

# Correlates of Mobilization in the Two World Wars

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## **Abstract:**

Richer countries had an advantage in both world wars, because they were able to mobilize the greatest quantity of military resources. To investigate the impact of income on mobilization statistically, we analyzed pre-war income, as well as structural (persistence of agriculture) and institutional (financial and political) mechanisms. In mobilization of total economic resources, pre-war income had a positive impact. Neither income nor institutions played a substantial role in mobilizing troops, but fiscal mobilization was explained well by all the mechanisms. Income had a positive impact, as did various financial and political institutions. The richer countries possessed an advantage in fiscal mobilization due to their superior institutions.

**JEL Classifications:** H56, N10, N20, N40

## 1. Introduction

The two world wars were the most destructive and costly conflicts in history. As Charles Tilly has pointed out, while the frequency of wars between European states decreased steadily from the 16th century on, their destructiveness increased almost exponentially, culminating in the world wars of the 20th century.<sup>1</sup> The early modern expansion of Western European states enabled them to challenge regimes all over the world on the basis of their military and naval supremacy and, later on, of their industrial prowess. They also continually competed with each other, of course, and this intra-European rivalry proved fatal in 1914 and 1939.

The comparative and international economics of the two world wars has attracted growing interest in recent years<sup>2</sup>. Warfare has proved to be of interest to economists both in its own right and for its indirect effects. There is a substantial literature that examines, for example, the impact of both world wars as a shock, most usually adverse, to stocks, flows, and institutions in the process of economic development. In this paper we focus on the process of war in its own right. Our analysis is based on a number of strong results found in the existing literature.<sup>3</sup>

First, in both wars the victory went to the side that supplied the greatest quantity of military resources to the theatres of war. This was not the intention; in both wars the participants intended to achieve (a quick) victory on the basis of purely military advantages. Economic factors came into play only after these plans had failed.

Second, time and geography mattered. Total war took time, and the time required to make superior resources count in total war only became available because the defenders successfully played for time. Geography played its part in both wars because the countries that were closer to the front line had to try harder to fulfill the requirements of total war.

Third, superiority in military resources was based in some way on superior wealth associated with higher levels of economic development: in both wars, controlling for time and distance, the richer countries turned out to have a systematic, disproportionate advantage in their ability to supply the front with troops and military equipment. This relationship appears to have been systematic, but we do not know exactly what formed it and there are several competing interpretations of “why the rich won.”

Fourth, non-economic factors like leadership, organization, discipline, and morale played their part, but this may have been largely conditional on wealth, geography, and time. Given superior resources and the need and opportunity to apply them, the richer countries could solve the problems and overcome the mistakes that defeated the poorer ones.

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<sup>1</sup> Tilly 1990, pp. 72-74.

<sup>2</sup> See especially Broadberry and Harrison 2005, Hardach 1977, Harrison 1998, Milward 1977, Overy 1995, Ránki 1993.

<sup>3</sup> In addition to those listed above, see Eloranta 2005 for a broader discussion.

Fifth, these were rules for market economies. In World War II Stalin seems to have broken them by bringing to bear a new kind of allocation system, a command economy that could produce military power out of proportion to its economic weight.

In the present paper<sup>4</sup> we introduce large data samples and pool the data from the two world wars to reconsider these propositions. Our goal in this paper is to explore whether the hypothesis that “the rich” won holds and, if so, why. We examine four possible explanatory mechanisms: a pure income effect, structure of the economy, financial institutions, and political institutions.

## **2. Rearmament and Wartime Mobilization**

Total war proved exceptionally taxing on economic life, literally as well as in the general sense; it pushed the great powers to adopt more efficient fiscal systems and enabled some of them to dedicate unprecedentedly high proportions of their national resources to the war effort.

Tables 1 and 2 illustrate the burdens of warfare on the economies of the great powers. Table 1 suggests that the French economy was the most mobilized, followed by the UK and Germany; the German government devoted almost all of its budgetary outlays to the war effort in World War I. The Russian army was large in absolute numbers but small in proportion to the immense Russian population. Finally, the United States barely participated in the war and its commitment and losses of personnel were relatively small, as were its economic burdens.

The economic impact of World War II was arguably still more profound. The military burden on the UK economy (defined as the share of military outlays in GDP), for example, peaked at around 27 per cent of GDP in World War I, whereas it ran consistently over 50 per cent throughout World War II.<sup>5</sup> A mass of other evidence confirms that the military burdens shouldered by the great powers were typically much higher than in World War I. So, too, were the losses which, however they are measured, surely exceeded those of World War I by several times. After the war, the European industrial and agricultural production amounted to only half of the 1938 total.<sup>6</sup>

The wartime mobilizations that we observe are striking against the background of generally low peacetime military spending in the eras before and between the world wars. Table 3 shows available summary data. The industrialization of war, which appears to have begun in the middle of the nineteenth century eventually made it possible for the newly industrialized countries to arm without a great fiscal burden.<sup>7</sup> There was some variation, of course. In no country did the annual average military burden exceed 5 per cent in the decades before 1914. On the other hand the defense share (defined as the share of military outlays in central or federal government spending) varied widely, and this

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<sup>4</sup> For earlier analysis, see Harrison 2004.

<sup>5</sup> Eloranta 2003.

<sup>6</sup> Cameron and Neal 2003, Harrison 1998.

<sup>7</sup> See especially McNeill 1982.

depended naturally on the extent of governments' nondefense commitments; Germany and Italy, for example, carried similar military burdens but the defense share in the French budget was one fifth, and in Germany more than half. It is characteristic of the interwar period that military burdens rose, while defense shares fell as government sectors generally expanded.<sup>8</sup>

The ability to move rapidly from peacetime military burdens of 3 or 4 percent of GDP to wartime levels of 30, 40, or 50 percent is one essential aspect of what we mean by mobilization. Strictly, it is the *fiscal* aspect. Other aspects of mobilization were also essential. To shift GDP from one use to another was of limited value if the size of GDP itself remained static or declined. The ability to increase total production in wartime we call the *product* aspect of mobilization. The purpose of increasing output and transferring it to military uses was to put armies in the field. The ability to mobilize a significant fraction of the working population into uniform, equipping it for combat, is the more narrowly *military* aspect of mobilization. Military, product, and fiscal mobilization (and the ability to sustain such a mobilization effort), taken together, form the object of study in this paper.

To what extent can we explain success in wartime mobilization by the underlying economic factors? In previous work one of the authors found a simple bivariate approach to be suggestive.<sup>9</sup> Figures 1 and 2 (reproduced here from Harrison 2004) plot production mobilization, the wartime change in real GDP, against prewar GDP per head as a measure of the general level of economic development, in the two world wars. The results are striking: there is, apparently, a rather strong linear relationship. It is certainly interesting that the more developed economies tended to be systematically better at wartime mobilization; this result flatly contradicts the expectations of those who associated fitness for war with food self-sufficiency, for example. The problem remains that we do not really know why.

