How Do States Pay for War?
A Model of Interstate War Finance*

Jeff Carter
Department of Political Science
The University of Mississippi
jcarter3@olemiss.edu

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Abstract

Existing scholarship that analyzes how states pay for interstate war largely ignores the interdependent and dynamic nature of governments' war finance strategies. I develop a theoretical framework that identifies the relative extent to which governments will pay for a war by reducing non-military spending, raising taxes, incurring debt, and printing money and how a government's finance strategy will change during a war. The model implies the extent to which a government uses a given finance option is never independent of its use of other finance methods, finance options are both substitutes and complements, and finance strategies generally vary over the course of a war. An analysis of U.S. finance strategies for the Spanish-American War, World War II, and the Vietnam War is consistent with the model's results and highlights the advantages of the framework developed here.

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Scholars generally agree states' capabilities influence patterns of interstate bargaining (Fearon 1995), war onset (Clark and Reed 2003), war duration (Bennett and Stam 1996), and war outcomes (Henderson and Bayer 2013). However, systematic research on how governments finance the resources that shape these characteristics of interstate war has lagged behind. Thus, we know interstate wars are expensive and capabilities are important to understanding conflict processes, but have largely ignored a fundamental question: how do governments pay for their wars?

Governments largely pay for interstate war by shifting existing spending away from non-military programs and/or increasing the total pool of resources through higher taxes, incurring debt, and printing money (Rasler and Thompson 1985). There exists systematic evidence of governments paying for war with each of these finance methods (Flores-Macías and Kreps 2013, Poast 2015, Capella 2013), yet theoretical explanations typically argue the use of each finance option implies the non-use of other finance methods. Further, existing scholarship assumes patterns of war finance are constant during a war, but governments often alter their finance strategies over the course of an interstate war (Rockoff 2012). These divides between theoretical expectations and the empirical record suggest existing scholarship on interstate war finance provides an incomplete account of how governments pay for their wars.

I develop a general model of interstate war finance that accounts for governments' ability to fund an interstate war effort using multiple options and allows governments to alter their finance strategies over the course of a war. My theoretical argument is developed with a formal model that treats interstate war as a costly process in which two governments bargain over a disputed good and must finance and fight a battle each time they fail to reach a negotiated settlement. I focus on four of the model's implications. First, the use of a given finance option is never independent of the use of the other finance options. Second, war finance methods are collectively substitutable for any given level of war effort. Third, the extent to which a government reduces non-military spending, raises taxes, increases debt, and prints money is complementary with respect to the level of war finance. Fourth, governments' optimal finance strategies will tend to vary over the course of a war.

The model implies a government's optimal war finance strategy depends on the relative cost of each finance option and its level of mobilization at a given point in time in a given war. I use a set of brief case studies of how the United States financed the Spanish-American War, World War II, and the Vietnam War to demonstrate the model's empirical utility. The model offers a rational explanation for aspects of the United States' war finance strategies that existing theoretical approaches cannot explain.

The remainder of the article proceeds as follows. The first section reviews existing literature on how governments pay for their interstate wars. The second develops the formal model while the third identifies states' optimal interstate war finance strategies. The fourth section presents my theoretically informed . The article concludes with a discussion of how the theoretical framework developed here can inform empirical research on interstate war finance.

1 How States Pay for War

Waging interstate war typically requires a government to increase the economic resources it allocates to the military (Sandler and Hartley 1995, Goldsmith 2003). How a government finances this increase in military spending represents its interstate war finance strategy. At a basic level, a government's finance strategy involves shifting existing resources to the military and/or increasing the pool of available resources (Rasler and Thompson 1985).

Financing an interstate war through a shift in existing resources is accomplished by reducing spending on non-military programs. This finance option typically is associated with the "guns-versus-butter" trade-off (e.g., Sprout and Sprout 1968). There is little empirical support for a generic trade-off between military and social spending (among others Domke, Eichenberg and Kelleher 1983), likely due to the fact that national budgets are rarely fixed (DiGiuseppe 2013). However, conditional on factors that include but are not limited to their capabilities, political orientation, regime type, and interstate war, some states appear to reduce social spending in order to increase military spending (Palmer 1990, Whitten and Williams 2011, Carter and Palmer 2015). Further, governments can finance higher military spending through a redistribution of government resources without cutting social spending. This could be accomplished by reducing government spending on debt service, bureaucrats' salaries, or other expenditures not marked for the welfare state. Consistent with this idea, Carter and Palmer (Forthcoming) find that democracies and dictatorships spent less on non-military expenditures during interstate wars between 1950 and 2007.

Reducing non-military spending offers governments a way to pay for an interstate war with their existing resources. Of course, governments also finance wars by increasing the pool of available resources through one of three common methods (Rasler and Thompson 1985). The first, and arguably most traditional method, is increasing tax revenue (Tilly 1992, Bank, Stark and Thorndike 2008). There are two problems with this historically popular finance option. First, raising taxes is politically unpopular (Ladd et al. 1979). Second, the money generated through increased tax revenue is often insufficient to pay for an interstate war (Slantchev 2012, Shea 2014). Despite these incentives to avoid doing so, governments often finance their war efforts at least partially through taxes. In particular, 22% of interstate war participants between 1823 and 2003 paid for at least 25% of their total war effort through taxes (Capella 2013).

The second way governments can finance an interstate war effort with additional resources is to borrow money. Indeed, recently scholars have argued paying for war through incurring debt is the most desirable war finance option (e.g., Schultz and Weingast 2003). The logic behind this claim is that borrowing money allows a government to pay for a war while avoiding the politically costly strategies of reducing non-military spending or raising taxes (Shea 2014). However, access to international credit markets and the cost of borrowing varies with lenders' expectations that a state will repay its debts (Beaulieu, Cox and Saiegh 2012, Poast 2015). Governments' ability to pay for an interstate war by borrowing money therefore varies considerably (Schultz and Weingast 1998, 2003).

Inflationary monetary policy is the third option for governments that want to finance higher wartime military spending through increased resources. Put simply, governments can pay for war by printing money (Rasler and Thompson 1985, Capella 2013). Governments have strong incentives to avoid financing a war effort through inflationary monetary policy. Inflation is politically unpopular and can harm the economic fortunes of a state's wealthy and poor (Sobel 2006). Perhaps more importantly, inflation can harm a state's economic performance, which endangers the survival of political leaders and regimes (Goemans 2008). Accordingly, financing an interstate war through inflationary monetary policy often is viewed as the option of last resort. Rockoff (2012) notes, though, that printing money has advantages over other war finance methods. Specifically, it raises money more quickly and has lower administrative costs than increasing taxes or borrowing money (pg. 21). Further, as long as any related inflation is moderate, printing money is likely less politically costly than reducing social spending or raising taxes.

Reviewing the existing literature on interstate war finance leads to three observations. First, scholars' theoretical arguments typically focus on particular war finance options in isolation or argue finance options are substitutes. Slantchev (2012) and Shea (2014), for instance, argue governments should pay for war by borrowing money instead of increasing taxes. Second, there exists evidence of the use of each finance option. Research suggests governments have paid for interstate war by reducing non-military spending (Carter and Palmer Forthcoming), raising taxes (Flores-Macías and Kreps 2013), increasing debt (Schultz and Weingast 2003), and printing money (Capella 2013). This is puzzling given that most theoretical arguments claim the use of any given finance option implies other finance options will not be used. Third, the literature treats the use of a given finance option as a discrete event that uniformly operates throughout a war. Theoretical and empirical analyses implicitly assume leaders, governments, central banks, and/or lenders choose to re-distribute government spending, raise taxes, borrow money, and/or print money in order to finance a war effort, and then a mobilization effort is funded as long as hostilities continue (e.g., Flores-Macías and Kreps 2013, Poast 2015).[1]

Existing war finance scholarship has increased our knowledge about how governments pay for interstate war. However, it suffers from an inherent tension between its theoretical arguments and empirical findings and a failure to consider whether and how governments' finance strategies change during a war. The next section presents a theoretical framework that addresses these issues.

