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# How does war shock the economy?

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**Abstract**

Wartime periods have frequently been treated as natural macroeconomic experiments, but the international pooled time series evidence presented here shows that the literature has overemphasized the experience of the United States and the United Kingdom. Wars fought exclusively on foreign soil do have marginally higher real output growth than peacetime periods, but real growth during all other wars is sharply below peacetime levels. Evidence for foreign and domestic wars is consistent with monetarist, fiscalist, and mixed theories of wartime booms. 

*Keywords:* Fiscal policy shocks; Monetary policy shocks; War

## 1. Introduction

The rapid expansions of output in the United States and the United Kingdom during the world wars—especially the dramatic US growth during World War II—have been widely perceived by economists as natural experiments demonstrating the effectiveness of expansionary demand policy (Vernon, 1994; Braun and McGrattan, 1993; Romer, 1992; DeLong and Summers, 1988; Barro, 1986a, 1981; Friedman and Schwarz, 1963; Friedman, 1952) But were the US and UK experiences typical of war economies? Since use of war-related information as an identification strategy is increasingly popular (Edelberg et al., 1998; Ramey and Shapiro, 1997; Caplan, 2000) it seems important to double-check. In order to do so, this paper examines the wartime performance of a large number of countries over long timespans (similar

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to the approach in Bordo and Jonung, 1996; Bordo, 1993; and Backus and Kehoe, 1992). It concludes that US and UK cases are unrepresentative.

When all wars are treated alike, the only obvious macroeconomic correlate of war is government spending. To learn anything further it is necessary to distinguish between wars fought exclusively on foreign soil ("foreign wars") and all other wars ("domestic wars"). Then several novel stylized facts emerge along with more predictable findings: Domestic wars have a clear and substantial *negative* impact on real output, while foreign wars are associated with slightly above-average real output growth. Inflation, money supply growth, and government spending are not always high during wars, but usually move in the same direction. (However, factoring in the impact of wartime tax increases makes the impact of fiscal policy less clear.)

The paper is organized as follows: Section 2 describes the two main data sets used. Section 3 presents the results for the non-policy variables (real output growth and inflation) and the policy variables (money growth, spending, and taxation). Section 4 presents sensitivity tests; the final section speculates about why the US and UK wartime experiences were unusual and concludes the paper.

## 2. The data

To check the results' robustness, the current paper conducts all tests on two distinct data sets: the "broad" data set of 66[1] countries over the period from 1950–1992, and the "narrow" data set of 15 countries[2] over the 1881–1988 period. The 15 countries in the "narrow" data set are all relatively advanced industrialized nations, while the 66 countries in the "broad" data set include advanced industrialized nations, LDCs, and a small number of Communist and former Communist countries.

Most of the "broad" data set comes from combining the *Annual Data on Nine Economic and Military Characteristics of 78 Nations, 1948–1983* (ICPSR 9273) with

[1] The 78 countries included in Annual Data on Nine Economic and Military Characteristics of 78 Nations, 1948–1983 (ICPSR 9273) and World Military Expenditures and Arms Transfers, 1983-1993 (ICPSR 6516) are: USA, UK, Austria, Belgium, Denmark, France, West Germany, Italy, Netherlands, Norway, Sweden, Switzerland, Canada, Japan, Finland, Greece, Iceland, Ireland, Malta, Portugal, Spain, Turkey, Yugoslavia, Australia, New Zealand, South Africa, Argentina, Bolivia, Brazil, Chile, Columbia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, Venezuela, Iran, Iraq, Israel, Jordan, Lebanon, Saudi Arabia, Syria, Egypt, Yemen, Afghanistan, Burma, Sri Lanka, India, Indonesia, South Korea, Nepal, Pakistan, Philippines, Thailand, Ethiopia, Liberia, Albania, Bulgaria, China, Cuba, Czechoslovakia, East Germany, Hungary, Mongolia, North Korea, Poland, Rumania, and the USSR. Due to missing data, my "broad" data set excludes Burma plus eleven Communist and former Communist countries: Yemen, Afghanistan, Albania, Bulgaria, China, Cuba, Czechoslovakia, East Germany, Mongolia, North Korea, and the USSR. Omitting the few remaining Communist and former Communist countries as well does not significantly change the subsequent results.

[2] The "narrow" data set is comprised of the following countries: USA, UK, Germany, France, Japan, Canada, Italy, Belgium, Netherlands, Switzerland, Denmark, Finland, Norway, Sweden, and Portugal.

*World Military Expenditures and Arms Transfers, 1983–1993* (ICPSR 6516).[3] Both series measure output in current dollars. To calculate real output, series were converted to constant dollars. Inflation was calculated using the dollar inflation rate and exchange rate information; the Pennworld data set supplied missing information on exchange rates.[4] The appropriate volume of *International Historical Statistics* (Mitchell, 1992; Mitchell, 1993; Mitchell, 1995) provides matching data for M2 and taxes; missing M2 data was supplemented with data from the *International Financial Statistics Yearbook* (1996).[5]

The "narrow" data set was provided courtesy of Michael Bordo, as compiled in several of his earlier studies (Bordo and Jonung, 1996; Bordo, 1993). Bordo's money supply data uses M2 if it available over a sufficiently long period, and M1 otherwise. Data on fiscal variables matching Bordo's data set were found in various volumes of *International Historical Statistics*.

