The Dynamics of Interstate War Finance

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Abstract

Governments pay for interstate war through a combination of reductions in non-military spending, higher taxes, increased debt, and printing money. We formally develop a general framework that identifies the relative extent to which governments will make use of each finance option and how a government's finance strategy will change over the course of an interstate war. Contrary to existing research on the topic, our model implies that the extent to which a government uses a given finance option is never independent of its uses of other finance options, the use of all finance options are complementary with respect to the level of war finance, and typically vary over the course of a war. Quantitative and qualitative analyses of patterns of U.S. war finance from 1816 to 2014 are largely consistent with the model's expectations.

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Whether and how a government wages interstate war is intimately related to its ability to pay for the war. Reflecting on this issue in 1502, Robert de Balsac noted that "most important of all, success in war depends on having enough money to provide whatever the enterprise needs" (quoted on page 84 of Tilly 1992). Fifteen hundred years earlier, Cicero famously claimed that "the sinews of war are infinite money" (among other sources, quoted in Rockoff (2012, pg. 1) and Poast (2015, pg. 63)). International relations scholars generally agree that governments' potential and/or actual war materiel 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). Systematic research on how governments finance the resources that shape the characteristics of interstate war, though, has lagged behind. Thus, we know that 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 obtain the seemingly infinite amount of money needed to finance 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). Increasingly scholars are analyzing governments' use of these war finance options (Schultz and Weingast 2003, Slantchev 2012, Flores-Macías and Kreps 2013). Almost without exception, research in this developing literature shares three characteristics. First, if the theoretical relationships among multiple finance options are considered, scholars argue the use of a particular finance option implies a trade-off in the use of other finance options (e.g., Flores-Macías and Kreps 2013). Second, scholars empirically assess the extent to which governments use a single interstate war finance option and find evidence in support of their arguments (among others, Schultz and Weingast 2003). Third, scholars treat interstate war finance as a discrete event in which a government decides how it will pay for its war effort before fighting begins and its finance strategy remains constant until hostilities end (Shea 2014, Poast 2015).

The picture of interstate war finance yielded by existing scholarship is in tension with itself and at odds with the historical record. There exists systematic evidence of governments paying for 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), yet theoretical explanations often argue that the use of each finance option implies the non-use of the other finance options. Further, existing scholarship assumes that patterns of war finance are constant during a war, but governments often alter their finance strategies over the course of an interstate war. For example, while its use of inflationary monetary policy was a near constant throughout the war, the United States' use of taxes to finance its war effort varied considerably during the Vietnam War (Rockoff 2012). These divides between theoretical expectations and the empirical record suggest that, while informative, existing scholarship on interstate war finance provides an incomplete account of how governments pay for their wars.

We develop a model of interstate war finance that accounts for governments' ability to fund an interstate war effort using multiple options and to alter their overall finance strategy over the course of a war. We argue that a government's use of a given finance option is a function of the total amount of resources a government allocates to a war effort and its relative political and economic costs compared to other finance options. A government's war finance strategy will vary over the course of a war if the resources required to fight or the relative efficiency of the possible finance options change. Our theoretical approach therefore allows for both interdependence and temporal dynamics in that a governments' use of a given finance option is related to its use of other finance options and its overall finance strategy can vary during a war.

We develop our theoretical argument 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. The model yields expectations about interstate war finance in general and can be used to explain governments' finance strategies in particular cases. We derive three general empirical expectations about patterns of war finance. First, the use of a given finance option is never independent of the use of the other finance options. Second, 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. Third, under all but the most restrictive conditions, governments' finance strategies will vary over the course of an interstate war. What the model implies for 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.

The nature of the formal model's equilibrium results precludes the possibility of directly assessing the model's implications with a single test. Our empirical strategy has four parts. The first uses a Vector Autoregressive (VAR) model to estimate whether non-military spending, taxation, debt, and inflationary monetary policy are independent of one another, partially endogenous, or fully endogenous. The second estimates whether the use of war finance methods systematically vary over the course of interstate wars within the context of a VAR model. Our third set of analyses estimate whether particular interstate war finance options are substitutes, complements, or independent of other war finance options and whether these relationships change with the level of economic mobilization for war. This is done by calculating the correlation between pairs of war finance options over time using a Dynamic Conditional Correlation (DCC) model and then modeling the dynamic correlations among pairs of finance options as a function of interstate war participation and level of war mobilization. The VAR and DCC models require relatively long time series to produce reliable estimates (Lebo and Box-Steffensmeier 2008, Box-Steffensmeier et al. 2015, Enders 2004). The degree of missingness in cross-national economic data sets especially over time precludes us from conducting time-series cross-sectional analyses. We therefore analyze how the United States has financed the interstate wars it has fought since 1816. The final part of our empirical strategy is a set of brief qualitative analysis of how the United States paid for its involvement in the Spanish-American War, World War II, and the Vietnam War.

Each of our empirical analyses offers support for the formal model's implications. The VAR models indicate that *all* of the interstate war finance options are statistically related to one another. This implies that scholars, at a minimum, need to consider how finance options are related to one another. More pointedly, our results suggest quantitative models of interstate war finance that do not estimate the use of finance options as a function of one another are misspecified. We find that patterns of non-military spending, taxes, and military spending, which measures the level of economic mobilization for war, vary over the course of interstate war. This implies that existing scholarship has ignored systematic variation in finance strategies within interstate wars.

Our analysis of how the finance methods are related to one another indicate that the extent to which reducing non-military spending and raising taxes and raising taxes and increasing debt are complementary to one another is increasing in the United States' mobilization effort. Finally, our qualitative assessment of U.S. interstate war finance is consistent with the formal model. The United States' use of finance methods is complementary and driven by their relative costs and level of mobilization for war.

The remainder of the manuscript proceeds as follows. We first review existing literature on how governments pay for their interstate wars. We then develop our argument with a bargaining model that requires governments to finance a series of battles if they fail to reach a negotiated agreement. The third section derives a set of empirical predictions from the formal model. The fourth reports our analyses of U.S. interstate war finance. We conclude with a brief review of our findings and contribution.

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 is typically associated with the idea of a "guns-versus-butter" trade-off between military and social spending (e.g., Sprout and Sprout 1968, Garfinkel 1994). 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, even assuming a fixed budget, 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, infrastructure projects, bureaucrats' salaries, or other expenditures not marked for the social welfare state. Consistent with this idea, Carter and Palmer (Forthcoming) find that both democracies and dictatorships allocated fewer resources to non-military spending during interstate wars between 1950 and 2007.

Reducing non-military spending offers governments a way to pay for an interstate war with the economic resources they already possess. Of course, governments can and do finance wars by increasing the pool of available resources (Rasler and Thompson 1985). There are three commonly used methods through which governments raise additional resources to pay for a war effort. The first is increasing tax revenue (Peacock and Wiseman 1961, Bank, Stark and Thorndike 2008, Flores-Macías and Kreps 2013). Raising taxes arguably is the most traditional way governments pay for war (e.g., Tilly 1992). There are two problems with this historical finance option for survival-motivated political leaders. First, raising taxes is politically unpopular (among others, Ladd et al. 1979). Second, the amount of 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, a number of governments finance their war efforts at least partially through taxes. Flores-Macías and Kreps (2013) find that U.S. Presidents hailing from the "pro-tax" party were more likely to use a dedicated war tax to help pay for a conflict. More generally, 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 that 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 (Slantchev 2012, Shea 2014). However, access to international credit markets and the cost of borrowing varies with lenders' expectations that a state will repay its debts (Schultz and Weingast 2003, 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 interstate war by printing more money (Rasler and Thompson 1985, Capella 2013). Generally speaking, though, governments have 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 (Gasiorowski 1995, 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 either increasing and collecting 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.

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, more commonly, argue that finance options are substitutes. For example, Slantchev (2012) and Shea (2014) argue that governments should pay for war by borrowing money instead of increasing taxes while Flores-Macías and Kreps (2013) claim that borrowing money reduces the need for governments to raise taxes. Capella (2013, pg. 20) argues there should be a trade-off between financing interstate wars through 1) taxation and 2) debt, inflationary monetary policy, and external support. Thus, theoretical accounts of interstate war finance typically argue for the existence of explicit trade-offs between finance options. Second, there exists some evidence of the use of each finance option. Research suggests that 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 that the use of any given finance option implies that other finance options will not be used.

The third observation is that existing research treats the use of a given finance option as a discrete event that uniformly operates throughout a war. Scholars implicitly assume that leaders, governments, central banks, lenders, and/or any other relevant actors choose to re-distribute government spending, raise taxes, borrow money, and/or print money in order to finance a war effort, and then the war effort is funded as long as hostilities continue. This assumption is present in both theoretical and empirical analyses of war finance. For example, Slantchev (2012) formally demonstrates that the ability to incur debt influences the probability of war, but treats the decision to borrow money as occurring before the onset of interstate bargaining process. With respect to empirical treatments, Flores-Macías and Kreps (2013) model the implementation of new taxes to finance an interstate war as a function of a number of variables, but do not consider how a war's dynamics would influence this decision. Poast (2015) analyzes the effect of central banks on wartime interest rates using a dichotomous variable identifying whether or not a country was involved in an interstate war.

Capella (2013) represents a partial exception to the treatment of war finance as constant throughout an interstate war in two ways. First, she argues that 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 interstate war efforts. She finds that states are less likely to rely on domestic or foreign debt and more likely to rely on printing money during longer wars. While an improvement over previous research, Capella's empirical analysis is limited in what it can tell us about the temporal dynamics of interstate war finance because of the structure of her data. Capella's unit-of-analysis is interstate war-participant. This set-up precludes inferences about how the use of a given finance option or a government's overall finance strategy changes over the course of a war because her data do not vary within wars.

Existing war finance scholarship has increased our knowledge concerning 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 seeks to address these

issues by explicitly incorporating interdependence and temporal dynamics into a model of interstate war finance.

2 Interstate War Finance Dynamics

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 for the duration of a conflict. In contrast, we argue that governments will seek to finance their interstate wars as efficiently as possible and that the optimal finance strategy, in terms of the amount and mix of finance options, can vary over the course of a war. Thus, our theoretical argument allows finance options to be substitutes and/or complements and temporal variation with respect to a government's interstate war finance strategy.

Our argument is based on a set of relatively uncontroversial assumptions. We assume that waging an interstate war is associated with an increase in the economic resources dedicated to the military that is financed through some combination of reduced non-military spending, higher taxes, increased debt, and printing money (Rasler and Thompson 1985). We further assume that a government's leadership will finance their interstate wars in an efficient manner. That is, governments will make more intensive use of finance options that cost relatively less than finance options that cost relatively more.[1] We define the cost of a finance option in terms of economic and political costs. For example, the cost of financing an interstate war through debt is a function of both the interest rate at which a government borrows money and a government's domestic constituents' willingness to go into debt to pay for a war. This aspect of our theory allows our argument to speak to existing war finance research whether its micro-foundations appeal to economic costs (Schultz and Weingast's (2003) focus on interest rates), political costs (Flores-Macías and Kreps's (2013) focus on tax preferences), or a combination of both (Capella (2013)).