[1] Capella (2013) represents a partial exception to the static treatment of war finance. First, she argues governments likely finance "short" wars and "long" wars differently. Second, her quantitative analyses estimate how a war's duration affects the extent to which governments rely on taxation, debt, and inflation to finance their war efforts. However, her analyses do not estimate whether or how patterns of finance change over the course of a war.

2 A Model of Interstate War Finance

The extant literature paints a static picture of interstate war finance in which governments make a single decision to reduce non-military spending, raise taxes, borrow money, ***or*** engage in inflationary monetary policy to an extent that is sufficient to pay for a country's mobilization effort. In practice, governments often use multiple options to pay for a given interstate war and finance strategies change over the course of a war (Rockoff 2012). The theoretical framework developed here explicitly allows for these characteristics of interstate war finance.

The theoretical model is developed in the context of an intra-war bargaining game in which governments choose how they will pay for the battles they fight. Following Wagner (2000), a number of scholars have modeled interstate war as a costly process in order to analyze intra-war dynamics (Filson and Werner 2002, Wolford, Reiter and Carrubba 2011). The model abstracts away from some common features of costly process models of war. Two are worth noting here. First, governments do not run the risk of collapsing as a result of defeat on the battlefield (for example, Powell 2004). Instead, governments fight non-decisive, costly battles upon their failure to reach an agreement that signal their resolve (e.g., Wolford, Reiter and Carrubba 2011). Second, instead of using an infinitely-repeated set-up (Powell 2004), the model takes place over a fixed number of periods (e.g., Filson and Werner 2002). The model developed here, therefore, provides a less nuanced depiction of intra-war bargaining than most costly process models of interstate conflict. However, the model is rich enough to allow for an analysis of how governments pay for war – my primary theoretical interest – while allowing them to select out of a war when they no longer wish to finance and fight battles.[2]

The model assumes Government 1 (G_1) and Government 2 (G_2) are in a dispute over good x, which is currently controlled by G_2. The game takes place over three time periods $p = \{1, 2, 3\}$ in which G_1 demands $x^p \in [0, 1]$ from G_2. If G_2 accepts (a) demand x^p, the game ends. If G_2 rejects (r) demand x^p, then G_1 and G_2 finance (F_i^p) and fight a costly battle against one another in that period. If the governments fight three battles, the game ends with G_2 in possession of the good

[2]The model closest to the one presented here is the game developed by Arena (2009, pgs. 20-28), which does not consider how governments finance their battles.

but each government having paid the costs of financing and fighting three battles. The level of mobilization in a given period (l_i^p) is an increasing function of the severity of fighting ($s_i^p > 0$) and public support ($r_i^{f_p} > 0$) for the war, which implies $\frac{\partial l_i^p(r_i^{l_p}, s_i^p)}{\partial s_i^{l_p}} > 0 \; \forall \; r_i^{l_p}$ and $\frac{\partial l_i^p(r_i^{l_p}, s_i^p)}{\partial r_i^{l_p}} > 0 \; \forall \; s_i^p$.

G_i pays for a given level of mobilization through a combination of reduced non-military spending (N), higher taxes (T), increased debt (D), and printing money (M). Thus, the level of mobilization in a given period is $l_i^p = n_i^p + t_i^p + d_i^p + m_i^p$. The model assumes G_1 and G_2 will finance their battles efficiently, making more intensive use of finance options that cost relatively less than options that cost relatively more. Finance costs are defined in terms of economic and political factors.[3] For example, the cost of financing an interstate war through debt is a function of, among other things, the interest rate and a government's willingness to go into debt to pay for a war. Formally, the relative efficiency of finance options are modeled as $\pi_i^p \in \{\nu_i^p, \tau_i^p, \delta_i^p, \mu_i^p\}$, where the relative efficiency of any given finance method falls on the closed interval $(0, 1)$ and $\nu_i^p + \tau_i^p + \delta_i^p + \mu_i^p = 1$. A government's finance strategy in a given period is written as the Cobb-Douglas production function $f_i^p = n_i^{p\nu_i^p} t_i^{p\tau_i^p} d_i^{p\delta_i^p} m_i^{p\mu_i^p}$.

I assume fighting a battle entails two types of costs. First, each government pays a financial cost for fighting a battle ($c_i^{f_p} > 0$). This cost can vary for each government and per period but is common knowledge. Second, G_1 and G_2 pay non-financial costs $c_i^o > 0$ each time they fight. Three types of G_2 exist and G_1 has beliefs over G_2's type.[4] More specifically, G_2 can be weak (w), average (a), or strong (s). The non-financial cost that G_2 pays for fighting varies with its type, such that $c_{2w}^o > c_{2a}^o > c_{2s}^o$. To simplify the analysis, the non-financial costs a given type of G_2 pays is held constant across periods. G_1 thinks G_2 is weak with probability w, average with probability a, and strong with probability s, where $s = 1 - w - a$. Figure 1 presents the extensive form of the game.

[3] Interstate war finance can be viewed as a form of foreign policy substitutability (Palmer and Morgan 2006) in which a government's finance strategy consists of the mix of policies that most efficiently pay for a given level of war effort.

[4] Assuming that only G_2 varies in its type avoids the complications that arise in models with two-sided uncertainty is consistent with most formal models of interstate conflict that include incomplete information (e.g., Fearon 1995).

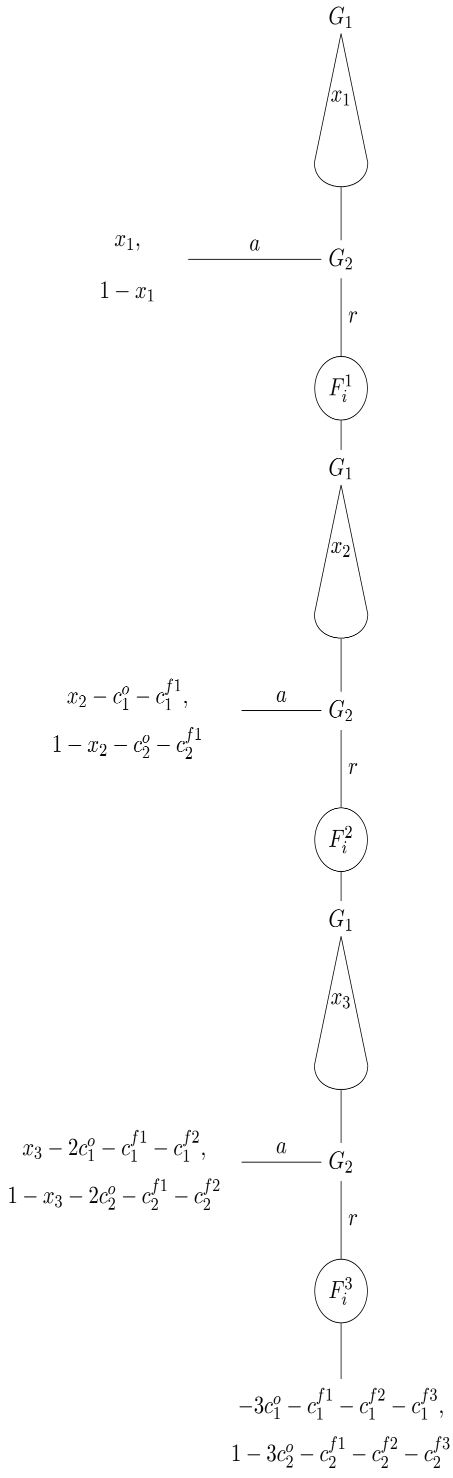

Figure 1: Extensive Form of Theoretical Model

2.1 Equilibrium Behavior

The following analysis focuses on the model's only screening perfect Bayesian equilibrium that results in the governments financing and fighting multiple battles. I describe equilibrium behavior with a minimal amount of notation here and provide the formal proof in the appendix.