The data on participation, dates, and battle deaths in wars all come from the *Correlates of War Project: International and Civil War Data, 1816–1992*. Since the *Correlates of War* records even extremely minor military incidents, my dummy variable *War* only "turns on" if both (battle deaths/population) and (battle deaths/population/year) exceeded 1 in 100 000 for a given country–year. This excludes both extremely long-term, low-intensity conflicts as well as extremely short high-intensity ones. The *Correlates of War* provides starting and ending dates for each country's participation in each conflict; these provide the basis for all time-related coding. *Foreign* (a variable equal to 1 if a war was fought exclusively on foreign soil and 0 otherwise) is derived from the information provided from the *Correlates of War*, with ambiguous cases resolved by examining historical atlases. In general, if the *Correlates of War* indicated that a country participated in a war during a given year, and if historical atlases showed any part of that country's territory under enemy occupation during that war, the conflict was coded as domestic.

How does the coding for wars work in practice? It is probably easiest to illustrate this by discussing examples from the narrow data set, where the countries and their historical experiences are relatively familiar. These 15 countries were at war in 15.6% of country–years; 4.2% of these country–year were foreign wars, and 11.4% were foreign. According to the *Correlates of War*'s coding, the United States was in the Spanish–American War and the subsequent Second Philippine War from 1898–1902; World War I from 1917–18; World War II from 1941–1945; the Korean War

[3] When the measurements for the overlapping year (1983) differed, the latter series was multiplied by a constant to make the two equal at the spline point.

[4] When there was a conflict between the two exchange rate measurements—almost always in fixed exchange rate regimes—the Pennworld data showing continuous "unofficial" changes in the exchange rate was used.

[5] When there was a change in the definition of a variable, or when it was necessary to supplement data from International Historical Statistics with data from *International Financial Statistics Yearbook*, the later measurements of the series were multiplied by a constant to make the divergent series equal at the spline point.

from 1950–3; and the Vietnam War from 1965–73.[6] All of these were coded as foreign wars. In contrast, consider the case of Italy. Before World War I, it fought a series of clearly foreign wars: the Italo–Turkish War from 1911–12, and colonial conflicts with Ethiopia in 1887 and again in 1895–6. Italy entered World War I in 1915 and fought through 1918; since parts of northern Italy were occupied, this is coded as a domestic war. During the interwar period, Italy was embroiled in the colonial Sanusi conflict from 1920–1932, which actually had a higher annual casualty rate than the better-known Italo–Ethiopian War of 1935–6. Italy's second domestic war during the sample period was of course World War II; its involvement lasted from 1940–5. Occupation of southern Italy by the Allies and later northern Italy by the Germans makes its classification as a domestic conflict unproblematic. No more wars are coded for Italy after 1945; while it did participate in the Gulf War, its casualty rate was, like that of the United States, below the minimum threshold.

All country–years for which observations of all variables exist were included, with one exception: country–years of hyperinflation (defined as country–years with nominal output growth in excess of 100%). Such country-years were excluded from all estimation except for some sensitivity tests in section five. Hyperinflations were very rare in the narrow data set,[7] but were fairly common in the broad data set. Theory and empirical research suggests that economies' response to high inflation differs from their response to moderate doses; see e.g. Engsted (1994); Christiano (1987); Sargent (1982); Sargent and Wallace (1973); Cagan (1956).

One important caveat for the following results is that governments frequently impose price controls and rationing during wars (Higgs, 1992). This biases measured results in predictable directions: the effect of wars on "true" inflation will be more positive than measured; the effect of wars on "true" real growth will be more negative than measured. Assuming that rationing affects the military sector less than the non-military sector, the response of (government spending/output) to wartime conditions will also be greater than measured. When interpreting the following results, then, the estimates should be seen as an upper bound for the effect of war on real growth, and a lower bound for its effect on inflation and government spending as a fraction of output.

## 3. The impact of wars, foreign and domestic

### *3.1. Real output growth*

During the world wars, measured real output in both the US and UK markedly increased (Braun and McGrattan, 1993). To test the generality of this conclusion, the following equation was estimated using both the narrow and the broad data sets:

[6] The US casualty rate in the Gulf War was so low that it falls short of my cut-off point described above. Conflicts as lop-sided as the Gulf War are extremely rare by historical standards; redefining the cut-off point to include them would have almost no effect on the overall results.