Where the relative efficiency of finance options determines the degree to which they are used

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

compared to one another, the level of military spending a government finances varies as a function of the intensity of fighting and the public's support for the war effort. These assumptions capture the ideas that, all else equal, more severe fighting requires a larger mobilization of resources (e.g., World War I vs. The Gulf War) and political constraints can limit the resources a government can allocate to a war (e.g., the Nixon Administration's inability to continue funding the Vietnam War in the face of domestic opposition). Importantly, we do not assume that the relative costs of particular finance options, the intensity of fighting, or public support for a war effort are constant throughout a conflict.

We develop our argument with a model of intra-war bargaining in which governments must 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 (e.g., Filson and Werner 2002, Slantchev 2003, Wolford, Reiter and Carrubba 2011). Our model abstracts away from many of the features of these and other 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 in our model (for example, Filson and Werner 2004, 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 (see Slantchev (2003) or Powell (2004)), our model takes place over a fixed number of periods (e.g., Filson and Werner 2002). The model closest to ours is the intra-war bargaining game developed by Arena (2009, pgs. 20-28). We extend Arena's model by forcing governments to choose how they will pay for the costly, non-decisive battles they fight upon failing to reach an agreement. While abstracting away from some common characteristics of other costly process models of interstate conflict, the model presented here allows us to formally analyze our primary question of theoretical interest. Figure 1 presents the extensive form of the game.

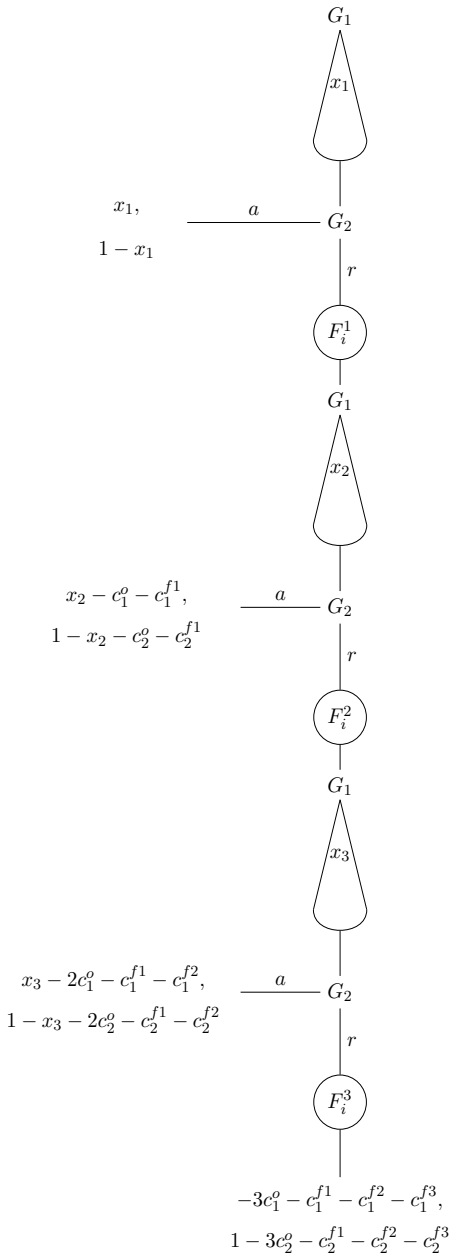

Figure 1: Extensive Form of Theoretical Model

The model assumes that 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. The level of mobilization for a given battle (l_i^p) is an increasing function of its expected severity ($s_i^p > 0$) and public support ($r_i^{f_p} > 0$) for the war, which implies the following:

$$\frac{\partial l_i^p(r_i^{l_p}, s_i^p)}{\partial s_i^{l_p}} > 0 \quad \forall\, r_i^{l_p} \tag{1}$$

$$\frac{\partial l_i^p(r_i^{l_p}, s_i^p)}{\partial r_i^{l_p}} > 0 \quad \forall\, s_i^p \tag{2}$$

G_i pays for a given level of war finance through a combination of reduced non-military spending (N), higher taxes (T), increased debt (D), and printing money (M). Thus, the level of economic mobilization in a given period is $l_i^p = n_i^p + t_i^p + d_i^p + m_i^p$. The extent to which G_i makes use of each finance option is a function of its relative efficiency or cost compared to other finance options in a given period. This captures the idea governments have multiple options with which to pay for interstate war, their overall finance strategy will rely more heavily on options that are relatively cheap than options that are relatively costly, and the cost of finance options can vary over the course of a war. Formally, this is modeled as $\pi_i^p \in \{\nu_i^p, \tau_i^p, \delta_i^p, \mu_i^p\}$, where $0 < \nu_i^p \leq 1$ represents the relative cost of n_i^p, $0 < \tau_i^p 1 \leq$ represents the relative cost of t_i^p, $0 < \delta_i^p \leq 1$ represents the relative cost of d_i^p, $0 < \mu_i^p \leq 1$ represents the relative cost of m_i^p, 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 $f_i^p = n_i^{p\nu_i^p} t_i^{p\tau_i^p} d_i^{p\delta_i^p} m_i^{p\mu_i^p}$.

We assume that fighting a battle entails two types of costs. First, and as discussed above, each government pays a financial cost each time they fight 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. More specifically, G_2 can be weak (w), average (a), or strong (s) and the non-financial cost that

G_2 pays for fighting varies with its type, such that $c^o_{2w} > c^o_{2a} > c^o_{2s}$. To simplify the analysis, we assume that the non-financial costs a given type of G_2 pays is constant across periods. G_1 thinks G_2 is weak with probability w, average with probability a, and strong with probability s, where $s = 1 - w - a$. We could allow G_1 to vary in its type and G_2 to be unsure about G_1's type, but doing so would result in a substantially more complicated model with two-sided uncertainty. Assuming that only G_2 varies in its type allows us to analyze our phenomenon of substantive interest with a relatively simple theoretical model and is consistent with most formal models of interstate conflict that include incomplete information (for a small sample, see Fearon 1995, Filson and Werner 2002, Wolford, Reiter and Carrubba 2011). If the governments fight three battles, the game ends with G_2 in possession of the good but each government having paid the financial and non-financial costs of fighting three battles.

2.1 Equilibrium Behavior

We focus our formal analysis on the model's only screening equilibrium that results in the governments financing and fighting multiple battles. For expositional purposes, we describe equilibrium behavior with a minimal amount of notation here and provide a technical proof in the appendix.

Proposition 1. 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.

Proof. See appendix.

□

G_1 believes it is unlikely to be dealing with a strong opponent (i.e., $w > a > s$) and seeks to avoid giving weaker types of G_2 more than the minimum bargain they will accept instead of fighting. By engaging in this risk-reward trade-off (Fearon 1995, Powell 2002), 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 relatively strong 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} will accept. One consequence of this strategy is that G_1 will need to finance and fight 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.[2] After each government chooses its optimal war finance strategies and fights a battle against one another in period 1, G_1 makes another demand 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 dealing with G_{2a} than G_{2s} and demanding less than x^{2*} would result in G_1 obtaining less in a negotiated 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 for period 2 and fight a battle. Upon the conclusion of the second battle, G_1 knows with certainty it is facing G_{2s} and makes a demand in the third period ($x^{3*} = c^o_{2s} + c^{f3}_2$) that will induce G_{2s} to accept a negotiated settlement instead of fighting a third battle.

Proposition 1 is the only pure strategy screening equilibrium in which governments will finance and fight multiple battles yielded by our model. To see why this is the case, 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 will accept and the game ends without a battle needing to be fought or financed. 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}

[2] We explicitly identify a government's optimal use of each finance option in a given period in the next section.

will accept and G_{2s} will reject. 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 will induce G_{2s}'s acceptance. The only other set of possible beliefs also ends after a single battle must be financed and fought. In this scenario, G_1 makes a strong demand in the first period that only G_{2w} will accept and results in battles with G_{2a} or G_{2s}. In the second period, G_1 makes a demand that will induce G_{2s} to accept a negotiated settlement instead of financing and fighting another battle. By definition, G_{2a} will accept any demand that G_{2s} will accept. Thus, Proposition 1 represents the only pure strategy, screening equilibrium of our model in which G_1 and G_2 finance and fight multiple battles. The next section derives a set of expectations about governments' optimal interstate war finance strategies.

3 Optimal Interstate War Finance

We begin by obtaining G_i's optimal war finance strategy in a given period.[3] Recall that G_i's finance strategy in period p is defined by the production function $f_i^p = n_i^{p\nu_i^p} t_i^{p\tau_i^p} d_i^{p\delta_i^p} m_i^{p\mu_i^p}$ and is subject to the budget constraint $l_i^p = n_i^p + t_i^p + d_i^p + m_i^p$. This implies the following LaGrangian function:

$$\mathcal{L}(f_i^p) = \nu_i^p \ln n_i^p + \tau_i^p \ln t_i^p + \delta_i^p \ln d_i^p + \mu_i^p \ln m_i^p + \lambda_i^p (l_i^p - n_i^p - t_i^p - d_i^p - m_i^p) \tag{3}$$

We can use Equation 3 to identify the optimal marginal provision of each war finance option in terms of the overall level of war finance and the relative efficiency of each finance option:[4]

$$n_i^{p^*} = \frac{\nu_i^p l_i^p}{\nu_i^p + \tau_i^p + \delta_i^p + \mu_i^p} \tag{4}$$

$$t_i^{p^*} = \frac{\tau_i^p l_i^p}{\nu_i^p + \tau_i^p + \delta_i^p + \mu_i^p} \tag{5}$$

[3] Our approach to identifying a state's optimal finance strategy for a given level of mobilization builds on Palmer and Morgan's (2006) model of foreign policy substitutablity.

[4] See the appendix for technical details.

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

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

Jointly, Equations 4 - 7 identify a government's optimal finance strategy in a given period and can be used to derive a number of implications about how governments pay for their interstate wars. We begin with our most straightforward and general expectation.

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

Our model indicates that governments' decisions regarding how and to what extent they should use a given finance option are not independent of their decisions regarding how and to what extent they should use 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. This is reflected in Equations 4 - 7 by the inclusion of $\nu_i^p + \tau_i^p + \delta_i^p + \mu_i^p$ in each equation's denominator. 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.

Our first empirical implication is intuitive and follows cleanly from the logic of our 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.[5] Our formal analysis indicates that the use of each war finance option is related to the use of other finance options, implying quantitative models that

[5]To our 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.

do not jointly estimate patterns of non-military spending, taxation, debt, and inflationary monetary policy are misspecified. Our second empirical implication goes beyond this claim of general interdependence and more precisely identifies the role of substitutability and complementarity in governments' optimal interstate war finance strategies.

