Long Waves and Hostility

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How do macroeconomic changes affect government decisions to enter wars? Extant research on this question largely focuses on the relationship between economic and political cycles over time. The question is typically modeled at the systemic level obscuring different types of economic change and their effects on government incentives. In this article, I model the impact of changes in factor prices on government incentives to engage in hostilities with other states. Governments in this model view prices as cues to the appropriateness of force as a policy tool. I test and find support for the model's predictions using time series data from Great Britain.

The relationship between security issues and political economy lies at the heart of the field of international relations. Literature on war causation, however, fails to adequately account for this relationship. In particular, the link between the movement of macroeconomic variables and government decisions to enter wars has not been adequately explored. Long wave theories posit a causal link between long-term global macroeconomic changes and systemic wars, but do not explain the governmental decision-making process at work. Meanwhile, micro-level approaches to war decisions either fail to yield determinate predictions or do not address the effect of economic movements.

This article attempts to combine the strengths of these two approaches by producing and testing a theory of the effects of macroeconomic variables on government decisions to use force to achieve foreign policy ends. I argue that movements in the price level and real prices of land, labor, and capital change the costs and benefits of entering wars as well as the probability of victory. A behavioral decision model is presented; government decisions in this model are based on responses to sets of cues. Time series regression is employed to test this model with military expenditure and hostility as dependent variables.

LITERATURE REVIEW

The relationship between price movements and government decisions about war is explored in the long-cycles literature. Models from this tradition theorize that economic and political processes operate in causally linked cycles. Goldstein's (1991) "War-Economy" model links economic cycles to the availability of resources for waging war, positing causal linkages between a number of key economic variables and national capabilities. Over time, the increasing availability of these national production resources and declining social memory of past wars causes severity of war to increase. His data analysis utilizes world production, British prices (wholesale index), Haustein's list of innovations, English wages, and U.S. building volume to predict logged war severity (Levy, 1981) from 1495 to 1975. With the exception of innovations and unexpected reverse feed-backs among production, prices, and wages, VAR analysis confirms the causal relationships he posits.

Modelski's (1981) first work on long cycles uses a model of alternating innovations and world leadership. Cycles are driven by demands for innovations that can be either political or economic. Economic innovations create leading sectors and concentrated benefits in particular nations. Demands for political innovations, such as the use of force or excessive politics to alter outcomes, result from the desire of these nations to assume world leadership as the previous leader loses its capacity to regulate global interaction.

Modelski and Thompson (1996) suggest that global system leaders rise by controlling leading sectors of production. The system leader translates its economic power into military power (especially sea power) and uses it to exercise governance over the international system, shaping the global economic order. As innovations and resulting growth spurts occur in other nations, competitors for global leadership rise. Simultaneous frustration by new economic competitors over their subordinate international political role and fears of leaders of losing their ability to compete lead to the outbreak of large systemic wars. Modeslki and Thompson plot growth rates of leading sectors against the timing of major wars. They argue that their graphic examination confirms the existence of waves in production which are followed by corresponding waves in war.

By contrast, Bergesen (1985) finds that wars occur after economic downswings brought about by overproduction. In a prolonged upswing, lack of planning between different producers around the world leads supply to rapidly outpace demand. In the resulting economic contraction, conflict emerges between rival capital and labor (over benefits), rival firms (market share), and eventually powerful states over the control of and access to markets in the

periphery. War serves as the necessary tool for facilitating economic reorganization by establishing a new global leader to quell these conflicts and coordinate global economic interaction.

Boswell and Sweat (1991) offer a resource theory of the size of wars. Long periods of expansion translate into an expansion of the war chest of resources for governments interested in using force to change outcomes. For either egocentric or ethnocentric reasons, state leaders view their own resources as inherently superior to those of other nations also experiencing growth. Also, due to their inability to adequately monitor other nation's resources, their assessments of their own capabilities are biased upward. As a result of this perceived rise in relative capabilities, leaders find the expected benefits of war to outweigh costs. This leads to an overall increase in the probability that nations will go to war.

Imbert (1959) also provides a resource theory of wars but emphasizes its relationship to global political conflict as well. Innovation in key industries leads to a rise in the need for raw materials and markets and, thus competition over colonial expansion. Increased state military expenditures result from this tension and begin to assume greater economic importance as industrial growth subsides. The combination of increased tensions and available military capabilities leads to increased probabilities of war.

