The Fiscal Role of Conscription in the U.S. World War II Effort*

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September 19, 2007

Abstract

I consider the role of conscription as a lump sum tax in times of war. Conscription of military personnel allows the fiscal authority to minimize wartime government expenditure, and hence, minimize tax distortions associated with war finance. I develop a simple dynamic general equilibrium model to articulate this view, and calibrate the model to mimic the U.S. World War II experience. Analysis of the calibrated model indicates that the welfare value of conscription as a fiscal policy tool is quantitatively large.

*I thank Stefania Albanesi, Hal Cole, Mick Devereux, Patrick Francois, Jeremy Greenwood, Marc Law, Ellen McGrattan, Lee Ohanian, Víctor Ríos-Rull, Tom Ross, François Velde, and participants at the 2007 NBER Macroeconomics Across Time and Space meeting for helpful discussion, and McGrattan and Ohanian for providing me with their data on after-tax real wage rates. Byron Shaw provided excellent research assistance. Part of this work was completed while I was a visiting scholar at the Federal Reserve Bank of Minneapolis during the 2006-07 academic year, and I thank them for their hospitality and support. Support from the SSHRC of Canada is also gratefully acknowledged. All errors are mine.

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1. INTRODUCTION

Conscription, or the "military draft," allows the government to bypass the labor market in meeting its military staffing needs. The government is thereby able to pay soldiers below market wages, thus minimizing tax distortions associated with financing military expenditures. In many countries, conscription has been used primarily during times of major war. It was instituted during the American Civil War by both the Union and the Confederacy, and during the U.S. involvement in World Wars I and II, and the Korean and Vietnam Wars. Given historical practice, conscription can be viewed as a fiscal shock absorber: a lump sum tax enacted in periods of unusual wartime spending.

The literature on optimal policy stresses the value of fiscal instruments that have this shock absorbing ability (see Lucas and Stokey, 1983; Chari et al., 1991). For instance, state-contingency in capital income tax rates or in returns on government liabilities act as ex post lump sum taxes that allow tax distortions to be smoothed in the face of budgetary shocks. Inspection of the U.S. experience during WWII indicates that such instruments were not used to the extent prescribed by theoretical analysis. The clearest indication of this is the accumulation of government debt throughout the war that was only gradually paid down through persistently higher postwar taxation (see Barro, 1979; Ohanian, 1997). The optimal state-contingent policy response would have involved something akin to a sharp capital income tax levy or a repudiation of real debt (either explicitly, or in the form of a spike in inflation) at the outset of the American involvement.

This observation leads to two natural questions. If not these, what policy instruments did the government use to help absorb the WWII shock? And given the magnitude of the war, was the welfare value of this policy instrument large or small?[1] I argue that military conscription played such a role, and that its value was quantitatively large.

I formulate a simple, dynamic general equilibrium model to articulate this view. I show

[1] See also Siu (2004), who shows that the welfare value of a 'complete markets' outcome (as implemented through state-contingent policy) is quantitatively large relative to an 'incomplete markets' outcome (as implemented via persistent innovations in debt and taxes), in an economy subject to war-and-peace shocks.

Conflict	Enrollment: total (000's)	Enrollment: per capita	Casualties: total per enrolled	Casualties: combat deaths per enrolled	Casualties: combat deaths per month	Cost (2002 $'s): avg ann GDP share	Cost (2002 $'s): per capita
Civil War	3713	15.2%	23.9%	5.8%	4478	17%	2532
World War I	4735	6.8%	6.8%	1.1%	2811	14%	2718
World War II	16113	15.6%	6.7%	1.8%	6626	41%	27957
Korean War	5720	5.1%	2.8%	0.6%	912	5%	2985
Vietnam War	8744	5.9%	2.8%	0.5%	354	2%	3340
Persian Gulf War	2322	1.2%	0.1%	0.01%	147	4%	384

Table 1. Military statistics from selected U.S. wars. See Appendix A for data sources and detailed description of statistics.

that conscription is part of an optimal policy when the economy is subject to episodes of war. I then calibrate the model to the U.S. WWII experience and perform two counterfactuals. The first replicates the war, but with the government hiring an all-volunteer armed forces. The second has the government instituting an "optimal" conscription. These experiments allow me to quantify the welfare value of conscription as a fiscal policy tool during WWII.

The U.S. experience represents a unique episode to address this question. Table 1 presents a comparison of selected statistics across major U.S. wars. It is clear that while some wars were truly massive endeavors, others were not. By virtually any measure, WWII was the largest war or military conflict in U.S. history. In the peak year of 1945, over 12 million men served on active duty in the armed forces.[2] This represented nearly 12% of the adult population and over a quarter of prime-aged American men. The vast majority were conscripted. The first Selective Service Act was passed in August of 1940, and inductions began in earnest in 1941. By December of 1942, conscription became the sole means of military recruitment. Of the 16 million men who served in WWII, approximately 10 million were conscripted, with a large proportion of the remaining men "draft-induced."[3]

[2] Sources and details on all data used in this paper are contained in Appendix A.

[3] Though no estimates for draft-induced volunteers exist for WWII, it is clear that this is the case.

Table 1 indicates that WWII was also the most costly war in American history. In 1944, government spending made up 48% of GDP; this represented an increase of around 500% in real spending relative to that of 1940. This necessitated drastic changes in the means and extent of government revenue collection. In 1939, federal personal and corporate income taxes totalled approximately 2.1 billion (current) dollars, or 33% of total federal tax receipts. By 1945, these figures had increased to 34.4 billion and 76%, respectively. Over the same period, the share of the labor force required to pay income taxes increased from 7% to 81%. Given these circumstances, it is interesting to determine the effect of concurrent wartime policies on fiscal policy. This is particularly true, given the massive nature of WWII. Of obvious importance is the fiscal consequences of conscription.

This is not the first paper to consider the economics of conscription. In the late 1960s and early 1970s, a series of important papers addressed the use of peacetime conscription relative to voluntary recruitment.[4] In addition to the obvious issues regarding equity and infringement on individual freedom, these papers focused on the distortions and inefficiencies associated with mandatory service. For example, these include the misallocation of labor skill across civilian and military uses, and the distortion on education, marriage and child-bearing incentives induced by the system of deferments and exceptions that were in place. Since these could be eliminated by employing a volunteer military, these papers argued strenuously for the termination of conscription as a means of peacetime recruitment.[5]

These costs and inefficiencies present a trade-off to the fiscal benefits of conscription in

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Volunteering presented clear benefits over being drafted, including the ability to go through basic training and serve in action with friends once enrolled. Department of Defense estimates from later periods corroborate this view. In 1964, 38% of volunteers reported being draft-induced, while in 1970, near the height of the Vietnam War recruitment, 50% reported similarly. See also Altman and Barro (1971) who estimate a draft-induced fraction of 41% for military officers in 1970.

[4]See, for instance, Friedman (1967), Hansen and Weisbrod (1967), Oi (1967), Fisher (1969), Altman and Barro (1971), and Amacher et al (1973). Many of these were written in association with the Marshall Commission's review of the Universal Military Service and Training Act of 1951 (which was due to expire in 1967) and the Gates Commission's inquiry of an all-volunteer military.

[5]Conscription was abandoned in the U.S. in 1973. Selective Service registration was terminated in 1975, and then reinstated in 1980.

determining the optimal system of military recruitment. In particular, as the size of the required force increases, tax distortions associated with financing a volunteer military are exacerbated, while some of the costs of conscription decrease.[6] Hence, conscription may be the preferred option when the demand for military personnel is large. This observation is clearly exposited by Friedman (1967), who was a leading advocate for the volunteer system:

> If a very large fraction ... of the relevant age groups are required ... in the military services, the advantages of a voluntary army become very small ... [T]o rely on volunteers under such conditions would then require very high pay in the armed services, and very high burdens on those who do not serve, in order to attract a sufficient number into the armed services. ... [I]t might turn out that the implicit tax of forced service is less bad than the alternative taxes that would have to be used to finance a voluntary army. Hence for a major war, a strong case can be made for compulsory service.[7]

A number of recent papers provide empirical evidence in support of this as a positive theory of conscription. Ross (1994) presents cross-country evidence linking larger armed forces to increased reliance on conscription, while Garfinkel (1990) shows in U.S. time series data that average marginal tax rates are negatively related to the use of conscription (after controlling for government spending).[8]

This paper differs from the recent literature in that it does not attempt to provide a

[6] As an obvious example, if all eligible individuals are required to serve, then issues regarding the misallocation of labor across civilian and military uses become irrelevant.

[7] An earlier discussion is provided by the British political economist, Henry Sidgwick (1887): "Where, indeed, the number ... is not large ... voluntary enlistment seems clearly the most economical system; since it tends to select the persons most likely to be efficient soldiers and those to whom military functions are least distasteful; ... But a nation may unfortunately require an army so large that its ranks could not be kept full by voluntary enlistment, except at a rate of remuneration much above that which would be paid in other industries ... in this case the burden of the taxation requisite ... may easily be less endurable than the burden of compulsory service."

[8] See also Mulligan and Schleifer (2004), who present an alternative positive theory of conscription based on the fixed costs associated with its administration and enforcement.

positive theory of conscription. Instead, the central objective is to quantify the welfare value of conscription in its fiscal policy role for the U.S. WWII effort. Indeed, if conscription was to be justified on fiscal grounds for any event in American history, WWII would represent the obvious episode. In the context of Friedman's discussion, the goal is to determine "how strong a case can be made" for conscription during a major war.

In the next section I present the model. The analysis abstracts from issues such as inequality, misallocation of labor skill, and distortions to education incentives; this allows me to focus on the paper's stated objective. Section 3 characterizes equilibrium as well as what I refer to as an optimal conscription. Section 4 presents data and details on calibration relevant to the quantitative exercise. Section 5 presents simulation results for the benchmark economy and counterfactual experiments. Despite the fact that the American involvement lasted only four years, the results indicate that the case for conscription is indeed strong. For conservative estimates of the cost of voluntary recruitment, the fiscal value of conscription is worth approximately 1.2% to 2.0% of consumption *in perpetuity*. When the model is calibrated to match mid-century estimates of the military-to-civilian wage premium, the welfare value of conscription *doubles*. Section 6 provides concluding remarks.

2. THE MODEL

Let s_t denote the event realization at any date t, where $t = 0, 1, \ldots$. The history of date-events realized up to date t is given by the history, or *state*, $s^t = (s_0, s_1, \ldots, s_t)$. The unconditional probability of observing state s^t is denoted $\pi\left(s^t\right)$, while the probability of observing s^t given state s^{t-1} is denoted $\pi\left(s^t|s^{t-1}\right) \equiv \pi\left(s^t\right)/\pi\left(s^{t-1}\right)$. The initial state, s^0, is given so that $\pi\left(s^0\right) = 1$. In the case of a deterministic economy, the state s^t is degenerate, and $\pi\left(s^t\right) = 1$ for all s^t.

Periods of war and peace differ along two dimensions: (i) the government's demand for privately produced goods, $g\left(s^t\right)$; and (ii) the fraction of the population it requires serving in the armed forces, $d\left(s^t\right)$. For simplicity, I assume that the government's demand for military personnel during peacetime is zero ($d = 0$).[9] This amounts to assuming that the production technology for the government's peacetime defense services is identical to that of privately produced goods. Further, I assume that the per-period-hours a soldier spends in military service is given exogenously. Hence, variation in military labor needs is met solely through variation in the number of service members, $d\left(s^t\right)$.

I first present the case in which all military personnel are conscripted. The discussion in Section I indicates that this simplification is not far from actual experience for the U.S. The case of a volunteer military, which I consider as a counterfactual, is presented separately.

2.1 Households

There is a large number of identical households. The representative household is composed of a unit measure of family members. All family members have identical preferences over consumption and labor, with current utility given by:

$$U(c,h) = u(c) + v(h),$$

where u is increasing and concave, v is decreasing and convex, and $h \in [0,1]$. At each state, a fraction, $d\left(s^t\right)$, of family members is drafted for military service. In the military, individuals work a prespecified number of hours per period, $\bar{h}$. Given additive separability in preferences, the household allocates the same amount of consumption to "draftees" and "civilians."