Implication 2: While finance methods are substitutable at a given level of mobilization, the their use is complementary with respect to the level of mobilization.

There are two parts to this claim. First, our model suggests that finance methods are substitutable for any given level of war mobilization. To see how this works, 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, $l_i^{p^*} = z_i^{p^*} + e_i^{p^*} \Rightarrow$ as $z_i^{p^*} \rightarrow l_i^{p^*}$, then $e_i^{p^*} \rightarrow 0$ Thus, our model implies that finance methods are substitutes for any particular level of mobilization. This fits with most people's intuition: if you need $100 million to fight a given portion of a war, each dollar you raise through taxes is one dollar less you need to raise through reducing non-military spending, borrowing money, and inflationary monetary policy. Further, this results is consistent with how much of the literature treats interstate war finance (e.g., Flores-Macías and Kreps 2013, Poast 2015).

Our model does not suggest, though, that war finance options are purely substitutes. Instead, it implies that as the level of economic resources in a government's optimal interstate war finance strategy changes, we should see the optimal amount of resources raised through the different war finance options move in the same direction. This is reflected in Equations 4 - 7 through the appearance of l_i^p in the numerator of each equation.[6] This result captures the intuition that, all else equal, the more money a government needs to allocate to the war effort, the more resources it will raise from its different sources of war finance.

This implication of the model potentially solves the puzzle of why theoretical arguments in the literature suggest war finance options are substitutes but empirical evidence indicates that govern-

[6]Formally, $n_i^{p^*}$, $t_i^{p^*}$, $d_i^{p^*}$, and $m_i^{p^*}$ are all increasing in $l_i^{p^*} \forall f_i^{p^*}$.

ments use each of the finance options to pay for interstate war. Specifically, our model implies that 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. However, as the total size of a mobilization effort increases, the optimal amount of money a government will raise through each finance option increases. Thus, our model suggests that the existing research has overlooked the complementary nature of interstate war finance. Our third empirical implication builds upon the previous two and concerns the existence of temporal dynamics in governments' war finance strategies.

Implication 3: A government's finance strategy will likely vary during an interstate war.

In contrast to the assumption of the existing literature, our model indicates governments will maintain the same finance strategy over the course of an interstate war in only the rarest of circumstances. The optimal use of a given finance option in a given time period is jointly determined by the relative efficiency of all finance options and the overall level of mobilization (Equations 4 - 7). 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 are the same in periods 1 and 2.[7] A government's optimal war finance strategy will exhibit temporal dynamics unless all of these conditions hold. Thus, it is likely the case that scholars have assumed away important variation in their theoretical accounts of war finance and, accordingly, misspecified their empirical models.

The empirical implications derived from the model thus far speak to general patterns of interstate war finance. A strength of our model is that it can also provide insight into governments' optimal finance strategies in particular circumstances as finance methods become more or less costly, the size of a mobilization effort changes, and the interaction of these two factors. We highlight this aspect of our model in the next section.

[7]More formally, $f_i^{1^*} = f_i^{2^*}$ iff $l_i^1 = l_i^2$, $\nu_i^1 = \nu_i^2$, $\tau_i^1 = \tau_i^2$, $\delta_i^1 = \delta_i^2$, and $\mu_i^1 = \mu_i^2$.

4 Empirical Analyses

The results of our formal model are expected to obtain for all governments. Commonly used cross-national economic indicators suffer from missing data and are only available for a limited time span. Unfortunately, our statistical models require relatively long, uninterrupted series in order to produce reliable estimates, ruling out a time-series cross-sectional approach. We therefore focus our empirical analyses on the United States. Table 1 presents the interstate wars the United States fought between 1816 and 2012 and identifies the methods of finance used in each war.[8]

Table 1: Interstate War Finance Methods, United States from 1816 to 2012

	Non-Military	Taxes	Debt	Print Money
Mexican-American	X	X		
Spanish-American	X	X	X	X
World War I	X	X	X	X
World War II	X	X	X	X
Korea		X		
Vietnam		X	X	X
Gulf			X	X
Iraq			X	X
Afghanistan			X	X

X: war finance method used per Bank, Stark and Thorndike (2008), Rockoff (2012), Capella (2013), and/or U.S. historical data (sources described below).

Table 1 identifies two important characteristics of U.S. war finance. First, the United States has paid for interstate war with each finance method at some point since 1816. Second, the United States used more than one finance method in all but the Korean War. These two observations are consistent with our model, highlight the importance of considering the use of multiple finance options, and imply that war finance methods are complementary.

While Table 1 is suggestive, rigorously assessing our model's implications requires that the use of all finance options be considered jointly and that we allow for variation in how governments pay for interstate war within and across conflicts. Our empirical strategy contains four parts. The first uses vector autoregression (VAR) models to estimate whether the war finance options are

[8]Interstate war participation is based on the MID4 project (Palmer et al. 2015). Data sources for non-military spending, taxes, debt, and inflation are described below.

interdependent. The second estimates whether the use of given finance methods systematically vary over the duration of a war. Our third set of analysis estimates whether or how the nature of the relationships between war finance options (i.e., are they substitutes, complements, or independent) changes as a function of the level of mobilization. We use dynamic conditional correlation (DCC) models to estimate the correlation between pairs of finance options and then model how these dynamic correlations vary in response to war-time military spending. The final aspect of our empirical strategy uses our theoretical model to explain variation within and across the financing strategies of the United States in the Spanish-American War, World War II, and the Vietnam War.

4.1 The Interdependence of Interstate War Finance

Our theoretical model indicates that a government's decision to use any given war finance option is never independent of its decision to use other war finance options. Empirically, this implies that patterns of non-military spending, taxation, debt, and inflationary monetary policy are related to one another. We assess this claim with a VAR model. A VAR estimator is a system of equations that typically includes relatively few variables and, importantly, places very few restrictions on the possible relationships among those variables. Each equation in the VAR regresses a given variable on its past values and the past values of all of the other variables in the system. The key feature of a VAR is that each variable is treated symmetrically: the model makes no assumptions regarding the exogeneity or endogeneity of variables included in the system of equations (Enders 2004, Freeman, Williams and Lin 1989). Put differently, theory dictates which variables are included in the system of equations and the relationships among the variables are empirically tested. VAR models, therefore, are well-suited for our purpose because they allow us to explicitly assess whether the factors used to finance interstate wars are exogenous or endogenous to one another.

We use a six-equation VAR to model the relationships between *Non-Military Spending* (calculated with data from Carter et al. (2006) and Correlates of War (2010)), *Taxes* (Carter et al. 2006), *Debt* (Global Financial Data 2012), *Inflation* (Officer and Williamson 2013), *Military Spending* (Correlates of War 2010), and *GDP* (Williamson 2015) using an annual data set from 1816 to 2012. The first four of these variables represent the primary ways in which governments pay for interstate

wars. Military spending is included in the model as it directly captures the demand for each of the four finance options. GDP controls for the pool of resources a government can draw upon to pay for its war effort. We transform non-military spending, debt, taxes, military spending, and GDP into growth rates to make them stationary.[9] Inflation is stationary and therefore is not transformed.[10] A modified likelihood ratio test indicates that 5 lag lengths best fits the data.

We also include three exogenous variables in each equation. The first is *Interstate War*, coded 1 if the United States is at war per the MID4 project (Palmer et al. 2015) and 0 otherwise. The second is the variable *Pro-Tax*, which is coded 1 when the president hails from the "pro-tax" party and 0 otherwise. This variable is taken from Flores-Macías and Kreps (2013) and accounts for their finding that the President's party influences whether the U.S. passes a war tax. Flores-Macías and Kreps identify the "pro-tax" party as the Federalist, Whig or Republican Parties before 1913 and the Democratic Party on or after 1913. The final exogenous variable identifies the Cold War period. This variable takes on a value of 1 between 1947 and 1991 and 0 otherwise.

The large number of lags associated with each variable in our system of equations renders meaningless the individual coefficients, and associated statistical significance, among any of the potentially endogenous relationships in the model (Enders 2004). Instead, we assess the relationships among our variables using Granger causality tests that jointly determine whether the lags for the endogenous variables are equal to zero using Wald tests.[11] Table 2 reports the results of our Granger causality tests.[12]

Overall, there is considerable support for the first empirical proposition. Starting with the first equation, we find that growth in taxes, military spending, and inflation Granger cause growth in

[9]There is some debate about whether series need to be stationary to use a VAR model (Enders 2004). Since the purpose of the VAR is to model the interrelationships between variables, transforming non-stationary data into stationary data may change those relationships. These arguments contend that by differencing the series, the most common way to transform a non-stationary series into a stationary series, you are throwing away information. Given that inflation was already stationary, we felt it was best to transform the series so that all of the series in our equations were stationary. Additionally, the levels versions of the series show a very steep increase starting in the 1950s, suggesting a different data generating process. The growth rates of the series appear to have a similar data generating process for the entire series.

[10]We used a variety of tests to assess the stationarity of the series, including visually examining the series, auto-correlation and partial auto-correlation functions, and augmented Dicky-Fuller tests.

[11]An alternative to the Granger causality test is to perform block F-tests to jointly test if the lags are different from zero. The Granger causality and block-F tests yield similar results.

[12]Because of space concerns and our limited ability to directly interpret it, the full set of VAR results are reported in the appendix.