Williams, McGinnis, and Thomas (1994) develop a very simple model of a government utility function to explain the link between economic cycles and war severity. They attempt to explain the statistical finding that the link between world production shocks and war severity described by Goldstein (1991) dissipates after the 1850s while the effect of war on prices increases in strength. Following Gilpin (1981), they model a government war decision as consisting of an expected utility calculation comparing the net benefits of going to war to some non-war alternatives (diplomacy, international legal system, etc.). The expected utility of war is based on economic and non-economic motivations. In addition to predicting a weakening of the link between economic change to war, they conclude that these changes also predict the large and costly systemic wars since the basis for war decisions is no longer economic rationality.

MISSING MICROFOUNDATIONS

While the long cycle literature makes important advances in understanding the intensity of systemic war, it falls short in exploring the more general link between economic change and war causation. Long cycle work appears to be driven by empirical results rather than well specified theories. As a result, the statistical tests utilized by many authors lead to ambiguous results which confirm the correlation of variables without analyzing the causal story supplied in the model. In general, the work suffers from three flaws.

First, the systemic approach to long cycle research precludes any careful exploration of war causation. The actual process of war initiation is under-specified and treated as mechanistic. Governments start wars; long cycle work gives no indication of how or why particular governments should respond to economic movements. While a few models do attempt to do this (Williams, McGinnis and Thomspon, 1994; Goldstein, 1991) on the theoretical side, the empirical work relies on aggregate variables such as worldwide production or prices and war intensity. Because all countries are lumped together in this analysis, it is impossible to conclude from these empirical analyses whether governments are responding to the economic movements in ways that these models would predict.

Moreover, given that the dependent variable measures war intensity (which gives systemic wars the most weight), these models cannot really speak to government decision-making. Systemic wars and their resulting casualty scores cannot really be accurately thought of as chosen in advance based on a set of underlying economic variables. Clearly, leaders were not consciously choosing to enter a war that would last for years and cost so many million lives. Yet, these exact events claim the most variance on the dependent variables, biasing any evidence of a relationship between economic change and government decision-making.

Second, the above problem with the systemic approach is further complicated by the unrealistic economic assumptions embedded in aggregate models. The use of one economic series for the entire world assumes that the same economic conditions prevail around the globe. For instance, Goldstein (1988) uses British wages and US building investment as explanatory variables for global war severity. This empirical test measures the response of governments around the globe to wages of South English carpenters. In effect, what is being argued is that the law of one price applies in all of these cases. This would require completely free and open international trade throughout the time series. The earliest that international trade could be considered free and open would be in the nineteenth century under British hegemony, although the actual level of openness has been questioned (McKeown, 1983). Even if this is granted, however, there is an obvious period of closure following World War I. Also, the claim of openness of the international system after World War II is not uncontroversial (McKeown, 1991). Given the historical evidence, the use of one series to model the economic incentives facing all major participants in the international system seems unwarranted.

Third, the bundling of the entire economic process into one variable (either prices or production) obscures

the differing incentives that the underlying economic movements create for governments to go war. In other words, this approach treats all growth in production or changes in prices as based on one fundamental process, ignoring some very basic insights of economics. In basic economic models, growth can result from rises in labor productivity, rises in capital productivity, or changes in technology. The type of process that is actually at work could make quite a difference to a government considering war. A growth spurt led by capital improvements would have vastly different effects on real wages than a growth spurt led by improvements in labor productivity. If governments are motivated by the opportunity costs of devoting labor to warfare, these types of growth would hold completely different predictions about government propensities to enter wars. To fully capture the relationship between economic change and political decision-making, the economic process must be broken into the different components that actually affect the government's incentives.

FROM LONG WAVES TO PRICES

The primary purpose of this article is to break the economic long wave into constituent movements in the price level and the factor prices of land, labor, and capital. Rather than address issues of cycles and periodicity, this shifts the focus of inquiry to the specific causal pathways between economy and war. To avoid the pitfalls of global open market assumptions, this analysis is best handled at the state level. Moving from a systemic level of analysis to the state level also allows better testing of an individual government's response to economic changes. This article argues that changes in the price level, land rents, labor wages, and interest rates cause changes in a government's valuation of war as a policy option.

In a classical sense, prices can be thought of as signals of the opportunity cost of utilizing certain factors of production. It should be noted that that the opportunity cost conception of prices implies efficient markets; that is, markets are well integrated such that the information transmitted through the price system is correct. For many of the relevant markets, this assumption will be time-bound. When markets are well developed, the information contained in prices will be of more use to state decision-makers. These prices inform decision-makers of the opportunity costs of using different resources.

