successful deterrence in some situations but does not provide general tools that defenders can use to deter challengers. It does not examine the possibility of imperfect choices or irrational actors, but instead assumes that parties act in their own best interests and make choices accordingly. (Zagare 1990). In reality, actors do not always choose the best, most rational option. In doing so, they make non-rational choices. Structural deterrence struggles to explain deterrence situations involving actors who make irrational choices. This said, even with rational actors and perfect decision-making, the mechanisms of structural deterrence suggest that it is only applicable to situations in which there is both parity and a high cost for action.

Structural deterrence is designed to examine situations where the states in question have unequal levels of power, or where the cost of action is relatively low (Karnad 2005). For example, structural deterrence theory is poorly suited to address situations in which the cost of action is lower because nuclear weapons are not involved (Karnad 2005). With lower costs, it is not unthinkable for an action to be committed, and threats are not as credible as in mutually assured destruction. Structural deterrence also is a poor fit in situations of asymmetric deterrence (Kilgour and Zagare 1993). In such situations, only one side is considering an attack and the other is attempting to deter that attack.

Decision-theoretic deterrence is the second category of classical deterrence. This approach was developed to address the existence of irrational actors and the possibility of imperfect choices (Zagare 1996). Decision-theoretic deterrence attempts to account for these

issues by focusing on outcomes, preferences, credibility, and choices (Kilgour and Zagare 1991). Outcomes refer to the potential end-scenarios for each situation. Both the defender and the challenger have an ordered set of outcome preferences. Credibility is largely derived from rational preferences in decision-theoretic deterrence (Kilgour and Zagare 1991). That is, states are unlikely to carry out threats if they would not benefit from doing so. In decision-theoretic deterrence, stability stems from the perceived credibility of the defender's threats, and the ways that those threats can shift challengers' decision-making based on their outcome preferences (Kilgour and Zagare 1993). In order to avoid miscommunication, theorists emphasize providing clear and credible threats. To plan for the other source of uncertainty, irrationality, it is important to understand the adversary's preferences, because challenger actions that seem irrational within a 'normal' belief system and may be perfectly rational within the challenger's own set of preferences. For instance, dictatorships may be willing to accept civilian casualties at much higher levels than democracies.

The classic decision-theoretic deterrence situation involves a conflict between two nuclear powers in which at least one state does not always act in its best interests. In such a situation, miscalculations or seemingly non-rational decisions are assumed to be possibilities. When threatened, a state may respond in a manner that seems to go against its interests. In some situations, actions that seem irrational even within a state's set of preferences may have unseen consequences and actually be rational calculations intended to achieve hidden goals. It is the decision-theoretic deterrence theorist's job to develop a way to predict these unexpected responses. Still, despite having a more nuanced approach to deterrence, decision-theoretic deterrence theory still has difficulty addressing situations that lack either a parity relationship between major powers or the threat of nuclear conflict (Geller 1990).

In the post-Cold War era, the vast majority of deterrence situations involve neither parity nor nuclear threats. Like structural deterrence, decision-theoretic deterrence is in effect tailored towards one unique type of deterrence situation. It focuses so heavily on the relationship between the United States and the Soviet Union that the collapse of the Soviet Union renders it moot (Zagare 1996). The collapse led scholars to develop a new approach to deterrence that could be applied to a much wider variety of situations.

The structure of the world changed abruptly after the collapse of the U.S.S.R. and the dissolution of the Warsaw Pact. Deterrence could no longer focus on the bilateral relationship between the U.S.S.R. and the U.S., but instead had to address a variety of situations. In order to maintain deterrence's effectiveness, theorists D. Marc Kilgour and Frank C. Zagare formulate a model for deterrence in the post-Cold War world. Rather than shoehorning all situations into a model developed for nuclear deterrence, Perfect Deterrence Theory models a wide variety of possible situations. The key factors are threat capabilities, each player's evaluation of the status quo, and the interaction of threat credibility (Kilgour and Zagare 2000). Perfect Deterrence allows defenders to use promises as well as threats. As such, it is able to address the situations which confound the earlier models.

The capability to carry out a threat is the single most important factor in Perfect Deterrence (Kilgour and Zagare 2000). Other factors, including the credibility of threats and evaluations of the status quo, are also important. When the challenger state's threat is not credible, deterrence will be successful regardless of capability. Evaluations of the status quo can be changed with the use of promises and soft power. For instance, a defender can engage a challenger economically or politically in order to both minimize the benefits of action and maximize the benefits of restraint by providing benefits which hinge upon the continuance of the

status quo. If a challenger is economically or politically dependent on a defender for diplomatic support or bilateral trade, that challenger is unlikely to risk losing those benefits by challenging the defender. The inclusion of promises strengthens Perfect Deterrence Theory.

Structural deterrence and decision-theoretic deterrence are both useful in addressing high stakes conflicts between nuclear powers, and should not be ignored in such cases. However, Perfect Deterrence Theory applies to a wider variety of deterrence challenges, ranging from conventional war to simple non-military trade disputes (Quackenbush 2010). Besides its applicability to a wider variety of situations, the model is also attractive because of its robustness. Through its shared emphasis on threat capabilities, perceptions of resolve, and evaluations of the status quo, Perfect Deterrence takes into account a larger information set than previous models and allows defenders access to more deterrence mechanisms. These changes positively affect its predictive power, as when tested in a variety of deterrence situations, Perfect Deterrence Theory is supported by a strong empirical record (Quackenbush 2010). Quackenbush applied Kilgour and Zagare's Perfect Deterrence methodology to a series of deterrence situations. Kilgour and Zagare's outcome predictions were largely accurate when compared to the actual outcomes of the situations.