Table 2: Interstate War Finance Options, 1816-2012
Granger Causality Tests from VAR Model

		χ^2	p-value
Non-Military Spending Growth			
	Tax Revenue Growth	17.80	0.003
	Debt Growth	3.74	0.588
	Inflation	11.55	0.042
	Military Spending Growth	9.90	0.078
	Growth GDP	3.23	0.664
	Joint-Significance Test	56.44	0.000
Tax Revenue Growth			
	Non-Military Spending Growth	24.62	0.000
	Debt Growth	10.85	0.054
	Inflation	11.78	0.038
	Military Spending Growth	53.85	0.000
	Growth GDP	36.40	0.000
	Joint-Significance Test	185.21	0.000
Debt Growth			
	Non-Military Spending Growth	6.77	0.239
	Tax Revenue Growth	5.66	0.340
	Inflation	23.03	0.000
	Military Spending Growth	11.47	0.043
	Growth GDP	5.63	0.344
	Joint-Significance Test	60.04	0.000
Inflation			
	Non-Military Spending Growth	17.31	0.004
	Tax Revenue Growth	17.08	0.004
	Debt Growth	13.90	0.016
	Military Spending Growth	43.43	0.000
	Growth GDP	16.57	0.005
	Joint-Significance Test	113.03	0.000
Military Spending Growth			
	Non-Military Spending Growth	6.68	0.245
	Tax Revenue Growth	13.36	0.020
	Inflation	23.35	0.000
	Debt Growth	23.54	0.000
	Growth GDP	5.91	0.315
	Joint-Significance Test	82.12	0.000
GDP Growth			
	Non-Military Spending Growth	3.78	0.582
	Tax Revenue Growth	17.98	0.003
	Debt Growth	9.19	0.102
	Inflation	3.12	0.682
	Military Spending Growth	22.80	0.000
	Joint-Significance Test	51.44	0.001

non-military spending (with a p-value of 0.1 or lower). The growth in the debt and GDP do not Granger cause non-military spending. The second equation examines growth in tax revenue. We find that growth in tax revenue is Granger caused by growth in non-military spending, growth in debt, growth in taxes, inflation, and growth in GDP. In the third equation, growth in military spending and inflation Granger cause growth in debt. We find that growth in non-military spending, growth in taxes, growth in debt, growth in military spending and growth in GDP Granger cause inflation. The fifth equation models growth in military spending. Growth in taxes, growth in debt, inflation, and growth in GDP Granger cause military spending. The only set of lags that is not significantly different from zero are those for growth in non-military spending. In the sixth equation, growth in taxes, growth in debt, and growth in military expenditures Granger cause growth in GDP. Growth in non-military sending and inflation do not Granger cause GDP. Finally, Table 2 indicates that all of the variables jointly Granger cause one another. This inference follows from the statistically significant, joint Granger causality tests in each equation.

The results in Table 2 are consistent with our model's claim that the use of interstate war finance options is interdependent. This inference, though, is not necessarily obvious from a quick look at Table 2. To aid with the interpretation of our results, Figure 2 presents the statistically significant, bilateral relationships among the four interstate war finance options, military spending, and GDP yielded by the VAR model. A solid, black line with arrowheads on each end represents a fully endogenous relationship between two variables. A dashed, black line indicates a directional relationship between two variables, with an arrowhead pointing to the variable that is Granger caused by the other variable.

Figure 2 nicely highlights three aspects of our results. First, there are four completely endogenous relationships among interstate war finance options: non-military spending and taxes, non-military spending and inflation, debt and inflation, and taxes and inflation. Additionally, the relationships between military spending and taxes, military spending and debt, military spending and inflation, and taxes and GDP are fully endogenous. Second, there are two significant, directional relationships among the variables included in our theoretical model as well: debt influences taxes and military spending influences non-military spending. Third, and most importantly, all of

the interstate war finance options are at least indirectly related to one another. For example, while we find no significant, direct relationship between debt and non-military spending, changes in debt are indirectly related to changes in non-military spending through, among other pathways, their mutual relationships with military spending, inflation, and taxes. At a basic level, then, our results indicate that *all* of the primary interstate war finance options are related to one another.

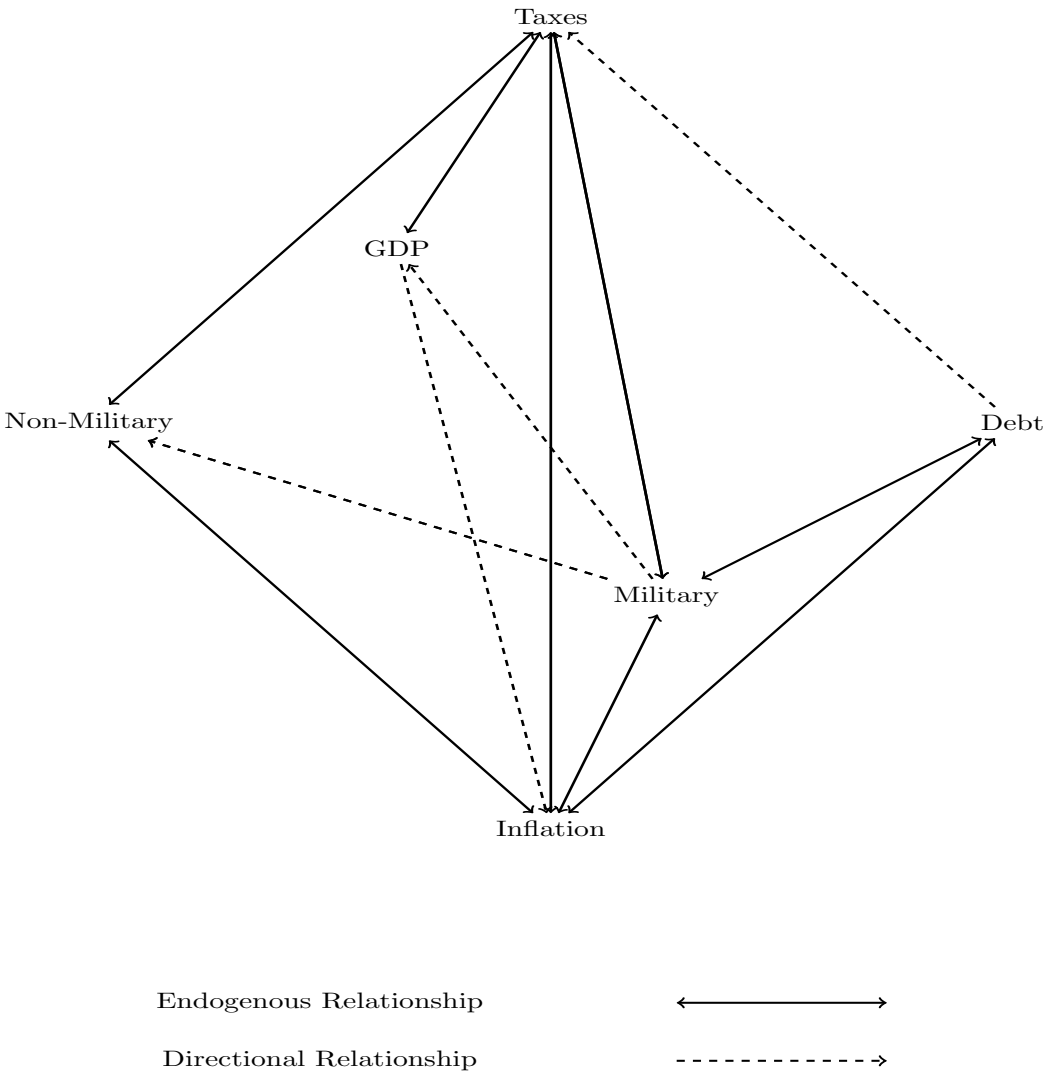

Figure 2: VAR Relationships among Interstate War Finance Options, 1816-2012.

Our VAR model also included three exogenous variables in order to estimate whether and, potentially, how involvement in an interstate war, a president from the "pro-tax" party, and the

Table 3: The Direct Effect of Interstate War on War Finance Options, 1816-2012

	Interstate War	
Equation in VAR	β	S.E.
Non-Military Spending Growth	-0.19	0.10*
Tax Revenue Growth	0.10	0.04**
Debt Growth	0.12	0.15
Inflation	0.68	0.61
Military Spending Growth	0.53	0.19**
GDP Growth	0.03	0.01**

$*p <= 0.10$, $**p <= 0.05$, $***p <= 0.001$
Results are from a 6 equation VAR estimated with interstate war, pro-tax party,and cold war as exogenous variables. The full results are reported in the Appendix.

Cold War directly affect each of our endogenous variables. We focus our discussion here on the relationship between interstate war and the endogenous variables, which is reported in Table 3.[13] U.S. involvement in interstate war was associated directly with significant decreases in non-military spending and significant increases in tax revenue, military spending, and GDP growth during the period between 1816 and 2012. These results indicate that fighting a war systematically was associated with direct changes in two of the war finance methods. This somewhat undersells the effect of interstate war, though, as these direct effects also imply significant changes in all of the other variables included in our model due to the interdependence among non-military spending, taxes, debt, inflation, military spending and GDP reported in Table 2 and Figure 2.

4.2 The Temporal Dynamics of Interstate War Finance

The results reported above support the formal model's claim that war finance options are interdependent. The VAR model they are based upon, though, does not allow for the possibility that patterns of interstate war finance vary over the course of a war. This is consistent with the existing theoretical and empirical literature, which implicitly assumes governments' finance strategies will not change during a conflict. Our formal model, though, indicates that governments' finance strategies will only remain constant throughout a war under very restrictive circumstances.

[13]The full results are reported in the appendix.

To assess whether the United States' use of particular finance options, and thus overall finance strategies, were constant throughout its interstate wars, we estimated a VAR among *Non-Military Spending*, *Taxes*, *Debt*, *Inflation*, *Military Spending*, and *GDP* that includes a count of the number of years the United States has been involved in an interstate war (*War Duration*) and its square (*War Duration*^{2}) as exogenous variables.[14] We include the squared term in order to model potential non-linearities in the use of given war finance methods. The full results of the VAR are reported in the appendix. Importantly, the interstate war finance options are fully interdependent in the model as well. We focus our discussion here on the results related to the duration of an interstate war, reported in Table 4.

Table 4: The Direct Effect of Interstate War Duration on War Finance Options, 1816-2012

	War Duration	War Duration^2
Equation in VAR	(S.E.)	(S.E.)
Non-Military Spending Growth	-0.13**	0.01
	0.06	0.01
Tax Revenue Growth	0.07**	-0.01**
	0.02	0.003
Debt Growth	0.09	-0.01
	0.10	0.01
Inflation	0.11	-0.001
	0.38	0.05
Military Spending Growth	0.31**	-0.04**
	0.12	0.02
Growth GDP	0.01*	-0.001
	0.01	0.001

$*p <= 0.10$, $**p <= 0.05$, $***p <= 0.001$
Results are from a 6 equation VAR estimated with war duration, war duration^2, pro-tax party, and cold war as exogenous variables. The full results are reported in the Appendix

We find that the United States systematically varied its use of non-military spending and taxes as finance methods in the interstate wars it fought between 1816 and 2012. On average, growth in non-military spending declines over the course of an interstate war. Tax revenue initially increases and then declines the longer a war lasts. More specifically, growth in tax revenue increases by for the first three years of a war (by 6%, 10% and 12%, respectively) before beginning to decline. This

[14] *Pro-Tax Party* and *Cold War* were also included as exogenous variables in the VAR.

result is consistent with Rockoff (2012)'s claim that it becomes political harder to raise taxes as a war endures and the initial surge of patriotism has worn off. Accordingly, it is also consistent with our model's implication that a government's use of taxes to pay for a war should be a function of the costs of doing so (see Equation 5). Table 4 also indicates that growth in military spending increases for the first seven years of an interstate war before it declines and that GDP growth generally increases over the course of a war. As with the results reported in Table 3, we stress that these findings likely underestimate the extent to which the United States' finance strategies have varied throughout its wars as the interdependent nature of the war finance options implies that changes in the use of a given finance method results in changes in the other finance methods.