One purpose of the present investigation is to explore and further test this apparent relationship. We see from limited samples that richer countries tended to mobilize output more effectively. Various mechanisms may have been at work, for example:

- (1) *A pure income effect*: richer countries could use the surplus of average incomes over subsistence to promote mobilization.
- (2) *A structural effect*: richer countries tend to have more flexible farming systems, and are less likely to suffer from the wartime tendency of peasant farmers to withdraw from the market under pressure.<sup>10</sup>
- (3) *An effect from financial institutions*: richer countries are likely to have deeper capital markets that cushion the fiscal strains of mobilization.<sup>11</sup>

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<sup>8</sup> Eloranta 2002, Eloranta 2003. See also Ferguson 2001. On the military spending patterns of great powers in particular, see Hobson 1993.

<sup>9</sup> Harrison 2004; see also Broadberry and Harrison 2005.

<sup>10</sup> E.g. Broadberry and Harrison 2005; Offer 1989.

<sup>11</sup> Ferguson 2001, especially chapter 1.

- (4) *An effect from political institutions*: richer countries are more likely to be democracies with governments that command the support and loyalty of the citizens; conversely, one author has argued that Stalin's dictatorship was the decisive factor in the exceptionalism of a poor country, the Soviet Union, that mobilized its resources successfully against Germany, a richer adversary.<sup>12</sup>

**Table 1. Resource Mobilization by the Great Powers in World War I**

<i>Country and years in the war</i>	<i>Military burden, annual average</i>	<i>Defense share, annual average</i>	<i>Military personnel, percent of population</i>	<i>Battle deaths, percent of population</i>
France 1914-1918	43	77	11	3.5
Germany 1914-1918	37	91	7.3	2.7
Russia 1914-1917	..	..	4.3	1.4
UK 1914-1918	22	49	7.3	2.0
USA 1917-1918	7.0	47	1.7	0.1

**Sources:** In addition to the sources listed in the Appendix, Fontvieille (1976) and Morgan (1952). See also Eloranta (2006). **Notes:** Military burden: Military spending, per cent of GDP. Defense share: Military spending, per cent of central government spending.

**Table 2. Resource Mobilization by the Great Powers in World War II**

<i>Country and years in the war</i>	<i>Military burden, annual average</i>	<i>Defense share, annual average</i>	<i>Military personnel, percent of population</i>	<i>Battle deaths, percent of population</i>
France 1939-1945	..	..	4.2	0.5
Germany 1939-1945	50	..	6.4	4.4
Soviet Union 1939-1945	44	48	3.3	4.4
UK 1939-1945	45	69	6.2	0.9
USA 1941-1945	32	71	5.5	0.3

**Sources:** In addition to the sources listed in the Appendix, Broadberry and Howlett (1998), Harrison (1998, 2000). The Soviet defense share only applies to years 1940-1945, whereas the military burden to 1940-1944. These two measures are not directly comparable, since the former is measured in current prices and the latter in constant prices. **Notes:** Military burden: Military spending, per cent of GDP. Defense share: Military spending, per cent of central or federal government spending.

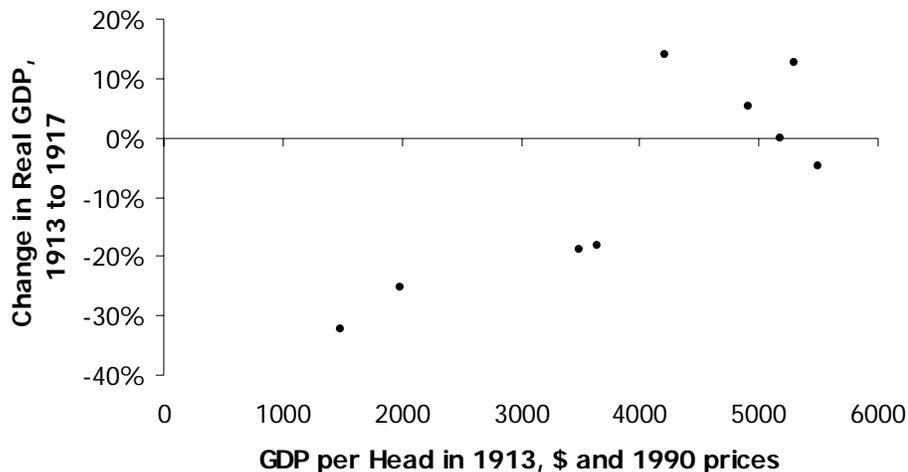
<sup>12</sup> Harrison 2005.

**Table 3. Peacetime Military Burdens and Defense Shares of the Great Powers, 1870-1913 and 1920-1938**

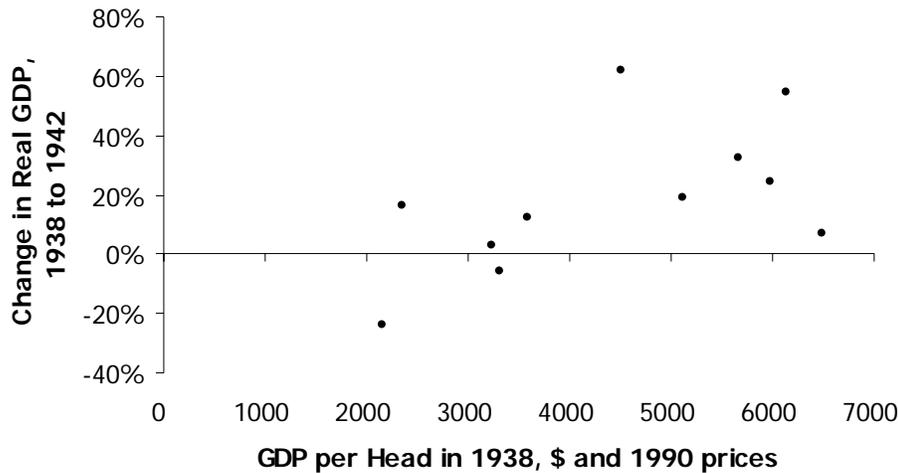
Country	Military Burden		Defense Share	
	1870-1913	1920-1938	1870-1913	1920-1938
Austria(-Hungary)	3.47	0.90	12.03	5.84
France	3.68	4.34	25.91	22.37
Germany	2.56	3.33	54.12	23.81
Italy	2.75	4.38	21.69	25.40
Japan	4.99	5.73	32.24	20.13
Russia (USSR)	3.87	7.11	27.91	11.93
UK	2.63	2.95	37.52	16.25
USA	0.74	1.21	29.43	22.36
Group mean	2.71	2.83	33.33	18.00

**Sources:** See Eloranta (2002), p. 110 for details. **Notes:** Group mean for 1870-1913 includes 16 countries: Austria(-Hungary), Belgium, Denmark, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Russia, Spain, Sweden, Switzerland, UK, and USA. The group mean for 1920-1938 includes, in addition to the 16 countries mentioned, also Finland. Military burden: Military spending, per cent of GDP. Defense share: Military spending, per cent of central or federal government spending.