This record could be further strengthened if the dimension of promises was emphasized. Joseph Nye and Richard Armitage are key figures in the development of a theory which emphasizes these promises, smart power. Smart power theory advocates the balanced use of soft power (including non-confrontational tools including diplomacy, trade, investment, *etc.*) and traditional hard power to further the United States' goals and increase both its global power and its level of esteem in the international community (Armitage and Nye 2007). Smart power's basic premise is that the United States has relied too heavily on hard power in the past and would

benefit greatly from building connections and alliances throughout the world with tools of soft power (Armitage and Nye 2007). The use of smart power can benefit the U.S. on two levels. First, in many instances it can be more cost effective to address upcoming challengers by channeling resources into the development of new political and economic relationships than to flex military power. Beyond initial costs, there might also be a greater return on investment. Second, the use of soft power is often perceived more positively in the international community than the use of hard power. In the current international climate, the U.S. and defenders in general benefit greatly from a more positive image.

In order to provide defenders with an opportunity to realize the potential benefits of soft power in conjunction with hard power, I propose integrating smart power theory and Perfect Deterrence theory. When used to shape deterrence strategies, smart power will expand the role of soft power, theoretically strengthening the benefit-shifting mechanisms previously mentioned. In order to accomplish this integration, I will take the basic framework of Perfect Deterrence and emphasize role of soft power. I will examine the effects that the application of soft power has on deterrence success and determine whether or not soft power can effectively complement threats in deterrence. I will also examine the effects of other variables on deterrence success.

A Hypothesis on Soft Power Deterrence

I use game theory to examine the effects of the use of soft power on deterrence success. Game theory explains individual decisions in strategic situations. It formalizes social structures—including the set of choices available, the characteristics of players, and other factors—and examines the effects of these structural factors on decision making (Morrow 1994). The games used in this project are designed to explain situations of asymmetric deterrence where

there are two players: a challenger that has threatened to commit an action and a defender that seeks to deter the challenger from committing that action.

The general structure of the game used in this paper is shown in Figure 1. At the first choice node, the defender chooses to use soft power (sp), make a promise (p), threaten (t), or concede (c). The use of soft power signals a weakening of resolve, while making a promise signals a lesser weakening. Threatening signals a hardening of resolve, while concession ends the game in deterrence failure. At the second choice node, the challenger chooses to either aggress (a) or not aggress (na). Aggression signals a hardening of resolve, while non-aggression ends the game in deterrence success. At the third choice node, the defender's available options will vary based on past actions. All possible choices include promising, threatening, initiating action, and conceding. Promises may only be made if the weakest option, soft power, was used at the first choice node. Threats may not be made twice, and as such are only available to players that did not threaten at the first node. Conversely, the initiation of action (war or conflict) is only available after a threat has been made. Concession is always available. A promise is considered a weak action. Threats signal a hardening of resolve. Both the initiation of action and concession end the game in deterrence failure. At the fourth choice node, the challenger can choose to aggress (a), initiate action (i), or concede (c). Challenger aggression signals a hardening of resolve, and continues the game. The initiation of action ends the game in deterrence failure. Concession ends the game in deterrence success. At the fifth node, the defender can choose to either threaten, initiate action, or concede. Available options will differ according to the same rules mentioned regarding node three. Making a threat signals a hardening of resolve and continues the game. Both initiating action and conceding end the game in deterrence failure. At the final node (only available in one tree of the game), the challenger can

either initiate action or concede. If the challenger initiates action, deterrence has failed. If the challenger concedes, deterrence has succeeded.

In order to accurately reflect differing characteristics, players will be divided by type: hard resolve and soft resolve. Players with hard resolve are less averse to the initiation of action than players with soft resolve. Players with soft resolve are less averse to their own concession than players with hard resolve. Resolve influences players' evaluations of the payoff for each outcome. The outcome preferences for each player type at each terminal node are included in Figures 2-5. Each type of player has been assigned different payoffs for each outcome in agreement with their preferences. At each of the twenty-one possible terminal nodes, hard and soft challengers and defenders realize different payoffs. Each type of defender is pitted against each type of challenger, creating a total of four games. The analysis of the games is detailed below.

The hard challenger-hard defender game is shown in Figure 2. It models conflict between a challenger of hard resolve and a defender of hard resolve. In this game, the challenger's outcome preferences are ranked in the following order: $cd > i > na > cc$. Defender outcome preferences are ordered as follows: $na > cc > i > cd$. In situations with a hard defender and a hard challenger, the defender will choose to threaten. In response, the challenger will choose to address. The defender will then choose to initiate action. Thus, the equilibrium outcome is the initiation of action by the defender and deterrence failure.