The second interpretation of price information takes into account the warning that markets do not function perfectly and unfettered as economists would hope. In addition to showing true opportunity costs associated with certain resources or the economy's value for these goods, prices reveal the extent to which the state has intervened in the economy. Prices can transmit information about prior state behavior and the expectations of economic actors over the state's future behavior. Government behavior in the realm of regulation, fiscal policy, or monetary policy can lead to changes in various factor prices. Moreover, if actors in a given market expect this behavior from the government in the future, their valuations of the given product or factor of production may change as a result. Again, this sort of conclusion relies on an assumption about the ability of the market to capture and aggregate this information.

The information contained in prices can be very useful for governments evaluating decisions to enter hostilities. First, for more basic and pedestrian reasons than war decisions, governments are motivated to collect information about the prevailing conditions in the economy. A government's finance ministry could be expected to have access to information about interest rates, price levels, and other macroeconomic variables. The military could be expected to have information about the costs of conscription, wages, and the prices of various other goods. Thus, models of decision-making based on prices do not require unrealistic assumptions about information processing by governments since bureaucracies make it readily available to government leaders.

More importantly, prices represent a set of constraints on the government's will and ability to engage in hostilities. For a government considering war or behavior that risks war, this information can be used to assess its capability to fight wars (what resources are available), the costs of fighting wars (how will losses of these resources be valued), and the benefits of fighting wars (how are possible gains in resources to be valued). As prices move, government decisions about the use of force in foreign policy should change.

Interest Rates. In a well-functioning market, interest rates represent the opportunity cost of investing money. The particular interest rate of greatest concern to a government is that charged on its debt; this determines the cost of financing deficits. In addition to indicating the cost of borrowing, interest rates can show the willingness of capital markets to extend further lending, as high rates may indicate that a particular borrower may eventually be denied access to credit. The war incentive information transmitted in rates on government debt can be viewed in two ways: as a measure of costs or as a measure of capability or credit-worthiness.

Finance is an important part of the cost of fighting wars. Governments can raise money from capital markets (if they have access) more quickly and easily than by levying taxes. The political costs, however, will occur in the repayment phase when the government is forced to raise taxes in order to retire its debt. Since higher interests payments require greater taxes later, rising interest rates on government debt should make

the government less willing to enter a war. It should be noted that this statement assumes that the government intends to honor its debts in the future. It is possible that a government, having borrowed heavily to finance its military, could simply default on its debts and forego the costs associated with higher interest rates. However, this would make borrowing in the future much more difficult as it acquired a reputation for default. Institutions are often designed in such a way that governments have strong incentives to avoid such an outcome (North & Weingast, 1989; Sargent & Velde, 1995).

Debt rates can also be viewed as an indicator of capabilities. Bordo and White (1991) argue that access to ample credit played a key role in British success in the Napoleonic Wars. Interest rates can be thought of as expressing the lenders' perceptions about the risk that the government will not repay the loan. On one hand, this shows a capability assessment directly. As Grossman and Han (1990) point out, lenders will charge a higher interest rate if they believe the government is likely to lose a war (and thus repudiate its debts). Less directly, the high rates indicate a scarcity of capital holders who are willing to lend to the government. Increasing the interest rate will not necessarily ensure full subscription of government offerings since past a certain level of risk, the market may simply ration governments out rather than accepting higher premiums. Absence of credit would force a government to resort to taxation to finance the war. Not only would this be costly politically, but also the slower, less efficient means of finance could handicap the government in the actual prosecution of the war.

Wages. Wage levels show the amount of slack in the labor market. Though present-day military forces are becoming more technologically advanced and the foot soldier is of less importance, war has historically been a labor-intensive effort. Though it may seem trivial, governments must pay soldiers and sailors to fight wars. Even assuming conscription and a soldier's low pay, war draws resources off of the labor markets, creating a number of potential costs for the government considering hostilities. These costs are magnified when wage levels are high.

First, there is the cost of conscription. If there are high wage levels, raising an army entails either hiring men away from the labor force or pressing them into service. If the wages they are receiving in the market are large, they will be less willing to join. This means mercenary troops will be more expensive and conscripted soldiers will be more tempted to dodge service. Moreover, soldiers who are pressed into service from good situations at home may be less motivated, more difficult to train, and less willing to fight in the field. Press gangs used by the British Navy during the Seven Years' War, for instance, were expensive to maintain and yielded less trustworthy seamen than voluntary recruiting according to the Admiralty (Gradish, 1980).

The second cost is political in nature. If high wage levels indicate an absence of slack in the labor market, capital owners who are already paying large wage bills will be aggravated when the labor market is tightened further and their employees are sent overseas. Commercial interests who use large amounts of labor will be more opposed to war if wage levels are high. In addition to this political problem of conscription, the government may endanger its revenue supply. By damaging the very commercial interests it relies on for taxes, the government constrains its own ability to pay for the war. Referring again to British naval conscription in the Seven Years' War, Gradish (1980) argues that increases in the naval wage bill met strong political opposition from the gentry while merchants and seaside town mayors opposed press gangs to the detriment of the British Navy and war effort. This implies that the rising wages affect capabilities as well as net benefits of fighting wars.