There are several possibilities, therefore, why the countries that proved more capable of shouldering wartime military burdens tended to be richer than the others, and wealth or income on their own may not have been the deciding factor. In short, we wish to know whether the relationship between income and mobilization is robust to the inclusion of other variables, the widening of the sample to include other countries, and the pooling of the data from two world wars.

**Figure 1. Production Mobilization: Nine Countries, 1913 to 1917**

**Source:** Harrison (2004). **Notes:** Observations from left to right are Russia, Austria-Hungary, France, Germany, Canada, UK, New Zealand, USA, and Australia. Territories are measured within contemporary frontiers. Currency units are international dollars at 1990 prices.

**Figure 2. Production Mobilization: Eleven Countries, 1938 to 1942**

**Source:** Harrison (2004). *Notes:* Observations from left to right are the Soviet Union, Japan, Italy, Finland, Austria, Canada, Germany (excluding Austria), Australia, UK, USA, and New Zealand. Territories are measured within contemporary frontiers. Currency units are international dollars at 1990 prices.

### 3. Statistical Analysis

Why was the level of economic development apparently so important for the Allied victories in the two world wars? Why did “the poor” lose? First of all, as the preceding analysis implies, our aim was to investigate whether mobilization of the great powers could be explained on the basis of pre-war income and geographic location (vis-à-vis the main war theater) alone. Initially, we also wanted to account for the one command economy, the USSR, as a possible outlier:

$$\text{MOBILIZATION} = f(\text{PRE-WAR INCOME, GEOGRAPHY, COMMAND}) \quad (1)$$

We also investigated further the channels whereby economic development might have influenced mobilization outcomes: higher incomes, a lesser dependence on subsistence agriculture, and the quality of institutions, financial and political. Agricultural employment is an often-used measure for the structure of the economy. As for institutional quality, below we include the level of democracy (as measured by the Polity IID index), public debt as a percentage of GDP, membership in the Gold Standard in 1913 or membership in the League of Nations in 1938 (proxying membership in the international system and globalization), dominant religion dummy (=1 if one religion is embraced by over 70 per cent of the population, proxying perhaps national unity in addition to religiosity), common law dummy (=1 if a country in the sample is a common law, otherwise 0). Overall, the expanded model encompasses the pure income and structural effects, as well as the impact of financial and political institutions:

$$\text{MOBILIZATION} = f(\text{PRE-WAR INCOME,} \\ \text{GEOGRAPHY or DISTANCE,} \\ \text{AGRICULTURAL EMPLOYMENT,} \\ \text{COMMAND,} \\ \text{DEMOCRACY,} \\ \text{PUBLIC DEBT,} \\ \text{INTERNATIONAL SYSTEM MEMBERSHIP,} \\ \text{DOMINANT RELIGION,} \\ \text{COMMON LAW}) \quad (2)$$

We expect, based on the literature cited in the introduction, a higher pre-war income level, a greater distance from the main theater of the war, a smaller agriculture share in employment, being a democracy, being a member in the international system, having a dominant religion, and being a common-law country to increase the effectiveness of mobilization. We expect having a command system to have compensated somewhat for the disadvantages of lower incomes and inferior market institutions. The size of the public debt might work either way: a large public debt implies a deep capital market and a degree of trust between government and bond holders, but a larger debt may be more difficult to add to. Data sources and constraints are identified in the Appendix.<sup>13</sup>

We first decided to pool the world wars (without accounting for annual observations rather than taking the wars as a whole) in the analysis, and later proceeded with annual panels. The dependent variables for most of the statistical analyses comprised of the *change in real GDP over 1913 or 1938* (denoted by  $\Delta\text{GDP}$ ) or the *military personnel as a percentage of population*. In the later exercises we also included *central government expenditures as a percentage of GDP* and *military burdens* as dependent variables, but only by pooling the two world wars together (with annual observations). Using a variety of approaches to pooling and in the statistical analyses we were able to achieve robust results and overcome some of the persistent problems related to small sample size and autocorrelation.

We started out with Equation 1 and a more limited sample, as we have already explained. The initial observation arising from the preceding section is that pre-war income level had a large impact on the ability to sustain economic expansion during the world wars, perhaps more so during World War II (a more massive and “total” conflict). This was confirmed by OLS (Ordinary Least Squares) analysis of the pooled sample (without annual observations) in Table 4. It seems that transoceanic location also helped, these being countries that were less burdened by the wars), and the sole command economy, USSR, did not do so well in its mobilization of aggregate economic resources during the war. The sample size was small and plagued by autocorrelation, however, alleviated here by introducing an autoregressive term.

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<sup>13</sup> The choice of countries in the samples was determined by: 1) data availability and reliability (thus, for example, Italy is not featured in the World War I sample, see Galassi and Harrison 2005 for details); 2) by selecting only countries credibly involved in the war, having to experience at least a fair degree of mobilization (thus, for example, Brazil is not featured in the World War I sample, but is included in the World War II sample).

**Table 4. OLS Correlates of Mobilization in the Two World Wars Combined (No Annual Observations): Dependent Variable is Change in Real GDP Over 1913 or 1938**

<i>Independent Variables</i>	<i>1</i>	<i>2</i>	<i>3</i>
Constant	-49.31	-24.12	-153.68**
Real GDP per capita in 1913 or 1938	3.84	0.72	18.57**
World War II dummy (=1 for 1939-1945)	23.79***	26.75***	17.16***
Transoceanic location dummy	25.64**	25.77**	-
European periphery location dummy	20.64*	19.78*	-
Command economy dummy	-	-31.85*	-
Autoregressive (AR1) term	-	-	-0.50**
N	24	24	24
Adjusted R <sup>2</sup>	0.48	0.55	0.47
F-statistic	6.38	6.58	7.60
DW	2.58	2.63	2.23

**Sources:** see Appendix. *Notes:* Countries included for World War I: Australia, Austria-Hungary, Canada, France, Greece, New Zealand, Portugal, Russia, UK, and USA. Countries included for World War II: Australia, Austria, Bulgaria, Canada, Finland, Germany, Italy, Japan, New Zealand, USSR, UK, and USA. Pre-war real GDP per capita in logs. \* = null hypothesis of no correlation rejected at 10 per cent level; \*\* = null rejected at 5 per cent level; \*\*\* = null rejected at 1 per cent level.

What about winning the war? Did pre-war income play a role? We tested this notion in a crude fashion by using a dummy variable (coded 1 for winners of the two world wars, 0 for losers) as the dependent variable. It appears (see Table 5) that pre-war income increased a country's chances of ending up on the winning side in the two world wars, as did location in the European periphery and being a command economy (USSR). But, the same caveats apply as above. The size of the sample was too small to say anything conclusive.

So, as indicated earlier, it is more efficient to analyze the world wars first separately, including annual observations in the panel; we then combined the samples (for common countries) to analyze fiscal mobilization as well. In addition to the variables pertaining to Equation 2, we included time controls (and certain other variables occasionally) in the analysis. We dropped the command dummy from subsequent analyses, since it did not seem to be statistically significant in any of the estimations. The independent variables were added in stages in the subsequent estimations, with the last specification representing the optimal specification.