Proposition 1. The following is a perfect Bayesian equilibrium in pure strategies if $w > a > s$. G_1 demands $x^{1*} = c^o_{2w} + c^o_{2a} + c^o_{2s} + c^{f1}_2 + c^{f2}_2 + c^{f3}_2$, $x^{2*} = c^o_{2a} + c^o_{2s} + c^{f2}_2 + c^{f3}_2$, and $x^{3*} = c^o_{2s} + c^{f3}_2$. G_{2w} accepts x^{1*} and the game ends in period 1 without a battle. G_{2a} rejects x^{1*}, G_1 and G_{2a} choose their optimal finance strategies f^{1*}_1 and f^{1*}_2 and fight a battle in period 1; and G_{2a} accepts x^{2*} and the game ends in period 2. G_{2s} rejects x^{1*}, G_1 and G_{2s} choose their optimal finance strategies f^{1*}_1 and f^{1*}_2 and fight a battle in period 1; G_{2s} rejects x^{2*}, G_1 and G_{2s} choose their optimal finance strategies f^{2*}_1 and f^{2*}_2 and fight a battle in period 2; and G_{2s} accepts x^{3*}, and the game ends in period 3.

Proof. See appendix.

□

G_1 seeks to avoid giving weaker types of G_2 more than the minimum bargain they will accept instead of fighting and believes it is unlikely to be dealing with a strong opponent ($w > a > s$). By engaging in this risk-reward trade-off, G_1 balances a desire to get the best possible deal with the possibility of fighting a longer war. G_1's optimal strategy in this case is to screen the types of G_2 with increasingly weaker demands. This strategy ensures that G_1 will not agree to a more generous bargain than is required to induce a given type of G_2 to end the the war in a given period. Thus, G_1 makes the demand of $x^{1*} = c^o_{2w} + c^o_{2a} + c^o_{2s} + c^{f1}_2 + c^{f2}_2 + c^{f3}_2$ in period 1 that only G_{2w} accepts. One consequence of this strategy is that G_1 finances and fights a battle against G_{2a} or G_{2s} in period 1. G_i's optimal war finance strategy in period p is the mix of cuts in non-military spending, higher taxes, increased debt, and printing money that most efficiently pays for a given level of mobilization; or, $f^{p*}_i(n^{p^*}_i, t^{p^*}_i, d^{p^*}_i, m^{p^*}_i, l^p_i)$.[5] After each government chooses its optimal war finance strategies and fights a battle against one another in period 1, G_1 makes another demand

[5] I explicitly derive a government's optimal use of each finance option in a given period in the next section.

of G_2. G_1's optimal play in period 2 is to make the strongest demand that G_{2a} will accept in lieu of fighting; $x^{2*} = c^o_{2a} + c^o_{2s} + c^{f2}_2 + c^{f3}_2$. The logic behind this result is that G_1 believes it is more likely to be facing G_{2a} than G_{2s} and demanding less than x^{2*} would result in G_1 obtaining less in a settlement with G_{2a} than it would through financing and fighting a battle and continuing the game. While G_{2a} accepts x^{2*} in period 2, G_{2s} rejects the demand. After G_{2s} rejects x^{2*}, G_1 and G_{2s} choose their optimal war finance strategies in period 2 and fight a battle. Upon the conclusion of the second battle, G_1 knows it is facing G_{2s} and makes a demand in the third period ($x^{3*} = c^o_{2s} + c^{f3}_2$) that induces G_{2s} to accept a settlement instead of fighting.

Proposition 1 is the model's only pure strategy screening equilibrium in which governments finance and fight multiple battles. To see why, consider what happens when G_1 holds different beliefs regarding G_2's type. If G_1 believes it is most likely dealing with the most resolved type of G_2, it makes a weak demand in the first period that all types of G_2 accept and the game ends without a battle needing to be financed or fought. If G_1 believes it is most likely dealing with a G_2 of average resolve, it makes a demand in period 1 that G_{2a} and G_{2w} accept and G_{2s} rejects. In these scenarios, G_1 and G_{2s} finance and fight a battle in period 1, but G_1 knows G_2's type with certainty and makes an offer in the second period that induces G_{2s}'s acceptance. The only other set of possible beliefs also ends after a single battle must be financed and fought. Here, G_1 makes a strong demand in the first period that only G_{2w} accepts and results in battles with G_{2a} or G_{2s}. In the second period, G_1 makes a demand that induces G_{2s} to accept a settlement instead of financing and fighting another battle, which G_{2a} also accepts. Thus, Proposition 1 represents the only pure strategy, screening equilibrium in which G_1 and G_2 finance and fight multiple battles. The next section derives a set of expectations about governments' optimal war finance strategies.

3 Optimal Interstate War Finance

I begin by identifying G_i's optimal war finance strategy in a given period.[6] Recall that G_i's finance strategy in period p is $f^p_i = n^{p\nu^p_i}_i t^{p\tau^p_i}_i d^{p\delta^p_i}_i m^{p\mu^p_i}_i$ and subject to the constraint $l^p_i = n^p_i + t^p_i +$

[6]My approach to identifying a government's optimal finance strategy for a given level of mobilization builds on Palmer and Morgan's (2006) model of foreign policy substitutability.

$d_i^p + m_i^p$. This implies the following LaGrangian function:

$$\mathcal{L}(f_i^p) = \nu_i^p \ln n_i^p + \tau_i^p \ln t_i^p + \delta_i^p \ln d_i^p + \mu_i^p \ln m_i^p + \lambda_i^p (l_i^p - n_i^p - t_i^p - d_i^p - m_i^p) \tag{1}$$

We can use Equation 1 to derive the optimal marginal provision of each war finance option in terms of the total level of war finance and the relative efficiency of each finance option. First, setting the partial derivatives of $\mathcal{L}(f_i^p)$ with respect to n_i^p, t_i^p, d_i^p, and m_i^p to zero and solving yields:

$$\begin{aligned} \frac{\partial \mathcal{L}(f_i^p)}{\partial n_i^p} &= \frac{\nu_i^p}{n_i^p} - \lambda_i^p = 0 \\ \Rightarrow n_i^{p*} &= \frac{\nu_i^p}{\lambda_i^p} \end{aligned} \tag{2}$$

$$\begin{aligned} \frac{\partial \mathcal{L}(f_i^p)}{\partial t_i^p} &= \frac{\tau_i^p}{t_i^p} - \lambda_i^p = 0 \\ \Rightarrow t_i^{p*} &= \frac{\tau_i^p}{\lambda_i^p} \end{aligned} \tag{3}$$

$$\begin{aligned} \frac{\partial \mathcal{L}(f_i^p)}{\partial d_i^p} &= \frac{\delta_i^p}{d_i^p} - \lambda_i^p = 0 \\ \Rightarrow d_i^{p*} &= \frac{\delta_i^p}{\lambda_i^p} \end{aligned} \tag{4}$$

$$\begin{aligned} \frac{\partial \mathcal{L}(f_i^p)}{\partial m_i^p} &= \frac{\mu_i^p}{m_i^p} - \lambda_i^p = 0 \\ \Rightarrow m_i^{p*} &= \frac{\mu_i^p}{\lambda_i^p} \end{aligned} \tag{5}$$

Substituting Equations 2 - 5 into the budget constraint and solving for λ_i^p we get

$$\lambda_i^p = \frac{\nu_i^p + \tau_i^p + \delta_i^p + \mu_i^p}{l_i^p} \tag{6}$$