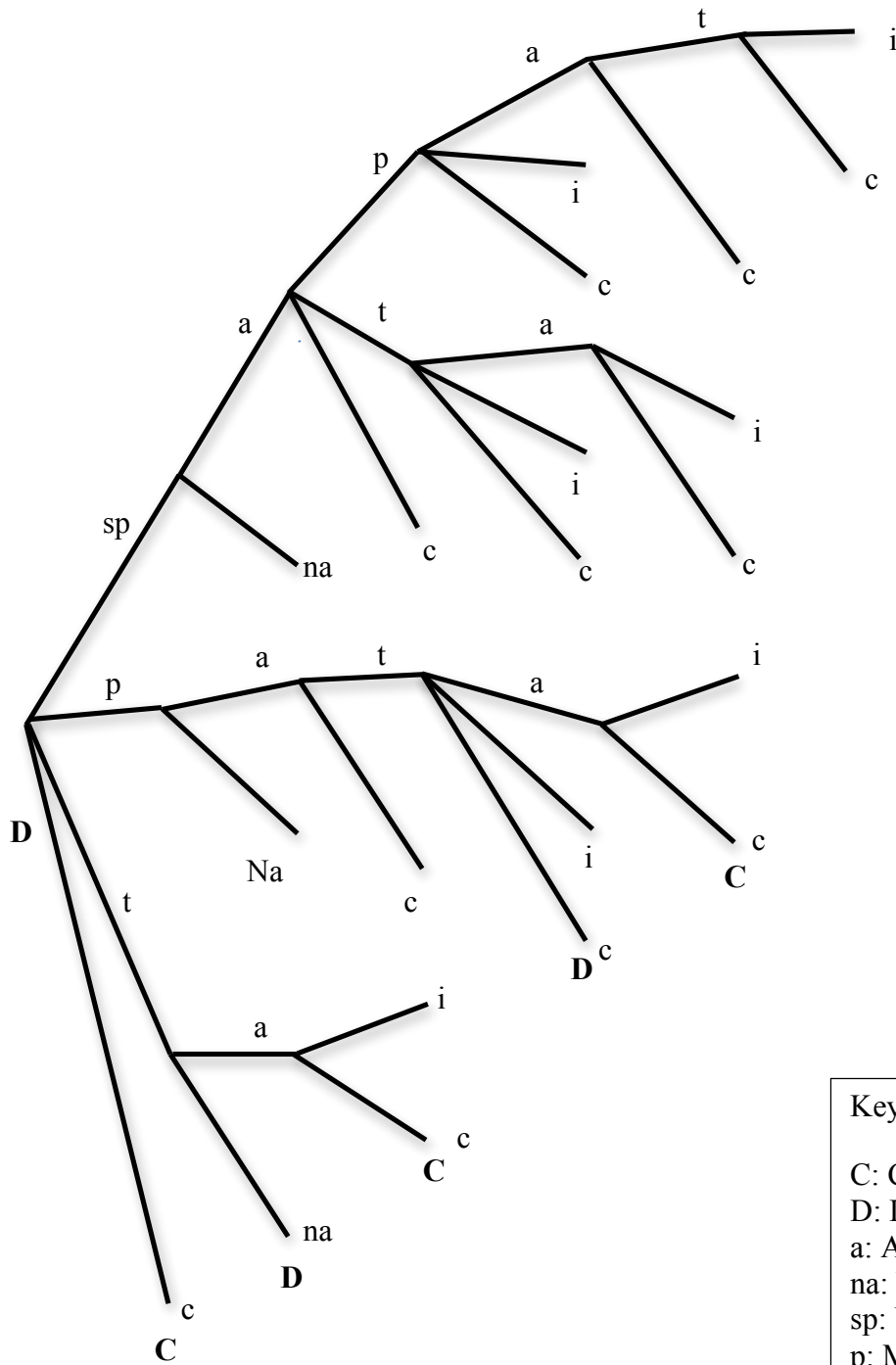
The soft challenger-soft defender game is shown in Figure 3. It models conflict between a soft challenger and a soft defender. The challenger's outcome preferences are ordered as follows: $cd > na > cc > i$. Preferences for the defender are $na > ct > cc > i$. In situations with a soft defender and a soft challenger, the defender will choose to use soft power, and the

challenger will choose not to aggress. Thus, the equilibrium outcome is non-aggression by the challenger and deterrence success.

The hard challenger-soft defender game is shown in Figure 4. It models conflict between a hard challenger and a soft defender. As in the first game, the challenger holds the following preferences: $cd > i > na > cc$. The defender holds the same preferences as in game two: $na > ct > cc > i$. In situations with a soft defender and a hard challenger, the defender will choose non-aggression. Thus, the equilibrium outcome is immediate non-aggression by the defender and deterrence failure.

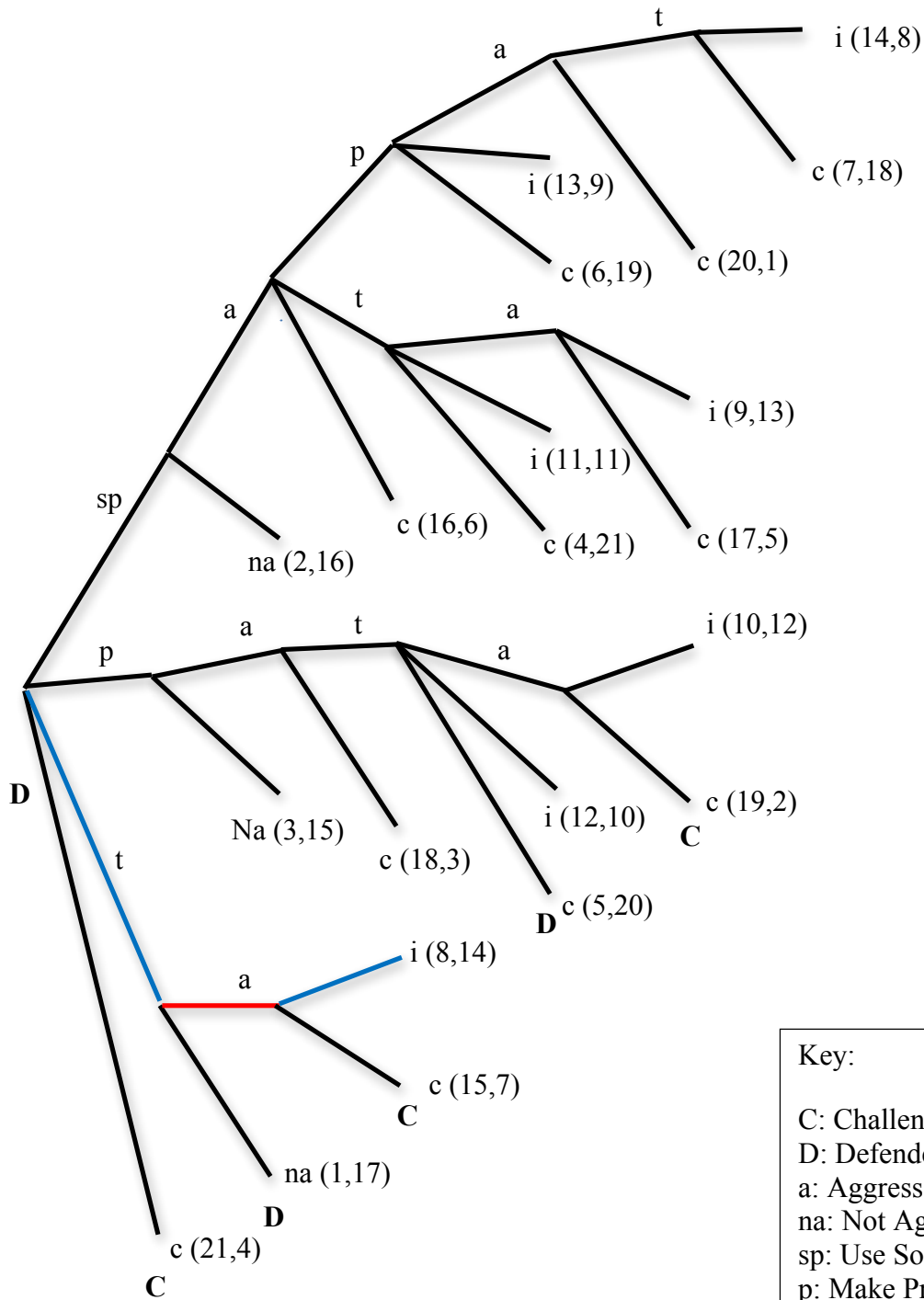
The soft challenger-hard defender game is shown in Figure 5. It models conflict between a soft challenger and a hard defender. The challenger's preferences remain the same as in game two. Defender preferences are the same as in game one. In situations with a hard defender and a soft challenger, the defender will initially threaten, and the challenger will choose not to aggress. Thus, the equilibrium outcome is non-aggression by the challenger and deterrence success.