**Table 5. Maximum Likelihood (Binary Logit) Analysis of Combined Determining Factors in Winning the World Wars (No Annual Observations): Dependent Variable is Win Dummy (1=Winner; 0=Loser)**

<i>Independent Variables</i>	<i>1</i>	<i>2</i>	<i>3</i>
Constant	-8.16	19.45	-22.19**
Real GDP per capita in 1913 or 1938	1.07	-2.46	2.97**
World War II dummy (=1 for 1939-1945)	-	-2.11	-3.03*
Transoceanic location dummy	-	45.89***	-
European periphery location dummy	-	45.34***	42.50***
Command economy dummy	-	-	45.17***
N	24	24	24
McFadden R <sup>2</sup>	0.05	0.64	0.41
Log likelihood	-15.10	-5.65	-9.31

**Sources:** see Appendix. *Notes:* Pre-war real GDP per capita in logs. QML (Huber/White) standard errors and covariance used here. \* = null hypothesis of no correlation rejected at 10 per cent level; \*\* = null rejected at 5 per cent level; \*\*\* = null rejected at 1 per cent level.

As Table 6 indicates, autocorrelation was a severe impediment in the analysis, so we decided to use a lagged dependent variable and period-specific PCSEs (Panel Corrected Standard Errors).<sup>14</sup> Income (see Specification 5) seems to have had a positive impact during World War I, but the parameter estimates fluctuated a lot here, indicating an element of uncertainty as to the reliability of this finding. Distance (0 for Eurasian frontline countries, 1 for European periphery, and 2 for others) seems to have had a persistent positive impact on  $\Delta$ GDP, as did the period 1915-1917 (introduced as representing the peak war years) in particular. In turn, pre-war level of democracy, public debt, and transoceanic location seemed to influence  $\Delta$ GDP negatively. What about military mobilization during the Great War?

The results contained in Table 7 suggest, again, that autocorrelation was a significant problem. Thus, given the persistence of autocorrelation displayed in Specifications 1 and 2, we decided to switch to period-specific PCSEs in the subsequent analyses, which seems to have alleviated the problem. The sample size was small in this case, however, because of gaps in the data. Overall, income did not seem relevant here, and became only slightly so when multiplied by time (exhibiting a small positive impact). In fact, only public debt had a persistent, positive impact on the mobilization of manpower during World War I. Conversely, distance, having a dominant religion, and the level of agricultural employment decreased the mobilization of military power.

<sup>14</sup> In general, given that  $N > T$  in these samples, one should use PCSEs (here we started out with cross-section specific PCSEs) with OLS to avoid overconfidence in the parameter estimates. See especially Beck and Katz 1995 for details. In addition, see Beck 2001. All the subsequent panels are unbalanced panels, which should not have an impact on the analysis given that the missing variables were not due to a sampling bias. When AR(1) terms were used here, it is important to note that EViews 5.1 utilizes nonlinear regression techniques on those occasions.

**Table 6. Pooled OLS Correlates of Mobilization in World War I (Including Annual Observations): Dependent Variable is Change in Real GDP Over 1913**

<i>Independent Variables</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
Constant	-10.54	2.54	89.13*	-136.51	-22.87*
Lagged dependent variable (t-1)	0.79***	0.92***	0.73***	0.73***	0.77***
Real GDP per capita in 1913	0.40	1.48	-6.39	16.36	4.23**
Distance	5.42***	5.39***	5.39	31.05	18.36***
Level of democracy in 1913	-	-1.14**	-1.23	-1.87*	-1.84***
Public debt as a percentage of GDP	-	-2.89**	-3.14*	-2.37	-2.96***
Member in the Gold Standard in 1913	-	-0.98	-1.57	2.06	-
Dominant religion dummy (level in 1913 over 70 per cent = 1, otherwise 0)	-	-	-1.30	-0.67	-
Common law dummy	-	-	4.42	-15.17	-
Level of agricultural employment in 1913	-	-	-6.40	2.03	-
Time	-	-	-	5.37	-
Time squared	-	-	-	-1.12	-
Transoceanic location dummy	-	-	-	-33.98	-19.68***
Dummy representing years 1915-1917	-	-	-	-	3.17**
N	47	39	39	39	39
Adjusted R <sup>2</sup>	0.80	0.89	0.92	0.92	0.93
F-statistic	63.88	52.94	47.19	36.07	73.30
DW	1.95	2.09	2.53	2.53	2.78

**Sources:** see Appendix. *Notes:* Pre-war real GDP per capita, public debt as a percentage of GDP, and the level of agricultural employment in 1913 in logs. \* = null hypothesis of no correlation rejected at 10 per cent level; \*\* = null rejected at 5 per cent level; \*\*\* = null rejected at 1 per cent level.

**Table 7. Pooled OLS Correlates of Mobilization in World War I (Including Annual Observations): Dependent Variable is Military Personnel, Percent of Population**

<i>Independent Variables</i>	1	2	3	4	5	6	7
Constant	-3.36	-1.56	-0.85	-8.96***	4.26	16.92	1.14
Real GDP per capita in 1913	0.46	0.32	0.30	0.75**	-0.32	-1.49	-
Distance	-	-0.95***	-0.92***	-0.14	-0.69	-2.03	-0.56***
Level of democracy in 1913	-	-	-	-0.11*	-0.01	0.05	-
Public debt as a percentage of GDP	-	-	-	1.04***	1.17***	0.92***	1.07***
Member in the Gold Standard in 1913	-	-	-	0.81**	-0.08	-0.36	-
Dominant religion dummy (measured as before)	-	-	-	-	-1.46**	-1.36**	-1.21***
Common law dummy	-	-	-	-	0.38	0.79	-
Level of agricultural employment in 1913	-	-	-	-	-1.12	-1.84	-1.04***
Time	0.24*	0.27	-	-	-	0.21	-
Transoceanic location dummy	-	-	-	-	-	1.87	-
Real GDP per capita in 1913 multiplied by time	-	-	-	-	-	-	0.02***
N	44	44	44	35	35	35	35
Adjusted R <sup>2</sup>	0.08	0.44	0.36	0.66	0.76	0.81	0.83
F-statistic	2.75	12.49	12.90	14.20	14.21	15.69	33.32
DW	0.40	0.68	0.72	1.10	1.68	2.18	1.93

**Sources:** see Appendix. *Notes:* Military personnel as a percentage of population, pre-war real GDP per capita, public debt as a percentage of GDP, and the level of agricultural employment in 1913 in logs. Moreover, specification 1 and 2 are measured with cross-section specific PCSEs, specifications 3-7 with period-specific PCSEs. \* = null hypothesis of no correlation rejected at 10 per cent level; \*\* = null rejected at 5 per cent level; \*\*\* = null rejected at 1 per cent level.