The results reported thus far indicate that the United States' use of interstate war finance options are related to one another and, at least for the reduction in non-military spending and increased taxes, systematically vary over the course of interstate wars. We now turn to an assessment of whether and how the relationships between war finance are related to one another.

4.3 The Complementary Nature of Interstate War Finance

Our formal model implies that governments' use of individual war finance methods are complementary with respect to their level of economic mobilization. In order to assess this implication, we need a method that allows us to test how the different war finance opinions are correlated over time and whether these correlations change as a function of a government's mobilization for interstate war. To do this we turn to Dynamic Conditional Correlation (DCC) models (Lebo and Box-Steffensmeier 2008, Enders 2004, Engle 2002). DCC models allow for the calculation of the correlation between variables at a given point in time. These dynamic correlations tell us how two finance options are related over time. We then use these correlations as the dependent variable is a series of auto-regressive distributed lag (ADL) models to examine how two finance options function as substitutes and/or complements as a function of the United States' war-time military spending.

The DCC models are a form of multivariate Generalized Auto-regressive Conditional Hetroskasticty (GARCH) models (Engle 2002, Lebo and Box-Steffensmeier 2008). Standard econometric time-series models assume that the disturbance terms have a constant variance. While many of the time series we are interested in modeling have a constant mean, many exhibit variation in

their variance. Periods of relative clam are interrupted by periods where the series experience greater volatility. GARCH models allow us to explicitly model these fluctuations in the variance (Enders 2004). DCC models are based on the family of GARCH models (Engle 2002). They allow us to examine whether two variables are moving together while taking into account the history of the variance. Thus, DCC models provide an estimate of how two variables are related in any time period, allowing for the correlation to be positive, negative, or for there to be no correlation. The DCC approach has several advantages over other ways to model time-varying relationships. Lebo and Box-Steffensmeier (2008) explain that by taking into account the variance and a weighted average of past observations, DCC models provide more accurate estimation of the relationship between two variables compared to either moving-average estimates or Kalman filters.

We use a DCC estimator to produce 6 sets of correlations: (1) taxes and non-military spending, (2) taxes and debt, (3) taxes and inflation, (4) debt and inflation, (5) non-military spending and inflation, and (6) non-military spending and debt. These Paris of correlations contain the four main ways the governments finance their wars and represent the trade-offs government may be making when financing a war. For this analysis we use a quarterly data from the United States between the first quarter of 1946 and third quarter of 2014. Data on each of the war finance options comes from the FRED website associated with the Federal Reserve Bank of St. Louis (Federal Reserve Bank of St. Louis 2015*a*).[15] Moving to the quarterly data set increases our number of observations to 272, which is helpful in estimating the DCC models. The drawback is that we lose observations associated with earlier wars, such as World War I and World War II, which require greater mobilization of resources.

Since our main purpose of using the DCC models is to calculate a set of dynamic correlations to use as dependent variables in another set of models, we do not report the results of the DCC models. Figure 3 presents the dynamic correlations among pairs of interstate war finance options in red, with the gray shaded areas representing periods in which the United States was fighting an interstate war.

[15]More specifically, we use the following series from FRED: non-military spending - FNDEFX; tax revenue - W006RC1Q027SBEA; debt - FGDSLIQ027S; inflation - CPIAUCSL. Current dollars were converted to constant dollars using the GDP deflator series GDPDEF.

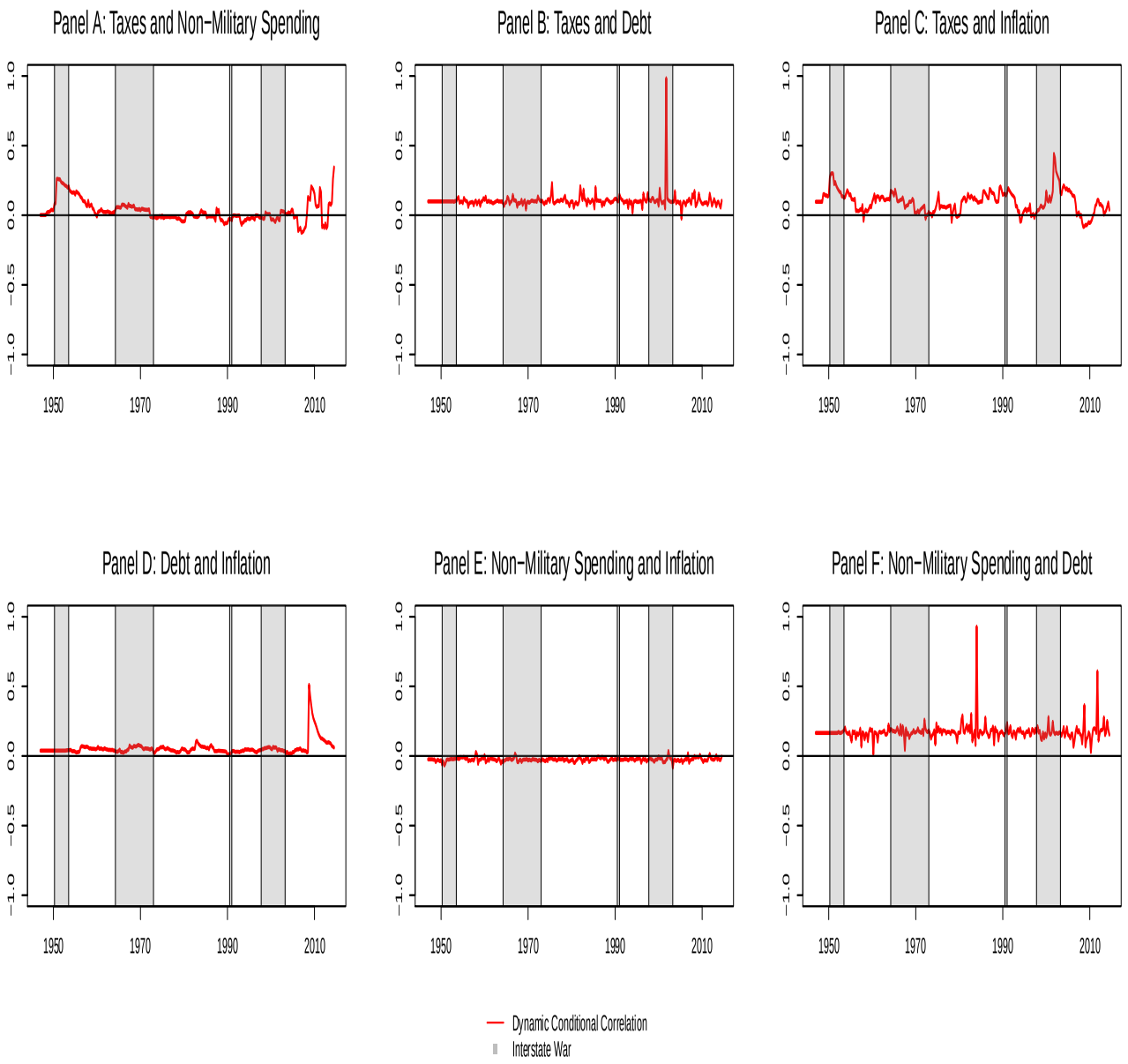

Figure 3: Dynamic Conditional Correlations among War Finance Methods, 1947-2014

Ultimately, we are interested in whether the level of economic mobilization affects the degree to which interstate war finance methods are complementary or substitutable. We therefore modeled the dynamic conditional correlations reported in Figure 3 as a function of U.S. involvement in an interstate war, military spending (in 2009 dollars), and an interaction between the two using an ADL(1) specification.[16] Table 5 presents our results.

Table 5: Military Spending and the Relationships between War Finance Options, 1947-2014

	Non-Mil/Tax	Non-Mil/Debt	Non-Mil/Inflation	Taxes/Debt	Taxes/Inflation	Debt/Inflation
Interstate War	0.074*	0.017	-0.015†	-0.038	0.040†	0.008
	(0.021)	(0.041)	(0.009)	(0.037)	(0.023)	(0.019)
Military Spending	0.001	0.003	0.001	-0.001	-0.001	0.003*
	(0.001)	(0.003)	(0.001)	(0.003)	(0.002)	(0.001)
War*Military	-0.016*	-0.004	0.003	0.011	-0.008	-0.002
	(0.005)	(0.009)	(0.002)	(0.008)	(0.005)	(0.004)
cor(Non-Mil,Tax)$_{t-1}$	0.903*					
	(0.028)					
cor(Non-Mil,Debt)$_{t-1}$		-0.106†				
		(0.061)				
cor(Non-Mil,Inflation)$_{t-1}$			0.240*			
			(0.060)			
cor(Taxes,Debt)$_{t-1}$				-0.033		
				(0.062)		
cor(Taxes,Inflation)$_{t-1}$					0.873*	
					(0.029)	
cor(Debt,Inflation)$_{t-1}$						0.788*
						(0.038)
Constant	-0.004	0.176*	-0.023*	0.107*	0.017+	-0.004
	(0.007)	(0.018)	(0.003)	(0.015)	(0.009)	(0.007)
N	270	270	270	270	270	270
r2	0.830	0.015	0.107	0.016	0.794	0.694
p	<0.01	0.407	<0.01	0.376	<0.01	<0.01

Two-tailed: †: $p \leq 0.1$; $*$: $p \leq 0.05$

Our use of a multiplicative interaction term limits our ability to accurately assess whether finance options are complementary with respect to the level of military spending in an interstate war using Table 5. This is because the coefficients of the constituent and interaction terms are accurate only when the other terms take on a value of zero (which never occurs with respect to military spending) and the standard errors in each term fail to account for the covariance among each other (most notably, Brambor, Clark and Golder 2006). We therefore used a set of post-estimation simulations to calculate the difference in the expected dynamic conditional correlation

[16]Regressing the errors at t on the errors at $t-1$ revealed no significant autocorrelation remained after including a single lag of the dependent variable in each specification.

between each pair of war finance options given 1) average military spending during peace-time and 2) increasingly higher levels of military spending during an interstate war.[17] The results of these simulations are reported in Figure 4.

Figure 4 offers mixed support for our theoretical model's expectation that finance options should be complementary with respect to a government's level of mobilization for interstate war. Consistent with our model, higher military spending during a war is associated with a statistically significant negative correlation between non-military spending and taxes (Panel A) and a positive and statistically significant correlation between taxes and debt (Panel B).[18] Contrary to expectations, it appears greater military spending is associated with a positive correlation between non-military spending and inflation when war-time military spending reaches approximately $700 million dollars (Panel C). We find no evidence that the level of military spending during an interstate war influences the correlations between the other pairs of finance methods. Thus, the results in Figure 4 indicate that the relationships between non-military spending and taxes and taxes and debt were complementary with respect to military spending during the interstate wars the United States fought between 1947 and 2014, while the other relationships were not.