Hence, the representative household's problem is to maximize:

$$\sum_{t=0}^{\infty}\sum_{s^t}\beta^t\pi\left(s^t\right)\left[u\left(c\left(s^t\right)\right)+\left(1-d\left(s^t\right)\right)v\left(h\left(s^t\right)\right)+d\left(s^t\right)v\left(\bar{h}\right)\right],\quad \beta\in(0,1),$$

subject to:

$$c\left(s^t\right)+i\left(s^t\right)+p\left(s^t\right)b\left(s^t\right)\leq b\left(s^{t-1}\right)+\left[\left(1-\theta\left(s^t\right)\right)r\left(s^t\right)+\theta\left(s^t\right)\delta\right]k\left(s^{t-1}\right)+$$
$$\left(1-\tau\left(s^t\right)\right)w\left(s^t\right)\left[\left(1-d\left(s^t\right)\right)h\left(s^t\right)+\phi d\left(s^t\right)\bar{h}\right],\quad (1)$$

[9] As will be shown below, this is a good approximation for the U.S. prior to 1941.

and $c\left(s^t\right), i\left(s^t\right) > 0$, for all s^t. The initial values, $k\left(s^{-1}\right) \equiv k_{-1} > 0$ and $b\left(s^{-1}\right) \equiv b_{-1}$ are taken as given. The right-hand side of the equation is total income earned at state s^t. Here, $b\left(s^{t-1}\right)$ denote units of real, one-period bonds purchased at s^{t-1} which mature at date t; note that each bond returns one unit of consumption, irrespective of the state realized at date t. The second term represents state s^t after-tax income earned on capital holdings chosen at s^{t-1}. Here, $\theta\left(s^t\right)$ is the state-contingent capital income tax rate, $r\left(s^t\right)$ is the real rental rate, and $\delta \in (0,1)$ is the depreciation rate, so that $\theta\left(s^t\right)\delta$ is a depreciation allowance in the tax code. The third term represents after-tax labor income earned at state s^t, where $\tau\left(s^t\right)$ is the state-contingent labor income tax rate, $w\left(s^t\right)$ is the civilian wage rate, and $h\left(s^t\right)$ is the number of hours worked by civilians. I model the military wage rate earned by draftees as equaling a fraction, $\phi \geq 0$, of the civilian wage. This fraction is a policy variable for the government.

State s^t income is used to finance purchases of consumption, $c\left(s^t\right)$, investment, $i\left(s^t\right)$, and non-contingent bonds. The state s^t consumption price of a bond which pays one unit of consumption at all s^{t+1} following s^t is denoted $p\left(s^t\right)$. Investment augments capital holdings according to the law-of-motion:

$$k\left(s^t\right) = i\left(s^t\right) + (1-\delta)\, k\left(s^{t-1}\right), \quad \forall s^t.$$

The first-order necessary conditions (FONCs) are standard:

$$-\frac{v'\left(h\left(s^t\right)\right)}{u'\left(c\left(s^t\right)\right)} = \left(1-\tau\left(s^t\right)\right) w\left(s^t\right), \tag{2}$$

$$u'\left(c\left(s^t\right)\right) = \beta \sum_{s^{t+1}|s^t} \pi\left(s^{t+1}|s^t\right) u'\left(c\left(s^{t+1}\right)\right) \left[\left(1-\theta\left(s^{t+1}\right)\right) r\left(s^{t+1}\right) + \theta\left(s^{t+1}\right)\delta + 1 - \delta\right], \tag{3}$$

$$u'\left(c\left(s^t\right)\right) p\left(s^t\right) = \beta \sum_{s^{t+1}|s^t} \pi\left(s^{t+1}|s^t\right) u'\left(c\left(s^{t+1}\right)\right). \tag{4}$$

The first FONC indicates that the presence of a proportional labor tax drives a wedge between the marginal rate of substitution in (civilian) leisure-and-consumption and the real wage. The second states that (future) capital taxation drives a wedge between the current marginal value of consumption and the expected marginal utility weighted return to capital. The third states the standard pricing formula for a risk-free, one-period bond.

2.2 Firms

Firms transform factor inputs into private sector output according to the constant returns to scale technology:

$$y\left(s^t\right) = z\left(s^t\right)\tilde{k}\left(s^t\right)^{\alpha}\left[\left(1+\gamma\right)^t\tilde{h}\left(s^t\right)\right]^{1-\alpha}, \quad \alpha \in (0,1)\,. \tag{5}$$

Here, $\tilde{k}\left(s^t\right)$ and $\tilde{h}\left(s^t\right)$ denote capital and labor hired at s^t, γ is the deterministic growth rate of labor-augmenting technology, and $z\left(s^t\right)$ is the level of productivity.

The representative firm's problem is static:

$$\max\left[y\left(s^t\right) - r\left(s^t\right)\tilde{k}\left(s^t\right) - w\left(s^t\right)\tilde{h}\left(s^t\right)\right],$$

and results in the standard FONCs relating factor prices to marginal revenue products:

$$r\left(s^t\right) = \alpha z\left(s^t\right)\left[\frac{\left(1+\gamma\right)^t\tilde{h}\left(s^t\right)}{\tilde{k}\left(s^t\right)}\right]^{1-\alpha}, \tag{6}$$

$$w\left(s^t\right) = \left(1-\alpha\right)z\left(s^t\right)\left[\frac{\left(1+\gamma\right)^t\tilde{h}\left(s^t\right)}{\tilde{k}\left(s^t\right)}\right]^{-\alpha}\left(1+\gamma\right)^t. \tag{7}$$

2.3 Government

The government's payment for privately produced output, $g\left(s^t\right)$, and conscripted labor services, $d\left(s^t\right)\bar{h}$, must satisfy the following flow budget constraint:

$$g\left(s^t\right) + \left(1-\tau\left(s^t\right)\right)\phi w\left(s^t\right)d\left(s^t\right)\bar{h} + b\left(s^{t-1}\right) \leq p\left(s^t\right)b\left(s^t\right) + \\ \tau\left(s^t\right)w\left(s^t\right)\left(1-d\left(s^t\right)\right)h\left(s^t\right) + \theta\left(s^t\right)\left(r\left(s^t\right)-\delta\right)k\left(s^{t-1}\right),$$

for all s^t. Note that the government's expenditures include only the after-tax value of military wages; this is in keeping with U.S. policy during WWII.[10]

[10] Beginning with the Korean War, military pay earned in combat zones by members of the armed forces was exempted from taxation. See the U.S. Internal Revenue Code, Section 112.

2.4 The case of an all-volunteer military

In this subsection, I characterize the case in which the government does not have the ability to conscript. Hence, the government must pay a market wage to induce the household to supply the required personnel in order to meet military demand. Given the fixity of hours each service member works in the military, the household has one additional choice variable. Let $e\left(s^t\right)$ denote the fraction of its family members the household chooses to allocate to military work.

The representative household's problem in this case is to maximize:

$$\sum_{t=0}^{\infty}\sum_{s^t}\beta^t\pi\left(s^t\right)\left[u\left(c\left(s^t\right)\right)+\left(1-e\left(s^t\right)\right)v\left(h\left(s^t\right)\right)+e\left(s^t\right)v\left(\bar{h}\right)\right],$$

subject to:

$$\begin{aligned}c\left(s^t\right)+i\left(s^t\right)+p\left(s^t\right)b\left(s^t\right)\leq b\left(s^{t-1}\right)+\left[\left(1-\theta\left(s^t\right)\right)r\left(s^t\right)+\theta\left(s^t\right)\delta\right]k\left(s^{t-1}\right)+\\ \left(1-\tau\left(s^t\right)\right)\left[\left(1-e\left(s^t\right)\right)w\left(s^t\right)h\left(s^t\right)+e\left(s^t\right)x\left(s^t\right)\bar{h}\right],\end{aligned}$$

for all s^t. Here, $x\left(s^t\right)$ is the military wage, which differs from the civilian wage, $w\left(s^t\right)$. This is due to the fact that: (i) v is convex in hours worked, and; (ii) in general, $h\left(s^t\right)\neq\bar{h}$. The firm's problem in this case is identical to that presented above, and the government's budget constraint is augmented in the obvious way to account for the fact that the military wage is now $x\left(s^t\right)$ as opposed to $\phi w\left(s^t\right)$.

3. COMPETITIVE EQUILIBRIUM AND OPTIMAL POLICY

A competitive equilibrium in the conscription economy is defined in the usual way.

Definition 1 *Given initial values,* k_{-1} *and* b_{-1}*, and the process,* $\{z\left(s^t\right), g\left(s^t\right), d\left(s^t\right)\}$*, a* competitive equilibrium *is an allocation,* $\{c\left(s^t\right), h\left(s^t\right), k\left(s^t\right), b\left(s^t\right); y\left(s^t\right), \tilde{k}\left(s^t\right), \tilde{h}\left(s^t\right)\}$*, price system,* $\{p\left(s^t\right), r\left(s^t\right), w\left(s^t\right)\}$*, and government policy,* $\{\phi, \theta\left(s^t\right), \tau\left(s^t\right)\}$*, such that:*

- $\{c(s^t), h(s^t), k(s^t), b(s^t)\}$ *solves the household's problem subject to the sequence of household budget constraints;*

- $\{y(s^t), \tilde{k}(s^t), \tilde{h}(s^t)\}$ *solves the final good firm's problem;*

- *the sequence of government budget constraints is satisfied;*

- *and factor markets clear:*

$$\tilde{k}\left(s^t\right) = k\left(s^{t-1}\right), \quad \tilde{h}\left(s^t\right) = \left(1 - d\left(s^t\right)\right) h\left(s^t\right), \quad \forall s^t.$$

Bond market clearing has been implicitly assumed, as both issues and holdings are denoted by the single variable, $b\left(s^t\right)$. By Walras' law, the market for private sector output clears:

$$c\left(s^t\right) + k\left(s^t\right) + g\left(s^t\right) = y\left(s^t\right) + (1 - \delta) k\left(s^{t-1}\right), \quad \forall s^t.$$

Equilibrium in the case without conscription is defined in an analogous manner. In addition to those stated above, the condition $e\left(s^t\right) = d\left(s^t\right)$ for all s^t must be satisfied.

Before proceeding to the quantitative analysis, I present two analytical results regarding conscription and optimal policy. The first relates to the budgetary implications of an all-volunteer military. From the household's FONC with respect to $e\left(s^t\right)$, it is easy to derive the following relationship between the military and civilian wage rates:

$$x\left(s^t\right) = \varphi\left(s^t\right) w\left(s^t\right),$$

where

$$\varphi\left(s^t\right) \equiv \frac{v\left(\bar{h}\right) - v\left(h\left(s^t\right)\right) + v'\left(h\left(s^t\right)\right) h\left(s^t\right)}{v'\left(h\left(s^t\right)\right) \bar{h}}. \tag{8}$$

Hence, the military wage is proportional to the civilian wage, and the factor of proportionality, $\varphi\left(s^t\right)$, is contingent on $h\left(s^t\right)$.

It is straightforward to show the following result:

Proposition 2 $\varphi\left(s^t\right) \geq 1$*; that is, in the case of an all-volunteer military, the military wage rate is greater than the civilian wage rate.*

See Appendix B for the proof, which follows directly from the convexity of v. Under conscription, the analogous factor of proportionality is given by ϕ. Hence, for $\phi < 1$, conscription confers a cost saving to the government in terms of military wage expenditures.

The second result relates to the determination of optimal policy under commitment. The policy problem is to find the government policy that induces competitive equilibrium associated with the highest value of the household's expected lifetime utility. This equilibrium is called the *Ramsey equilibrium.* Specifically, the government commits to its chosen policy at the beginning of time, and in all periods agents optimize taking policy as given.

For this economy, the optimal military recruitment policy is straightforward:

Proposition 3 *If the government's intertemporal budget constraint, (10), is binding, then it is optimal to set $\phi = 0$; that is, all military personnel are conscripted and paid nothing in the Ramsey equilibrium.*

The proof is contained in Appendix C. The intuition for this result is obvious. Since in any competitive equilibrium military service must be fulfilled, it is optimal to minimize military pay to minimize the tax distortions associated with financing it. In the model presented here, military service is required only in times of war. Hence, in the context of this model, conscription acts as a fiscal shock absorber, minimizing tax distortions associated with wartime spending.