[7] The data for the post World War I European hyperinflation in Germany was missing in the 15-country pool, whereas there was quite complete data on several hyper-inflationary regimes among the LDC's.

$$\Delta R = \alpha + X\beta + \rho War + \varepsilon, \quad (1)$$

where $\Delta R$ is the percentage change in real output, $\alpha$ is the constant, $X$ is a complete vector of country and year dummies, and *War* is a dummy variable equal to 1 if a country was at war in a given year, and 0 otherwise. The first block of Table 1 shows that there is no apparent impact of wars on growth for either data set—a rather puzzling result given the literature's emphasis on wartime expansions.

To check this finding's sensitivity, eq. (1) was re-estimated, but the wars were broken into two distinct classes. *Foreign* was defined as =1 if all of the wars a country was engaged in during a given year were exclusively on foreign soil, and 0 otherwise. *Foreign* and $1-Foreign$ were then interacted with *War* to yield $Forwar \equiv Foreign*War$ and $Domwar \equiv (1-Foreign)*War$. $Forwar = 1$ if a country fought wars during a given year, but these were exclusively on foreign soil, and 0 otherwise; $Domwar = 1$ if a country fought a war on its home soil during a given year and 0 otherwise. During years of peace, $Forwar = Domwar = 0$. Real growth was then regressed on foreign wars, domestic wars, a constant, and a complete vector of country and year dummies:

$$\Delta R = \alpha + X\beta + \rho_1 Forwar + \rho_2 Domwar + \varepsilon. \quad (2)$$

This slight change in specification drastically alters the results, revealing a pattern in both data sets. In the second block of Table 1, domestic wars associate with significantly lower growth rates: 7.1 percentage-points less for the narrow data set, and 2.0 for the broad. In contrast, there is a marginally statistically significant positive effect of foreign wars: about 0.7 percentage-points higher for the narrow data set, and 2.3 for the broad. The negative effect of domestic wars looks bigger, both substantively and statistically, than the modest expansionary impact of foreign wars.

The strong negative impact of domestic wars on growth contrasts with a great deal of earlier literature—both Keynesian and Classical—which emphasizes the

Table 1
Regression of real output growth on war-related variables, controlling for country and year effects. All variables expressed in percentage-point terms

| Variable | Narrow data set | Broad data set |
|---|---|---|
| War | −0.049 (0.407) | −0.380 (0.805) |
| $R^2$ | 0.273 | 0.226 |
| Forwar | 0.694* (0.407) | 2.333* (1.294) |
| Domwar | −7.123*** (0.972) | −2.027** (1.012) |
| $R^2$ | 0.309 | 0.229 |
| *SEs below coefficient* | *Years:1884–1988* | *Years:1953–92* |
| | *N=1339* | *N=2056* |
| | *Missing Observations: 236* | *Missing Observations: 584* |
| | *# Countries: 15* | *# Countries: 66* |

* significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

unusually high growth rate of real output during war. No previous study uses the *Foreign* variable, but it presumably proxies for wartime aggregate supply shocks, which are likely to be worse if a country's territorial integrity is violated.

### 3.2. Inflation

The distinction between foreign and domestic wars also helps clarify the link between war and inflation. Regressions parallel to Eqs. (1) and (2) with inflation as the dependent variable were run for both data sets:

$$\Delta P = \alpha + X\beta + \rho War + \varepsilon, \tag{3}$$

$$\Delta P = \alpha + X\beta + \rho_1 Forwar + \rho_2 Domwar + \varepsilon. \tag{4}$$

The first block of Table 2 shows the results for Eq. (3), the second block for Eq. (4). For the narrow data set, inflation appears to marginally rise during wars. Separately analyzing foreign and domestic wars shows a strong effect of domestic wars that drive this finding, with inflation rising by almost 15 percentage-points. In the broad data set, in contrast, there is no apparent connection between inflation and war, whether foreign or domestic.

The most obvious explanation for the negative impact of domestic wars on real growth is that negative supply shocks dominate any positive demand shocks. The evidence for both data sets is fairly consistent with this interpretation. Both data sets have negative real growth shocks during domestic wars. The difference is that for the narrow data set, inflation rises more than real growth falls. In contrast, for the broad data set, real growth declines while inflation stays steady. In effect, during the broad data set's domestic wars there is no perceptible positive demand shock to counter-balance negative supply shocks.

Table 2
Regression of inflation on war-related variables, controlling for country and year effects. All variables expressed in percentage-point terms

| Variable | Narrow data set | Broad data set |
|---|---|---|
| War | 1.174* (0.703) | −0.242 (1.428) |
| $R^2$ | 0.456 | 0.373 |
| Forwar | −0.233 (0.701) | −0.344 (2.301) |
| Domwar | 14.571*** (1.673) | −0.180 (1.800) |
| $R^2$ | 0.488 | 0.373 |
| *SEs below coefficient* | *Years: 1884–1988* | *Years: 1953–92* |
| | *N=1339* | *N=2056* |
| | *Missing Observations: 236* | *Missing Observations: 584* |
| | *# Countries: 15* | *# Countries: 66* |

* significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

### 3.3. Fiscal policy

All previous papers in the literature find that fiscal policy is expansionary during wartime. The next set of tests looks at the relationship between war-related variables and some indicators of fiscal policy. The first specification regresses total government (i.e., combined military and non-military) spending as a fraction of output on *War*, a constant, and a complete set of country and year dummies:

$$Gfrac = \alpha + X\beta + \rho War + \varepsilon \quad (5)$$

Table 3's first block displays the estimation results for Eq. (5). Government spending as a fraction of GDP is significantly greater for the narrow data set (about 4.4 percentage-points), but small and statistically insignificant for the broad data set. Eq. (6) disaggregates foreign and domestic wars:

$$Gfrac = \alpha + X\beta + \rho_1 Forwar + \rho_2 Domwar + \varepsilon \quad (6)$$

The output (shown in the second block of Table 3) sharpens the conclusions qualitatively and quantitatively. Foreign wars accompany large and statistically significant increases in total spending for both data sets. Government spending as a fraction of output shows a 2.7 percentage-point increase in the broad data set, and 4.4 points rise in the narrow. Yet the two data sets diverge for domestic wars: there is a 4.3 percentage-point increase ($G/Y$) for the narrow data set, but approximately zero change for the broad data set.

The failure of government spending to increase in the broad data set is puzzling but explicable. Disaggregated data on military vs. non-military spending are available

Table 3
Regression of government spending as a percent of GDP on war-related variables, controlling for country and year effects. All variables expressed in percentage-point terms

| | Narrow data set | Broad data set | | |
|---|---|---|---|---|
| Variable | Total spending | Total spending | Non-military spending | Military spending |
| War | 4.432*** (0.588) | 0.808 (0.504) | −1.573*** (0.468) | 2.382*** (0.164) |
| $R^2$ | 0.729 | 0.771 | 0.762 | 0.743 |
| Forwar | 4.447*** (0.604) | 2.723*** (0.811) | −0.488 (0.753) | 3.211*** (0.263) |
| Domwar | 4.289*** (1.441) | −0.354 (0.634) | −2.232*** (0.589) | 1.878*** (0.205) |
| $R^2$ | 0.729 | 0.772 | 0.762 | 0.745 |
| *SEs below coefficient* | *Years: 1884–1988* | *Years: 1953–92* | | |
| | *N=1339* | *N=2056* | | |
| | *Missing Observations: 236* | *Missing Observations: 584* | | |
| | *# Countries: 15* | *# Countries: 66* | | |

* significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

for the broad data set, allowing additional tests for the effect of war on both military and non-military government spending. Separately re-estimating the spending regressions for both sorts of spending shows that *military* spending always rises during wars—by 3.2 percentage-points for foreign wars and 1.9 for domestic. Overall spending fails to go up during domestic wars because non-military spending falls as military spending increases: during domestic wars the broad data set shows a 2.2 percentage-point fall in non-military spending as a fraction of output.

One somewhat neglected feature of wars that may partially mitigate fiscal expansion is the simultaneous rise in taxation. The first block of Table 4 shows the results of regressing taxes as a percentage of output on the war dummy, a constant, and a full set of country and year dummies:

$$Tfrac = \alpha + X\beta + \rho War + \varepsilon. \tag{7}$$

Taxes go up during war by 2.0 percentage-points for the narrow data set and 1.6 for the broad, but it is again helpful to separately look at the role of foreign vs. domestic wars:

$$Tfrac = \alpha + X\beta + \rho_1 Forwar + \rho_2 Domwar + \varepsilon. \tag{8}$$

The second block of Table 4 displays Eq. (6)'s output. For the narrow data set, tax collections as a fraction of output rise by 2.3 percentage-points during foreign wars, but show no appreciable change due to domestic wars. The coefficients for the broad data set are qualitatively similar but less precisely estimated: taxes increase by almost 7 percentage-points for foreign wars, and decline by 1.6 percentage-points for domestic wars.

Credibility is a plausible explanation for the two data sets' different fiscal patterns. The 15 relatively advanced nations in the narrow data set are likely to repay their war debts, so they do not need to reduce total expenditures or drastically raise taxes

Table 4
Regression of taxation as a percent of GDP on war-related variables, controlling for country and year effects. All variables expressed in percentage-point terms

| Variable | Narrow data set | Broad data set |
|---|---|---|
| War | 2.039*** (0.423) | 1.588*** (0.583) |
| $R^2$ | 0.779 | 0.743 |
| Forwar | 2.287*** (0.434) | 6.849*** (0.928) |
| Domwar | −0.317 (1.036) | −1.607*** (0.726) |
| $R^2$ | 0.780 | 0.750 |
| *SEs below coefficient* | *Years: 1884–1988* | *Years: 1953–92* |
| | *N=1339* | *N=2056* |
| | *Missing Observations: 236* | *Missing Observations: 584* |
| | *# Countries: 15* | *# Countries: 66* |

* significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

in order to sustain a military expansion. (Ohanian, 1997; Grossman, 1990) In contrast, the broad data set includes many nations with credibility problems that limit their ability to borrow. They must therefore fund their wars by cutting other areas of the budget or by raising taxes (or the inflation tax). Domestic wars make credibility problems especially severe for less reliable countries. Even marginally credit-worthy nations might credibly commit to repay when the survival of the regime is not in doubt, but the presence of a domestic military threat could make such a commitment impossible or at least require a prohibitive risk premium. (Barro, 1986b; Rogoff, 1985; Benjamin and Kochin, 1984) The credibility of punishments for tax evasion also diminish when a government's survival is in danger, which helps explain why tax collections as a fraction of output tend to fall at the very time that governments need revenue the most.