[17]The simulations were based on 10,000 draws from a multivariate normal distribution based on the coefficient and variance-covariance matrices of each model reported in Table 5. The simulations set each lagged dependent variable to the value of its mean, peace-time observation in our data set.

[18]The correlation between taxes and debt becomes insignificant at the 95% level at approximately $600 billion of military spending. This relationship is significant throughout the range of military spending with 90% confidence intervals.

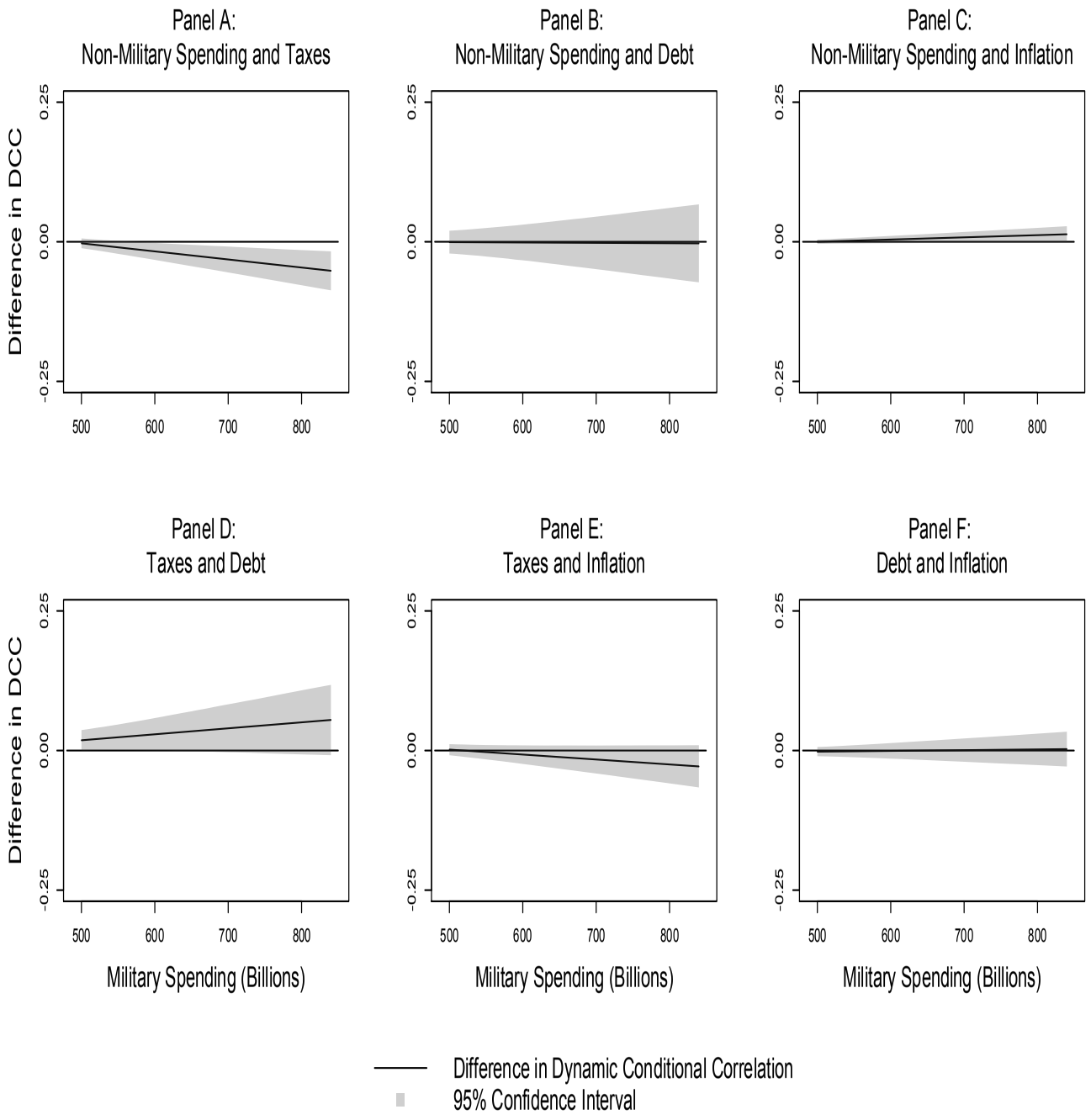

Figure 4: Military Spending and the Relationships between War Finance Options, 1947-2014

4.4 Financing the Spanish-American War, World War II, and Vietnam War

The results reported above largely are consistent with our model's general expectations. Here, we demonstrate the model's ability to speak to specific cases with a short discussion of how the United States financed its participation in the Spanish-American War, World War II, and Vietnam War.

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. 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 (selling $200 million worth of bonds), printing money (approximately $12 million) and reducing non-military spending by $67 million (respectively, $4.6 billion, $274 million, and $1.5 billion in 2009 dollars).[19] Thus, even in a short interstate war with a relatively small mobilization, the United States relied on each of the four methods of war finance.

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 of resources for interstate war in modern history. Compared to 1940, when the United

[19]The amounts of debt and printing money reported here come from Rockoff (2012, pgs. 60-61). Our data also indicate that U.S. debt and inflation were higher during the Spanish-American War than in the previous year. Non-military spending are from Carter et al. (2006).

States began its build-up, 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.[20] The Correlates of War data indicate the United States spent approximately $2.9 trillion dollars on military spending between 1940 and 1945. This is a conservative estimate of what the U.S. spent fighting World War II: for example, 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 and excise taxes and implemented (and then raised) an "excess profits" tax (which topped out at 95% in 1943) throughout World War II (Bank, Stark and Thorndike 2008, pgs. 83-108). The bulk of tax revenue was raised through increases in personal income taxes. "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. Everything else in the twentieth century was second order by comparison" (Rockoff 2012, pg. 165). By the end of the war, personal income taxes provided 40% of total 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 its World War II expenses through taxes.

Taxes were not enough, though. 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%), the latter of which were sold largely to the general public (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) (quoted in Rockoff (2012, pg.171)).[21] Second, the Federal Reserve also indirectly created $72.7 billion

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

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

dollars (approximately $755 billion in 2009 dollars) per Friedman and Schwartz (1970). This indirect money creation occurred because "when the recipients of government spending deposited their payments, the banks found themselves with more reserves. This increase in reserves in turn produced a multiple increase in bank lending...the money that ends up in the US Treasury ... really came from the printing press" (Rockoff 2012, pg. 172). Finally, the United States 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 reached $26 billion in 1945, which represents a 73% reduction from 1940 levels. These figures likely underestimate the extent to which non-military, government spending was reduced during World War II, as Rockoff (2012) reports that spending at the state and local level fell during the war (pgs. 217-218).

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). Compared to its expenditures in 1963, U.S. military spending was, on average, 15% higher during its participation in the Vietnam 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).[22] However, focusing on average annual and/or overall military spending masks important dynamics in the United States' war effort in Vietnam. Specifically, U.S. military spending peaked in 1968 and then steadily declined until the U.S. exited the war in 1973. The American mobilization effort, therefore, was large but varied over the course of the Vietnam War.

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 (and later Johnson) Administration, the Federal Reserve began to increase the money supply in late 1961 to

[22]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.

help combat unemployment and, importantly, finance the deficit, a pattern that would continue throughout the rest of the decade (Rockoff 2012, pgs. 289). For example, converting data in current dollars from the Federal Reserve (2015*b*) to constant 2009 dollars, the money supply in January 1961 was $225 billion, $244 billion in February 1964 (U.S. entrance per MID4), $274 billion in March 1968 (the quarter in which military spending was at its highest during Vietnam), and $296 billion in January 1973 (U.S. exit per MID4). Overall, Capella (2013) estimates that 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 (Rockoff 2012, pg. 290). The U.S. national debt grew 6% during the Vietnam War, from approximately $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. Despite his best efforts to avoid it, President Johnson got Congress to pass a temporary 10% "surcharge" on 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," which was paid for exclusively through taxes (Bank, Stark and Thorndike 2008, pg. 136). President Nixon extended the surcharge in July 1969, though the 10% increase was 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, how they were financed. Our model 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. That is, finance options were complements and not substitutes. 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 (e.g., Shea 2014, Poast 2015). However, the U.S. government made use of each of the four primary methods of finance to pay for the Spanish-American War. Such a finance strategy is assumed away by existing theoretical arguments that consider finance options to be substitutes. In contrast to the existing literature, our model suggests that 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 appears to have been the case in the Spanish-American War. While the war was financed primarily with a tax increase, Rockoff (2012) claims that McKinley did not think the American people would be willing to endure a tax increase large enough to pay for the entire war effort and therefore also reduced non-military spending, engaged in borrowing, and printed money. Our theoretical model captures why McKinley made use of each method to finance the 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 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.[23] In contrast to World War II, the economic mobilization for

[23] All figures in constant 2009 dollars. The only annual change during this time period that did not represent an increase in resources available for war finance was non-military spending in 1942, which increased to \$97 billion. Non-military spending was then reduced to \$66 billion in 1943 and \$43 billion in 1944.

Vietnam was uneven: military spending increased from $379million 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 $249million to $305million), 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.

That the extent to which the United States took in tax revenue and increased the debt is correlated with military spending during Vietnam speaks to the model's result that levels of mobilization and finance vary with one another (note that l_i^p is in the numerator of Equations 4 - 7). Importantly, our 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 finance the war effort with other less costly options. This behavior implies that the relative efficiency of particular finance options changed along with the level of mobilization, or values of $\nu_i^p, \tau_i^p, \delta_i^p$, and μ_i^p changed as values of l_i^p changed. Bank, Stark and Thorndike (2008), Rockoff (2012), and Capella (2013) report that this is precisely what occurred with President Johnson with respect to his use of taxes to pay for Vietnam. From the beginning, Johnson wanted to avoid raising taxes to pay for the Vietnam War because he thought doing so would spell the end of his Great Society programs. He was able to achieve this by largely financing the war through inflationary monetary policy and debt for most of his presidency. However, the a 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). In the language of our model, as the level of mobilization (l_i^p) increased, the relative efficiency of printing money (μ_i^p) decreased and the relative efficiency of increasing taxes (τ_i^p) increased. These changes in the parameters of the model predict that, relatively speaking, we should observe a relatively greater portion of a mobilization effort being financed by taxes than printing money than was the case before the parameters changed. This would seem to fit with Johnson's

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. Thus, our model can account for changes in the relative use of taxes and the printing press by the Johnson administration during the course of the Vietnam War.

5 Conclusion

Waging interstate war is one of the most economically costly decisions a political leader can make. In this paper, we develop 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 strategy to vary over the course of a conflict. Assuming that a government's overall finance strategy is a function of the relative efficiency of each finance method and the level of mobilization, the model implies that the extent to which particular finance options are used are inherently related to one another and complementary with respect to the war effort and governments' optimal finance strategies are likely to change throughout an interstate war.