It is important to note that actual government policy during WWII was far from optimal, as characterized by the Ramsey equilibrium for this model economy. Hence, in the quantitative analysis, I evaluate the fiscal value of conscription in the more "realistic" context of observed historical policy experience, in addition to the Ramsey context discussed here.

4. QUANTITATIVE SPECIFICATION

In this section, I calibrate the model of Section 2 to study the U.S. WWII experience. Among other things, this requires specifying the process governing wartime spending and military staffing, $\{g\left(s^t\right), d\left(s^t\right)\}$, and fiscal policy rules, $\{\phi, \theta\left(s^t\right), \tau\left(s^t\right)\}$, to match historical observation. With this calibrated model as a benchmark, I conduct two counterfactual simulations: the first with an *optimal conscription* (with $\phi = 0$), and the second with an all-volunteer military (with $x\left(s^t\right) = \varphi\left(s^t\right) w\left(s^t\right)$). Together, these experiments allow me to quantify the fiscal value of conscription.

4.1 Data description

I begin with a description of the data relevant for this exercise. Further detail and source information is contained in Appendix A. Figure 1, panel A plots the ratio of total (i.e., federal, state, and local) government spending to GDP, 1935-65. In addition to WWII, this period is marked by a shift in the size of government coinciding with the onset of the Cold War. Excluding the war years, government spending averaged 15.5% of GDP between 1932 and 1950. With respect to WWII, the government's share increased to 21% in the build-up year of 1941, when real total spending increased 66% – and military equipment spending increased 16-fold – over 1940. This was due to the passing of the Lend-Lease Act and overall military mobilization. With the onset of the war, government spending increased each year until it peaked in 1944 at 48% of GDP.

Panel B displays similar dynamics for the number of active duty military personnel, normalized by the adult population. When Germany invaded Poland in September 1939, the U.S. military employed 330,000 men, roughly the same size as the forces of Portugal or Romania, and 1/10 that of Germany (see Cardozier, 1995). Prior to this, approximately 0.3% of the U.S. population served in active duty. With the passing of the Selective Service Act of 1940, inductions began in earnest so that by 1941, 1.8 million men were serving in the military. Conscription became the sole means of recruitment in December 1942, and by 1945, the armed forces peaked at 12.1 million men or 11.5% of the population. In 1946 conscription was terminated, military strength dropped, and leading up to the Korean War active duty personnel numbered approximately 1.5 million annually.

As described by Ohanian (1997) and many others, the war effort was largely deficit financed allowing tax distortions to be smoothed forward in time. Panel C displays average marginal labor income and capital income tax rates as constructed by Joines (1981). Both tax rates increased noticeably during the war. Between 1940 and 1945, the labor tax rate (solid line) increased from 9.1% to 19.7%, and the capital tax (dashed line) from 45.1% to 62.9%. These increases did not nearly cover the increased spending. Panel D displays Seater's (1981) data for the market value of outstanding total government debt as a ratio of GDP. Government indebtedness rose throughout the war until it peaked at 108% of GDP in 1945. After the war, the debt was gradually paid off as taxes remained high.

Finally, panel E displays two measures of total factor productivity in the private sector (i.e. calculated net of government production). The dashed line is from Kendrick's (1961) treatment, and the solid line is from Christensen and Jorgenson (1995). Both series have been detrended by a constant annual growth rate and normalized to unity in 1940. These data reveal three notable features. First, in both series, the pre- and post-WWII periods can be characterized as displaying a common trend in TFP growth. In the 1946-68 period detrended TFP fluctuates around zero growth, while in the 1929-41 period TFP falls precipitously at the onset of the Great Depression, but grows rapidly beginning in 1934 to return to its detrended 1929 level. The second thing to note is that across the pre- and post-war periods, there is a marked break in levels, indicating a 'permanent' TFP increase. Finally, during WWII productivity displays a pronounced hump relative to the pre- and post-war periods, peaking in 1945.

A number of recent papers address these productivity observations. Important considerations include the implementation of product and process innovations during the 1930s (see Field, 2003), the accumulation of road and highway infrastructure during the pre- and post-war periods (Field, 2003), and the provision of government-owned-privately-operated capital during the war (see Gordon, 1969; Braun and McGrattan, 1993; McGrattan and Ohanian, 2006). Following the war, the economy underwent conversion of plant and equipment from military to civilian purposes; this was particularly pronounced in manufacturing industries. This reallocation was partially responsible for the fall in productivity after 1945.

Finally, it should be noted that while the productivity series have been constructed to account for changes in factor input composition, changes in utilization have not been accounted for. Hence, variation in workweek and labor effort that were operative appear in these TFP series.[11] To keep the policy analysis tractable, variable factor utilization has been excluded from the model of Section 2. Variation in observed productivity is accounted for in the quantitative exercise via the exogenous process, $\left\{z\left(s^t\right)\right\}$.

4.2 Calibration and specification

For the numerical experiments, the period length is taken to be a year. Preferences are specified as $u(c) = \log(c)$ and $v(h) = \psi \log(1-h)$. I take the exogenous growth rate of productivity to be $\gamma = 0.02$ (see Kendrick, 1961; Field, 2003; and Cole and Ohanian, 2004). The discount factor and capital share parameter are set to $\beta = 0.95$ and $\alpha = 0.36$. As in McGrattan and Ohanian (2006), the depreciation rate is set to $\delta = 0.07$. The peacetime steady state is specified such that $d_{ss} = 0$, $g_{ss}/y_{ss} = 0.155$, $\tau_{ss} = 0.091$, and $\theta_{ss} = 0.451$. The latter two values match those observed in the U.S. data in 1940, while the former two values match the observations discussed above. The value of ψ is set so that $h_{ss} = 0.27$ in the peacetime steady state. The model produces predictions for government debt accumulation. Because of this, I introduce a lump-sum tax into the household and government budget constraints, solely for the purposes of calibration to the steady state. This tax is specified as a constant so that in the peacetime steady state, the market value of outstanding debt to output ratio is $p_{ss}b_{ss}/y_{ss} = 0.505$.

The history of date-events evolves as follows. The economy begins in steady state in 1940. In 1941, agents learn that they are in a one year build-up phase, and will be involved in the war between 1942 and 1945. In 1946, the economy exits the war and transits back to the peacetime steady state. Between 1941 and 1945, the values for taxes, $\{\theta\left(s^t\right), \tau\left(s^t\right)\}$, are set to their historical values. The values for $d\left(s^t\right)$ are set to match the wartime active duty military personnel to population ratio displayed in Figure 1, panel B. The values for $z\left(s^t\right)$ and $g\left(s^t\right)$ are set to jointly match the observations for the government spending to

[11] Note also that the presence of time-varying monopoly mark-ups affects the interpretation of TFP measurement. See Cole and Ohanian (2004) for a discussion of cartelization and unionization and New Deal policies during the mid- to late-1930s.

GDP ratio of Figure 1, panel A and Kendrick's (1961) measure of civilian hours worked, which is displayed below. Starting in 1946, the values for $g\left(s^t\right)$ and $d\left(s^t\right)$ return to their steady-state values.

From the perspective of 1941, the evolution of exogenous variables just described are known with certainty. That is, the model is a perfect foresight economy, except in the following two features of the postwar period. First, from the perspective of 1941-45, the postwar state of productivity is uncertain. I allow for two possible values of $z\left(s^t\right)$ to occur in all periods from 1946 onward. In one case, $z\left(s^t\right) = 1.1$ to account for the break in productivity found in the data. In the other, $z\left(s^t\right) = 0.90$; Gallup poll and survey data during the war indicated a widely held belief that once over, the economy would re-enter a depression or severe recession (see McGrattan and Ohanian, 2006). To accord with this evidence, I set the probability of each (permanent) productivity regime occurring to 0.5. Ex post, only the high productivity regime is realized in the simulations reported below.

Second, I allow for a one-time, unanticipated debt repudiation in 1946. The U.S. experienced a sharp spike in inflation following the war. Inspection of nominal interest rates indicates that this was largely unanticipated. Since bond returns were set in nominal terms, this resulted in an unanticipated erosion of the real value of outstanding government debt. Ohanian (1998) estimates that the post-war inflation amounted to a repudiation of debt worth approximately one third of GDP. Since the model does not include this type inflationary taxation, I include a one-time, unanticipated debt repudiation worth 33% of 1946 GDP. This allows for a closer correspondence in debt dynamics between the model and data.

Unfortunately, data for total hours worked in the military during WWII does not exist.[12] During the initial months spent in basic training, enlisted personnel spent approximately 54 hours per week in drills and exercises. Once in action, official estimates and documentation of hours worked are not available. Information is available, however, from letters written by soldiers during the war. For instance, during a typical 19-day cycle, I estimate that a bomber pilot spent 7 days off, 8 days on-base/in briefings, 3 days flying bombing missions, and 1

[12] In Kendrick's (1961) data, weekly hours worked by military personnel during the war was imputed as being identical to those of civilian government employees. This obviously representes a severe underestimate.

day de-briefing, totalling approximately 145 hours worked (see Parillo, 2002). Since pilots typically worked fewer hours (in a given time period) than ground and naval personnel, I take this to be a conservative lower bound for combat troops. Given this, I set per period military hours to $\bar{h} = 0.64$ in the benchmark case, so that out of a possible 84 hours per week, 54 are spent working.

Data on total wage and salary compensation for the armed forces is available from *Historical Statistics of the United States, Colonial Times to 1970* (U.S. Department of Commerce, 1976). From this and BLS employment data, I determine that average annual earnings in the military was 76% of that earned in the civilian economy during WWII. This also corresponds with independent data available for 1945, in which basic pay plus allowances in the military equaled 77% of average earnings of non-military employees.[13] Given this, and the difference in average annual hours worked across military and civilian sectors, I set $\phi = 0.63$ so that in the benchmark calibration, the military wage is 63% of the civilian wage.

The final elements to be specified are the peacetime policy rules for capital and labor tax rates. I specify these as being non-linear functions of the deviation of inherited government debt from its peacetime steady-state value. These rules are specified in order to match the capital and labor tax rate series observed between 1946 and the onset of the Korean War.

[13] It should be noted that this difference in pay does not primarily reflect lower labor skill among members of the military relative to the civilian sector. Indeed, WWII draftees were positively selected. Using U.S. census data, Angrist and Krueger (1994) show that favorable post-war labor market outcomes of veterans relative to non-veterans is due to non-random selection into the miliary. Bedard and Deschenes (2002) present evidence from the 1973 *Occupational Change in a Generation* Survey for men born 1920-29. Relative to non-veterans, WWII veterans were typically from higher income families with parents of higher educational attainment, were more likely to be urban, and less likely to be from the South. Moreover, veterans had higher educational attainment before the war relative to the 'ever-completed' education level of non-veterans.

5. QUANTITATIVE RESULTS

5.1 The historical simulation

Figure 2 displays time series of key macroeconomic variables for the model and the U.S. data. The solid line corresponds to the U.S. data and the dashed line to the "historical simulation" of the model.[14] The model series are simulated by feeding through the exogenous variables corresponding to the observed WWII experience, as described above. Model variables are defined in an analogous manner to the U.S. data. Specifically, real GDP is defined as the sum of private sector output and government (i.e. military) wages, $y\left(s^t\right) + \phi w\left(s^t\right) d\left(s^t\right) \bar{h}$; government spending as the sum, $g\left(s^t\right) + \phi w\left(s^t\right) d\left(s^t\right) \bar{h}$; and civilian hours worked (normalized by the adult population) as $\left(1 - d\left(s^t\right)\right) h\left(s^t\right)$. For all growing variables, the figure displays series that are detrended and normalized to unity in 1940.

Panels A and B display the government spending to GDP ratio and civilian hours worked, respectively. As discussed above, the wartime values for $z\left(s^t\right)$ and $g\left(s^t\right)$ have been specified so that between 1941 and 1945, the model matches U.S. observation along these dimensions. Panel C displays the time series for (detrended, normalized) real GDP. The model does a very good job of mimicking the output boom associated with the U.S. war effort.[15] However, the model is less successful at accounting for the U.S. economy's strong performance in the years following the war. This is mirrored by the historical simulation for civilian hours worked. This drop-off in hours worked is due principally to the post-war drop-off in productivity, $z\left(s^t\right)$, and the high labor tax rate which persisted after the war. Taken together, these simulation results suggest that the U.S. WWII "miracle" was not necessarily

[14] A non-linear solution algorithm was used to derive nearly exact solutions for the model economy. Details on the method are available from the author upon request.