### *3.4. Money growth*

Monetary policy is also generally supposed to be expansionary during wartime (Hamilton, 1977; Benjamin and Kochin, 1984; Friedman and Schwartz, 1963; Friedman, 1952), so Eqs. (9) and (10) were estimated.

$$\Delta M = \alpha + X\beta + \rho War + \varepsilon \tag{9}$$

$$\Delta M = \alpha + X\beta + \rho_1 Forwar + \rho_2 Domwar + \varepsilon \tag{10}$$

The first block of Table 5 shows that money growth during wars is above normal for the broad data set but not the narrow. The narrow data's set's coefficient on *War* is barely different from zero, but the broad data set's is significant at the 5% level, with money growth around 2.6% higher.

But once again, matters hinge on the war's location. In the narrow data set, domestic wars are associated with a money supply growth rate 4.9 percentage-points in excess of what one would otherwise expect. Foreign war episodes still show no sign

Table 5
Regression of money growth on war-related variables, controlling for country and year effects. All variables expressed in percentage-point terms

| Variable | Narrow Data Set | Broad Data Set |
|---|---|---|
| War | 0.340 (0.709) | 2.621** (1.208) |
| $R^2$ | 0.423 | 0.432 |
| Forwar | −0.141 (0.726) | 2.884 (1.947) |
| Domwar | 4.930*** (1.732) | 2.462 (1.523) |
| $R^2$ | 0.427 | 0.432 |
| *SEs below coefficient* | *Years: 1884–1988* | *Years: 1953–92* |
| | *N=1339* | *N=2056* |
| | *Missing Observations: 236* | *Missing Observations: 584* |
| | *# Countries: 15* | *# Countries: 66* |

of unusually rapid monetary growth. For the broad data set, separately estimating the impact of foreign and domestic wars does not change the coefficients much: 2.9 percentage-points for foreign wars, 2.5 for domestic. But for this specification the standard errors for the broad data set become too large to reject the null that the true coefficients are zero.

### *3.5. Fiscal versus monetary accounts of wartime expansions*

Caplan (2000) uses the narrow and the broad data sets to examine the relative importance of monetary and fiscal policy in detail. The findings of the current paper are not enough to resolve this question. Both monetary and fiscal policy are often expansionary during wartime. But on the surface either fiscal or monetary forces might be responsible for supernormal real or nominal wartime growth; the stylized facts assembled here cannot rule either out.[8]

Consider foreign wars first. During foreign wars, the narrow data set has slightly greater real growth, no change in inflation, no change in monetary growth, a 4.4 percentage-point rise in spending as a fraction of output, and a 2.3 percentage-point rise in taxation as a fraction of output. If real growth indeed rises, the fiscal expansion appears to be the most plausible agent. In contrast, the broad data set's foreign wars exhibit higher real growth, no change in inflation, higher monetary growth,[9] a 2.7 percentage-point increase in spending as a fraction of output, and a 6.8 percentage-point increase in taxation as a fraction of output. Since the increase in taxation greatly outstrips the increase in spending, monetary factors seem to be driving the expansion.

The picture differs for domestic wars. Then the narrow data set shows lower real growth, much higher inflation, 4.9 percentage-point faster monetary growth, a 4.3 percentage-point increase in spending/output, and no increase in taxation. Both monetary and fiscal policy are more expansionary than for foreign wars, so either or both could be responsible for the fact that nominal output ($\Delta R + \Delta P$) rises. For the broad data set, in contrast, real growth falls, inflation stays the same, monetary growth rises, spending as a fraction of output does not change, and taxation as a fraction of output falls by 1.6 percentage-points. On net then, both monetary and fiscal policy are expansionary, but ($\Delta R + \Delta P$) seems to fall or remain steady rather than rise. The sensitivity tests in the next section put this seeming anomaly in perspective.

Since wars can bring higher taxes along with higher spending, one might well wonder when wars are *on net* fiscally expansionary. This question is fairly easy to answer in terms of the simple Keynesian model that treats taxes and spending as negative and positive demand shocks, respectively. From this perspective, the evidence from Tables 3 and 4 show that wars are most expansionary for the narrow data set during domestic wars: Spending significantly rises, while taxes remain unchanged. During foreign wars, the net effect for the narrow data set still looks

[8] Productivity data would certainly help resolve this question. Unfortunately, productivity data that roughly matches either of my data sets is, to the best of my knowledge, currently unavailable.