Figure 1: Game Structure



Key:
C: Challenger
D: Defender
a: Aggress
na: Not Aggress
sp: Use Soft Power
p: Make Promise
t: Threaten
c: Concede
i: Initiate Action

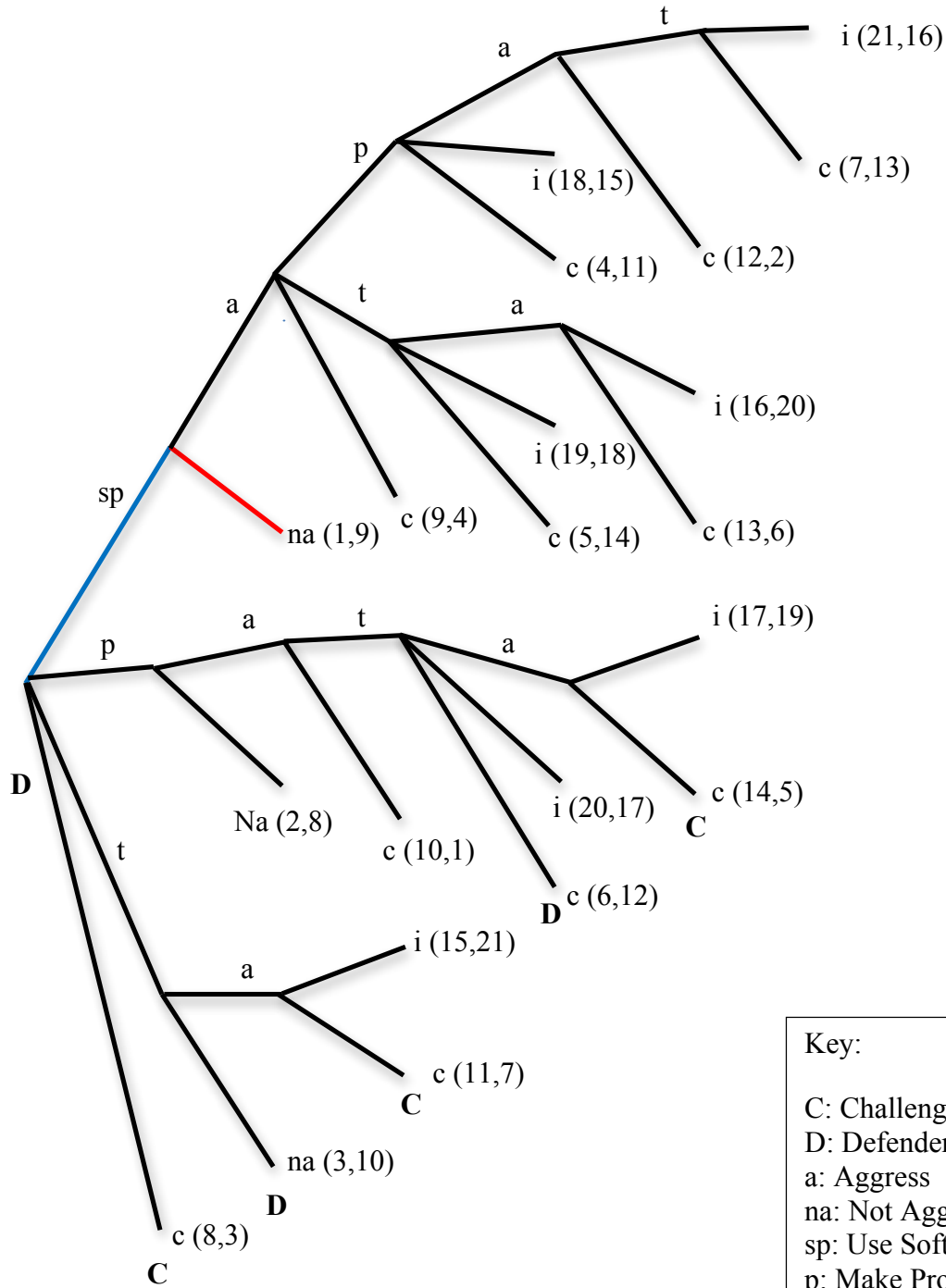
Figure 2: Hard Defender-Hard Challenger (1 Best 21 Worst), (D, C)