[15] McGrattan and Ohanian (2006) demonstrate that reasonably specified variants of the neoclassical growth model are able to quantitatively account for the effects of large fiscal shocks. Though the features of my model differ from theirs, the close correspondence in output dynamics – as well as that for the consumption-output ratio, investment-output ratio, and after-tax real wages – to the U.S. data corroborates their view.

the economy's ability to mobilize during the war, but the economy's strong performance immediately afterward.

Panel D displays the after-tax real wage rate; the U.S. data corresponds to non-farm hourly compensation. Though the exact timing in the model is shifted forward by a period, this figure indicates that the benchmark model is able to replicate the experience for hours worked during the war, without predicting counterfactually large gains in the return to work. In order to match the historical observations for civilian hours, the maximal wartime value for $z\left(s^t\right)$ is 1.27, which is within 7.5% of the maximal value displayed in Figure 1, panel E. In experiments not reported here, I find that through various changes to the benchmark specification, it is possible to generate the observed boom in civilian hours with smaller gains in wartime productivity. One such change involves accounting for the Great Depression by lowering the initial capital stock in 1940 below its steady-state value (see Ohanian, 1997). Another involves allowing for uncertainty in the transition across states with respect to the severity and duration of the war (see McGrattan and Ohanian, 2006). Though these considerations allow for a closer match between the model's productivity series and those estimated by Kendrick (1961) and Christensen and Jorgenson (1995), they do not significantly alter the results for the welfare value of conscription relative to the benchmark specification.

Panels E and F display the capital and labor tax rates, respectively. As discussed above, the model has been specified to match the 1941-49 data.[16] The model does a good job of matching the market value of outstanding debt to GDP ratio observed during the war, displayed in panel G. The correspondence in postwar dynamics of government indebtedness between model and data is also acceptable (recall that the model includes an unexpected debt repudiation in 1946); the primary reason for the discrepancy is the model's underprediction for output following the war.

The final three panels display further successes of the model in its ability to match the

[16] The match breaks down in 1950, since the model does not account for the onset of the Korean War. As discussed in Ohanian (1997), tax rates were increased sharply in response to the Korean War, as U.S. policy aimed to finance war spending through current taxation.

U.S. experience. Panel H displays the ratio of military wage and salary compensation to government spending. Panels I and J display the ratios of private consumption and investment to GDP, respectively. Again, the historical simulation does a good job of matching the U.S. data, though it slightly underpredicts the relative fall in investment. Taken as a whole, these results indicate that the current quantitative model represents a good laboratory with which to study the fiscal role of conscription.

To this end, I present three counterfactual *experiments* in the following subsections. The experiments differ in their specification for tax policy in response to the counterfactual modifications. For each experiment, two different *simulations* are performed – one with an all-volunteer military, and the other with an optimally implemented conscription.

5.2 Counterfactual experiments: version A

The specification for taxes in this experiment is as follows. I keep the capital and labor tax rates during the war at their historically observed values. After the war, I let the tax rates follow the benchmark policy rules. I call this *Experiment A*.

In the first simulation, I feed the exogenous WWII variables through the version of the model without conscription. Hiring an all-volunteer military involves greater labor compensation relative to the historical simulation with conscription; in the model, this stems from the convexity of preferences (v) in hours, and the fact that per-period hours worked in the military is greater than in the civilian sector ($\bar{h} > h\left(s^t\right)$). This means greater government debt accumulation during the war. Given the specification of the tax rate rules, postwar taxes respond positively to the accumulated debt, and the counterfactual economy eventually converges to the same steady state as in the historical simulation.

The results from this counterfactual are displayed in Figure 3. Panel A shows the difference in the military pay to government spending ratios between the counterfactual simulation (solid line) and the historical one (dashed line). The ratio peaks at 35% in 1945 as opposed to 22% under conscription, and is greater throughout the war for the counterfactual. The degree to which military pay increases depends on the predicted military-to-civilian wage premium, $\varphi\left(s^t\right)$; given the importance of this prediction for the model's welfare calculations, I provide more detailed discussion below.

The increased military spending coupled with unchanged fiscal policy during the war results in greater debt accumulation in the counterfactual economy. This is displayed in panel B. The market value of outstanding debt to GDP ratio now reaches 139% as opposed to 118% in the benchmark economy in 1945, and peaks at 156% as opposed to 120% in 1946. As a result, the capital and labor tax rates (displayed in panels C and D) are higher in the years following the war until the debt level is drawn down to that of the historical simulation.

As a result of the higher tax rates, counterfactual postwar economic activity is depressed relative to the historical simulation, as the returns to working and capital accumulation are lower. In 1946, private sector output (panel E) in the counterfactual simulation is 6.5% lower than in the historical one, and is 7.0% lower in 1950; private sector output does not converge to within 1.0% across simulations until 25 years after the war.[17] This depressed economic activity is particularly pronounced in investment. While investment is lower in the counterfactual during the war, it falls dramatically in 1946 due to the jump in future capital tax rates. In 1946, investment is approximately 43% lower than in the historical simulation, and in 1950 it is still 18% lower. The high postwar taxation generates a prolonged transition to the steady state.

The increased wartime spending and postwar taxation associated with the all-volunteer military results in lost welfare relative to the historical simulation. To quantify this, I consider the period-by-period consumption compensation that must be given to the representative household in the counterfactual economy during its lifetime in order for it to be as well off as in the historical simulation. I calculate this to be a consumption increase of 1.24% in perpetuity.

The counterfactual simulation's military-to-civilian wage premium is an important element in this welfare assessment. In the counterfactual, the military wage premium ranges

[17] Recall that private sector output, $y\left(s^t\right)$, is the sum of private consumption, government consumption, and private investment.

between 15.5% and 20.5% during 1941-45. To gauge the plausibility of this prediction, I first consider results from the "value of a statistical life" or VSL literature. In a recent survey article, Viscusi and Aldy (2003) find a median estimate from this literature that implies a wage elasticity with respect to the probability of death of approximately 8 (see also Moore and Viscusi, 1988). Given that the fatality rate was approximately 2% in the armed forces during WWII (see Table 1) as compared to near zero in the civilian sector, it is reasonable to conclude that the predicted wage premium is not unreasonably large.

Indeed, several arguments can be made for why this is likely to be an overly conservative estimate for the cost of an all-volunteer military. First, the occupational fatality probabilities observed in the VSL studies are very close to zero. Given that the probability of death in the armed forces during WWII was substantially "out of sample," it possible that the locally estimated elasticities in the VSL studies do not apply; this would represent an underestimate of the military-to-civilian wage premium if the wage elasticity was increasing in the probability of death.

Second, this simple comparison with the VSL literature does not account for the other obvious disamenities associated with military work. In this respect, Altman and Barro (1971) provide more direct evidence on the military-to-civilian sector wage premium using data from 1960-70, a period covering the height of the Vietnam War recruitment. Using college Army ROTC enrollment rates, conscription rates of college graduates, and data on annual earnings of first-term army officers, draftees, and civilian sector college graduates, they estimate a wage premium for military officers of 64%.[18] This figure is substantially higher than the premia generated by the counterfactual simulation for the benchmark calibration.

To gauge the implication of this, I consider an alternative calibration intended to match Altman and Barro's estimate. I refer to this as the *high wage premium* calibration. Specifically, I increase the value of $\bar{h}$ in the counterfactual simulation so that during 1941-45, the average military wage premium is 60%. To accomplish this, $\bar{h}$ is increased from 0.64 to 0.86;

[18] This estimate holds the effect of war-related casualty rates on the wage premium constant at zero. Estimates using casualty rates observed during the Vietnam War are substantially higher; see Altman and Barro (1971) for details.

no other element of the counterfactual experiment is altered. In the high wage premium counterfactual, welfare is lowered relative to the historical simulation for two reasons: (1) the fiscal consequences associated with increased military spending, and (2) the fact that military personnel experience greater displeasure from working more.

Since the objective of the paper is to explore the welfare implications of feature (1), and to maintain comparability with the counterfactual in the benchmark calibration, I measure the welfare cost in the high wage premium calibration as follows. I compute the consumption compensation for the representative household in the counterfactual in order for its *civilian* family members to be as well off as in the historical simulation. That is, I explicitly omit the direct welfare effect of military hours worked. I calculate this to be a consumption increase of 3.40% in each period of the household's infinite lifetime. This is appreciably larger than the value of 1.24% computed for the counterfactual simulation under the benchmark calibration, in which the average military wage premium is 17.5% during the war years.

Note that neither of these simulations capture the full welfare value of conscription. This is because conscripted military personnel are paid a wage that is 63% of the civilian wage in the historical simulation, while it is optimal to pay the military no wages at all.

To this end, I consider a second simulation – the optimal conscription case – in which military personnel are conscripted and paid nothing. As before, taxes are unchanged relative to the historical simulation during the war, and follow the benchmark policy rules afterward. Since wartime expenditures are minimized under the optimal conscription, less government debt is accumulated. This implies lower postwar taxation and a faster transition to the steady state in the optimal conscription counterfactual relative to the historical simulation.

This implies a welfare gain for the optimal conscription case. Lifetime consumption would need to be increased by 0.67% in the historical simulation in order for the household to be as well off as under optimal conscription. Hence, for the tax rate specification of Experiment A, the total value of conscription from a fiscal perspective equals 1.92% of lifetime consumption for the benchmark calibration. For the high wage premium calibration, the full value is worth 4.07% of lifetime consumption.

5.3 Counterfactual experiments: version B

The welfare value of conscription obviously depends on the specification of the government's other policy variables. In this subsection, I consider a second experiment to gauge the robustness of the results to the details regarding counterfactual tax rates. In Experiment B, both the labor and capital tax rates are scaled by a constant factor during the war years. This is done so that in 1945, the market value of government debt in the counterfactual simulations is equal to that of the historical one. Given that peacetime tax rates are specified as functions of inherited government debt, the postwar tax rates are (virtually) identical across simulations.

Figure 4 displays the results from simulating the all-volunteer economy in this experiment for the benchmark calibration. Again, the ratio of military pay to government spending is higher without conscription relative to the historical simulation. As a result, both tax rates must be increased by 17% during the 1941-45 period; this is seen in panels C and D. This has the effect of depressing civilian hours worked and private sector output (panels E and F) during the war by an average of approximately 4% compared to the historical simulation. As a result of the lower private sector output, consumption and investment are lower in the counterfactual experiment as well. Given the increased capital income taxation, wartime investment is disproportionately affected relative to consumption.

Output in the counterfactual simulation is lower in the years following the war as well. This is due to depressed investment during the war, resulting in a lower postwar capital stock. After the war, hours worked are (slightly) higher, and consumption lower, relative to the historical simulation as the economy transitions to steady state.

Again, the increased spending associated with the all-volunteer military results in lost welfare relative to the historical case, this time due primarily to the uneven distribution of tax distortions over time. In order to compensate the household, consumption would need to be increased by 0.92% in perpetuity relative to the historical simulation.

On the other hand, under the optimal conscription simulation, wartime tax rates would be decreased by 20% relative to the historical simulation in Experiment B, representing a much smoother time profile for taxes. As a result, lifetime consumption in the historical simulation would need to be increased by 0.83% in order to make the household as well off as in the optimal conscription case. Hence, under the tax policy of Experiment B, the full value of conscription is equivalent to 1.75% of lifetime consumption.

Finally, I consider the counterfactual simulation of the case with an all-volunteer military, this time under the high wage premium calibration. I compute the compensation for the representative household in the counterfactual so that its civilian family members are as well off as in the historical simulation to be 3.52% of lifetime consumption. Hence, when military wage premia during the war match the estimates of Altman and Barro (1971), the welfare value of conscription as a fiscal policy tool is equivalent to 4.35% of lifetime consumption.