Quantitative and qualitative analyses of U.S. interstate war finance between 1816 and 2014 offer support to our model's empirical implications. A set of VAR models indicate interstate war finance methods are interdependent and that the duration of a conflict directly affects the extent to which the United States reduces non-military spending and raises taxes and indirectly affects debt and inflation. We then used a set of DCC models to estimate the correlations between pairs of finance methods over time. Subsequent analysis of these dynamic correlations indicate that cuts in non-military spending and taxes and taxes and debt become increasingly complementary as the level of war mobilization increases. Finally, brief case studies of the Spanish-American War, World War II, and the Vietnam War demonstrate our model's ability to account for patterns of finance in specific wars that existing theoretical approaches cannot explain.

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6 Appendix

A Formal Proof

The model's set-up is described fully in the main text. Here, we 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 $x^{1*} = c_{2w}^o + c_{2a}^o + c_{2s}^o + c_2^{f1} + c_2^{f2} + c_2^{f3}$, $x^{2*} = c_{2a}^o + c_{2s}^o + c_2^{f2} + c_2^{f3}$, and $x^{3*} = c_{2s}^o + c_2^{f3}$. 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 $EU(a|x^1) \geq EU(a|x^2) \Rightarrow 1 - x^1 \geq 1 - x^2 - c_{2w}^o - c_2^{f1}$. Given x^{1*} and x^{2*}, G_{2w} accepts x^{1*} iff:

$$1 - c_{2w}^o - c_{2a}^o - c_{2s}^o - c_2^{f1} - c_2^{f2} - c_2^{f3} \geq 1 - c_{2w}^o - c_{2a}^o - c_{2s}^o - c_2^{f1} - c_2^{f2} - c_2^{f3}$$

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 $EU(a|x^1) \geq EU(a|x^3) \Rightarrow 1 - x^1 \geq 1 - x^3 - 2c_{2w}^o - c_2^{f1} - c_2^{f2}$. Given x^{1*} and x^{3*}, G_{2w} accepts x^{1*} iff:

$$1 - c_{2w}^o - c_{2a}^o - c_{2s}^o - c_2^{f1} - c_2^{f2} - c_2^{f3} \geq 1 - 2c_{2w}^o - c_{2s}^o - c_2^{f1} - c_2^{f2} - c_2^{f3}$$

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:

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

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:

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

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

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

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

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

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 $EU(a|x^1) \geq EU(a|x^3) \Rightarrow 1-x^1 \geq 1-x^3-2c^o_{2s}-c^{f1}_2-c^{f2}_2$:

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

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

The model assumes that when x^{p*} is rejected, G_1 and G_2 will finance and fight a battle. As described in the main text, G_i's finance strategy in period p is defined by the production function $f^p_i = n^{p\nu^p_i}_i t^{p\tau^p_i}_i d^{p\delta^p_i}_i m^{p\mu^p_i}_i$ and is subject to the budget constraint $l^p_i = n^p_i + t^p_i + d^p_i + m^p_i$. We therefore

solve for the optimal use of each finance option given a specific level of mobilization by maximizing the following LaGrangian function:

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

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 the following:

$$\begin{aligned} \frac{\partial \mathcal{L}(f_i^p)}{\partial n_i^p} &= \frac{\nu_i^p}{n_i^p} - \lambda_i^p = 0 \\ \Rightarrow n_i^{p*} &= \frac{\nu_i^p}{\lambda_i^p} \end{aligned} \tag{A-1}$$

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

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

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

Substituting Equations A-1 - A-4 into the budget constraint and solving for λ_i^p we get

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

Substituting the above equation into Equations **??** - **??** allows us to define the optimal marginal provision of n_i^p, t_i^p, d_i^p, and m_i^p in a given f_i^p in terms of l_i^p, ν_i^p, τ_i^p, δ_i^p, and μ_i^p:

$$n_i^{p^*} = \frac{\nu_i^p l_i^p}{\nu_i^p + \tau_i^p + \delta_i^p + \mu_i^p} \tag{A-5}$$

$$t_i^{p^*} = \frac{\tau_i^p l_i^p}{\nu_i^p + \tau_i^p + \delta_i^p + \mu_i^p} \tag{A-6}$$

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

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

Equations A-5 - A-8 identify the optimal use of each interstate war finance method for a given level of economic mobilization. Thus, a state's optimal interstate war finance strategy is defined as $f_i^{p*}(n_i^{p^*}, t_i^{p^*}, d_i^{p^*}, m_i^{p^*}, l_i^{p^*})$.

Given the above, the following is a screening perfect Bayesian equilibrium in pure strategies if $w > a > s$. G_1 demands $x^{1*} = c_{2w}^o + c_{2a}^o + c_{2s}^o + c_2^{f1} + c_2^{f2} + c_2^{f3}$, $x^{2*} = c_{2a}^o + c_{2s}^o + c_2^{f2} + c_2^{f3}$, and $x^{3*} = c_{2s}^o + c_2^{f3}$. 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_2^{1*} 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_2^{1*} and fight a battle in period 1, G_{2s} rejects x^{2*}, G_1 and G_{2s} choose their optimal finance strategies f_1^{2*} and f_2^{2*} and fight a battle in period 2, G_{2s} accepts x^{3*}, and the game ends in period 3. ■

B VAR Results

Table A-1: VAR of Interstate War Finance Options, 1816-2012

	Non-Military	Taxes	Debt	Military	Inflation	GDP
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Non-Military Spending Growth$_{t-1}$	0.13	0.10	-0.13	0.27	-0.06	-0.005
	(0.08)	(0.03)	(0.11)	(0.14)	(0.44)	(0.01)
Non-Military Spending Growth$_{t-2}$	-0.07	0.06	0.25	-0.09	0.61	0.01
	(0.08)	(0.03)	(0.12)	(0.14)	(0.46)	(0.01)
Non-Military Spending Growth$_{t-3}$	-0.23	-0.03	-0.06	0.06	-1.05	-0.01
	(0.08)	(0.03)	(0.12)	(0.14)	(0.46)	(0.01)
Non-Military Spending Growth$_{t-4}$	0.06	-0.03	0.06	0.08	-0.08	-0.002
	(0.08)	(0.03)	(0.11)	(0.14)	(0.44)	(0.01)
Non-Military Spending Growth$_{t-5}$	-0.13	-0.01	0.005	0.16	1.52	0.01
	(0.08)	(0.03)	(0.11)	(0.14)	(0.44)	(0.01)
Tax Revenue Growth$_{t-1}$	0.08	-0.38	-0.80	-1.07	-3.05	-0.09
	(0.25)	(0.09)	(0.37)	(0.45)	(1.47)	(0.03)
Tax Revenue Growth$_{t-2}$	-0.60	-0.25	-0.34	0.09	1.65	0.03
	(0.25)	(0.09)	(0.37)	(0.45)	(1.48)	(0.03)
Tax Revenue Growth$_{t-3}$	-0.02	0.02	-0.27	0.12	-1.24	-0.04
	(0.26)	(0.09)	(0.38)	(0.46)	(1.49)	(0.03)
Tax Revenue Growth$_{t-4}$	-0.52	-0.01	0.13	-0.68	-2.51	-0.02
	(0.23)	(0.08)	(0.34)	(0.42)	(1.36)	(0.03)
Tax Revenue Growth$_{t-5}$	0.61	-0.11	-0.24	-0.62	-3.16	-0.03
	(0.21)	(0.07)	(0.31)	(0.37)	1.21	0.02
Debt Growth$_{t-1}$	0.02	0.04	0.88	0.05	0.80	0.01
	(0.06)	(0.02)	(0.08)	(0.10)	(0.34)	(0.01)
Debt Growth$_{t-2}$	0.03	-0.07	-0.63	0.02	-1.01	-0.01
	(0.07)	(0.03)	(0.11)	(0.13)	0.43	0.01
Debt Growth$_{t-3}$	-0.02	0.03	0.23	-0.32	0.17	0.004
	(0.08)	(0.03)	(0.12)	(0.14)	(0.47)	(0.01)
Debt Growth$_{t-4}$	0.01	-0.01	0.06	0.59	0.54	0.01
	(0.07)	(0.03)	(0.11)	(0.13)	(0.43)	(0.01)
Debt Growth$_{t-5}$	-0.07	-0.01	-0.06	-0.33	-0.68	-0.01
	(0.06)	(0.02)	(0.09)	(0.11)	(0.34)	(0.01)
Inflation$_{t-1}$	0.02	0.01	0.10	0.13	0.53	0.002
	(0.02)	(0.01)	(0.02)	(0.03)	(0.09)	(0.002)
Inflation$_{t-2}$	0.01	-0.01	-0.08	-0.06	-0.05	-0.001
	(0.02)	(0.01)	(0.03)	(0.03)	(0.11)	(0.002)
Inflation$_{t-3}$	-0.02	0.01	0.04	-0.01	0.16	0.002
	(0.02)	(0.01)	(0.03)	(0.03)	(0.10)	(0.002)
Inflation$_{t-4}$	0.05	0.01	-0.04	0.01	-0.20	-0.002
	(0.02)	(0.01)	(0.02)	(0.03)	(0.10)	(0.002)
Inflation$_{t-5}$	-0.02	-0.001	0.01	0.02	0.12	0.001
	(0.01)	(0.005)	(0.02)	(0.02)	(0.08)	(0.001)

$*p <= 0.10$, $**p <= 0.05$, $***p <= 0.001$

Significance of endogenous relationships are reported in the Granger Causality Table.