Key:

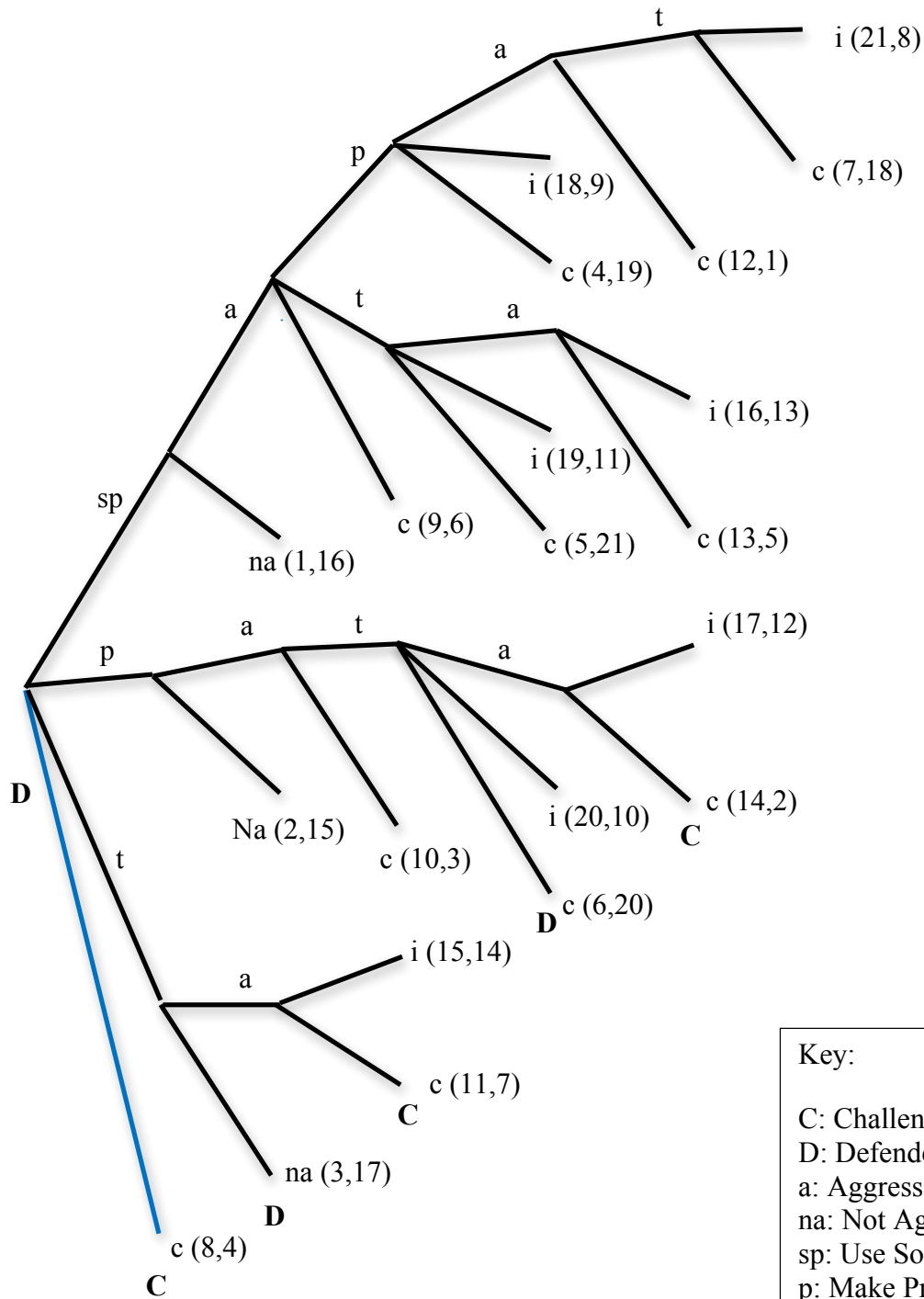
- C: Challenger
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- p: Make Promise
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- c: Concede
- i: Initiate Action

Figure 3: Soft Defender-Soft Challenger



Key:
 C: Challenger
 D: Defender
 a: Aggress
 na: Not Aggress
 sp: Use Soft Power
 p: Make Promise
 t: Threaten
 c: Concede
 i: Initiate Action

Figure 4: Soft Defender-Hard Challenger



Key:

- C: Challenger
- D: Defender
- a: Aggress
- na: Not Aggress
- sp: Use Soft Power
- p: Make Promise
- t: Threaten
- c: Concede
- i: Initiate Action