Substituting Equation 6 into Equations 2 - 5 defines the optimal marginal provision of n_i^p, t_i^p, d_i^p, and m_i^p in terms of l_i^p, ν_i^p, τ_i^p, δ_i^p, and μ_i^p:

$$n_i^{p^*} = \frac{\nu_i^p l_i^p}{\nu_i^p + \tau_i^p + \delta_i^p + \mu_i^p} \tag{7}$$

$$t_i^{p^*} = \frac{\tau_i^p l_i^p}{\nu_i^p + \tau_i^p + \delta_i^p + \mu_i^p} \tag{8}$$

$$d_i^{p^*} = \frac{\delta_i^p l_i^p}{\nu_i^p + \tau_i^p + \delta_i^p + \mu_i^p} \tag{9}$$

$$m_i^{p^*} = \frac{\mu_i^p l_i^p}{\nu_i^p + \tau_i^p + \delta_i^p + \mu_i^p} \tag{10}$$

Equations 7 - 10 jointly identify a government's optimal finance strategy in a given period and can be used to derive implications about how governments pay for their interstate wars. I begin with the most straightforward and general expectation.

Implication 1: The use of a given finance option is not independent of the use of other finance options.

The model indicates governments' decisions regarding the use of a given finance option are not independent of their decisions regarding the use of other finance options. This is because the optimal use of a particular finance option in a given time period is a function of the relative efficiency of all finance options. Formally, this is reflected by the inclusion of $\nu_i^p + \tau_i^p + \delta_i^p + \mu_i^p$ in the denominators of Equations 7 - 10. The intuition behind this result is that governments consider all of their possible options when deciding how to fund their interstate wars. The decision whether or not to raise taxes, for example, is not made independently of a government's ability to borrow money on the international credit market or reduce non-military spending.

Implication 1 is intuitive and follows immediately from the model. The existing literature, though, only partially acknowledges the interdependent nature of governments' war finance decisions. Specifically, despite the fact that their theoretical arguments often imply trade-offs among finance options, scholars inevitably analyze the extent to which governments pay for war with each finance option in isolation (e.g., Flores-Macías and Kreps 2013).[7] The model developed here, though, indicates the use of war finances option are *always* related to one another, implying quantitative models that do not jointly estimate patterns of non-military spending, taxation, debt, and inflationary monetary policy are misspecified. The model's second empirical implication goes beyond a claim of general interdependence and more precisely identifies the role of substitutability in governments' optimal interstate war finance strategies.

Implication 2: For any given level of war mobilization, finance options are collectively substitutable and the extent each is used is a function of its relative efficiency.

There are two aspects of Implication 2. First, the model suggests finance methods, when considered jointly, are substitutable for any given level of war mobilization. To see how this works, recall that the total level of war finance in a given period is defined as $l_i^p = n_i^p + t_i^p + d_i^p + m_i^p$. Define $z_i^{p^*}$ as the optimal resources raised through a given finance option and $e_i^{p^*}$ as the sum of the optimal resources raised through all other finance options. Accordingly, $l_i^{p^*} = z_i^{p^*} + e_i^{p^*}$, which implies as $z_i^{p^*} \to l_i^{p^*}$, $e_i^{p^*} \to 0$. Thus, finance methods are collectively substitutable for a given level of mobilization. Second, the rate of substitution among finance options is a function of their relative efficiency. In particular, the extent to which each finance option is used at a given level of mobilization is increasing in its relative efficiency compared to the other finance options. Formally, this follows from the inclusion of the terms ν, τ, δ, and μ in the numerators of the equations that, respectively, identify the optimal reductions in non-military spending (7), increase in taxes (8), increase in debt (9), and use of monetary policy (10) to finance a given level of war effort.

To help demonstrate Implication 2, Figure 2 presents a government's optimal use of each finance option when it needs to raise $100 million dollars to fight an interstate war and the relative efficiency

[7] To my knowledge, Carter and Palmer (Forthcoming) is the lone exception to this claim. However, even they only jointly model patterns of non-military spending, taxation, debt, and inflation as a robustness check.

of taxation (τ) varies from 0 to 1 at the expense of the relative efficiency of reducing non-military (ν), incurring debt (δ), and printing money (μ). The calculations in Figure 2 assume that $\nu = (1-\tau)*0.6$, $\delta = (1-\tau)*0.25$, and $\mu = (1-\tau)*0.15$.

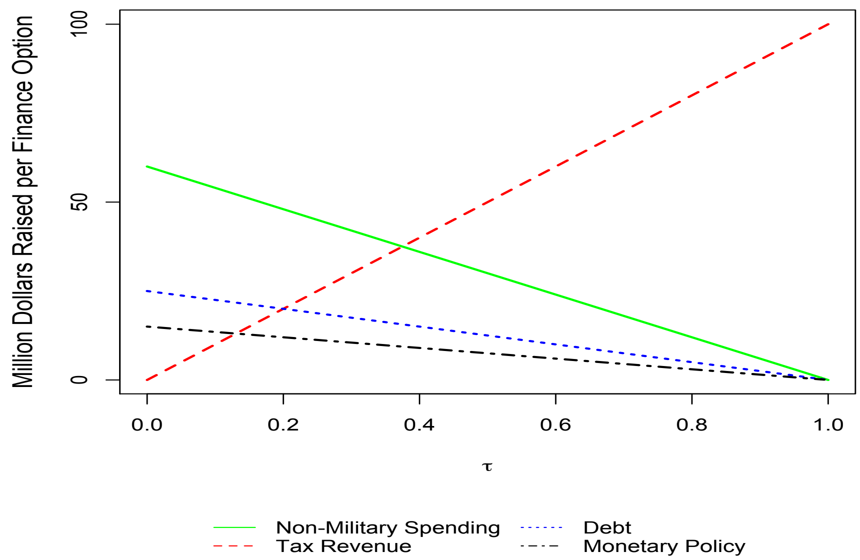

Figure 2: Optimal Interstate War Finance as the Relative Efficiency of Options Change.

The two aspects of Implication 2 are immediately apparent in Figure 2. First, as the proportion of the total war effort that is financed through taxation (dashed red line) increases, the proportion collectively funded through non-military spending (solid green line), debt (dotted blue line), and monetary policy (dashed-dotted black line) decreases. Second, as the relative efficiency of financing a war effort with taxes increases compared to the other finance methods, the proportion of the total war effort funded with taxes is increasing and the proportion financed with other options is decreasing. For example, when τ is equal to 0.1, ν is equal to 0.54, δ is equal to 0.225, and μ is equal to 0.135. In this scenario, the $100 million war effort is financed with $10 million in taxes, $54 million worth of cuts in non-military spending, $22.5 million in debt, and $13.5 million from monetary policy. When τ increases to 0.57, ν is equal to 0.258, δ is equal to 0.1075, and μ is equal to 0.0645. This results in the $100 million in war finance coming from $57 million in higher taxes, $25.8 million worth of cuts in non-military spending, $10.75 million in higher debt, and $6.45

million through monetary policy.

Figure 2 nicely captures the model's result that finance methods are collectively substitutable for a given level of mobilization and their relative efficiency determines the extent a government uses each method. This fits with most people's intuition and, to the extent it considers the use of multiple finance methods, is consistent with how the literature treats interstate war finance (e.g., Flores-Macías and Kreps 2013, Poast 2015). Importantly, though, the model suggests war finance options are not strictly substitutes.

Implication 3: The extent to which finance options are used is complementary with respect to the level of mobilization.