Table A-2: VAR of Interstate War Finance Options, 1816-2012

	Non-Military	Taxes	Debt	Military	Inflation	GDP
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Military Spending Growth$_{t-1}$	-0.02	0.05	-0.20	0.10	0.90	0.01
	(0.05)	(0.02)	(0.07)	(0.09)	(0.28)	(0.01)
Military Spending Growth$_{t-2}$	-0.03	0.11	0.13	-0.15	0.86	0.01
	(0.05)	(0.02)	(0.07)	(0.09)	(0.30)	(0.01)
Military Spending Growth$_{t-3}$	0.02	0.01	-0.06	0.01	-0.92	-0.004
	(0.06)	(0.02)	(0.09)	(0.11)	(0.35)	(0.01)
Military Spending Growth$_{t-4}$	0.16	0.07	0.07	-0.15	-0.11	-0.002
	(0.06)	(0.02)	(0.08)	(0.10)	(0.33)	(0.01)
Military Spending Growth$_{t-5}$	-0.02	0.01	0.02	0.23	0.62	0.02
	(0.06)	(0.02)	(0.09)	(0.10)	(0.34)	(0.01)
Growth GDP$_{t-1}$	-0.59	1.16	-1.20	-1.30	15.21	0.40
	(0.93)	(0.32)	(1.37)	(1.68)	5.44	0.10
Growth GDP$_{t-2}$	1.50	0.87	2.04	3.09	-3.84	0.02
	(1.01)	(0.35)	(1.49)	(1.82)	5.91	0.11
Growth GDP$_{t-3}$	0.14	-0.12	1.60	0.37	-6.97	-0.16
	(1.02)	(0.35)	(1.50)	(1.84)	(5.97)	(0.11)
Growth GDP$_{t-4}$	-0.20	-1.27	-1.29	-3.08	4.33	-0.08
	(1.02)	(0.35)	(1.51)	(1.84)	(5.99)	(0.11)
Growth GDP$_{t-5}$	0.76	0.09	1.52	1.33	16.27	0.12
	(0.96)	(0.33)	(1.42)	(1.73)	(5.63)	(0.10)
War	-0.19*	0.10**	0.12	0.53**	0.68	0.03**
	(0.10)	(0.04)	(0.15)	(0.19)	(0.61)	(0.01)
Pro-Tax Party	0.23**	0.02	-0.04	0.18	1.26 **	0.02**
	(0.08)	(0.03)	(0.12)	(0.15)	(0.48)	(0.01)
Cold War	-0.05	-0.07*	-0.39 **	-0.68**	0.91	0.01
	(0.12)	(0.04)	(0.18)	(0.21)	(0.70)	(0.01)
constant	-0.08	0.02	0.12	0.11	-1.24 **	0.02
	0.10	0.03	0.15	0.18	0.58	0.01

$*p <= 0.10$, $**p <= 0.05$, $***p <= 0.001$

Significance of endogenous relationships are reported in the Granger Causality Table.

Table A-3: Full VAR Results with War Duration, 1816-2012

	Non-Military (SE)	Taxes (SE)	Debt (SE)	Military (SE)	Inflation (SE)	GPD (SE)
Non-Military Spending Growth$_{t-1}$	0.11	0.11	-0.12	0.30	-0.06	-0.004
	(0.08)	(0.03)	(0.11)	(0.14)	(0.450	(0.01)
Non-Military Spending Growth$_{t-2}$	-0.08	0.06	0.25	-0.08	0.59	0.01
	(0.08)	(0.03)	(0.12)	(0.14)	(0.46)	(0.01)
Non-Military Spending Growth$_{t-3}$	-0.23	-0.03	-0.06	0.06	-1.07	-0.007
	(0.08)	(0.03)	(0.11)	(0.14)	(0.46)	(0.01)
Non-Military Spending Growth$_{t-4}$	0.05	-0.03	0.05	0.08	-0.06	-0.002
	(0.08)	(0.03)	(0.11)	(0.14)	(0.45)	(0.01)
Non-Military Spending Growth$_{t-5}$	-0.13	-0.01	0.002	0.16	1.53	0.01
	(0.07)	(0.03)	(0.11)	(0.14)	(0.44)	(0.01)
Tax Revenue Growth$_{t-1}$	0.10	-0.39	-0.81	-1.11	-3.00	-0.09
	(0.25)	(0.09)	(0.37)	(0.46)	(1.48)	(0.03)
Tax Revenue Growth$_{t-2}$	-0.57	-0.26	-0.34	0.05	1.73	0.03
	(0.25)	(0.09)	(0.37)	(0.46)	(1.48)	(0.03)
Tax Revenue Growth$_{t-3}$	-0.01	0.02	-0.26	0.11	-1.22	-0.04
	(0.25)	(0.09)	(0.38)	(0.46)	(1.50)	(0.03)
Tax Revenue Growth$_{t-4}$	-0.52	-0.01	0.14	-0.67	-2.55	-0.02
	(0.23)	(0.08)	(0.34)	(0.42)	(1.37)	(0.03)
Tax Revenue Growth$_{t-5}$	0.60	-0.11	-0.23	-0.61	-3.20	-0.03
	(0.21)	(0.07)	(0.31)	(0.37)	(1.21)	(0.02)
Debt Growth$_{t-1}$	0.02	0.04	0.88	0.05	0.80	0.01
	(0.08)	(0.02)	(0.08)	(0.10)	(0.34)	(0.01)
Debt Growth$_{t-2}$	0.02	-0.07	-0.63	0.02	-1.02	-0.02
	(0.07)	(0.03)	(0.11)	(0.13)	(0.43)	(0.01)
Debt Growth$_{t-3}$	-0.02	0.03	0.23	-0.32	0.18	0.004
	(0.08)	(0.03)	(0.12)	(0.14)	(0.47)	(0.01)
Debt Growth$_{t-4}$	0.01	-0.01	0.06	0.59	0.55	0.01
	(0.07)	(0.03)	(0.11)	(0.13)	(0.43)	(0.01)
Debt Growth$_{t-5}$	-0.08	-0.01	-0.06	-0.33	-0.69	-0.01
	(0.06)	(0.02)	(0.09)	(0.11)	(0.34)	(0.01)
Inflation$_{t-1}$	0.03	0.01	0.10	0.13	0.52	0.001
	(0.02)	(0.01)	(0.02)	(0.03)	(0.09)	(0.002)
Inflation$_{t-2}$	0.004	-0.01	-0.07	-0.06	-0.05	-0.001
	(0.02)	(0.01)	(0.03)	(0.03)	(0.11)	(0.002)
Inflation$_{t-3}$	-0.02	0.01	0.04	-0.004	0.16	0.002
	(0.02)	(0.01)	(0.03)	(0.03)	(0.10)	(0.002)
Inflation$_{t-4}$	0.04	0.01	-0.04	0.01	-0.19	-0.002
	(0.02)	(0.01)	(0.02)	(0.03)	(0.10)	(0.002)
Inflation$_{t-5}$	-0.02	-0.002	0.01	0.02	0.12	0.001
	(0.01)	(0.005)	(0.02)	(0.02)	(0.08)	(0.002)

Table A-4: Continued Full VAR Results with War Duration, 1816-2012

	Non-Military (SE)	Taxes (SE)	Debt (SE)	Military (SE)	Inflation (SE)	GPD (SE)
Military Spending Growth$_{t-1}$	-0.01	0.05	-0.20	0.10	0.91	0.01
	(0.05)	(0.02)	(0.07)	(0.09)	(0.28)	(0.01)
Military Spending Growth$_{t-2}$	-0.03	0.11	0.13	-0.16	0.87	0.01
	(0.05)	(0.02)	(0.07)	(0.091)	(0.30)	(0.01)
Military Spending Growth$_{t-3}$	0.01	0.01	-0.06	0.01	-0.93	-0.004
	(0.06)	(0.02)	(0.09)	(0.11)	(0.35)	(0.01)
Military Spending Growth$_{t-4}$	0.17	0.07	0.06	-0.15	-0.12	-0.002
	(0.06)	(0.019)	(0.08)	(0.10)	(0.33)	(0.01)
Military Spending Growth$_{t-5}$	-0.02	0.01	0.02	0.23	0.619	0.02
	(0.06)	(0.02)	(0.09)	(0.10)	(0.33)	(0.01)
Growth GDP$_{t-1}$	-0.62	1.186	-1.15	-1.09	15.73	0.43
	(0.92)	(0.32)	(1.36)	(1.67)	(5.42)	(0.10)
Growth GDP$_{t-2}$	1.56	0.84	2.01	3.00	-3.66	0.02
	(1.01)	(0.35)	(1.49)	(1.82)	(5.93)	(0.11)
Growth GDP$_{t-3}$	0.21	-0.17	1.51	0.14	-7.05	-0.17
	(1.02)	(0.35)	(1.50)	(1.84)	(5.98)	(0.11)
Growth GDP$_{t-4}$	-0.15	-1.30	-1.34	-3.30	3.83	-0.10
	(1.02)	(0.35)	(1.50)	(1.84)	(5.98)	(0.11)
Growth GDP$_{t-5}$	0.76	0.11	1.55	1.46	16.69	0.13
	(0.96)	(0.33)	(1.41)	(1.73)	(5.63)	(0.10)
Exogenous Variables						
War Duration	-0.13**	0.07***	0.09	0.31**	0.11	0.01*
	(0.06)	(0.02)	(0.10)	(0.12)	(0.38)	(0.01)
War Duration^2	0.01	-0.01**	-0.01	-0.04**	-0.001	-0.001
	(0.01)	(0.003)	(0.01)	(0.02)	(0.05)	(0.001)
Pro-Tax Party	0.23**	0.02	-0.05	0.18	1.35	0.02**
	(0.08)	(0.03)	(0.12)	(0.15)	(0.49)	(0.01)
Cold War	-0.05	-0.07	-0.37**	-0.65**	0.96**	0.02
	(0.12)	(0.04)	(0.18)	(0.21)	(0.70)	(0.01)
Constant	-0.08	0.02	0.14	0.13	-1.26**	0.02*
	(0.10)	(0.03)	(0.15)	(0.18)	(0.58)	(0.01)

$*p <= 0.10$, $**p <= 0.05$, $***p <= 0.001$

Significance of endogenous relationships are reported in the Granger Causality Table.

Table A-5: Interstate War Finance Options, 1816-2012 Granger Causality Tests from VAR Model with War Duration

		χ^2	p-value
Non-Military Spending Growth			
	Tax Revenue Growth	17.34	0.004
	Debt Growth	3.63	0.603
	Inflation	11.20	0.047
	Military Spending Growth	10.05	0.074
	Growth GDP	3.54	0.617
	Joint-Significance Test	57.31	0.000
Tax Revenue Growth			
	Non-Military Spending Growth	27.29	0.000
	Debt Growth	10.82	0.055
	Inflation	11.93	0.036
	Military Spending Growth	54.00	0.000
	Growth GDP	38.78	0.000
	Joint-Significance Test	188.8	0.000
Debt Growth			
	Non-Military Spending Growth	6.65	0.248
	Tax Revenue Growth	5.76	0.330
	Inflation	22.63	0.000
	Military Spending Growth	11.49	0.042
	Growth GDP	5.43	0.365
	Joint-Significance Test	59.89	0.000
Inflation			
	Non-Military Spending Growth	17.53	0.004
	Tax Revenue Growth	17.30	0.004
	Debt Growth	14.11	0.015
	Military Spending Growth	43.61	0.000
	Growth GDP	17.49	0.004
	Joint-Significance Test	113.86	0.000
Military Spending Growth			
	Non-Military Spending Growth	7.36	0.195
	Tax Revenue Growth	3.47	0.019
	Inflation	21.64	0.001
	Debt Growth	23.47	0.000
	Growth GDP	6.06	0.301
	Joint-Significance Test	81.06	0.000
GDP Growth			
	Non-Military Spending Growth	3.64	0.602
	Tax Revenue Growth	17.66	0.003
	Debt Growth	9.27	0.099
	Inflation	2.49	0.778
	Military Spending Growth	22.36	0.000
	Joint-Significance Test	49.60	0.002