Do the same conclusions hold for World War II? The results in Table 8 indicate that period-specific PCSEs and utilizing a lagged dependent variable in the analyses alleviated autocorrelation. Income had a persistent *negative* impact on  $\Delta$ GDP, as did distance, public debt, League of Nations membership (since League members might have

been slower to rearm in the 1930s), and time squared.<sup>15</sup> In turn, the level of democracy had a positive impact, as did being a common law country. Moreover, when the level of agricultural employment increased, so did  $\Delta$ GDP, other things being equal. Obviously these results are not in line with earlier findings on World War I, and it seems the impact of pre-war income was not straightforward. There were significant differences between the two world wars, in terms of both the impact of income and the scale and scope of the war itself.

Do we find the same results for the mobilization of military personnel? As shown in Table 9, it was again necessary to lessen autocorrelation by using period-specific PCSEs and lagged dependent variables. Overall, the model utilized did not work very well in explaining the mobilization of military personnel in World War II. It seems that almost half of the overall variation was explained by the lagged dependent variable, pre-war income, and time. None of the institutional variables seemed to play any role. Pre-war income did have a positive impact on mobilization. It appears likely that the mobilization of the economy and the military establishment were not necessarily influenced by the same factors. Given contradictory findings, we tried to clear up any of the uncertainty by pooling the data for both the world wars. This approach, however, was applicable only for a smaller set of countries (see Table 10 below for details).

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<sup>15</sup> For discussion of the impact of League of Nations' membership on rearmament, see Eloranta 2002 for details.

**Table 8. Pooled OLS Correlates of Mobilization in World War II (Including Annual Observations): Dependent Variable is Change in Real GDP Over 1938**

<i>Independent Variables</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
Constant	-37.40	10.82	215.34***	199.37***	164.59***
Lagged dependent variable (t-1)	0.98***	0.99***	0.86***	0.90***	0.93***
Real GDP per capita in 1938	4.01	1.36	-26.66***	-25.17***	-22.06***
Distance	4.66**	-2.22	-21.13***	-20.48***	-19.60***
Level of democracy in 1938	-	1.55	3.25***	4.02**	3.14***
Public debt as a percentage of GDP	-	-4.08	-4.34	-0.76	-4.41*
Member in the League of Nations in 1938	-	-11.72	-24.34***	-17.49*	-22.35***
Dominant religion dummy (measured as before)	-	-	-2.46	-3.12	-
Common law dummy	-	-	40.35***	15.30	36.39***
Level of agricultural employment in 1937	-	-	10.93***	3.57	10.90***
Time	-	-	-	8.53***	9.01***
Time squared	-	-	-	-1.44***	-1.49***
Transoceanic location dummy	-	-	-	13.01	-
N	78	57	57	57	57
Adjusted R <sup>2</sup>	0.79	0.92	0.94	0.96	0.96
F-statistic	97.20	112.86	95.74	101.80	125.81
DW	1.26	1.28	1.54	1.85	1.88

**Sources:** see Appendix. *Notes:* Pre-war real GDP per capita, public debt as a percentage of GDP, and the level of agricultural employment in 1937 in logs. \* = null hypothesis of no correlation rejected at 10 per cent level; \*\* = null rejected at 5 per cent level; \*\*\* = null rejected at 1 per cent level.

**Table 9. Pooled OLS Correlates of Mobilization in World War II (Including Annual Observations): Dependent Variable is Military Personnel, Percent of Population**

<i>Independent Variables</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
Constant	-2.02	-0.61	-3.91	1.42	-2.40
Lagged dependent variable (t-1)	0.54***	0.55***	0.53***	0.51***	0.64***
Real GDP per capita in 1938	0.33	0.09	0.51	0.06	0.41*
Distance	0.06	-0.07	0.26	0.10	-
Level of democracy in 1938	-	0.04	0.01	0.25	-
Public debt as a percentage of GDP	-	0.12	0.18	1.12	-
Member in the League of Nations in 1938	-	-0.09	0.10	1.43	-
Dominant religion dummy (measured as before)	-	-	0.04	-0.40	-
Common law dummy	-	-	-0.62	-6.52	-
Level of agricultural employment in 1937	-	-	-0.18	-2.10	-
Time	-	-	-	0.48	-0.02*
Time squared	-	-	-	-0.10	-
Transoceanic location dummy	-	-	-	3.42	-
N	61	50	50	50	61
Adjusted R <sup>2</sup>	0.44	0.45	0.42	0.49	0.48
F-statistic	16.76	7.70	4.87	5.00	19.61
DW	1.71	1.99	2.00	2.38	1.96

**Sources:** see Appendix. *Notes:* Military personnel as a percentage of population, pre-war real GDP per capita, public debt as a percentage of GDP, and the level of agricultural employment in 1937 in logs. \* = null hypothesis of no correlation rejected at 10 per cent level; \*\* = null rejected at 5 per cent level; \*\*\* = null rejected at 1 per cent level.

**Table 10. Pooled OLS Correlates of Mobilization in the Two World Wars (Including Annual Observations): Dependent Variable is Change in Real GDP Over 1913 or 1938**

<i>Independent Variables</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>
Constant	-58.33	20.48	351.62***	839.40***	-247.82	113.26
Real GDP per capita in 1913 or 1938	5.06	-6.18	-47.65***	-90.50***	16.75	-20.06*
Distance	10.74***	7.98*	-10.31	-66.34**	32.40	-42.21***
World War II dummy (=1 for 1939-1945)	22.94***	23.61***	17.71***	20.73***	-57.03	-7.98***
Level of democracy in 1913 or 1938	-	2.04	-0.59	-0.79	-8.16***	-
Public debt as a percentage of GDP	-	3.22	11.99***	2.34	0.48	-
Member in the Gold Standard in 1913 or the League of Nations in 1938	-	-12.32	-17.29***	-29.17***	18.06	-
Dominant religion dummy (measured as before)	-	-	-29.35***	-17.03***	3.81	-
Common law dummy	-	-	74.49***	97.79***	-46.82	-
Level of agricultural employment in 1913 or 1937	-	-	-1.16	-29.44**	-7.82	-
Time	-	-	-	5.06*	-5.04	-
Time squared	-	-	-	0.05	-1.45***	2.15***
Transoceanic location dummy	-	-	-	93.93**	-64.88	-
AR(1)	-	-	-	-	1.06***	1.08***
N	107	86	86	86	78	97
Adjusted R <sup>2</sup>	0.33	0.39	0.64	0.74	0.93	0.81
F-statistic	18.69	10.19	17.53	20.67	75.65	80.80
DW	0.49	0.39	0.62	0.56	1.29	1.44

**Sources:** see Appendix. *Notes:* Countries included: Australia, Austria (-Hungary), Canada, Germany, New Zealand, Japan, Russia (USSR), United Kingdom, and the United States. Pre-war(s) real GDP per capita, public debt as a percentage of GDP, and the level of agricultural employment in either 1913 or 1937 in logs. \* = null hypothesis of no correlation rejected at 10 per cent level; \*\* = null rejected at 5 per cent level; \*\*\* = null rejected at 1 per cent level.