Figure 5: Hard Defender-Soft Challenger

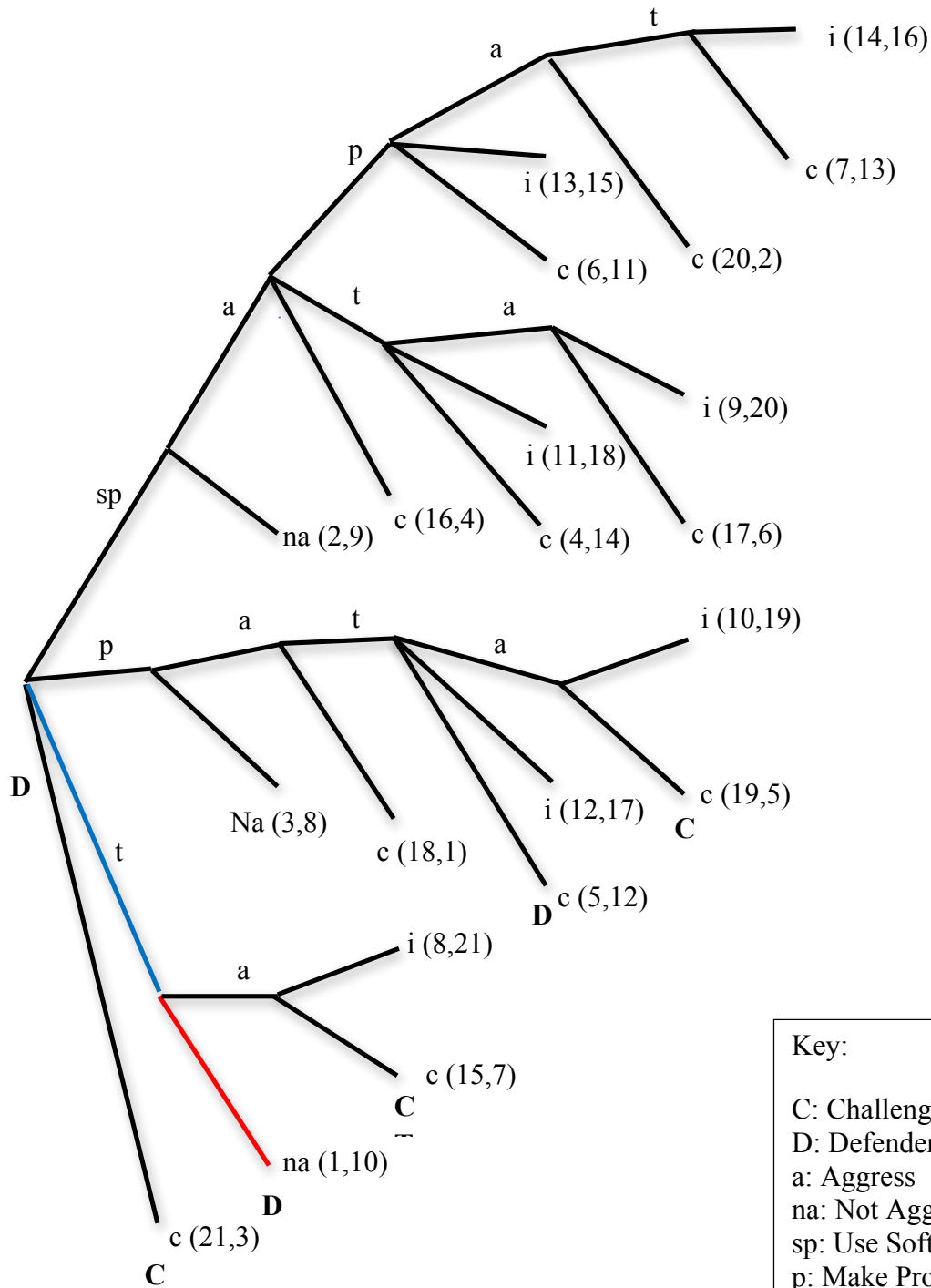


Table 1 summarizes the information displayed in Figures 2-5.

Table 1
Game Outcome Predictions

	Soft Defender	Hard Defender
Soft Challenger	(soft power, ~aggress)	(threaten, ~aggress)
Hard Challenger	(concede)	(threaten, aggress, initiate)

In both games involving a soft challenger, deterrence is expected to be successful. In both games involving a hard challenger, deterrence is expected to fail. The two defender resolve variables and the use of soft power do not demonstrate any consistent patterns. Thus, the models predict the following: *Soft power will have no effect on deterrence success. Defender resolve will have no effect on deterrence success. Challenger resolve will have a negative effect on deterrence success.*

Testing Soft Power Deterrence

I use a binary logistic regression model with 74 cases to test these expectations. The dependent variable is the effectiveness of deterrence (Success.) The two measures of challenger resolve are the variables of interest. I also include two soft power variables, diplomacy and trade, and the two measures of defender resolve. They are primarily obtained from Huth and Russett's list of deterrence cases (Huth and Russett 1984). Table 3 provides univariate statistics for all variables in the model.

The dependent variable is binary, coded either one or zero (yes or no) for the success or failure of deterrence. When deterrence success is coded one for success, the game has ended in either non-aggression or challenger concession. The defender seeks both to avoid conflict and to win, so non-aggression and challenger concession lead to successful deterrence. In games that end in non-aggression, the challenger backs down in the early stages of conflict. In games that

end in challenger concession, the challenger aggresses rather than backing down initially and then concedes in the later stages of conflict. When deterrence success is coded zero for failure, the game has ended in either defender concession or the initiation of conflict. Defender concession and the initiation of conflict both lead to the failure of deterrence. In games that end with defender concession, the defender backs down rather than escalate the conflict. In games that end in the initiation of conflict, the challenger chooses initiation over concession. Fifty-five percent of the cases result in successful deterrence and 45% result in deterrence failure. The median and mode values are both one.

The variables of interest are challenger military personnel and challenger battlefield deaths. Other independent variables are defender military personnel, defender battlefield deaths, trade, and diplomacy. Both sets of variables were derived from data provided by Correlates of War's (CoW) interstate war database and Angus Maddison's historical economic data (Ghosn, Palmer, and Bremer 2004; Maddison 2008). An earlier model also included a measure of military expenditures, but this variable was highly correlated with the military personnel variable and as such was removed.