5.4 Counterfactual experiments: version C

The final experiment I consider evaluates the value of conscription when the government's tax rates solve the Ramsey policy problem. This provides an additional check on the robustness of results to the specification of tax policy across counterfactual experiments. Given the extensive literature on the welfare value of implementing the Ramsey equilibrium, it also provides a benchmark with which to evaluate the welfare value of conscription.

I first solve the optimal policy problem outlined in Section 3 for the case of conscription, with the restriction that $\phi = 0.63$, as in the historical simulation. It is well known that in the Ramsey equilibrium, the policy maker has an incentive to confiscate the real value of private assets at date 0 in order to relax the present-value government budget constraint (see, for instance, Chari et al., 1994). In the present model, this would be accomplished through an arbitrarily high initial tax rate on capital income. In order to make the problem interesting, I restrict tax rates in all periods to be at most 100%. In a non-stochastic setting and for the functional form on preferences considered here, Chari et al. (1994) show that optimality involves setting the capital tax to its upper bound for a finite number of periods beginning at date 0, followed by a one-period transition; after that, the optimal capital income tax rate is zero (see also Chamley, 1985).

The solid line depicted in panel A of Figure 5 confirms this: the Ramsey policy sets the capital tax to 100% in the first three periods (1941-43), and to 0% by 1945; there is a single deviation from zero thereafter, when the high productivity state in 1946 is realized. The optimal labor income tax is plotted in Panel B. Following a labor subsidy in the first period, the labor tax gradually increases before settling around 27% in 1946. Evidently, tax rates under the Ramsey plan differ drastically from those in the historical simulation (plotted as the dashed lines), which are specified to match historical observation.

These differences are reflected in the dynamics of government debt, plotted relative to GDP in panel C. The initial periods of high capital income taxation drive down the debt to GDP ratio under the Ramsey plan. The ratio rises in the latter stages of the war, before a final jump and stabilization in 1946 when the high productivity peace state is realized.

Private sector output, civilian hours worked, and investment are plotted in panels D through F. All three measures boom during the war relative to the historical simulation. The Ramsey values for output and, especially, investment remain high after the war. This reflects the stimulus induced by the move to zero capital taxation.

To gauge the quantitative importance of these differences, I calculate the compensation that must be given to the household in the historical simulation in order for it to be as well off as in the current case (when tax rates solve the Ramsey problem, imposing the restriction that $\phi = 0.63$). On a period-by-period basis, lifetime consumption would need to be increased by 3.47% to make the household as well off. This primarily reflects the move to zero capital taxation under the Ramsey plan. This long-run policy change allows for a 11% reduction in hours worked in the steady state of the Ramsey economy relative to the historical simulation, with virtually identical levels of steady-state consumption.

Finally, I calculate the welfare value of conscription in the Ramsey equilibrium by solving the optimal policy problem for two cases. The first assumes the government is restricted to hiring an all-volunteer military. Relative to the conscription case with $\phi = 0.63$ depicted in Figure 5, the volunteer military represents a 0.63% welfare loss, as measured in units of per period consumption. The second case involves the implementation of a fully optimal policy, namely, the Ramsey case with conscription and $\phi = 0$. Per period consumption in the $\phi = 0.63$ economy would need to be increased by 0.55% in order to make the household as well off as in the Ramsey equilibrium.[19]

Hence, the welfare value of conscription in its fiscal role is worth 1.18% of lifetime consumption when tax rates solve the Ramsey problem. This is somewhat smaller, but similar in magnitude to the values found in Experiments A and B. Finally, I consider the high wage premium calibration of the model in which $\bar{h}$ is increased to 0.86 in the volunteer military simulation. The welfare value of conscription is 2.06% percent of lifetime consumption; again this is similar to, but smaller than the values for Experiments A and B.[20]

To summarize, the welfare gain in moving from voluntary recruitment to an optimal conscription remains quantitatively large when tax policy solves the Ramsey problem in the counterfactual experiment. Moreover, the welfare value of conscription is of the same order of magnitude as the value of switching from the benchmark specification of tax policy to the Ramsey specification, for a given military recruitment regime. In fact, the welfare values are very close in the case of the high wage premium calibration.

6. CONCLUSION

This paper quantifies the welfare value of conscription as a fiscal policy tool. Conscription allows the government to pay below-market wages to military personnel. As a result, it allows the government to minimize wartime expenditures and their associated tax distor-

[19] Note that the welfare loss of 0.61% in moving from the $\phi = 0.63$ case to the all-volunteer case is small, relative to the values of 1.24% and 0.92% derived in Experiments A and B. By contrast, the welfare gain of 0.55% in moving from the $\phi = 0.63$ case to the $\phi = 0$ case is proportionately closer to the values of 0.67% and 0.83% in Experiments A and B. This is partly due to the fact that the Ramsey plan calls for high levels of civilian hours during the war, regardless of the military recruitment regime; see, for instance, panel E of Figure 5. This reduces the difference between civilian and military hours, and thus, the wage premium that must be paid to volunteer military personnel.

[20] Again, the welfare cost of moving to an all-volunteer military is mitigated because the Ramsey policy induces high levels of civilian hours during the war. This limits the difference between civilian and military hours, and thus limits the wage premium paid to military personnel under the volunteer system.

tions. In a model calibrated to the U.S. WWII experience, I find that the welfare gains from instituting an optimal conscription are large. Relative to the case in which the government hires an all-volunteer military, the welfare gains are conservatively estimated to be equivalent to $1.2\% - 2.0\%$ of consumption in perpetuity, depending on the exact specification of tax policy in the counterfactual experiment. When the model is calibrated to match Altman and Barro's (1971) estimate of the military-to-civilian sector wage premium during the 1960s, the predicted welfare value of conscription doubles.

This is a first step in the determination of optimal policy during a large fiscal event such as the U.S. WWII effort. One could consider the optimal use of other government policy tools, such as government provision of private sector capital (again, see Gordon, 1969; Braun and McGrattan, 1993; McGrattan and Ohanian, 2006), price controls and rationing (a form of non-linear taxation which provides expenditure saving on goods with competing private and military uses), and state-contingent monetary policy (see Chari et. al., 1991; and Siu, 2004). Finally, there are many important considerations specific to conscription that could be fruitfully incorporated into a normative analysis like the one considered here. These include issues such as conscription's effect on resource misallocation and redistribution.

APPENDIX A

For Table 1, data for total military enrollment and casualties is from the U.S. Department of Veterans Affairs (2006). Combat deaths refer to those killed in action or who died of combat wounds. They do not include deaths for other reasons, e.g., due to disease and privation; non-combat deaths were only quantitatively significant for the Civil War. Data for total direct war costs is from Nordhaus (2002). The average annualized GDP share refers to the war cost normalized by GDP over the duration of the war.

The data for adult population corresponds to the total population (including armed forces overseas), 15 years and older, July estimates; these are obtained from the U.S. Census Bureau website, www.census.gov/statab/www/minihs.html. Exceptions to this relate only to the calculations of Table 1. For the Civil War, and Persian Gulf War, resident (as opposed to total) population was used. For the Civil War, resident population data are from *Historical Statistics of the United States, Colonial Times to 1970* (U.S. Department of Commerce, 1976), series A7, with imputations by age using series A92-3, A99-100, A120-1 (details on imputations are available from author upon request). *Historical Statistics* is also the source for data on annual active duty military personnel (series Y904), military wage and salary compensation (F167), basic pay plus allowances in the military (D924), and average annual earnings of non-military employees (D724) discussed in Section 4.

Total selective service inductions data are available from the U.S. Selective Service System website, www.sss.gov/induct.htm. Data on disaggregated government spending, national income and product accounts, and fixed assets and consumer durable goods are available from the U.S. Department of Commerce, Bureau of Economic Analysis, National Economic Accounts website, www.bea.gov/bea/dn1.htm. National income data for the pre-1929 period are from EH.net, eh.net/hmit/gdp/.

Data on federal tax receipts are from the Executive Office of the President (2002). The labor and capital income tax rates correspond to series MTRL1 and MTRK1, respectively from Joines (1981). The market value of total outstanding government debt is the sum of series MPRIV2, MSAVB, and MVSL from Seater (1981). The TFP measures are taken from Kendrick (1961), Appendix A, Table A-XXII, and Christensen and Jorgenson (1995), Table 5.15, column 1. The data for civilian hours worked are from Kendrick (1961), Appendix A, Table A-X. The after-tax real wage data are those displayed as nonfarm compensation per hour in Figure 4 of the 2003 version of McGrattan and Ohanian (2006).

APPENDIX B

The following is the proof of Proposition 1:

Proof. For exposition, denote $h\left(s^t\right)$ as h, and $\varphi\left(s^t\right)$ as $\varphi(h)$, or simply φ. First, it is obvious that $\varphi(h) = 1$ at $h = \bar{h}$. It remains to show that $\varphi(h)$ obtains a minimum at $h = \bar{h}$. The first derivative of φ is:

$$\varphi'(h) = \frac{v''(h)\left[v(h) - v\left(\bar{h}\right)\right]}{v'(h)^2 \bar{h}},$$

and the second derivative is:

$$\varphi''(h) = \frac{v''(h)\, v'(h)^2 + \left[v'''(h)\, v'(h) - 2v''(h)^2\right]\left[v(h) - v\left(\bar{h}\right)\right]}{v'(h)^3 \bar{h}}.$$

As long as $v'(h)$ is finite, the only critical value for φ is $\varphi'(h) = 0$ at $h = \bar{h}$. Since $v' < 0$ and $v'' < 0$, $\varphi''\left(\bar{h}\right) > 0$, so that φ reaches a minimum at $h = \bar{h}$. ■

APPENDIX C

Following the seminal work of Lucas and Stokey (1983), I characterize equilibrium in the conscription economy in primal form. This is a useful first step in deriving results on the optimal implementation of conscription. The primal representation requires consideration of the following two constraints. The first is the aggregate resource constraint which ensures that the private sector output market clears state-by-state:

$$c\left(s^t\right) + k\left(s^t\right) + g\left(s^t\right) = z\left(s^t\right) k\left(s^{t-1}\right)^\alpha \left[(1+\gamma)^t h\left(s^t\right)\right]^{1-\alpha} + (1-\delta)\, k\left(s^{t-1}\right), \quad \forall s^t. \quad (9)$$

The second is the implementability constraint which ensures that the government's budget is balanced in present value:

$$\sum_{t=0}^{\infty} \sum_{s^t} \beta^t \pi\left(s^t\right) \left\{u'\left(s^t\right) c\left(s^t\right) + v'\left(s^t\right)\left[\left(1 - d\left(s^t\right)\right) h\left(s^t\right) + \phi d\left(s^t\right) \bar{h}\right]\right\} = u'\left(s^0\right) a_0, \quad (10)$$

where $a_0 = b_{-1} + \left[r\left(s^0\right) - \theta\left(s^0\right)\left(r\left(s^0\right) - \delta\right) + 1 - \delta\right] k_{-1}$, and the date-0 rental rate is $r\left(s^0\right) = \alpha z\left(s^0\right)\left[h\left(s^0\right)/k_{-1}\right]^{1-\alpha}$.

Proposition 4 *In any competitive equilibrium, the allocation,* $\{c(s^t), h(s^t), k(s^t)\}$*, must satisfy constraints (9) and (10). Furthermore, given* ϕ*,* $\theta(s^0)$*, and sequences* $\{c(s^t), h(s^t),$ $k(s^t)\}$ *that satisfy these constraints, it is possible to construct all of the remaining equilibrium allocation, price and policy variables.*

Proof. The aggregate resource constraint is obtained easily through substitution. To obtain the implementability constraint take the household's budget constraint, (1), multiply by $\beta^t \pi(s^t) u'(s^t)$, and sum over all s^t and t. Using (2) – (4) and the following transversality conditions:

$$\lim_{r\to\infty} \beta^r \pi(s^r) u(s^r) k(s^r) = 0,$$

$$\lim_{r\to\infty} \beta^r \pi(s^r) u'(s^r) p(s^r) b(s^r) = 0,$$

for all s^r, this simplifies to obtain (10).