The model implies that as the level of economic resources in a government's interstate war finance strategy increases (decreases), the optimal amount of resources raised through the different war finance options increases (decreases). That is, the use of finance options is complementary with respect to the level of war finance. This is reflected in Equations 7 - 10 through the appearance of l_i^p in the numerator of each equation. Formally, this implies $n_i^{p^*}$, $t_i^{p^*}$, $d_i^{p^*}$, and $m_i^{p^*}$ are all increasing in $l_i^{p^*}$. Figure 3 demonstrates Implication 3 by plotting the optimal amount of money raised from each finance option as the total level of mobilization (l_i^p) varies from \$1 million to \$1 billion. The calculations in Figure 3 assume that $\nu = 0.2$, $\tau = 0.25$, $\delta = 0.5$, and $\mu = 0.05$.

Figure 3 nicely illustrates the complementary relationship between finance options and the level of total war finance. When a state allocates \$250 million to a war effort, its optimal finance strategy consists of \$50 million in non-military spending cuts, \$62.5 million from higher taxes, \$125 million in debt, and \$12.5 million through monetary policy. When its mobilization effort requires \$850 million, its optimal finance strategy calls for \$170 million from cuts in non-military spending, \$212.5 in tax revenue, \$425 through debt, and \$42.5 through monetary policy. Thus, the extent to which any given finance method is used is increasing in the overall level of interstate war effort.

Implication 3 indicates that, all else equal, the more money a government allocates to the war effort, the more resources it will raise from its different sources of war finance. This is intuitive.

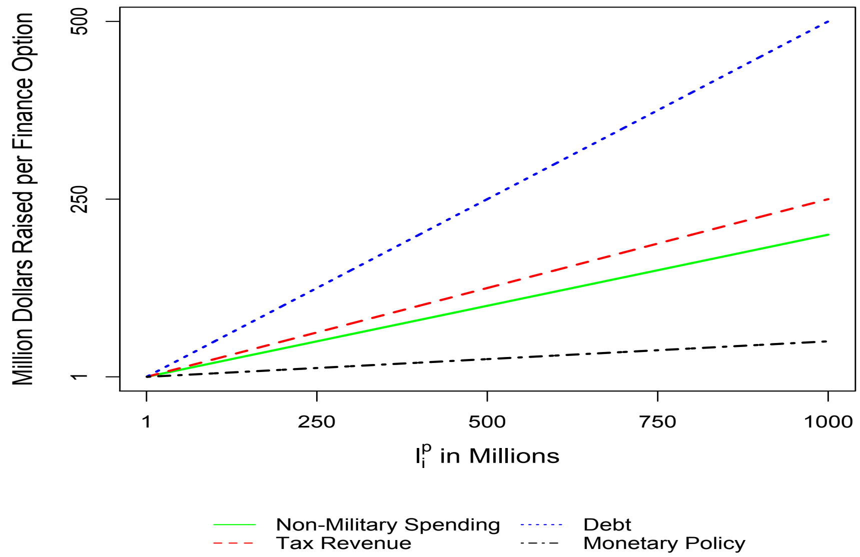

Figure 3: Optimal Interstate War Finance as Total War Effort Changes.

When considered jointly with Implication 2, though, this result solves a puzzle present in the existing literature. As discussed above, theoretical arguments claim the use of a given war finance method leads to the non-use of other finance methods. However, empirical evidence indicates governments pay for war using all methods of finance. The model suggests this tension in the literature exists because war finance options are substitutes *and* complements. If we consider a mobilization effort of a fixed size, every dollar that a government raises through a given finance option implies the government will need to raise less money through the other finance options. Simultaneously, the optimal amount of money a government will raise through each finance option increases as its mobilization effort increases. Thus, the model suggests the disconnect between scholars' theoretical arguments and empirical findings follows from a failure to appreciate that war finance methods are both substitutes and complements.

The model's fourth empirical implication builds upon the previous three and concerns the existence of temporal dynamics in governments' war finance strategies.

Implication 4: A government's finance strategy will almost always vary during an interstate war.

The model indicates a government's finance strategy will remain constant over the course of an interstate war in only the rarest of circumstances. The optimal use of a finance option in a given period is jointly determined by the relative efficiency of all finance options and level of mobilization. Accordingly, a government's optimal finance strategy is the same in periods 1 and 2 if and only if the total mobilization of resources and the relative efficiency of reducing non-military spending, raising taxes, increasing debt, and printing money all remain constant. More formally,

$$f_i^{1^*} = f_i^{2^*} \text{ iff } l_i^1 = l_i^2 \wedge \nu_i^1 = \nu_i^2 \wedge \tau_i^1 = \tau_i^2 \wedge \delta_i^1 = \delta_i^2 \wedge \mu_i^1 = \mu_i^2 \tag{11}$$

A government's war finance strategy will exhibit temporal dynamics unless Equation 11 holds. This would seem to be a high bar to clear, as it is unlikely that the relative attractiveness of all finance methods, the severity of fighting, and public support for a conflict will remain constant over the course of an interstate war. As described above, the issue of dynamic variation in war finance strategies has not been addressed in the literature. The model then suggests scholars have overlooked the existence of intra-war variation in the use of finance methods in their theoretical arguments and misspecified their empirical models.

The model's empirical implications speak to general patterns of interstate war finance. A strength of the model is that it can also provide insight into governments' optimal finance strategies in particular circumstances as finance methods become more or less costly and/or the size of a war effort changes. The next section demonstrates this with a set of brief case studies of how the United States financed its participation in the Spanish-American War, World War II, and Vietnam War.

4 U.S. Financing of the Spanish-American War, World War II, and Vietnam War

The model provides a general framework with which one can analyze governments' use of reductions in non-military expenditures, higher taxes, increased debt, and monetary policy to finance interstate wars. I first describe how the U.S. paid for its participation in the Spanish-American

War, World War II, and Vietnam War and then discuss how American finance strategies in these wars fit with the model developed here.

While general relations between the two countries had been souring for some time, the Spanish-American War lasted less than a year (January 3, 1898 through August 12, 1898 per MID4 (Palmer et al. 2015)), with fighting limited to between May and late July. Involvement in the Spanish-American War was associated with a $144 million increase in U.S. military spending from 1897 to 1898 (Correlates of War 2010), equal to $3.3 billion in 2009 dollars.[8] Rockoff (2012) estimates the war resulted in $274 million of "extra" spending on the U.S. army and navy in 1898 and 1899 (equal to $6.3 billion in 2009 dollars). President McKinley largely paid for the Spanish-American war with two acts, one before and the other shortly after the fighting began (Rockoff 2012, pgs. 57-58). First, following the explosion of the U.S.S. Maine on February 15th, Congress unanimously appropriated an additional $50 million in defense spending ($1.1 billion in 2009 dollars). Second, the War Revenue Act, passed on June 13th, increased sin taxes on, among other things, tobacco, alcohol, bowling alleys, and pool rooms; inheritance taxes; and stamp taxes. Rockoff (2012, pgs. 59-60) estimates that these taxes raised $226 million over two years ($5.1 billion in 2009). The remainder of the war was paid for through a combination of debt ($200 million worth of bonds), printing money ($12 million) and reducing non-military spending by $67 million (respectively, $4.6 billion, $274 million, and $1.5 billion in 2009 dollars).[9] Thus, even in a short interstate war with a small mobilization, the United States relied on each of the four war finance methods.

The United States formally entered World War II on December 8, 1941 and ceased fighting on V-J Day, August 15, 1945. The United States' effort in World War II represents the single largest mobilization for war in history. Compared to 1940, U.S. military spending increased by 67% in 1941 (to $20 billion), another 256% in 1942 (to $73 billion), and continued to increase until it reached $875 billion in 1945.[10] The Correlates of War data indicate the United States spent approximately

[8]Unless otherwise noted, figures on war finance options and military spending come from the website associated with the Federal Reserve Bank of St. Louis (Federal Reserve Bank of St. Louis 2015*a*). More specifically, we use the following series from FRED: non-military spending - FNDEFX; tax revenue - W006RC1Q027SBEA; debt - FGDSLIQ027S; inflation - CPIAUCSL; money base - AMBSL; military spending - A824RC1. Current dollars were converted to constant dollars using the GDP deflator series GDPDEF.