Finally, higher wage levels may affect a government's valuation of the losses it may sustain in battle. War disrupts production and deploys factors of production away from their peacetime use. If labor is scarce, a government will be less willing to risk its country's supply on the battlefield. Conceptualizing soldiers as simple factors of production in this way, the wage rate represents a proxy for their replacement cost as economic inputs. This cost represents some measure of prosperity the government chooses to forego by entering a war.

Land. Since land cannot really be considered an input of war, the price of land should not affect the costs of fighting. Instead, the price of land represents a possible indicator of the benefits of fighting a war and securing foreign territory or, for that matter, successfully preventing the loss of territory to another state. Higher land prices would, therefore, indicate greater spoils to the victor in an armed conflict. This assumes that the government is fighting with the expectation of seizing control of foreign lands for the purpose of revenue extraction. Higher land prices would mean that the land captured could either be sold for more money or given away for more political favors to domestic actors.

Price Level. The final piece of information that might interest a government concerns the price level. Theoretically, the price level is a function of two variables: the money supply and the amount of output produced by the economy. Decreases in the price level could be taken to mean that either the money supply has decreased or the amount of output has increased (or that the movement of one of these variables in the specified direction outstripped the movement of the other variable). Each interpretation has implications for the government's assessment of its capability to fight war.

First, one way for a government to finance wars is through seigniorage, printing more money or producing debased currency. This effectively amounts to an inflation tax that falls onto the entire society. Rising or unanticipated inflation is costly in that it entails disruption of the information function of the price system, imposing costs on actors as they adjust to new price levels. Also, it may spiral out of control as economic actors begin to expect this behavior leading to political problems for the government. The excessive use of inflationary finance may preclude the government from further access to capital markets. For example, in the case of France after the Revolution, investors no longer believed the government promise to repay its debt without resorting to an inflation tax to be credible and refused to buy government securities (Bordo & White, 1991; Sargent & Velde, 1995). Lower and stable rates of inflation mean that the government has more room, to use this measure before the consequences become very costly.

Second, interpreting a fall in the price level as an increase in production also suggests that governments will be more capable of fighting wars. If production has increased, there should be more resources in the economy that the government can extract. This could mean more financial resources or better military goods and technologies. So, a price level decrease should lead a government to believe it is more capable of fighting wars.

MODELING DECISIONS

The previous section specified how governments' valuation of warfare as a policy option should be affected by changes in four prices. However, the manner in which this valuation affects outcomes of international interactions is not immediately clear. For example, a government's alternate valuation of war as a policy option may induce a possible target state to capitulate and make concessions. An increase in war valuation would lead to less observed hostility. On the other hand, if leaders operate in absence of such information about possible foes, governments may act based on simple assessments of whether or not war will be net beneficial. An increase in war valuation in this case would lead to more observed hostility.

Game theoretic models of war initiation typically specify detailed calculations by governments involving sophisticated assessments of other players' probable actions. Bueno de Mesquita and Lalman (1992) use a game theoretic model to explain how states involved in disputes with one another interact. Decisions by each actor are made using backwards induction. This requires the actor to analyze the contingent outcomes and opponent's reactions to each decision. Bueno de Mesquita and Lalman generate the necessary and sufficient conditions for the initiation of a war by *A* in a perfect information state and then derive the "Basic War Theorem." Working from their extensive form game, they derive a set of four preference restrictions to add to their minimal preference assumptions in order to show that war can be an equilibrium outcome. While Bueno de Mesquita and Lalman's model does provide an interesting challenge to realist work on war causation, it does not provide any leverage in understanding how changing war payoffs affect decisions to enter wars. If war valuation is altered by the economic changes described above, the resulting changes in terms of Bueno de Mesquita and Lalman's variables do not yield a determinate prediction about the likelihood of war. Some of the conditions are more likely to be satisfied while others are less likely to be met.

Gartzke (1999) discusses the problem more generally, arguing that rationalist approaches to war causation fail to provide determinate predictions for when states will go to war. In Fearon's (1995) argument, for war to be a rational outcome there must be uncertainty about capabilities and intentions between two rivals. Gartzke argues that in this framework, one must be able to explain why some states overestimate and others underestimate their rivals' characteristics in order to explain why some go to war and others do not amid uncertainty. Since overestimation and underestimation constitute irrational sets of expectations, the rationalist framework cannot explain the occurrence of war. The rationalist framework explains conditions under which war is more likely but cannot predict when wars begin because the occurrence of war is due to a "mistake" in assessments.