Using  $\Delta\text{GDP}$  as the dependent variable (Table 10), we encountered persistent autocorrelation (see, for example, specifications 4 and 5) once again, and we used period-specific PCSEs and an autoregressive AR(1) term to deal with the problem. In sum, income seems to have had a *negative* impact on  $\Delta\text{GDP}$ , as did World War II period in general, pre-war democracy level (possibly arising from slower rearmament in the 1930s), and time squared (implying some nonlinearities in the estimations). Compared to earlier results, we thus found that during World War I pre-war income had a positive impact, whereas during World War II it had a negative impact (which seemed to influence the overall results for both wars). The earlier finding, vis-à-vis  $\Delta\text{GDP}$ , that there were significant differences in the factors influencing the economic mobilization in the two wars is reinforced here.

The results for the mobilization of military personnel (Table 11) once more exhibited autocorrelation and was resolved as before. Pre-war income, public debt, membership in the international system, and time had a positive impact on the mobilization. Moreover, there did not seem to be differences between the two world wars in respect of this dependent variable. Conversely, pre-war level of democracy and time squared had negative impacts. In comparison with the earlier, war-specific pooled results, pre-war income did not seem relevant in the earlier war-specific panels, yet it had overall a slight positive impact. Furthermore, institutional factors were only barely statistically significant, which underscores the earlier findings on World War II, namely the absence of impact from these variables.

**Table 11. Pooled OLS Correlates of Mobilization in the Two World Wars (Including Annual Observations): Dependent Variable is Military Personnel, Percent of Population**

<i>Independent Variables</i>	1	2	3	4	5	6
Constant	-0.13	-9.81	-18.12	-2.38	-52.44**	-10.65**
Real GDP per capita in 1913 or 1938	0.16	0.91	2.14	0.52	4.76**	1.09*
Distance	-0.51***	0.04	0.55	-0.07	5.71*	-
World War II dummy (=1 for 1939-1945)	0.50	-0.41	-1.10	-0.05	0.33	-
Level of democracy in 1913 or 1938	-	-0.20	-0.08	-0.06	-0.32*	-0.16*
Public debt as a percentage of GDP	-	1.00***	1.19***	0.24	0.67*	0.51*
Member in the Gold Standard in 1913 or the League of Nations in 1938	-	0.96***	1.10**	0.33	1.63**	0.87*
Dominant religion dummy (measured as before)	-	-	-0.68	-0.16	-0.71	-
Common law dummy	-	-	-2.27	-1.23	-0.97	-
Level of agricultural employment in 1913 or 1937	-	-	-0.73	-0.77	2.89	-
Time	-	-	-	0.94***	0.81**	0.71***
Time squared	-	-	-	-0.08**	-0.09**	-0.07*
Transoceanic location dummy	-	-	-	-0.06	-9.34	-
AR(1)	-	-	-	-	0.62***	0.52***
N	84	70	70	70	62	62
Adjusted R <sup>2</sup>	0.08	0.20	0.21	0.58	0.65	0.66
F-statistic	3.46	3.92	3.07	9.00	9.59	18.08
DW	0.71	0.73	0.77	1.00	2.21	2.08

**Sources:** see Appendix. *Notes:* Countries included: Australia, Austria (-Hungary), Canada, Germany, New Zealand, Japan, Russia (USSR), United Kingdom, and the United States. Military personnel as a percentage of population, pre-war(s) real GDP per capita, public debt as a percentage of GDP, and the level of agricultural employment in either 1913 or 1937 in logs. \* = null hypothesis of no correlation rejected at 10 per cent level; \*\* = null rejected at 5 per cent level; \*\*\* = null rejected at 1 per cent level.

**Table 12. Pooled OLS Correlates of Mobilization in the Two World Wars (Including Annual Observations): Dependent Variable is Central or Federal Government Expenditures, Percent of GDP**

<i>Independent Variables</i>	1	2	3	4	5	6
Constant	6.07***	5.22*	10.27**	-7.09	-46.96***	-53.27***
Real GDP per capita in 1913 or 1938	-0.33*	-0.51	-0.37	1.12	4.69***	5.17***
Distance	-0.39***	-0.39	2.97***	5.16***	7.16***	6.58***
World War II dummy (=1 for 1939-1945)	0.89***	0.78***	0.87***	0.75***	0.48	-
Level of democracy in 1913 or 1938	-	-0.04	-1.02***	-1.00***	-0.34	-
Public debt as a percentage of GDP	-	0.57***	0.68***	0.69***	0.94***	0.90***
Member in the Gold Standard in 1913 or the League of Nations in 1938	-	0.51**	1.11***	1.20***	1.71**	1.33**
Dominant religion dummy (measured as before)	-	-	-0.31	-0.43	-1.19**	-1.36***
Common law dummy	-	-	2.93***	2.13**	-2.86*	-3.95***
Level of agricultural employment in 1913 or 1937	-	-	-2.15***	-0.82*	1.27	2.16**
Time	-	-	-	0.21***	0.47***	0.38***
Time squared	-	-	-	-0.02	-0.05***	-0.04***
Transoceanic location dummy	-	-	-	-4.07***	-8.87***	-9.62***
AR(1)	-	-	-	-	0.75***	0.80***
N	82	76	76	76	69	69
Adjusted R <sup>2</sup>	0.44	0.62	0.75	0.85	0.89	0.89
F-statistic	21.92	21.05	25.53	35.32	43.29	50.85
DW	0.57	0.77	1.21	1.16	1.75	1.74

**Sources:** see Appendix. *Notes:* Countries included: Australia, Austria (-Hungary), Canada, Germany, New Zealand, Japan, Russia (USSR), United Kingdom, and the United States. Central (or federal) government expenditures as a percentage of GDP, pre-war(s) real GDP per capita, public debt as a percentage of GDP, and the level of agricultural employment in either 1913 or 1937 in logs. \* = null hypothesis of no correlation rejected at 10 per cent level; \*\* = null rejected at 5 per cent level; \*\*\* = null rejected at 1 per cent level.

Next, we decided to see how fiscal mobilization was impacted by the four explanatory mechanisms in our model. The analysis becomes more plausible when we analyze the two world wars together, given the data gaps and constraints (see the Appendix for details).

The first dependent variable we use in analyzing fiscal mobilization is central government expenditures as a percentage of GDP, indicating the willingness of these states to dedicate overall resources for government use, moving in some cases towards a *de facto* command economy. The results are displayed in Table 12. The estimations seemed to exhibit less autocorrelation than before, but we use the same tools to solve the problem. This model, compared with that used to analyze the mobilization of military personnel, seemed to work well in explaining fiscal mobilization. Income had a positive impact, as did distance, public debt, international system membership, agricultural employment, and time. Of these, only public debt and agricultural employment were hypothesized as having a negative impact. Negative coefficients were in turn incurred by the dominant religion dummy and time squared. Moreover, there did not appear to be major differences between the two world wars in terms of fiscal mobilization.

Do the results hold when we substitute the military burden as the dependent variable? Again (see Table 13), autocorrelation seemed to be prominent, and we used the same tools as previously. As with central government spending, the model seemed to work well in explaining mobilization. Here, however, there seemed to be some differences between the wars, as indicated by the World War II dummy. Quite naturally, the second war was a more massive conflict, hence the positive coefficient. Income also had a positive impact, as did distance, public debt, international system membership, agricultural employment, and time. Time squared and transoceanic location had negative impacts, the latter most likely because a more secure location reduced the need to mobilize the economy.