[9]The amounts of debt and printing money reported here come from Rockoff (2012, pgs. 60-61). Non-military spending are from Carter et al. (2006).

[10]Figures in constant 2009 U.S. dollars.

$2.9 trillion dollars on military spending between 1940 and 1945. This is a conservative estimate of what the U.S. spent on the war: Bank, Stark and Thorndike (2008) estimate the cost at $4.8 trillion (constant 2003 dollars), Rockoff (2012, pg. 217) puts the cost at $3.3 trillion (in 2009 U.S. dollars), and Daggett (2010) estimates the cost at $4.1 trillion (in 2011 U.S. dollars).

Paying for "The Arsenal of Democracy" required the use of each war finance option. Beginning with the War Revenue Act passed on June 25, 1940, Congress raised personal and corporate income taxes, excise taxes, and implemented and then raised an "excess profits" tax (which topped out at 95% in 1943) during World War II (Bank, Stark and Thorndike 2008, pgs. 83-108). The bulk of tax revenue was raised through increases in personal income taxes. To give some sense of the increase, Rockoff (2012) notes that "For a family earning the equivalent of $50,000 in 2010 dollars, for example, the marginal rate went from 0.04 in 1939 to 0.29 in 1944" (pg. 165). By the end of the war, personal income taxes provided 40% of federal revenue (Bank, Stark and Thorndike 2008, pg. 80). All told, Rockoff (2012) and Capella (2013) estimate that the United States paid for approximately half of World War II through taxes.

The United States could not rely on taxes alone to pay for World War II. U.S. debt rose from $630 billion in 1939 to $2.6 trillion in 1945 (in constant 2009 dollars) (Global Financial Data 2012). This debt was financed through a combination of long-term bonds (approximately 50%), short-term securities (roughly 30%) and savings bonds (about 20%) (Rockoff 2012, pg. 167). The United States also resorted to printing money in order to help finance the war effort. The Federal Reserve helped pay for mobilization in two ways. First, it engaged in direct money creation by purchasing approximately $22 billion dollars in bonds (equivalent to roughly $228 billion in 2009 dollars) during the war according to Friedman and Schwartz (1963).[11] Second, the Federal Reserve also indirectly created $72.7 billion dollars (approximately $755 billion in 2009 dollars) to help finance the war effort (Friedman and Schwartz 1970). Finally, the United States dramatically reduced non-military spending during World War II. According to Carter et al. (2006), the U.S. federal government spent approximately $96 billion (constant 2009 dollars) on non-military expenditures in 1940. Non-military spending was reduced to $85 billion in 1941 and continued to be cut until it

[11] Constant dollar calculation based on average GDP deflator between 1941 and 1945.

reached \$26 billion in 1945, a 73% reduction from 1940 levels.

With 58,220 official fatalities (DeBruyne and Leland 2015), the Vietnam War represents the United States' most severe interstate conflict in the post-World War II period. While its involvement in Vietnam began under the Kennedy administration and ended with fall of Saigon on April 30, 1975, the MID project identifies the United States as a participant in the war from February 23, 1964 until January 27, 1973 (Palmer et al. 2015). The American mobilization effort was large and varied over the course of the Vietnam War. Compared to its expenditures in 1963, U.S. military spending was, on average, 15% higher during the war (\$332 million versus \$289 million in constant 2009 dollars). Rockoff (2012) estimates that, overall, the United States spent \$542 billion (in 2008 dollars) fighting the Vietnam War (pg. 295).[12] However, focusing on average annual or total military spending masks important dynamics in the United States' war effort. Specifically, U.S. military spending peaked in 1968 and then steadily declined until the U.S. exited the war in 1973.

The United States paid for the Vietnam War with a combination of printing money, debt, and taxes. Largely due to the influence of Keynesian economic advisors in the Kennedy Administration, the Federal Reserve began to increase the money supply in late 1961 to help combat unemployment and finance the deficit, a pattern that would continue through the rest of the decade (Rockoff 2012, pgs. 289). Converting data from the Federal Reserve (2015*b*) to constant 2009 dollars, the money supply in January 1961 was \$225 billion, \$244 billion in February 1964, \$274 billion in March 1968 (the quarter in which military spending was at its highest during Vietnam), and \$296 billion in January 1973. Overall, Capella (2013) estimates the United States financed approximately 60% of its mobilization in Vietnam through printing money (pg. 7). One of the things the Federal Reserve's decision to print money did for the United States, at least initially, was allow it to pay for Vietnam through deficit spending. The U.S. national debt grew 6% during the Vietnam War, from \$1.03 trillion to \$1.1 trillion (in 2009 dollars) (Global Financial Data 2012).

Inflationary monetary policy and deficit spending were not sufficient to pay for Vietnam, though. Despite his best efforts to avoid it, President Johnson eventually reconciled himself to the need for a tax increase to help finance the war. At Johnson's urging, Congress passed a 10% "surcharge" on

[12]This figure represents the cumulative difference in actual military spending and "baseline spending" between 1966 and 1973, with baseline spending defined by the mean of 1965 and 1974 military expenditures.

personal and corporate income taxes on June 21, 1968. To put this tax increase into context, "the Revenue and Expenditure Control Act of 1968 represented the largest single-year tax increase in U.S. history since the end of World War II, outstripping each of the three tax bills enacted during the Korean War," (Bank, Stark and Thorndike 2008, pg. 136). President Nixon extended the surcharge in July 1969, though the 10% increase was later reduced to 6% beginning on January 1, 1970 (Bank, Stark and Thorndike 2008, pg. 139).

The Spanish-American War, World War II, and the Vietnam War vary in important ways. They differ dramatically in their duration, level of mobilization, and, in some ways, the finance strategies used to pay for the United States' war efforts. The theoretical model developed above nicely captures two aspects of the United States' war finance strategies that existing scholarship struggles to explain. First, the United States relied on multiple finance methods to pay for their involvement in each war. The United States reduced non-military spending, raised taxes, increased the debt, and printed money to pay for the Spanish-American War and World War II and engaged in the latter three finance methods in the Vietnam War. That the U.S. used multiple finance methods to pay for World War II and Vietnam War is unsurprising given the level of mobilization required to fight each war. More problematic for the existing literature, though, is the fact that the United States used each finance option in the Spanish-American War. Because the war was short and required a relatively small mobilization of economic resources, the U.S. government essentially financed the entire war effort in a single shot. Thus, how the United States paid for the Spanish-American War matches previous scholarship's implicit model of finance in that a government was able to pay for an interstate war with the same finance strategy throughout the conflict. However, the U.S. government made use of each of the four primary methods of finance to pay for the Spanish-American War, something not considered by research that focuses on individual finance options in isolation. In contrast, the model developed here indicates governments will use multiple finance methods to pay for an interstate war when doing so is less costly, in either an economic or political sense, than using a single method. This was the case with the Spanish-American War. While the war was financed primarily through taxes, McKinley did not think the American people would be willing to endure a tax increase large enough to pay for the entire war effort. He therefore decided to supplement the increase in taxes with a reduction in non-military spending, increased borrowing, and printing money (Rockoff 2012). The model therefore captures why the United States used each of the four finance methods to pay for the relatively short and small Spanish-American War.