The need for the rationalist framework to appeal to elements of irrationality for a fully specified theory of war causation is mirrored by three practical difficulties that rational choice models of war causation encounter in their assumptions. First, as Steinbruner (1976) argues, the body of information relevant to full expected utility calculation is so exceedingly large and diffuse that governments are overwhelmed in both the information collection and processing tasks. Second, even when large amounts of information are available, organizational difficulties may preclude its collection and presentation. Third, the assumption of sophisticated calculations in game theoretic models places unrealistic demands on what is actually an array of differing individuals each positioned in a different organizational context.

Finally, there is a fundamental contradiction that lies at the heart of Bueno de Mesquita and Lalman's (1992) domestic variant of the international interaction game (the variant with the best empirical fit). War, in this variant, is made by possible under full information conditions by the assumption that demands made by states are generated by domestic political processes rather than expected utility maximizing calculations. Bueno de Mesquita and Lalman provide no explanation for why choices made at one level of the game are not

based on rational calculation while the choices in the rest of the game are. Again, the rationalist framework must appeal to elements of irrationality to close the model.

Behavioral decision theories suggest that actors operate in fundamentally different ways than expected utility models predict, given these sorts of constraints. Attention to the external environment by organizations is problematic (Cyert & March, 1963). Rather than monitoring all possible information and processing it, actors instead rely on sets of cues in the external environment. Rather than engaging in complex calculations over these cues, actors respond on the basis of certain rules of thumb. Several studies discuss the use of standard operating procedures in foreign policy decision-making (Allison, 1971; Levy, 1986; Steinbruner, 1974). Given the complex information environment that governments operate in, this sort of decision-making process seems entirely plausible and raises doubts about the appropriateness of game theoretic models stressing calculation.

This is not to say that governments are completely without information or the ability to make decisions. Governments prefer to stay in power avoiding wars that will lead to either military defeat or the loss of the support of their constituency. They can be expected to devote time, effort, and resources to the collection of information and its proper use regarding decisions about hostilities. Neither does a limited rationality argument imply that the resulting decisions are completely irrational and bear no relation to the government's preferences. Governments with relatively inefficient sets of cues and heuristics (i.e., those that lead them to choose costly wars) are likely to be selected out of the system, either through removal by conquering powers or by dissatisfied domestic constituents (Bueno de Mesquita, Siverson, & Woller, 1992).

Taking into account these objections to expected utility models, a model of crisis decision-making based on difficulties in information processing should emphasize the evolution and importance of heuristics and cues. The discussion about the constraints on decision-making imposed by the information environment suggests two necessary characteristics of a model based on cues and heuristics. First, the cues must rely on proximate sources of information. The information attended to by a government must be readily available and acquired without excessive cost. Price data fulfills this criterion. The information is gathered by bureaucracies; bureaucracies track domestic economic information (interest rates, wages, land prices, price level) and information about the distribution of power (rough estimates of the balance of capabilities).

Second, the information, though not completely capturing the expected utility equation, must nonetheless be relevant to the decision (i.e., it must capture some element of the costs and benefits of the actions considered). Governments face large political costs when they choose to enter wars that yield net losses. Prices give information about the costs and benefits of war involvement as well as capabilities (or probability of success).

To summarize, the limited rationality perspective suggests the following propositions about governments in crisis situations. They have limited attention and ability to assess foreign states' intentions, capabilities, and likely behavior. They respond to a crisis by looking at information cues that indicate possible costs and benefits associated with hostilities and their potential for military success. When these cues indicate that war fighting entails falling costs, rising benefits, or increasing chances of success, they choose more hostile courses of action. Below, the hypotheses are summarized:

- ***Hypothesis 1***: Increases in interest rates reduce the level of initiated hostility.
- ***Hypothesis 2***: Increases in wage rates reduce the level of initiated hostility.
- ***Hypothesis 3:*** Increases in land rents increase the level of initiated hostility.
- ***Hypothesis 4***: Increases in the price level of consumption goods, reduce the level of initiated hostility.

DATA

The empirical test of the two models departs from the long wave literature approach by considering economic variables and war decisions within a single state. The data for the empirical tests consist of economic variables and dispute data for Great Britain from 1816 to 1900. Using Britain during this time period offers several advantages for testing the model. First, as the leading economic power in the world (and a free trading state for at least the latter half of the period), Britain's markets certainly must have been less segmented than other countries' markets. This means that the information contained in the relevant prices more closely fits the neo-classical conception of prices as signals of scarcity. Moreover, the British bureaucracy was well developed and more likely to be collecting that information, especially in the area of finance.