Battlefield deaths are measured using CoW data for the period 25 years prior to each deterrence case and include both the defender or challenger state and that state's protégé if applicable (for instance, Taiwanese battlefield deaths are included in the United States battlefield deaths total for the 1954 and 1958 conflicts with China) in conjunction with Angus Maddison's population data (Maddison 2008). The ratio includes the state's battlefield deaths within that period of time, divided by the total population in the state in the year of the deterrence case. The mean for challenger battlefield deaths is 7.371, the median is 0.47, and the mode is zero. This indicates that many challengers have either not suffered any battlefield deaths or suffered very

few. Several values lie outside three standard deviations from the mean. The variable is greatly influenced by a handful of states which all suffered large numbers of battlefield deaths. It is not normally distributed and is skewed towards the right. The mean for defender battlefield deaths is 5.073. The median is 1.006, and the mode is zero.

The military personnel variable is a ratio of the number of military personnel in a state to the total population of that state (number of personnel per 1000 population.) This variable was measured in the year of the applicable deterrence case. The mean for challenger military personnel is 11.749, the median is 10.8, and the mode is 12.716. The mean for defender military personnel is 11.881, the median is 9.714, and the mode is 9.056.

The use of soft power is measured by diplomacy and bilateral trade. Diplomacy is derived from CoW's diplomacy database (Bayer 2006). It is a binary variable, coded either one or zero (yes or no) for the presence or absence of diplomacy. Table 3 illustrates that 85% of cases are coded yes for the presence of diplomacy while 15% of cases are coded no for the absence of diplomacy. The median and the mode for diplomacy are also one. Bilateral trade measures the total amount of bilateral trade between challenger and defender during the year of the deterrence situation. It is derived from CoW's trade database (Barbieri, Keshk, and Pollins 2009). It is a continuous variable measured in current U.S. millions. The mean is 748.966 million. The median is 42.16 million, and the mode is zero. The data are not normally distributed as a decent percentage of values fall outside of three standard deviations from the mean. The data are skewed towards the right.

All variables have been tested for multicollinearity with a correlation table, Table 3. As shown in Table 3, no remaining variables are highly correlated. Military personnel was highly correlated with military expenditures, and the expenditures variable was removed in response.

I expect a statistically significant model with a relatively high pseudo r-squared. I also expect that my variable of interest will be statistically significant with a p value less than 05.

Table 2
Univariate Statistics

	Military Personnel (C)	Battlefield Deaths (C)	Military Personnel (D)	Battlefield Deaths (D)	Success	Diplomacy	Trade
Mean	11.749	7.371	11.881	5.073	0.554	0.851	748.966
Median	10.800	0.470	9.714	1.006	1	1	42.160
Mode	12.716	0	9.056	0	1	1	0
Standard Deviation	6.908	12.920	6.618	9.180	0.500	0.358	3367.412
Range	32.710	43.870	35.179	39	1	1	28315.380

Table 3
Variable Correlations

Variable	Success	Military Personnel (C)	Battlefield Deaths (C)	Military Personnel (D)	Battlefield Deaths (D)	Trade	Diplomacy
Success	1.000	-	-	-	-	-	-
Military Personnel (C)	-0.068	1.000	-	-	-	-	-
Battlefield Deaths (C)	0.204	0.490	1.000	-	-	-	-
Military Personnel (D)	0.195	0.222	0.093	1.000	-	-	-
Battlefield Deaths (D)	0.041	0.347	0.138	0.321	1.000	-	-
Trade	-0.136	-0.153	-0.110	-0.095	-0.109	1.000	-
Diplomacy	0.084	0.146	0.108	-0.123	0.094	0.076	1.000

Results of Models

Both models test challenger military personnel, challenger battlefield deaths, defender military personnel, defender battlefield deaths, trade, and diplomacy on deterrence success. They differ in the time period of the cases used. The results of the robust binary logistic regression models are shown in Table 4.

Table 4
Robust Binary Logistic Regression Results

Variable	Model 1	Model 2
Constant	-0.716 (0.935)	-1.311 (1.089)
Challenger Military Personnel	-0.118* (0.051)	-0.259* (0.116)
Challenger Battlefield Deaths	0.067* (0.026)	0.127* (.06)
Defender Military Personnel	0.091* (0.043)	0.137* (0.059)
Defender Battlefield Deaths	-0.001 (0.029)	0.037 (0.038)
Trade	-0.000 (0.000)	0.012** (0.004)
Diplomacy	1.037 (0.741)	1.093 (0.921)
N	74	57
Prob.>Chi2	0.033	0.085
Pseudo R-Squared	0.133	0.365

Calculated by Matthew Hansen Using STATA 12

*Significant at less than $p=.001$

**Significant at less than $p=.05$

In the first model, I test challenger military personnel, challenger battlefield deaths, defender military personnel, defender battlefield deaths, trade, and diplomacy on deterrence success. The number of cases present in the model is 74. Challenger military personnel, challenger battlefield deaths, and defender military personnel are statistically significant. P-values are as follows: 0.021 for challenger military personnel, 0.010 for challenger battlefield deaths, 0.035 for defender military personnel, 0.161 for diplomacy, 0.104 for trade, and 0.959 for

defender battlefield deaths. Diplomacy, defender military personnel, and challenger battlefield deaths show a positive relationship with deterrence success while all other independent variables show a negative relationship with deterrence success. The model has relatively poor goodness of fit based on the pseudo r-squared value of 0.133. The chi-squared value indicates that there is a 3.3% chance that the same results could have been achieved without the effects of the tested variables.

In the second model, I again test challenger military personnel, challenger battlefield deaths, defender military personnel, defender battlefield deaths, trade, and diplomacy on deterrence success. However, I remove more recent historical cases to focus on older deterrence scenarios. I chose to do this because I believed that the selected variables may have been better indicators of deterrence success in less recent cases. I think that this is at least partially due to the increased incidence of conflicts involving non-state actors and changes in the way that wars are fought with a shift away from raw manpower and towards technologically advanced weapons.