[9] Note that this increase is statistically significant when money growth is regressed on *War*, but not statistically significant when regressed on *Forwar* and *Domwar* separately.

expansionary, but the tax increase partially counteracts the spending increase. For the broad data set, in contrast, domestic wars on net look mildly expansionary, while foreign wars look sharply contractionary, with the tax increase greater than the spending increase. From this simple Keynesian view, supply shocks and/or monetary shocks are definitely necessary to reconcile the net fiscal stimuli with the behavior of real output. The most positive fiscal shock (narrow data set during domestic wars) shows the largest decline in real output; the most negative fiscal shock (broad data set during foreign wars) shows the largest increase in real output.

Matters are more complex in the light of more modern theories of fiscal policy. (Barro, 1981) These still predict that temporary spending increases will increase real output. But higher taxation—present or future—can also increase output via a negative wealth effect. The predicted effects on real output are thus in large part ambiguous. But the *negative* shocks to real growth during domestic wars suggest that RBC-type theories must also admit a role for war-related negative supply shocks.

## 4. Sensitivity tests

I conducted three types of sensitivity checks. The first set tests and corrects for autocorrelation by adding lagged dependent variables to the set of regressors. The second set corrects for possible concerns about using discrete measures of wartime conditions. The third examines the impact of including hyperinflation country–years in the sample.

### *4.1. Lags and autocorrelation*

One potentially serious problem with the preceding estimates is their high level of autocorrelation. (Parks, 1967) For every single one of the preceding equations, the Durbin–Watson statistic indicates at least a moderate level of positive autocorrelation. This suggests the possibility that lagged dependent variables have been improperly omitted from the specification. To explore this possibility, all of the regressions from Tables 1–5 were re-estimated with three lags of the dependent variable added to the list of regressors (coefficients not shown). Two main findings emerge.

First, the evidence for positive autocorrelation almost entirely disappears. Running the appropriate one-tail test for autocorrelation with a lagged dependent variable (Pindyck and Rubinfeld, 1998, pp.169–170), we can accept the null of no autocorrelation for all of the narrow data set's results. For the broad data set, the same test finds no evidence for autocorrelation of total spending, non-military spending, inflation, monetary growth, and real growth; positive autocorrelation for taxes and military spending does however persist. On the whole, this procedure leaves no more than weak evidence of autocorrelation.

Second, most of the qualitative results from Tables 1–5 remain intact after adding the lagged dependent variables. For the narrow data set, the specification change generally decreased the magnitude of the coefficients for the war-related variables,

but did not change their sign or the statistical significance. The broad data set's results were more sensitive to this specification change. Those for real growth and inflation are robust. But now, military spending rises only during domestic wars, and non-military spending only declines during foreign wars; and coefficients for the money growth and taxation equations ceased to be statistically significant.

### *4.2. Continuous measures of wartime conditions*

Discrete measures of war participation lump together an extremely diverse set of shocks. So long as they start and end in the same calendar year, brief wars of a few days count just as much as longer wars of eleven months. Similarly, "phony wars" involving minimal action count just as much as total wars of full mobilization. To counteract concerns this might raise, I re-run the regressions from Tables 1–5, using two different continuous measures.

The first alternative is to add a measure of casualty rates similar to that found in Barro (1981). Unfortunately, international data directly comparable to Barro's measure of annual US battle death is unavailable, but a slightly coarser measure which treats casualty rates as constant thorough a war's duration can be derived from the *Correlates of War* data set. For every war, there is data on each country's *total* battle deaths, duration of participation, and pre-war population. *Casualty* for a given country in a given year $t$ is then defined as the number of battle deaths in a given war divided by the pre-war population (expressed in 1000's), times the length of the war during year $t$, divided by the total duration of the country's involvement in that war.

The Tables 1–5 regressions can then be re-run, jointly estimating how *Forwar*, *Domwar*, $Forcas \equiv Foreign*Casualty$, and $Domcas \equiv (1-Foreign)*Casualty$ affect the dependent variables of interest. Table 6 shows the results for the narrow

Table 6
Regression of dependent variables on Forwar, Domwar, Forcas, and Domcas, controlling for country and year effects. All variables expressed in percentage-point terms

(Narrow data set)

| Dependent variable | Forwar | Domwar | Forcas | Domcas |
|---|---|---|---|---|
| Real Growth | 0.844** (0.433) | −10.582*** (1.216) | −0.196 (0.301) | 2.265*** (0.499) |
| Nominal Growth | 0.401 (0.712) | 3.027 (1.999) | 0.138 (0.495) | 1.047 (0.820) |
| Money Growth | −0.229 (0.778) | 6.569*** (2.185) | 0.126 (0.541) | −1.063 (0.896) |
| Spending/Output | 2.369*** (0.621) | 0.900 (1.743) | 4.137*** (0.432) | 3.581*** (0.715) |
| Taxation/Output | 2.609*** (0.462) | −3.542*** (1.297) | −0.537* (0.321) | 2.000*** (0.532) |
| *SEs below coefficient* | *Years: 1884–1988* | | | |
| | *N=1339* | | | |
| | *Missing Observations: 236* | | | |
| | *# Countries: 15* | | | |

* significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

set; Table 7 does the same for the broad. Both the discrete and the continuous measures matter some of the time for both data sets. For the narrow data set, *Forwar* and/or *Domwar* matter for everything, and casualty rates matter for real growth, inflation, spending, and taxation. For the broad data set, foreign and domestic wars have a discrete impact solely on the policy variables (money growth, spending, taxation). The domestic casualty rate alone matters for real output.