Second, the British Empire was vast, extending into all parts of the globe during this time period. This means that decision-makers within the British government faced a complex information environment that consisted of a very large number of possible opponents and conflict locations. Not only does this mean that the decision process was conducive to the use of cues, but also that the extent of British involvement abroad presented British decision-makers with a myriad of possible opportunities for new conflicts. Hostility

could be increased incrementally in response to changes in the cues the decision-makers were tracking.

Finally, Great Britain offers a good test case for the model since they suffered few major military defeats in wars within this time period. Given that the regime did not change during the time period, the responses of the government to the one set of cues might be expected to be more stable throughout the series. This should yield regression coefficients that are stable over time.

Dependent Variables. Two separate dependent variables are modeled to measure the change in government decision-making resulting from changes in prices. The primary indicator of government use of force is **an index of hostility** constructed from *Bremer's Militarized International Dispute* data from the *Correlates of War*[1] project. In this data set, there is a hostility level variable that gives the highest level of action each state takes (from no militarized action to war, five points) in each year of a militarized dispute. This score was taken for each year Great Britain was involved in a dispute (non-dispute years were coded zero) and weighted based on the capabilities of the rivals in the dispute. If the rival was a major power (as defined by Singer and Small, 1993), the hostility score was multiplied by a constant. The constant was derived by taking the ratio of average capability of major powers to minor powers over the time range of the series. If Great Britain was involved in multiple disputes in a year, the weighted hostility measures of each dispute were summed for that year. High scores on this variable indicated greater use of force by British government.

The second dependent variable used to model government response was a **differenced measure of real military expenditure**. The data for this variable came from Mitchell (1988). The army and navy expenditure series were summed and then divided by the price level series found in Phelps Brown and Hopkins (1962) in order to put the variable in real terms. The first difference of this series was taken in order to remove the effect of economic growth and confine the series to innovations based on government decision-making.

Independent Variables. Four price variables and one control variable were used. The control variable, **capability**, was a measure of Great Britain's share of global military capability derived from the *Singer and Small National Material Capabilities*[2] data set. A raw series was constructed by taking the arithmetic mean of military personnel and expenditure for each country each year. The final series consisted of Great Britain's proportion of the total of all countries' capability for each year. The interest rate variable, **yield**, came from yearly data in Mitchell (1988) on the yield of British Consols. Mitchell includes corrections for the original data for the years 1879 to 1902 due to the fact that Consols rose above par making them no longer loans of infinite duration (Mitchell, 1988: 678). These corrected figures are used instead of the initial values. The **wage** variable is the first difference of a series of real wages. The data come from the Phelps Brown and Hopkins (1962) series of South England building craftsman wage rates. The first difference was taken to remove the variation caused by economic growth (increases in productivity) and isolate innovations in the time series due to the scarcity or abundance of labor. The price level variable is a measure of **inflation**. The Phelps-Brown and Hopkins (1962) series of the price of a composite unit of physical unit of consumables was used as the raw series. The final series consisted of the percentage change from last year's price level each year. The **rent** variable is a series of real rents on agricultural land in Great Britain. The raw data, found in Thompson (1968), consisted of average of rents at several estates throughout Lincoln, Essex, Hereford, and North Wales. To put the series into real terms, the raw rent data were divided by the Phelps-Brown and Hopkins price level for the given year.

RESULTS AND ANALYSIS

To test the decision model, one time series regression was estimated for each dependent variable for the period from 1816 to 1900. The independent variables in each equation were lagged one year to prevent any illogical causal orderings (e.g., a full year's price information being used to predict hostile action in the first month of that year) and avoid simultaneity issues. This lag can also be thought of as reasonable government response time. To remedy the problem of serial correlation, a lagged dependent variable was included in each equation. The equations for military expenditure and hostility are presented in Table 1.

The hostility index regression, while significant, yielded a relatively low R-square. Nonetheless, two variables showed significant effects consistent with the behavioral decision model. Yield on British Consols had a significant, negative effect on the level of hostile action by the British government. This finding supports Hypothesis 1 of the behavioral decision model. Interest rates on government debt were argued to have a negative effect on both capabilities and the net benefits of war. In the behavioral model, governments responded to such effects by choosing less hostile courses of action. The large, negative coefficient on the yield variable confirms this hypothesis. Similarly, the negative coefficient on the real wage variable also supports the behavioral model's Hypothesis 2. Like interest rates, positive real wage changes were argued to have negative effects on war capabilities as well as net benefits. In the behavioral decision model, governments choose less hostile actions when capabilities and net benefits are falling.