The number of cases in this model is 57. Challenger military personnel, challenger battlefield deaths, defender military personnel, and trade are all statistically significant. P-values are as follows: 0.033 for challenger battlefield deaths, 0.337 for defender battlefield deaths, 0.026 for challenger military personnel, 0.020 for defender military personnel, 0.001 for trade, and 0.235 for diplomacy. The model has a better goodness of fit than the first, with a pseudo r-squared of 0.365. The chi-squared value indicates that there is an 8.51% chance that the same results could have been achieved without the independent variables.

Several variables are statistically significant in both models. For challenger military personnel, challenger battlefield deaths, and defender military personnel, the direction of the

relationship with the dependent variable also remains constant through both models. It is unclear whether or not the results of the models support the hypothesis that challenger resolve will have a negative effect on deterrence success. The challenger military personnel variable does seem to have a decidedly negative relationship with deterrence success. However, challenger battlefield deaths has a conversely positive relationship with deterrence success. It is also difficult to determine whether or not the defender resolve variables have no effect on deterrence success. The statistically significant variable, defender military personnel, has a consistently positive relationship with deterrence success. Based on the limited sample of the two models, it does appear that the two soft power variables have little effect on the success of deterrence.

Conclusions

Overall, the results of the models were not sufficient to reject the hypothesis that challenger resolve will have a negative effect on deterrence success, at least not across both measured resolve variables. The two challenger resolve variables showed differing relationships with deterrence success. The challenger military personnel variable had a statistically significant negative relationship across both models, while the challenger battlefield deaths variable had a statistically significant positive relationship.

I cannot reject the hypothesis that defender resolve will have no effect on deterrence success. Again, the two variables show different results. The defender military personnel variable had a statistically significant positive relationship with deterrence success, while the defender battlefield deaths variable showed no statistically significant relationship.

I also cannot reject the hypothesis that soft power will have no effect on deterrence success. Based on the results of the models and the general lack of a strong statistically significant relationship for the soft power variables, it does seem that their effects on deterrence

success were at least limited. However, I am concerned that the variables used may not be true indicators of soft power. This is discussed below.

In the models, the military personnel variables proved to be a more effective indicator of deterrence success than the battlefield deaths variables. For defenders, greater military personnel ratios were related to higher levels of deterrence success. For challengers, greater ratios were related to higher levels of deterrence failure. As such, the models support the logical conclusion that those countries which make the greatest commitment to strengthening military forces will tend to prevail more often in deterrence scenarios. The battlefield deaths variable appears to be a strong indicator for challengers but not for defenders. This could be interpreted to mean that challengers are more easily dissuaded from aggression in deterrence scenarios through loss of life than are defenders. By definition defenders fight for the status quo; to retain something that they already hold. Challengers, on the other hand, fight for change that will benefit them. It seems that in general states will be more committed to fighting to retain assets than fighting to gain assets. While the above thoughts do not fully explain the situation, the factors discussed may at least contribute to the relationships shown in the models.

Of the two soft power variables, trade is perhaps the more reliable measure of the two as it shows statistical significance in one of the models. It had little to no relationship with deterrence success. Diplomacy, on the other hand, had a positive relationship with deterrence success but showed no statistical significance. Diplomacy was present in 85% of all cases, which leads me to further question the validity of the relationship. I am unsure whether or not the soft power variables used in the model truly measure soft power in the way intended as both diplomacy and trade can be used as means of hard power as well as soft power. I believe that it

would be beneficial to locate or develop a variable to measure interstate cultural appeal, a potentially better soft power variable.

Beyond from relationships between individual variables, differences between the two models also provide useful information. The first model included cases from a wider range of dates. In the second model, many of the more modern deterrence cases were removed. Goodness of fit was much greater for the second model. This seems to indicate that the method used to evaluate the indicators of successful deterrence in this study has greater predictive power when applied to less recent deterrence scenarios. As mentioned above, this may have to do with changes in the actors who engage in conflicts and the methods used in those conflicts. This is problematic, as the primary application of this model would be predicting deterrence success in future scenarios.

Through an examination of the outcomes of the games, we can attempt to identify potential changes in outcome preferences that could shift the outcomes of the two games which otherwise ended in deterrence failure. In the hard defender – hard challenger game, challenger preferences for certain initiation outcomes and certain non-aggression outcomes are adjacent. In order to shift the outcome from initiation to non-aggression, defenders could potentially alter their postures to be more open to making promises to challengers rather than limiting themselves to threats. Strategies relying on a mix of hard power and soft power will likely lead to more effective deterrence than strategies which rely on one or the other.

In the soft defender – hard challenger game, there is no likely avenue available for shifting the outcome from defender concession to another node. Soft defenders are unable to effectively threaten, and hard challengers are unresponsive to the provision of soft power and

promises. As such, defenders with soft resolve are unable to change the outcome of the game without shifting their resolve.

From the standpoint of predictive effective strategic actions that can be actively used in deterrence scenarios, without altogether changing resolve, the usefulness of the models is limited to deterrence scenarios with a hard defender and a hard challenger. From the standpoint of predicting the outcome of potential conflicts, the models are more widely useful. For instance, we can predict that a hard defender will at least likely be able to successfully deter a soft challenger, though that will not always be true. We can also predict that a soft defender will have few options when facing a hard challenger.

However, as mentioned above, the models seem to show less predictive power in recent years. Efforts to expand on this study would be best directed towards testing more potential resolve variables and in turn attempting to develop a model that is more applicable to modern deterrence scenarios. An adjusted model would be a more effective predictive tool for policymakers to use when planning international relations strategies.

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