With sequences $\{c(s^t), h(s^t), k(s^t)\}$ that satisfy (9) and (10), construct the remaining equilibrium objects at s^t as follows. Private sector output, $y(s^t)$, the rental rate, $r(s^t)$, and the civilian wage rate, $w(s^t)$, are given by (5), (6), and (7), respectively, with $\tilde{h}(s^t) = h(s^t)$ and $\tilde{k}(s^t) = k(s^{t-1})$. Using the household's FONCs, the labor tax rate and the price of a one-period bond are, respectively:

$$\tau(s^t) = 1 + \frac{v'(s^t)}{u'(s^t) w(s^t)},$$

$$p(s^t) = \beta \sum_{s^{t+1}|s^t} \pi(s^{t+1}|s^t) \frac{u'(s^{t+1})}{u'(s^t)}.$$

To obtain real bond holdings, take the household's date r budget constraint, multiply by $\beta^r \pi(s^r) u'(s^r)$, and sum over states s^r following s^t for $r \geq t+1$ to get:

$$b(s^t) = \left[\sum_{r=t+1}^{\infty} \sum_{s^r} \beta^{r-t} \pi(s^r|s^t) \frac{\chi(s^r)}{u'(s^t)} - k(s^t)\right] / p(s^t),$$

where $\chi(s^r) = u'(s^r) c(s^r) + v'(s^r) h(s^r) \left[(1 - d(s^r)) h(s^r) + \phi d(s^r) \bar{h}\right]$. Finally, the state s^t capital tax rate:

$$\theta(s^t) = \{g(s^t) + \phi w(s^t) d(s^t) \bar{h} + b(s^{t-1}) - p(s^t) b(s^t) - \\ \tau(s^t) w(s^t) \left[(1 - d(s^t)) h(s^t) + \phi d(s^t) \bar{h}\right]\} / \left[(r(s^t) - \delta) k(s^{t-1})\right],$$

is obtained from the government's budget constraint. ■

First, a similar result to Proposition 4 holds in the case without conscription. In particular, without conscription, the term '$\phi d\left(s^t\right)\bar{h}$' in the implementability constraint, (10), is replaced by the term '$\varphi\left(s^t\right)d\left(s^t\right)\bar{h}$', where $\varphi\left(s^t\right)$ is defined in (8).[21] Second, this economy features a complete set of tax instruments, despite the fact that the government issues non-contingent debt. This can be seen from the primal representation, since the only cross-state restriction on equilibrium allocations is due to the requirement of intertemporal budget balance, (10). In this economy, complete cross-state risk-sharing is achieved through the use of the state-contingent tax rate on capital (see Chari et. al., 1991 and 1994).

In light of Proposition 4, solving for the Ramsey equilibrium is equivalent to finding the allocation $\{c\left(s^t\right),\ h\left(s^t\right),\ k\left(s^t\right)\}$ that maximizes the household's welfare subject to the aggregate resource constraint, (9), and implementability constraint, (10). Let λ denote the Lagrange multiplier associated with (10) and let:

$$W\left(s^t;\lambda\right) \equiv \left[u\left(c\left(s^t\right)\right) + \left(1 - d\left(s^t\right)\right)v\left(h\left(s^t\right)\right) + d\left(s^t\right)v\left(\bar{h}\right)\right] + \\ \lambda\left\{u'\left(s^t\right)c\left(s^t\right) + v'\left(s^t\right)\left[\left(1 - d\left(s^t\right)\right)h\left(s^t\right) + \phi d\left(s^t\right)\bar{h}\right]\right\}.$$

The Ramsey problem can be stated as maximizing:

$$\sum_{t=0}^{\infty}\sum_{s^t}\beta^t\pi\left(s^t\right)W\left(s^t;\lambda\right) - \lambda u'\left(s^0\right)a_0,$$

subject to (9).

In order for this problem to be interesting, it must be that a_0 is sufficiently non-negative. To see this, note that $-a_0$ represents the government's initial asset position (the household's initial liabilities against the government). If $-a_0$ is large, the government could finance its stream of spending by simply running down its assets. In this case the government's intertemporal budget constraint would not bind, $\lambda = 0$, and there would be no need to resort to distortionary taxation or conscription. Hence, I restrict attention to the case where a_0 is sufficiently large, so that $\lambda > 0$. This amounts to restricting the initial values for the

[21] The details of the proof are analogous to that presented here.

capital tax rate, $\theta\left(s^0\right)$, and bond holdings, b_{-1}. Given this characterization, the proof of Proposition 3 is straightforward.

Proof. Let $\mathcal{U}(\phi)$ denote the household's expected lifetime utility in the Ramsey equilibrium for a given value of ϕ. From the envelope condition:

$$\mathcal{U}'(\phi) = \lambda \sum_{t=0}^{\infty} \sum_{s^t} \beta^t \pi\left(s^t\right) v'\left(s^t\right) d\left(s^t\right) \bar{h}.$$

Since $\lambda > 0$ and $v' < 0$, $\mathcal{U}'(\phi) < 0$. Hence, under conscription, welfare is maximized by minimizing military pay and setting $\phi = 0$. In the case without conscription, the proportionality factor ϕ is replaced by $\varphi\left(s^t\right)$. But since $\varphi\left(s^t\right) \geq 1$ (see Proposition 1), welfare in this case is always lower than in the case with conscription. ■

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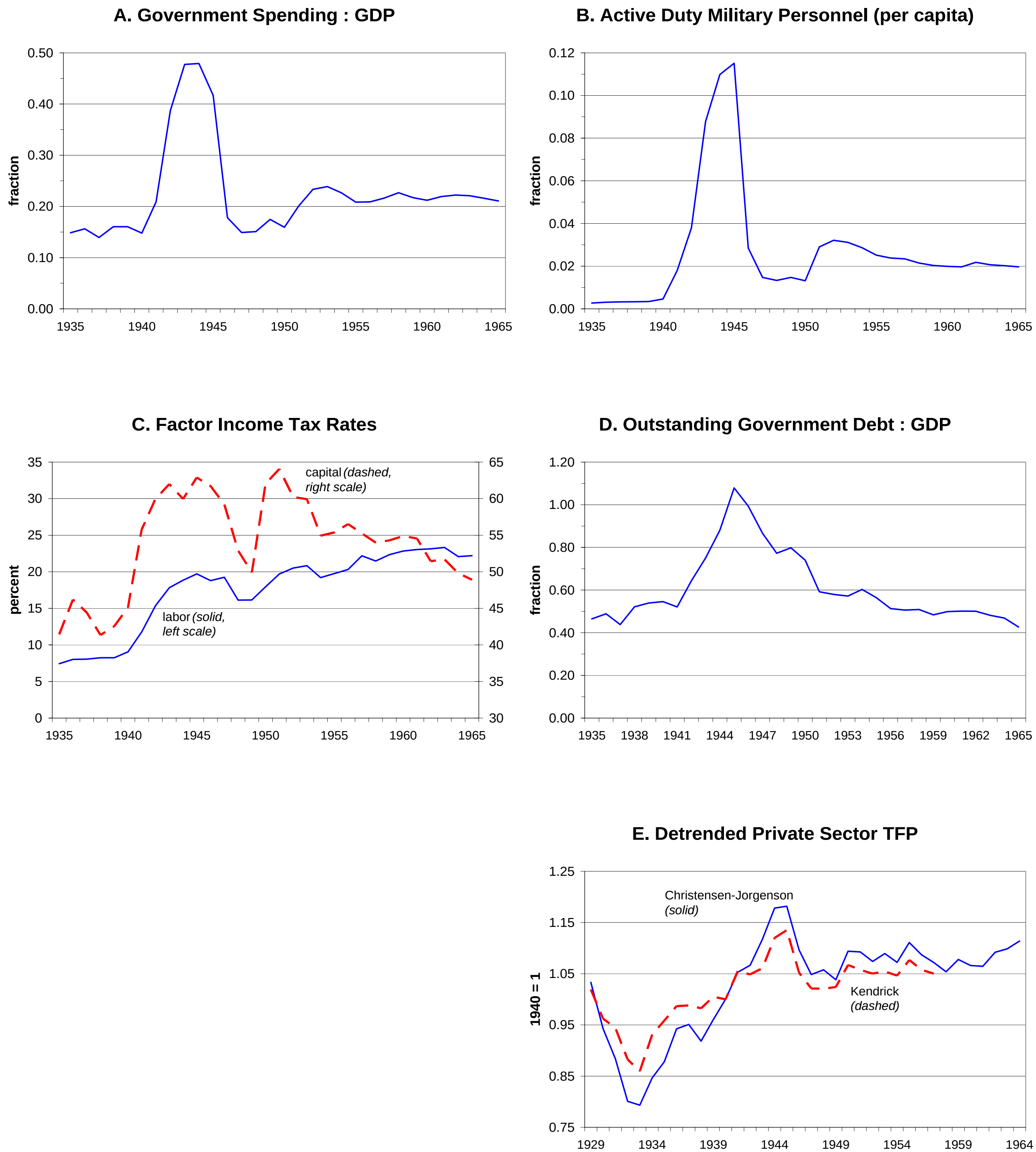

Figure 1. U.S. Data, 1929 – 1965.

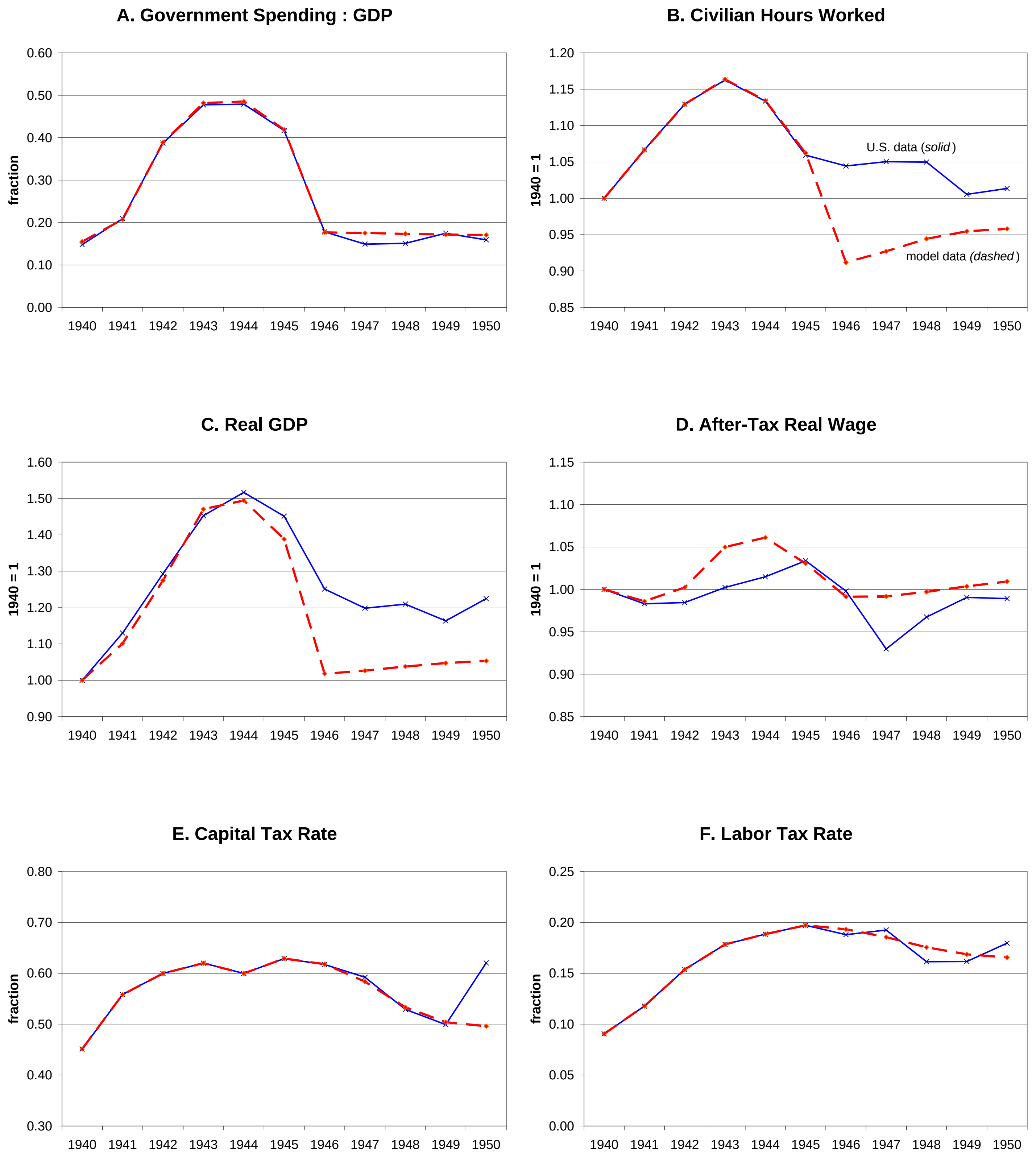

Figure 2. U.S. Data and Historical Simulation of Benchmark Model, 1940 - 50 (page 1).