**Table 13. Pooled OLS Correlates of Mobilization in the Two World Wars (Including Annual Observations): Dependent Variable is Military Expenditures, Percent of GDP**

<i>Independent Variables</i>	1	2	3	4	5	6
Constant	2.38	-2.47	-15.77*	-16.59	-88.06***	-93.07***
Real GDP per capita in 1913 or 1938	0.07	0.33	1.83*	1.57	8.00***	7.71***
Distance	-0.62***	-0.33	0.18	1.79	9.07***	9.50***
World War II dummy (=1 for 1939-1945)	1.15***	0.76*	0.37	1.23***	2.24	3.25*
Level of democracy in 1913 or 1938	-	-0.14	-0.07	-0.07	-0.37**	-0.41***
Public debt as a percentage of GDP	-	0.72***	0.87***	0.17	0.63**	0.64**
Member in the Gold Standard in 1913 or the League of Nations in 1938	-	0.92**	1.29***	0.75*	1.48**	1.35**
Dominant religion dummy (measured as before)	-	-	0.10	0.13	-0.20	-
Common law dummy	-	-	-1.94	-1.05	-2.35	-
Level of agricultural employment in 1913 or 1937	-	-	0.03	1.39	4.54***	5.68***
Time	-	-	-	0.52***	1.15***	1.30***
Time squared	-	-	-	-0.03	-0.10***	-0.11***
Transoceanic location dummy	-	-	-	-4.21	-13.57**	-15.04***
AR(1)	-	-	-	-	0.84***	0.88***
N	81	75	75	75	67	67
Adjusted R <sup>2</sup>	0.30	0.40	0.41	0.63	0.87	0.87
F-statistic	12.65	9.33	6.66	11.41	33.71	40.63
DW	0.71	0.74	0.74	0.69	2.06	2.07

**Sources:** see Appendix. *Notes:* Countries included: Australia, Austria (-Hungary), Canada, Germany, New Zealand, Japan, Russia (USSR), United Kingdom, and the United States. Military expenditures as a percentage of GDP, pre-war(s) real GDP per capita, public debt as a percentage of GDP, and the level of agricultural employment in either 1913 or 1937 in logs. \* = null hypothesis of no correlation rejected at 10 per cent level; \*\* = null rejected at 5 per cent level; \*\*\* = null rejected at 1 per cent level.

Given that autocorrelation was featured so prominently in the analyses, and that we had to use a lagged dependent variable (or an autoregressive term) to derive the results, we decided to verify them for the combined pool of data for the world wars (Tables 10-13) by using General Method of Moments (GMM).<sup>16</sup> This approach, while suffering from its own shortcomings, takes into account the correlation between the lagged dependent variable and the error term by using instrumental variables in the analysis, thereby reducing autocorrelation and providing more accurate coefficient estimates. Here the version of GMM we used (with EViews 5.1) did not, given the limitations of sample size, utilize first-order differencing or orthogonal variations. We utilized period-specific weighting throughout the estimations. Only the best approximations are listed in Table 14.

**Table 14. GMM Correlates of Mobilization in the Two World Wars (Including Annual Observations): Four Types of Mobilization as Dependent Variables**

<i>Independent Variables</i>	<i>Dependent Variable: Change in real GDP over 1913 or 1938</i>	<i>Dependent Variable: Military personnel, percent of population</i>	<i>Dependent Variable: Central or federal government expenditures, percent of GDP</i>	<i>Dependent Variable: Military expenditures, percent of GDP</i>
Constant	-59.10***	-1.87*	-4.82***	-4.93***
Lagged dependent variable (t-1)	1.24***	1.07***	1.29***	1.36***
Real GDP per capita in 1913 or 1938	7.27***	0.22*	0.45***	0.46***
Distance	-	0.22**	0.21***	0.41***
Member in the Gold Standard in 1913 or the League of Nations in 1938	-	-	-	-0.41***
Dominant religion dummy (measured as before)	-6.03***	-	-0.27***	-
N	57	54	56	55
Adjusted R <sup>2</sup>	0.94	0.91	0.99	0.99
J-statistic	4.85	1.77	2.64	1.45
DW	1.71	1.85	2.13	1.87

**Sources:** see Appendix. **Notes:** same as in Table 13. Period-specific weighting used throughout. Military expenditures as a percentage of GDP, pre-war(s) real GDP per capita, public debt as a percentage of GDP, and the level of agricultural employment in either 1913 or 1937 in logs. Instruments: constant, lagged dependent variable, and most of the independent variables used in Tables 10-13. \* = null hypothesis of no correlation rejected at 10 per cent level; \*\* = null rejected at 5 per cent level; \*\*\* = null rejected at 1 per cent level.

<sup>16</sup> For details on dynamic panel data analysis and the GMM, see e.g. Baltagi 2005, Chapter 8. The other options, besides the tools used so far in this paper, include using first differences, one or two-step GMM, and the Newey-West estimator.

The results suggest that autocorrelation may have distorted some of the results, especially vis-à-vis pre-war income. Overall, income had a consistently positive coefficient in Table 14, even for production mobilization. The results for military mobilization seemed similar to the earlier results. The finding of an income effect for this variable should still be considered inconclusive. Moreover, the institutional channels may not have been as important as the preceding tables indicated, but did seem to play a role, in a more limited fashion, in fiscal mobilization. However, we must be somewhat cautious in interpreting the results, given the problems indicated earlier.

#### **4. Discussion: Did the Rich Win and, If So, Why?**

The two world wars were pivotal breaks in the history of the 20<sup>th</sup> century. They were the ultimate embodiment of total war. They required national resources to be measured, collected, and thrown into the war effort. The ability to mobilize and sustain this effort was the key to victory on both occasions.

In this paper we investigated what mechanisms could account for the scale and scope of mobilization in the two world wars. We observed from the limited samples used in previous research that, controlling for time and distance, richer countries appeared to mobilize output more effectively on average. This could be due to a pure *income effect*, inasmuch the richer countries could utilize the surplus of average incomes over subsistence to promote mobilization; a *structural effect*, since richer countries had more developed and flexible farming systems with the ability to sustain agricultural markets under wartime pressures; an outcome of *financial institutions*, since richer countries had more developed capital markets; or an effect arising from *political institutions*, since democracies tended to inspire greater confidence and participation among their citizenry.

We utilized panel data samples to analyze these mechanisms, using new data arising from recent studies on the economic aspects of the two world wars. We were able to analyze the correlates of production (change in real GDP), military (change in the number of military personnel), and fiscal (change in central or federal, and military spending) mobilization in a comprehensive fashion.