The real military expenditure models both achieved the high R-squares commonly associated with time series regressions. Several of the parameters estimated

TABLE 1. Regression Results

	Hostility	Real Military Expenditure Model 1	Real Military Expenditure Model 2
Lagged Dependent	.162 (1.385)	.360** (2.294)	.336** (2.195)
Inflation	-9.754 (-1.554)	3.085 (.176)	-1.350 (-.078)
Yield	-1.348** (-2.069)	-5.832*** (-3.333)	-5.792*** (-3.339)
Real Wages	-.137* (-1.756)	.035 (.017)	-.06901 (-.344)
Real Rent	-59.271 (-.273)	-1110.116* (-1.908)	-2597.413** (-3.264)
Capability	-3.213 (-.717)	57.280*** (4.439)	57.784*** (4.608)
Yield*Capability	8.399 (.949)	-125.355*** (-4.157)	-158.782*** (-4.981)
Pre-1846 Dummy	------	------	1.829** (-2.273)
Real Rent*Pre-1846	------	------	2273.132** (2.421)
Constant	1.601 (.559)	16.637** (2.176)	.308** (3.423)
R-Squared	.179	.574	.611
F, (P-value)	2.360, (.031)	14.632, (.000)	12.910, (.000)
N	83	83	83

* significant at .1; ** significant at .05; *** significant at .01

TABLE 2. Interpreting the Coefficient of Yield in the Second Real Military Expenditure Regression Conditional upon Values of Capability

Capability value	Yield Coefficient
High – one standard deviation above mean	-15.207***
Mean	-5.792**
Low – one standard deviation below mean	2.908

** significant at .05; *** significant at .01

were highly significant including the lagged dependent variable. Most notably, the yield coefficient was significant and negative. The second interaction included in the model tested the effect of yield conditional on world capability share. The resulting coefficients, shown in Table 2, showed that the effect of yield depended upon the level of capability. The effect of yield was strongly negative at high capabilities, less so at mean levels, and insignificant at low levels. High costs of financing deterred large spending increases but only at average and high levels of capability. At low capability, a government could be expected to be less sensitive to these costs.

This result suggests a pattern of diminishing marginal returns. A government's most fundamental concern is survival which, in the international system, is only guaranteed by force. The first units of military strength purchased by a government ensure survival, while additional increments afford political control, a desirable but less fundamental goal. At low levels of capability, a government fearing external threats would be less concerned with the costs of acquiring military strength. At higher levels of capability, however, a government would have a modicum of security from external enemies so costs would be more important. The insignificance of the low capability yield coefficient is consistent with this explanation.

The fact that the negative effect of yield is consistent across both the hostility and the spending models emphasizes the importance of interest rates and supports the behavioral decision model. Higher finance costs and constraints on access to capital deter the government from aggression either through spending or direct action. While the effect of yield changes on spending changes is conditional on capability, this interaction is not significant in the hostility equation. Hostility, however, does not necessarily face the same return structure. By definition less defensive in nature than spending, the returns on hostile actions do not necessarily decrease. In fact, there is little to suggest why returns on a given level of hostility would vary at all with capability.

The effect of inflation is insignificant in all three models. This finding does not confirm the expectations of the model about the impact of changes in the price level on government decision-making. The lack of significance of this variable, however, holds a more general implication. Typical long wave studies, such as Goldstein (1991), utilize price changes to explain

changes in war outcomes. However, in the models estimated here, other macroeconomic changes are controlled and the price level has no impact. Refocusing inquiry from the system level (worldwide production and war severity) to the state level (factor price changes and war decisions), minimizes the importance of price level given that it is less readily available and obviously useful to governments as a cue for decision-making.

The lack of significance of the wage variable in the spending models is also notable and, along with the weak significance in the hostility model, challenges its importance to government decision-making. Goldstein (1991) and Boswell and Sweat (1991) – to the extent that real wage increases correspond to the economic upswings they discuss – both assert the importance of wage increases in predicting levels of war severity. However, the spending models both find this variable to be insignificant. Moreover, although the variable has marginal significance in the hostility model (.10 level), it is incorrectly signed since wage increases are associated with decreasing hostility. This would be more consistent with Bergeson's (1985) interpretation than Goldstein (1991) or Boswell and Sweat (1991).

However, military spending should be expected to be less responsive to real wage changes than hostility. Hostile actions require military personnel to man ships and fight infantry battles (during the nineteenth century at least). During hostilities, it is difficult to substitute expenditures on materiel for manpower. However, in the face of rising wages, spending increases could be shifted away from manpower to acquiring armaments. As a case in point, Gradish (1980) notes that while the British had a large number of warships that could have been useful in the Battle of Minorca during the Seven Years' War, the high costs of manning them prevented their deployment. This could be interpreted as an increase in wages that constrained hostility but not spending.