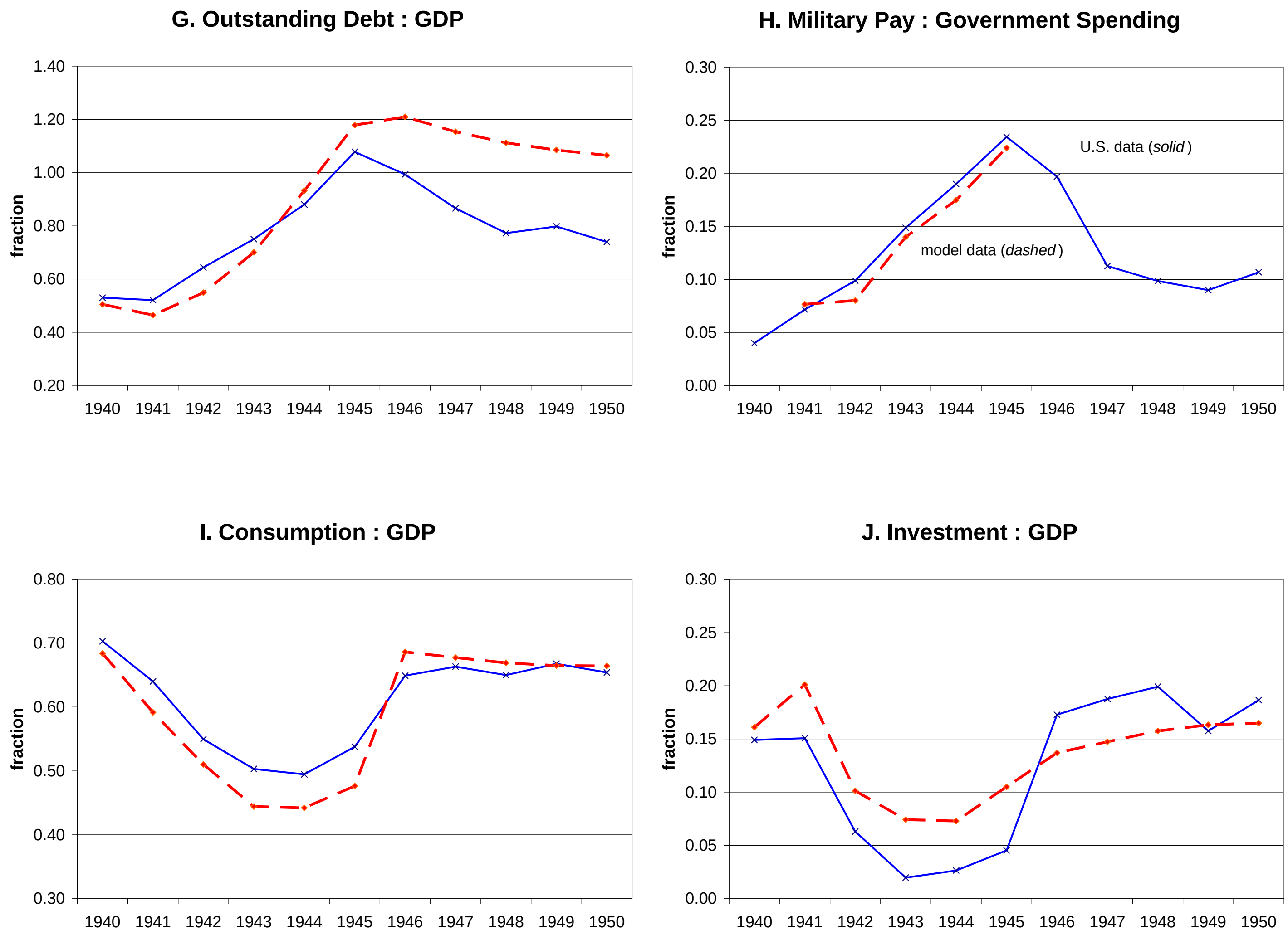

Figure 2. U.S. Data and Historical Simulation of Benchmark Model, 1940 - 50 (page 2).

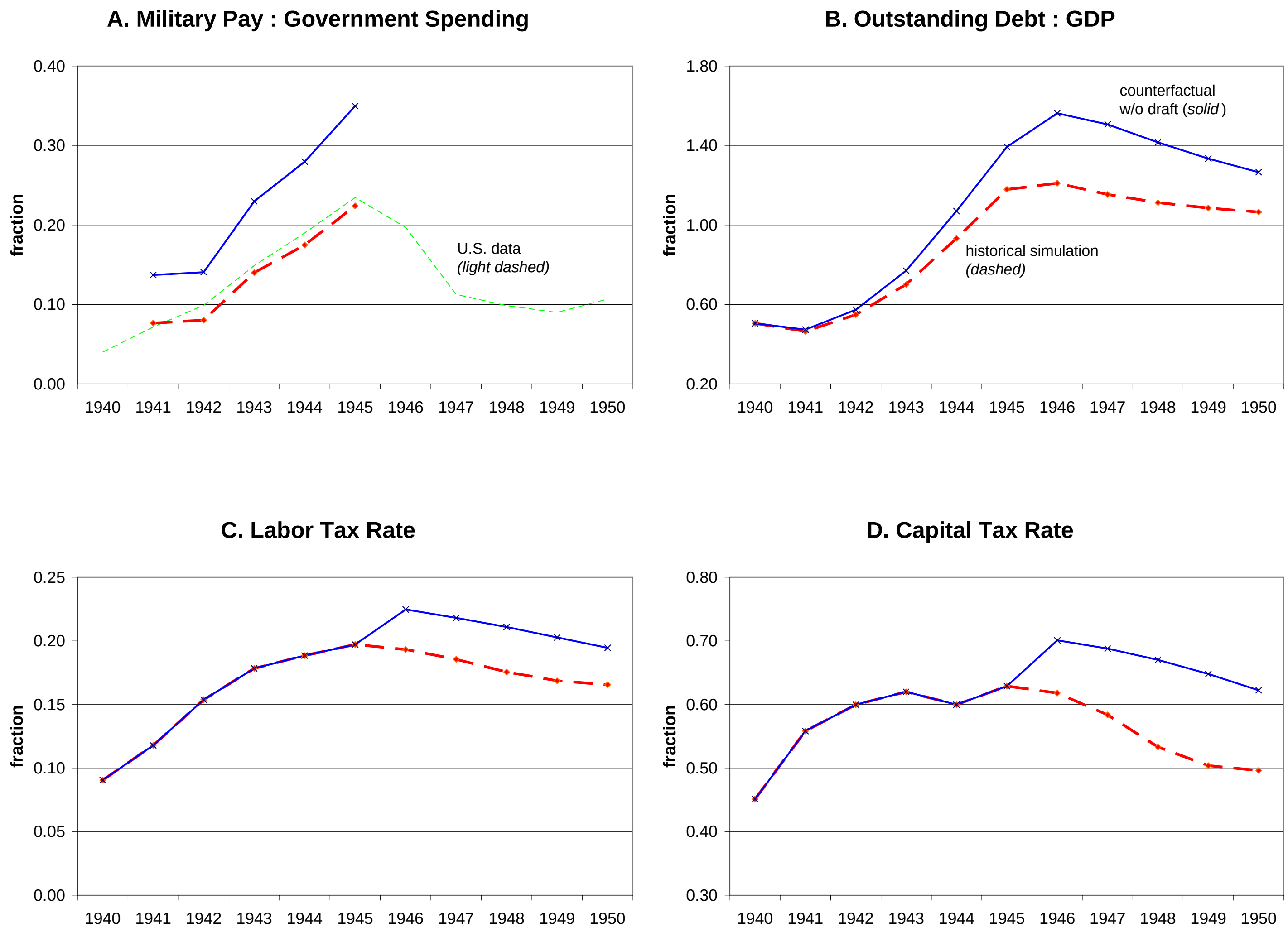

Figure 3. Historical Simulation and Counterfactual Experiment A, Volunteer Military Simulation (page 1).

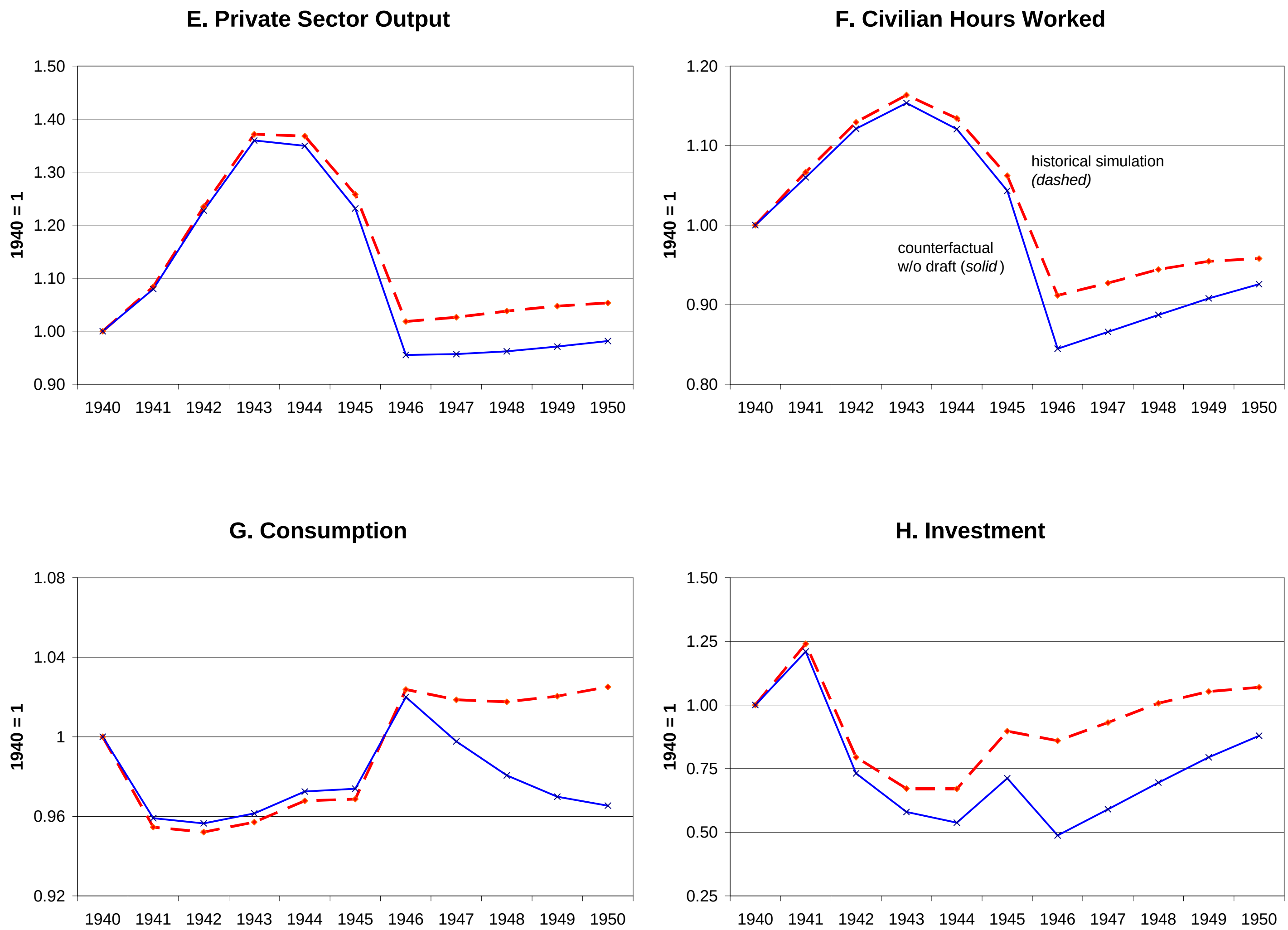

Figure 3. Historical Simulation and Counterfactual Experiment A, Volunteer Military Simulation (page 2).