It is noteworthy that the apparent impact of the discrete war measures and the casualty measures on real growth vary widely for the two data sets. For the broad data set, *Domcas* fully captures the negative impact of wars on real growth; for the narrow, controlling for casualty rates actually increases the discrete impact of domestic wars from −7.1% to −10.6%. What could account for this difference? Recall that the narrow pool includes only relatively advanced industrialized countries, whereas the broad pool is a much more heterogeneous sample, including not only LDCs but also a couple of Communist and former-Communist countries. Since World War I and World War II were virtually the only periods when $War*(1-Foreign) = 1$ for any advanced industrialized countries, one can speculate that countries partly or fully under foreign occupation suffered common shocks unrelated to casualty rates from battle. Such common shocks include naval blockade, military occupation, and disruption of pre-war trading patterns. For example, during World War II, France had a much higher casualty rate than Belgium, the Netherlands, or Norway, but all four bore non-combat-related costs of German occupation for about five years. Perhaps *Domcas* appears unimportant merely due to the unusual similarities of the experiences of occupied advanced industrialized countries in the world wars. In contrast, the broad set encompasses a much wider variety of domestic wars. Their real growth during domestic wars was also impaired by factors besides casualty

Table 7
Regression of dependent variables on Forwar, Domwar, Forcas, and Domcas, controlling for country and year effects. All variables expressed in percentage-point terms

(Broad data set)

| Dependent variable | Forwar | Domwar | Forcas | Domcas |
|---|---|---|---|---|
| Real growth | 2.077 (1.544) | 1.843 (1.153) | 1.163 (3.521) | −4.373*** (0.644) |
| Nominal growth | 4.018 (2.133) | 1.587 (1.593) | −2.439 (4.865) | −3.967*** (0.889) |
| Money growth | 3.784 (2.347) | 4.270** (1.753) | −3.618 (5.353) | −2.006** (0.978) |
| Spending/Output | 6.475*** (0.966) | −0.017 (0.722) | −15.297*** (2.204) | −0.247 (0.403) |
| Taxation/Output | 10.563*** (1.109) | −1.468 (0.828) | −15.146*** (2.530) | −0.024 (0.462) |
| *SEs below coefficient* | *Years: 1953–92* | | | |
| | *N=2056* | | | |
| | *Missing Observations: 584* | | | |
| | *# Countries: 66* | | | |

* significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

rates, but their variation was great enough to make continuous casualty rates a better proxy than the discrete war dummy.

The alternative way to code for wars is to replace the dummy variable *War* with the continuous variable *Wartime* (results not shown). *Wartime* indicates the fraction of a given year (bounded between 0 and 1) that a country was at war. The corresponding definitions of *Forwartime* and *Domwartime* are *Foreign*∗*Wartime* and (1−*Foreign*)∗*Wartime*. For the narrow data set, this new specification barely changed the results. But the broad data set was slightly more sensitive to the change. For the broad set, real output loses any statistically significant association with either *Forwartime* or *Domwartime* (the coefficient for the former changes from 2.3% to 2.2%, while the coefficient for the latter goes from −2.0% to +0.4%). But money's response to war rises in magnitude and statistical significance. The coefficient on *Forwartime* goes from 2.9% to 3.5% (significant at the 10% level) and the coefficient on *Domwartime* from 2.5% to 6.4% (significant at the 1% level). Thus, the monetary growth is now higher during domestic wars for both data sets.

### *4.3. Hyperinflations*

All of the previous results exclude years of hyperinflation. The concern was that a few hyperinflation episodes might muddy the results, especially since economies' reaction to moderate inflation differs from their response to high rates. A last set of sensitivity tests removes this sampling restriction.

Hyperinflation country–years were rare in the narrow data set, so including them in the estimation changes little (coefficients not shown). The main difference is that the estimated impact of domestic wars on money growth rises from 5 to 7 percentage points, while the negative impact of domestic wars on growth falls from 6.9% to 4.5%. The estimated impact of foreign and domestic wars on fiscal policy does not change.

The broad data set is a different story: it has almost 50 hyperinflation country–years. Including them changes the results substantially, especially for inflation and money growth. Table 8 displays the findings. The association between foreign and domestic wars and inflation and money growth becomes very large. The estimated coefficients for inflation go up to 25 percentage-points for foreign wars and 70 for domestic; monetary growth similarly rises by 22 and 62 percentage-points, respectively. However, the standard errors increase so much that only the domestic war coefficients are statistically significant.