The first spending model created a puzzle that required a second regression to explain it. Contrary to the predictions of both the game theoretic and the behavioral decision models, the coefficient for the rent variable was significant and negative in the first model. One possible explanation for this result could be the diminishing marginal utility of income for politically powerful British landowners. At low levels of rent, landowners make small returns on their assets and might be willing to support government military spending for the purpose of forcibly acquiring income streams from abroad. At higher levels of rent, however, each further increment of income brings less utility so landowners would oppose military spending. Landowners would oppose government spending increases (which would mean higher taxes) since they would no longer bring large benefits. This explanation of the negative rent coefficient rests on the assumption that landowners had the political clout to successfully oppose spending increases.

TABLE 3. Interpreting the Coefficient of Real Rent in the Second Real Military Expenditure Regression Conditional upon Values of the Time Dummy Variable

DUMMY value	Rent Coefficient
0 (1816-1846)	-2597.413***
1 (1846-1900)	-324.281

*** significant at .01

If the explanation rests on landowners' clout, then the strength of the relationship should vary with the gentry's political power. Historically, the landed class in Britain gradually lost power and political control over the nineteenth century. The *Reform Bill of 1832* broadened the franchise, giving representation to a wider array of interests. The repeal of the *Corn Laws* in 1846 represented an unprecedented defeat for the landed class as the British agricultural market was opened to world trade. This shift in power implies that, if the diminishing marginal utility of income argument were true, the rent coefficient would be stronger in the first part of the century then the second.

To test this explanation, a second model of real military expenditure changes was estimated including an interaction between rent and time. The **time** variable, labeled dummy, was a dichotomous coding: zero from 1816 to 1846, one from 1846 to 1900. The rent coefficient conditional upon time proved to be significant and negative before 1846 and insignificant thereafter (see Table 3). This is consistent with the hypothesis that changing rents determined landowner support for military spending and that this support was no longer politically decisive in the latter half of the nineteenth century.

This finding supports the conclusions of Williams, McGinnis, and Thomas (1994); the importance of land as a motivation for war declines as agrarian economies are transformed and the value of conquered territory falls. However, one need not adopt their overall conclusions of dissolution of the link between war and economic change. Their argument that wars since the 1850s are not based on economic rationality assumes that governments make decisions based on net welfare gains to society. However, a decision to enter war may be politically rational based on economic considerations even if it is costly to the nation as a whole provided that the decision is beneficial to the government's constituency. The significance of the interaction suggests that certain components of political-economic calculations of government change as key constituents change. Rather than concluding that economic change no longer matters for war, one may conclude that the

relevant economic factors of interest to governments have changed.

CONCLUSIONS

This article establishes the link between macroeconomic change and government decisions to use force in the international system. The findings suggest that the long wave argument is more properly addressed by disassembling economic change into its component parts to identify particular sources of incentives. Interest rates, real wages, and rents each seem to be individually important in this respect while inflation, the traditional cornerstone of long wave analysis, shows less influence. These findings also suggest the importance of a state-level approach given the problematic assumptions entailed in generalizing economic data across the globe. The state-level approach avoids these difficulties and allows clearer examination of government response.

The long wave literature models the relationship between economics and war at the system level. However, the variables of interest to long wave researchers lose significance when other economic variables are controlled for in the state-level analysis. Focusing on government decisions rather than overall war severity results in a change in the importance of these predictor variables. A state-level approach suggests that different variables drive short-term hostility decisions than those specified in long wave explanations of systemic wars. The statistical result supports the article's contention that the way economic change affects decision-making is under-specified in the long wave literature. The model in this article bridges this gap by exploring a more detailed specification of economic change.

The results suggest that traditional long wave variables like prices and wages are less important than interest rates in predicting government decisions. This highlights the difference between the system-level and state-level focus. Price, production, and wage levels purportedly measure the availability of resources within society that can be mobilized for large wars. Interest rates on government debt, on the other hand, provide a measure of what resources are readily available from an economy and the cost at which they may be acquired. In accordance with the model, the information is readily available in addition to being quite relevant to the decision. As such, the more detailed array of economic changes captured in this model provides a more accurate picture of the link between war and economics.

NOTES

[1] The Correlates of War Project can be found at: http://correlatesofwar.org/

[2] The Singer and Small National Material Capabilities data set can be found at: http://arc.irss.unc.edu/dvn/dv/ICPSR/faces/study/StudyPage.xhtml?globalId=hdl:1902.2/9903&studyListingIndex=0_4a461488bd6235013d49ee6eb153

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