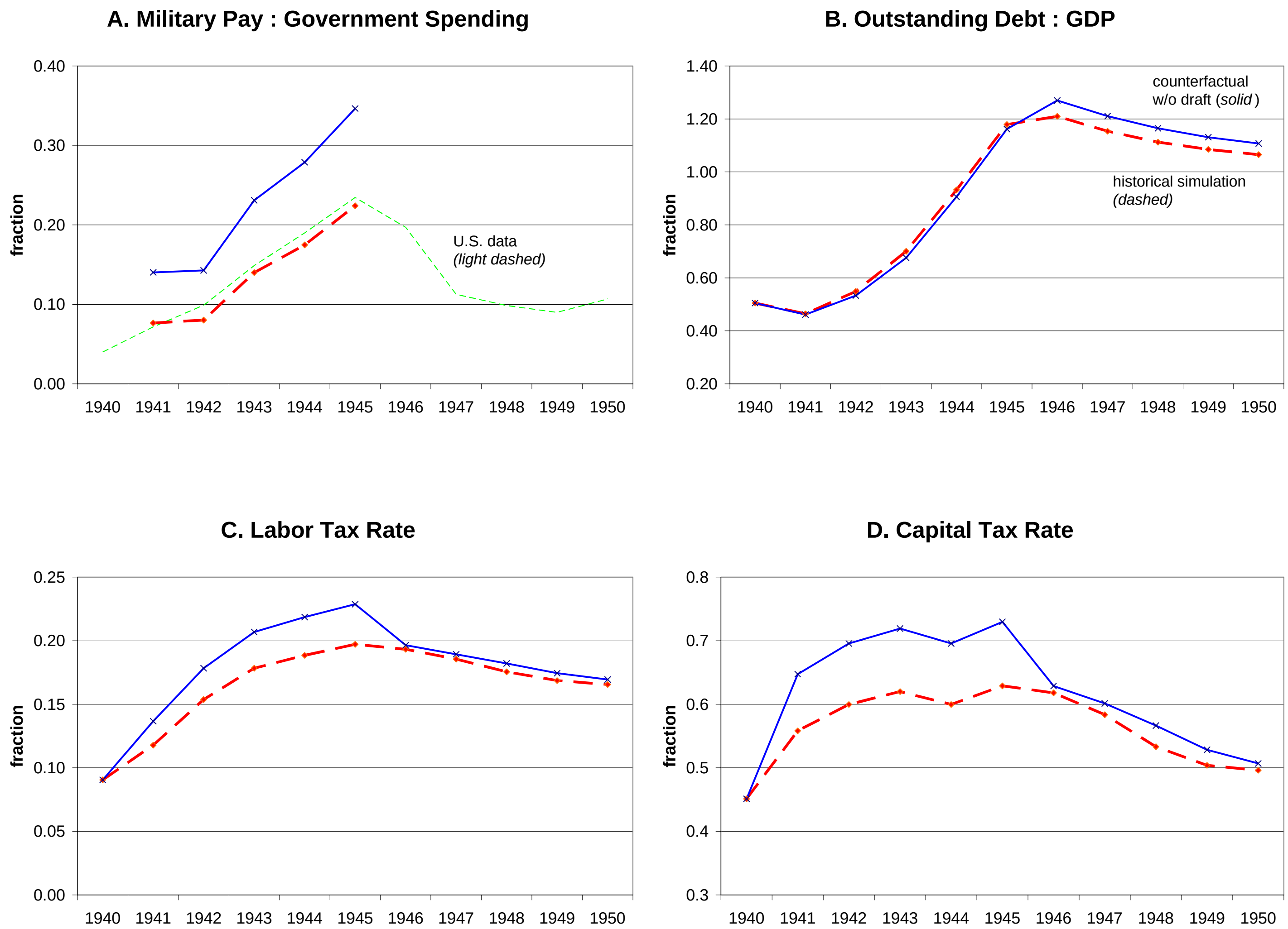

Figure 4. Historical Simulation and Counterfactual Experiment B, Volunteer Military Simulation (page 1).

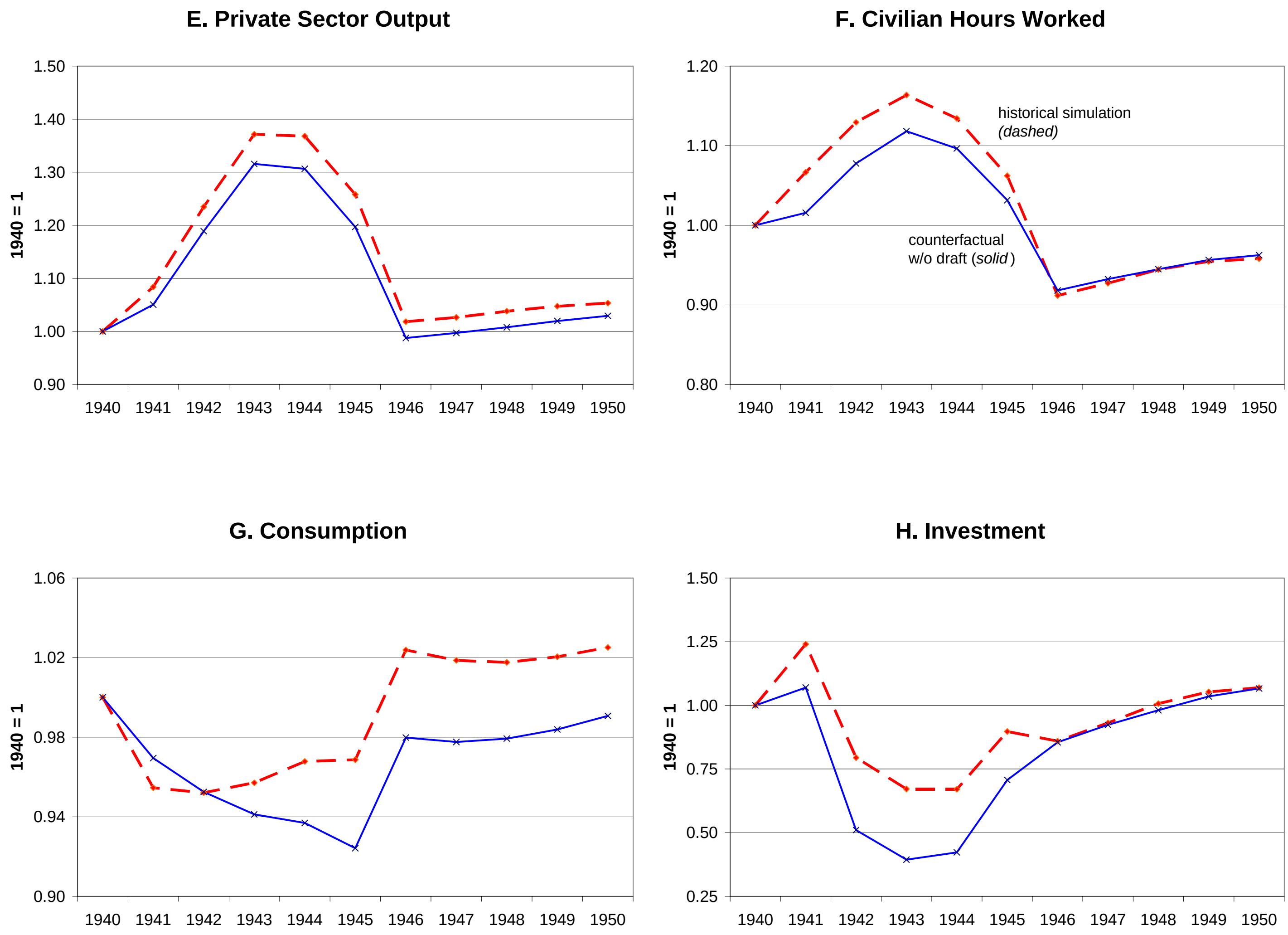

Figure 4. Historical Simulation and Counterfactual Experiment B, Volunteer Military Simulation (page 2).

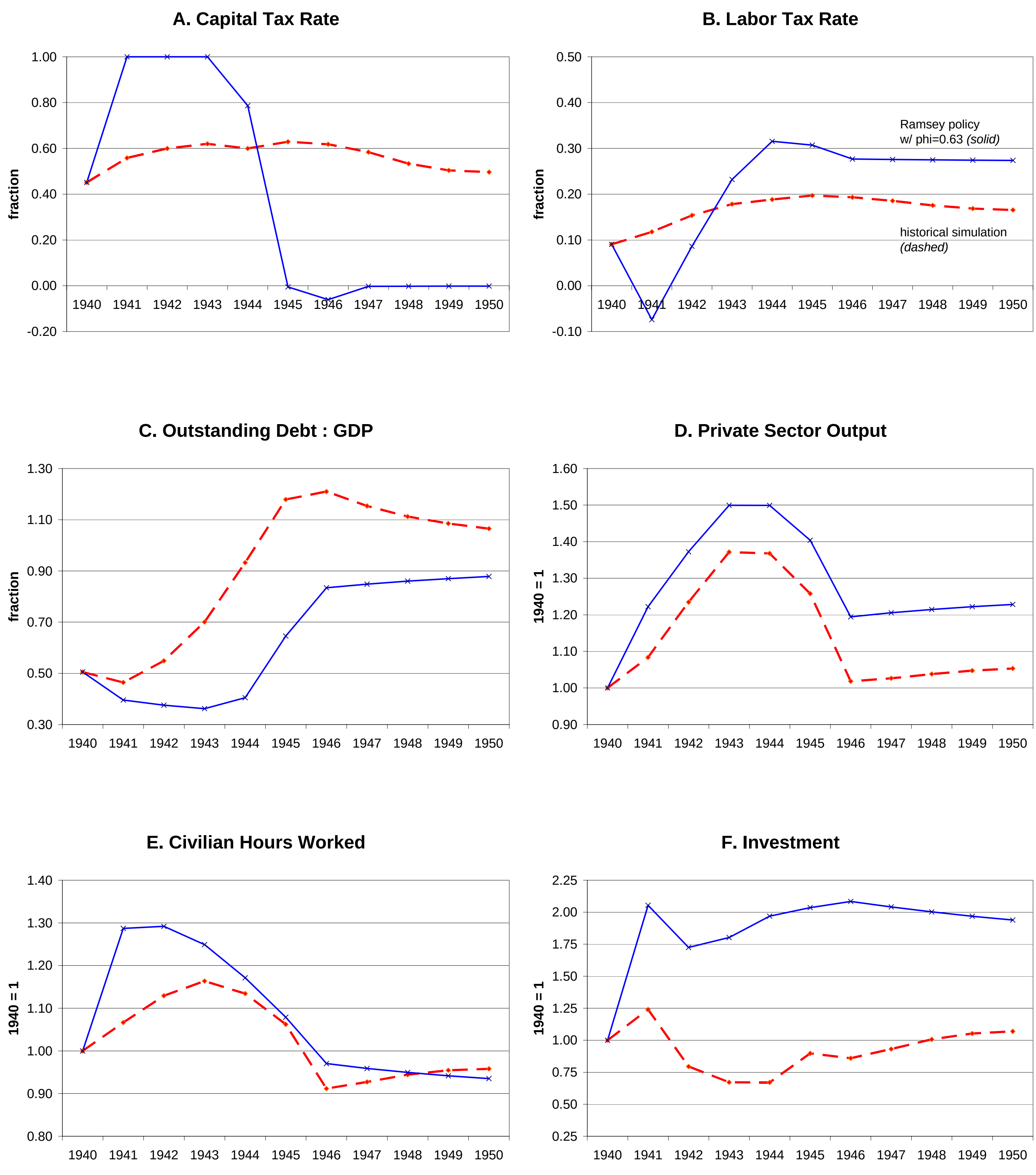

Figure 5. Historical Simulation and Ramsey Policy Simulation.