Second, the United States' war finance strategies changed over the course of World War II and the Vietnam War. Importantly, these changes track closely with the level of mobilization and the relative costs of finance options. As discussed above, the patterns of mobilization in World War II and Vietnam were very different. The United States consistently increased military spending throughout World War II. These increases in spending were matched with consistent increases in the extent to which the United States made use of each finance option. From 1941 to 1945, non-military spending was reduced from $85 billion to $26.4 billion, taxes increased from $100 billion to $439 billion, the debt increased from $539 billion to $1.5 trillion, and the money supply went from $17 billion to $32 billion.[13] In contrast to World War II, the economic mobilization for Vietnam was uneven. Military spending increased from $379 million in the second quarter of 1964 until it peaked in the first quarter of 1968 at $495 million, at which point it declined, although not monotonically, until it reached $401 million at the end of the war in the first quarter of 1973. While the money supply increased throughout Vietnam (from $249 million to $305 million), the changes in taxes revenue and debt mirrored military spending. Tax revenue rose from $465 billion in the second quarter of 1964 to $689 in the second quarter of 1969 before declining, again non-monotonically, to $652 billion. Similarly, U.S. debt rose from $1.46 trillion in the second quarter of 1964, peaked at $1.51 trillion in the first quarter of 1968, and then declined non-monotonically to $1.48 trillion at the end of the war.

Patterns of U.S. tax revenue and debt are correlated with military spending during the Vietnam War, which speaks to the model's result that levels of mobilization and the use of finance methods are complementary (Implication 4). Importantly, the model can capture this dynamic and the fact that the United States made more extensive use of the more political costly finance option of taxation only when it could not sufficiently fund the war effort with the less costly options. From the beginning of his Presidency, Johnson wanted to avoid raising taxes to pay for the Vietnam

[13] All figures in constant 2009 dollars.

War because he thought doing so would spell the end of his Great Society programs.[14] He was able to achieve this by largely financing the war through inflationary monetary policy and debt for most of his presidency. However, the fear of rising inflation ultimately led Johnson to start pushing for a tax increase to fund the escalation in Vietnam in January of 1967 (Rockoff 2012, pgs. 287-288). That is, Johnson was able to maintain his unwillingness to pay for the war with higher taxes until the high political costs of inflation reduced the attractiveness of financing Vietnam by printing money.[15] These changes imply the United States should have increased the proportion of the war effort funded through taxes relative to the proportion financed by printing money. Bank, Stark and Thorndike (2008), Rockoff (2012), and Capella (2013) report that this is precisely what occurred. The model therefore accounts for variation in the overall and relative uses of taxes, debt, and the printing press by the United States to pay for its mobilization efforts over the course of the Vietnam War.

5 Conclusion

This paper develops a general model of interstate war finance that allows governments to use multiple methods to pay for a war and the use of particular war finance options and overall finance strategies to vary over the course of a conflict. The model implies the use of finance options are inherently related to one another, collectively substitutable for a given level of war effort, and complementary with respect to the total level of war effort. Further, because a government's optimal finance strategy is jointly determined by the total level of war effort and the relative efficiency of each finance method, finance strategies will almost always vary over the course of an interstate war. Ananalysis of how the United States paid for the Spanish-American War, World War II, and Vietnam War demonstrates the model's advantages over existing theoretical accounts of interstate war finance. I conclude with a discussion of three ways the theoretical framework developed here can inform empirical research on patterns of war finance.

[14] Bator (2008) offers a particularly nice treatment of Johnson's efforts to simultaneously finance the Vietnam War and the Great Society. See also Bank, Stark and Thorndike (2008), Rockoff (2012), and Capella (2013).

[15] In terms of the model, the relative efficiency of printing money (μ_i^p) decreased and the relative efficiency of increasing taxes (τ_i^p) increased.

First, the model's most general empirical implication indicates the extent to which any given finance option is used is related to the extent other finance methods are used. This interdependence has been ignored, or at least minimized, by scholars of interstate war finance. However, the model developed here implies quantitative assessments of war finance should jointly estimate patterns of non-military spending, taxation, debt, and the money supply/inflation. Analysts that fail to do so are getting only a partial picture of how governments pay for their interstate wars, at best.

Second, the model implies the comparative use of given finance options is driven by their relative efficiency compared to other finance options. This has numerous implications for empirical research. For example, recent research investigates how domestic politics can affect the use of particular finance methods (e.g., Flores-Macías and Kreps 2013), but does not consider the theoretical interdependence among finance options identified here. It is generally thought that "right" governments are more opposed to tax increases than "left" governments while left governments are more open to inflation than right governments (e.g., Fordham 1998). The model developed here, then, suggests that right governments should finance less of their interstate war efforts through taxes and/or inflationary monetary policy and more through debt and reductions in non-military spending while the opposite is true of left governments.

Finally, perhaps the model's most important result indicates finance strategies should rarely be constant over the course of an interstate war. Indeed, governments' optimal finance strategies will vary unless the severity of a conflict, popularity of a conflict, and relative efficiency of each finance method *all* remain the same throughout a war. This has both substantive and methodological implications. Substantively, the model suggests scholars would be well served to consider intra-war variation in, say, interest rates or the popularity of a conflict or a particular finance method. Methodologically, the model implies analysts need to think carefully about the interdependent and dynamic data generating processes that underlie how governments pay for their interstate wars.

Fighting an interstate war is one of the costliest decisions a political leader can make. Scholars have long recognized the importance of material capabilities to the onset, prosecution, and outcome of wars, but often ignored how states obtain the seemingly infinite money required to wage war. While research on interstate war finance is more common now than in the past, existing scholarship largely overlooks the interdependent and dynamic nature of governments' war finance strategies. This article provides a framework with which to consider these issues and, hopefully, will inform future research on a topic central to understanding interstate conflict processes.

6 Appendix

The model's set-up is described fully in the main text. Here, I provide the proof for the only screening equilibrium that results in multiple battles.

Proof of Proposition 1. G_1's goal is to maximize the concessions from G_2 in each period. It does this by making a series of progressively smaller demands that ensure a given type of G_2 will be forced to concede to the worst possible deal it prefers to fighting. If $w > a > s$, G_1 demands $x^{1*} = c^o_{2w} + c^o_{2a} + c^o_{2s} + c^{f1}_2 + c^{f2}_2 + c^{f3}_2$, $x^{2*} = c^o_{2a} + c^o_{2s} + c^{f2}_2 + c^{f3}_2$, and $x^{3*} = c^o_{2s} + c^{f3}_2$. This set of demands guarantees weaker types of G_2 never get more than the minimum bargain they prefer to fighting because, as demonstrated below, x^{1*} makes G_{2w} indifferent from accepting and rejecting the demand in period 1, x^{2*} makes G_{2a} indifferent from accepting and rejecting the demand in period 2, and x^{3*} makes G_{2s} indifferent from accepting and rejecting the demand in period 3. Accordingly, these demands maximize the concessions G_1 can hope to obtain from each type of G_2.