First, in explaining the change in real GDP, pre-war income had a positive impact during World War I, whereas during World War II it seemingly had a negative impact. Therefore, earlier findings on the income effect were at first confirmed only for the Great War; in this respect there seems to have been substantial differences between the wars. The later analysis, taking into account autocorrelation more effectively, indicated that the overall impact was positive for both wars. Distance had a positive effect during World War I, given that the war was less global in its reach, enabling free riding, but it incurred a negative coefficient during World War II. The later analysis suggested that the overall impact might have been positive, when autocorrelation is accounted for. In sum, the other mechanisms were not, by and large, particularly significant. Only democracy and public debt had slight negative impacts on production mobilization during World War I.

Second, in explaining the number of military personnel, pre-war income was not statistically significant in the war-specific, pooled analyses; overall, however, it did

exhibit a slight positive impact. Furthermore, structural and institutional factors such as public debt, having a dominant religion, and agriculture's share of employment were significant factors in military mobilization during World War I, but not the second. Larger public debt, for example, seemed to inspire greater participation by the citizens in the war effort, and this is consistent with the Ferguson hypothesis. In sum, there were again substantial differences between the two wars, and the mobilization of troops may have been influenced more by non-economic factors.

Third, the overall model, including all four mechanisms, seemed to perform well in explaining the mobilization of central-government fiscal resources in the two wars. Pre-war income had a positive impact, as did distance, public debt, international system membership, agricultural employment, and time. Of these, we expected only public debt and agricultural employment to have had a negative impact. The same applied to the second fiscal mobilization variable, military expenditures as a percentage of GDP, as well. Here, however, there seemed to be some differences between the wars, as shown by a World War II dummy. Quite naturally, the second war was a more massive conflict, hence the positive coefficient. Income also had a positive impact, as did distance, public debt, international system membership, agricultural employment, and time. Negative impact was incurred by time squared and transoceanic location, the latter most likely implying the lesser need to mobilize the economy due to more secure location.

In summary, pre-war income did play an important role in all of the types of mobilization that we investigated. For World War I, there is evidence of a pure income effect, but for World War II the evidence suggests that the structural and institutional channels may have mattered as well. The negative impact uncovered for World War II production mobilization is somewhat puzzling, but may be due to nonlinearities or other factors that we have missed so far, resulting in autocorrelation. When data from both wars are pooled and autocorrelation controlled for, pre-war income had a positive impact on mobilization, suggesting that it was "the rich" that won. Why, then, did the rich win? The structural and institutional channels were particularly important for the fiscal mobilization variables, whereas military mobilization was not explained very well by this model, but rather by non-economic factors. Thus, the rich countries had a substantial edge on the poorer countries partly because of their higher incomes, partly because of their democratic and financial institutions, which were rooted in the greater participation of the citizens.

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## Appendix. Data Samples and Sources

### *Samples:*

Countries included in World War I sample: Australia (AUS), Austria-Hungary (AUT), Canada (CAN), France (FRA), Germany (GER), Greece (GRE), Japan (JAP), New Zealand (NZ), Portugal (POR), Russia (RUS), United Kingdom (UK), United States (USA).

Countries included in World War II sample: AUS, AUT, Brazil (BRA), Bulgaria (BUL), CAN, Finland (FIN), GER, Italy (ITA), JAP, NZ, Russia/USSR (RUS), UK, USA.

Countries in the combined world war sample: AUS, AUT, CAN, GER, NZ, JAP, RUS, UK, USA.

### *Data:*

Nominal GDP: Unless otherwise mentioned, Mitchell (1998a, 1998b, 2003). *Exceptions:* AUS 1913-1918 from Obstfeld and Taylor (2003); CAN 1913-1918 from Obstfeld and Taylor (2003); GER 1938-1943 from Abelshauser (2000); GRE 1913-1918 from Kostelenos (1995); ITA 1938-1945 from Rossi, et al. (1993); NZ 1913-1918 from Obstfeld and Taylor (2003), 1938-1945 (GNI) from Global Financial Data (2000); POR 1913-1918 from Batista, et al. (1997); USA (GNP) 1913-1918, 1938-1945 from United States. Bureau of the Census. 1976 (1976). *Data missing for:* AUT 1914-1918, 1939-1945; GER 1914-1918, 1944-1945; JAP 1944-1945; POR 1914-1918; RUS 1914-1918, 1939-1945.

Real GDP: Unless otherwise mentioned, Maddison (1995, 2003) (updated from [http://www.ggd.net/Maddison/Historical\\_Statistics/horizontal-file.xls](http://www.ggd.net/Maddison/Historical_Statistics/horizontal-file.xls)). *Exceptions:* GRE 1913-1918 from Kostelenos (1995); POR 1913-1918 from Batista, et al. (1997); RUS 1939-1945, updated figures, see Harrison (2005). *Data missing for:* RUS 1918.

Population: From Maddison (1995, 2003) and Singer and Small (1993).

Number of military personnel: From Singer and Small (1993).

Nominal public debt: Unless otherwise mentioned, Obstfeld and Taylor (2003) and United Nations. Dept of Economic Affairs (1948). *Exceptions* (public debt as a percentage of GDP taken from): AUT 1913-1918 from Schulze (2005). *Data missing for:* AUT 1938-1945; BUL 1938-1945; FRA 1915-1916; GER 1944-1945; GRE 1913, 1915-1917; RUS 1913-1918; 1938-1945 (assumed 0).

Level of democracy: From Gleditsch (2000). Updated with EUGene software, available from: <http://www.eugenesoftware.org/>.

Membership in the Gold Standard or the League of Nations: Gold Standard from Meissner (2002) and Obstfeld and Taylor (2003). League of Nations from League of Nations (1939).

Level of adherence to the leading religion before the world wars: Based on Lindert (2003) database, as well as personal correspondence with several scholars.

Level of agricultural employment before the world wars: Based on Lindert (2003) database, as well as personal correspondence with several scholars.

Nominal central (or federal) government expenditures: Unless otherwise mentioned, Mitchell (1998a, 1998b, 2003). *Exceptions:* CAN 1939-1945 from Urquhart, et al. (1965); FIN 1939-1945 from Eloranta and Kauppila (2006); GER 1939-1944 from Abelshauser (2000); JAP 1939-1944 from Hara (2000). *Data missing for:* AUT 1914-1918, 1939-1945; GER 1914-1918, 1944-1945; JAP 1945; RUS 1914-1918, 1941.

Nominal military expenditures: AUS: Singer and Small (1993), converted in to Australian dollars using Global Financial Data (2000) exchange rates; AUT: Schulze (2005); CAN: Urquhart, et al. (1965); GER: 1914-1918 (as percentage of national income, series VIa) from Ritschl (2005), 1939-1943 from Abelshauser (2000); NZ: Singer and Small (1993), converted in to New Zealand dollars using Global Financial Data (2000) exchange rates; JAP: 1914-1918 from Singer and Small (1993), converted in to Japanese yen using Global Financial Data (2000) exchange rates, 1939-1944 (as percentage of GDP) from Hara (2000); RUS: 1939-1944 from Harrison (2000); UK: Mitchell (1988); USA: United States. Bureau of the Census. 1976 (1976). *Data missing for:* AUS -1914-1918; AUT 1918, 1939-1945; GER 1944-45; NZ 1914-1918; JAP 1945; RUS 1914-1918.