The other coefficients for the broad data set show little response to the sampling change. Real growth still falls during domestic wars (though it becomes less clear that real growth rises during foreign wars); government spending still goes up during foreign wars and stays flat during domestic wars; and taxation still rises during foreign wars and falls during domestic wars.

Including hyperinflation country–years does dissolve some puzzling qualitative differences between the narrow and the broad data set. Now, during domestic wars *both* data sets show high inflation, high monetary growth, lower real growth, *and* stable or declining levels of taxation as a fraction of output. It seems to be a general

Table 8
Regression of dependent variables on Forwar, Domwar, controlling for country and year effects, including country-years of hyperinflation. All variables expressed in percentage-point terms

| (Broad data set) | | |
|---|---|---|
| Dependent variable | Forwar | Domwar |
| Real growth | 1.188 (1.314) | −2.111** (1.053) |
| Inflation | 24.673 (25.789) | 70.202*** (20.665) |
| Nominal growth | 15.161 (14.092) | 11.702 (11.293) |
| Money growth | 21.952 (19.820) | 62.040*** (15.882) |
| Spending/Output | 5.605*** (0.822) | −0.700 (0.658) |
| Taxation/Output | 10.495*** (0.958) | −2.100*** (0.767) |
| *SEs below coefficient* | *Years: 1953–92* | |
| | *N=2105* | |
| | *Missing Observations: 535* | |
| | *# Countries: 66* | |

* significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

pattern that during domestic wars, governments tend to shift from standard taxes to the inflation tax, as explained in e.g. Barro (1990); Grossman (1990); Sargent (1990); Barro (1987); Benjamin and Kochin (1984).

## 5. Conclusion

After surveying the US and UK experiences during the two world wars, Braun and McGrattan (1993) ask: "What general lessons can we draw about the effects of large increases in government purchases?" One of their central lessons: "The large increases in government expenditures increased output and crowded out consumption and investment in both countries during both wars". (p. 222) The main lesson of the present paper is that we should hesitate to draw any general lessons from these four famous wartime episodes alone. Sifting through a much larger body of evidence yields more robust stylized facts about the macroeconomics of war, and shows that the world war experiences of the US and UK were unusual. The pooled time series evidence shows that there is only one clear stylized fact of note that works for *all* wars:

1. Spending and taxation as a percentage of GDP both rise during wars.
   This does not mean that war is macroeconomically uninteresting, merely that it is necessary to distinguish between foreign and domestic wars to learn more:
2. Real output growth clearly *declines* substantially during domestic wars, even though it slightly increases during foreign wars.
3. Inflation is greater during domestic wars than during foreign wars.

4. Money supply growth is greater during domestic wars than during foreign wars.
5. Taxation as a fraction of output rises during foreign wars, but stays unchanged or actually declines during domestic wars.
   The results for the advanced industrialized countries (i.e., the narrow data set) do differ in one important ways from the results for the world as a whole (i.e., the broad data set):
6. Government spending as a percentage of output increases in the advanced industrialized countries during *both* foreign and domestic wars. However, for the world as a whole, government spending as a percentage of output only increases during foreign wars; domestic wars are largely financed by lower non-military spending.

What accounts for the unusually large wartime booms in the United States and Great Britain? Part of the explanation is that all four of these were foreign soil wars, but the US and UK cases were exceptional even for that subset. The extent of unemployed resources at the war's outset is a partial explanation for World War II, but unemployment was not high in either country when they entered World War I (Vernon, 1994; Braun and McGrattan, 1993; Romer, 1992) Fiscal and monetary policy were much more expansionary than in the typical foreign soil war, so a larger than normal increase in nominal and real growth make sense. Finally, higher real growth makes victory more likely; conditional on the fact that the US and Britain won, above-average economic performance is to be expected. In sum, the Anglo-American world war experiences are not so much anomalies as special cases of my general findings.

This paper's results complement several strategies for future research. During domestic wars there is a strong tendency for real growth to sharply decline; a plausible explanation is that negative supply shocks dominate positive demand shocks, but this presumption needs to be more thoroughly tested. This paper confirms that both fiscal and monetary policy tend to be expansionary during wartime, but leave open monetarist, fiscalist, and mixed explanations for accompanying growth in real output.[10]

A substantial amount of literature notes that unusual macroeconomic conditions prevail during war, but the present paper provides the first systematic, comparative study of wartime macroeconomics. Wartime economies have important features in common, but these features are often different from those of the US and UK during the world wars. While testing macroeconomic theories under extreme wartime conditions is a potentially fruitful research strategy, broadening the sample yields more robust conclusions.

[10] Caplan (2000) uses both the narrow and the broad data sets explored here to study the latter question in some detail, finding considerable support for the strong monetarist interpretation.

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