We begin with the weakest type of G_2. G_{2w} will accept x^1 instead of financing and fighting a battle in period 1 and then accepting x^2 iff $EU(a|x^1) \geq EU(a|x^2) \Rightarrow 1 - x^1 \geq 1 - x^2 - c^o_{2w} - c^{f1}_2$. Given x^{1*} and x^{2*}, G_{2w} accepts x^{1*} iff:

$$1 - c^o_{2w} - c^o_{2a} - c^o_{2s} - c^{f1}_2 - c^{f2}_2 - c^{f3}_2 \geq 1 - c^o_{2w} - c^o_{2a} - c^o_{2s} - c^{f1}_2 - c^{f2}_2 - c^{f3}_2$$

Thus, G_{2w} prefers to accept x^{1*} over rejecting it, fighting a battle in period 1 and accepting x^{2*}. G_{2w} will accept x^1 instead of fighting in periods 1 and 2 and accepting x^3 iff $EU(a|x^1) \geq EU(a|x^3) \Rightarrow 1 - x^1 \geq 1 - x^3 - 2c^o_{2w} - c^{f1}_2 - c^{f2}_2$. Given x^{1*} and x^{3*}, G_{2w} accepts x^{1*} iff:

$$1 - c^o_{2w} - c^o_{2a} - c^o_{2s} - c^{f1}_2 - c^{f2}_2 - c^{f3}_2 \geq 1 - 2c^o_{2w} - c^o_{2s} - c^{f1}_2 - c^{f2}_2 - c^{f3}_2$$

As $c^o_{2w} > c^o_{2a}$, G_{2w} prefers accepting x^{1*} to x^{3*}. The expected utility to G_{2w} for rejecting x^{3*} and fighting a third battle is $1 - 3c^o_{2w} - c^{f1}_2 - c^{f2}_2 - c^{f3}_2$. As $c^o_{2w} > c^o_{2a} > c^o_{2s}$, it follows that G_1 prefers to accept $x^{1*} = c^o_{2w} + c^o_{2a} + c^o_{2s} + c^{f1}_2 + c^{f2}_2 + c^{f3}_2$ than reject x^{1*}, x^{2*}, and, x^{3*} and pay the cost of financing and fighting three battles against G_1. Next, consider G_{2a}'s behavior. G_{2a} will reject x^{1*} in favor of fighting a battle and accepting x^{2*} iff $EU(a|x^2) \geq EU(a|x^1) \Rightarrow 1 - x^2 - c^o_{2a} - c^{f1}_2 \geq 1 - x^1$. Given x^{1*} and x^{2*}, G_{2a} rejects x^{1*} in favor of x^{2*} iff:

$$1 - (c^o_{2a} + c^o_{2s} + c^{f2}_2 + c^{f3}_2) - c^o_{2a} - c^{f1}_2 \geq 1 - c^o_{2w} - c^o_{2a} - c^o_{2s} - c^{f1}_2 - c^{f2}_2 - c^{f3}_2$$
$$\Rightarrow c^o_{2a} \leq c^o_{2w}$$

As this is true by definition, G_{2a} prefers to reject x^{1*} and fight a battle in period 1 and then accept x^{2*}. G_{2a} will prefer to accept x^{2*} than reject it and fight a battle in period 2 before accepting x^{3*} iff $EU(a|x^2) \geq EU(a|x^3) \Rightarrow 1 - x^2 - c^o_{2a} - c^{f1}_2 \geq 1 - x^3 - 2c^o_{2a} - c^{f1}_2 - c^{f2}_2$. Given x^{2*} and x^{3*}, G_{2a} accepts x^{2*} in favor of x^{3*} iff:

$$1 - 2c^o_{2a} - c^o_{2s} - c^{f1}_2 - c^{f2}_2 - c^{f3}_2 \geq 1 - (c^o_{2s} + c^{f3}_2) - 2c^o_{2a} - c^{f1}_2 - c^{f2}_2$$
$$\Rightarrow 1 - 2c^o_{2a} - c^o_{2s} - c^{f1}_2 - c^{f2}_2 - c^{f3}_2 \geq 1 - 2c^o_{2a} - c^o_{2s} - c^{f1}_2 - c^{f2}_2 - c^{f3}_2$$

Thus, G_{2a} prefers to accept x^{2a} to rejecting it and financing and fighting a battle in period 2 and accepting x^3. Given that rejecting x^{3*} and fighting a battle in period 3 is equal to $1 - 3c^o_{2a} - c^{f1}_2 - c^{f2}_2 - c^{f3}_2$ and $c^o_{2a} > c^o_{2s}$, G_2, prefers to accept $x^{2*} = 1 - 2c^o_{2a} - c^o_{2s} - c^{f1}_2 - c^{f2}_2 - c^{f3}_2$, than reject it and x^{3*} and fight a battle in period 3.

Finally, consider the decisions of G_{2s}. G_{2s} will prefer to accept x^{3*} than reject it and finance and fight a battle in period 3 iff $EU(a|x^3) \geq EU(r|x^3) \Rightarrow 1-x^3-2c^o_{2s}-c^{f1}_2-c^{f2}_2 \geq 1-3c^o_{2s}-c^{f1}_2-c^{f2}_2-c^{f3}_2$. Given x^{3*}, G_{2s} will accept x^{3*} iff

$$1-(c^o_{2s}+c^{f3}_2)-2c^o_{2s}-c^{f1}_2-c^{f2}_2 \geq 1-3c^o_{2s}-c^{f1}_2-c^{f2}_2-c^{f3}_2$$
$$\Rightarrow 1-3c^o_{2s}-c^{f1}_2-c^{f2}_2-c^{f3}_2 \geq 1-3c^o_{2s}-c^{f1}_2-c^{f2}_2-c^{f3}_2$$

This must be true. G_{2s} will prefer to accept x^{2*} than reject it and fight and finance a battle in period 2 before accepting x^{3*} iff $EU(a|x^2) \geq EU(a|x^3) \Rightarrow 1-x^2-c^o_{2s}-c^{f1}_2 \geq 1-x^3-2c^o_{2s}-c^{f1}_2-c^{f2}_2$. Given x^{2*} and x^{3*}, G_{2s} will accept x^{2*} iff

$$1-(c^o_{2a}+c^o_{2s}+c^{f2}_2+c^{f3}_2)-c^o_{2s}-c^{f1}_2 \geq 1-3c^o_{2s}-c^{f1}_2-c^{f2}_2-c^{f3}_2$$
$$\Rightarrow 1-c^o_{2a}-2c^o_{2s} \geq 1-3c^o_{2s}$$

As $c^o_a > c^o_s$, G_{2s} prefers to reject x^{2*} and finance and fight a battle in period 2 before accepting x^{3*} than to accept x^{2*}. Last, consider G_{2s}'s expected utility for accepting x^{1*} vs x^{3*}. G_{2s} will accept x^{1*} iff $EU(a|x^1) \geq EU(a|x^3) \Rightarrow 1-x^1 \geq 1-x^3-2c^o_{2s}-c^{f1}_2-c^{f2}_2$:

$$1-c^o_{2w}-c^o_{2a}-c^o_{2s}-c^{f1}_2-c^{f2}_2-c^{f3}_2 \geq 1-3c^o_{2s}-c^{f1}_2-c^{f2}_2-c^{f3}_2$$
$$\Rightarrow 1-c^o_{2w}-c^o_{2a}-c^o_{2s} \geq 1-3c^o_{2s}$$

As $c^o_w > c^o_a > c^o_s$, G_{2s} prefers to accept x^{3*} over x^{1*}.

Given the above, the following is a screening perfect Bayesian equilibrium in pure strategies if $w > a > s$. G_1 demands $x^{1*} = c^o_{2w}+c^o_{2a}+c^o_{2s}+c^{f1}_2+c^{f2}_2+c^{f3}_2$, $x^{2*} = c^o_{2a}+c^o_{2s}+c^{f2}_2+c^{f3}_2$, and

$x^{3*} = c^o_{2s} + c^{f3}_2$. G_{2w} accepts x^{1*} and the game ends in period 1 without a battle. G_{2a} rejects x^{1*}, G_1 and G_{2a} choose their optimal finance strategies f^{1*}_1 and f^{1*}_2 and fight a battle in period 1, G_{2a} accepts x^{2*}, and the game ends in period 2. G_{2s} rejects x^{1*}, G_1 and G_{2s} choose their optimal finance strategies f^{1*}_1 and f^{1*}_2 and fight a battle in period 1, G_{2s} rejects x^{2*}, G_1 and G_{2s} choose their optimal finance strategies f^{2*}_1 and f^{2*}_2 and fight a battle in period 2, G_{2s} accepts x^{3*}, and the game ends in period 3. ■

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