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

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Abstract

I consider the role of conscription as a fiscal shock absorber 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 value of conscription as a fiscal policy tool is quantitatively large.

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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. As a result, it allows governments 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. Conscription was instituted during the American Civil War by both the Union and the Confederacy, and during the U.S. involvement in World War I, World War II, the Korean War, and the Vietnam War. Hence, given historical practice, conscription can be viewed as a fiscal shock absorber, minimizing tax distortions associated with periods of wartime spending.[1]

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 allow tax distortions to be smoothed in the face of wartime shocks. Inspection of the U.S. experience during WWII indicates that such instruments were either not available or not used to the extent prescribed by theoretical analysis. The clearest indication of this is the fact that the government accumulated real debt throughout the war, and only gradually paid it down afterward with persistently higher tax rates (see 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 sharp spike in inflation) at the outset of the American involvement.

This observation leads to two natural questions. If not these ones, what policy instruments did the government use in a state-contingent manner? And given the magnitude of the war effort, was the welfare value of this policy instrument large or small?[2] In this paper, I argue

[1] It should be noted that the U.S. continued the practice during the peacetime episode between the wars in Korea and Vietnam. I return to this below.

[2] 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.

that military conscription played such a role, and that its welfare value was quantitatively large.

In particular, I formulate a simple, dynamic general equilibrium model to articulate this view. I show that conscription can be part of an optimal fiscal policy when an economy is subject to episodes of war. I then calibrate this model to the U.S. WWII experience and perform two counterfactual simulations. The first replicates the war, but with the government hiring an all-volunteer armed forces. The second has the government instituting an 'optimal' conscription policy. These experiments allow me to quantify the welfare value of conscription as a fiscal policy tool during WWII.

The U.S. experience represents an ideal episode to address this question. Table 1 presents a comparison of selected statistics across major U.S. wars. By virtually any measure, WWII was the largest war or military conflict in its history. In the peak year of 1945, over 12 million men served on active duty in the armed forces.[3] 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'.[4]

Table 1 indicates that WWII was also the most costly war in U.S. history. In 1944, government spending made up 48% of GDP; this represented an increase of 550% 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,

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

[4] Though no estimates for draft-induced volunteers exist for WWII, it is clear that this is the case. Volunteering presented clear benefits over being conscripted, including the ability to train 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 recruitment during the Vietnam War, 50% reported similarly.

	Enrollment		Casualties			Cost (2002 $'s)	
Conflict	total (000's)	per capita	total per enrolled	battle deaths per enrolled	battle deaths per month	avg ann GDP share	per capita
Civil War	3263	13.3%	23.9%	6.6%	4478	17%	2532
World War I	4735	5.0%	6.8%	1.1%	2811	14%	2718
World War II	16112	15.6%	6.7%	1.8%	6626	41%	27957
Korean War	5720	5.1%	2.8%	0.6%	910	5%	2985
Persian Gulf War	2322	1.2%	0.1%	0.01%	148	4%	384

Table 1. Statistics from selected U.S. wars. See Appendix A for data sources and description.

the percentage 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 government fiscal policy. Of obvious importance is the fiscal consequences of conscription.

This is not the first paper to consider the economics of conscription. In the late 1960's, a series of important papers addressed the then current use and implementation of peacetime conscription.[5] These papers focused on its associated distortions and inefficiencies, effects that could be eliminated by employing an all-volunteer military. These include: the misallocation of labor skill across civilian and military uses, and the distortion of incentives for human capital accumulation that arise from a randomized selection process; the distortion on education, marriage and child-bearing incentives induced by the system of deferments and exceptions; and the obvious issues regarding equity and the infringement on individual freedom arising from mandatory service. As a summary, these papers made a strong case for the termination of conscription in favor of a volunteer system as means of peacetime military recruitment.[6]

[5] See, for instance, Friedman (1967), Hansen and Weisbrod (1967), Oi (1967), Fisher (1969), 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.

[6] Conscription was abandoned in the U.S. in 1973. Selective Service registration was reinstated in 1980.

These costs and inefficiencies present a trade-off to the fiscal benefits of conscription in 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 service are exacerbated, while some of the costs of conscription may actually decrease.[7] 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.[8]

Recently, a number of papers have presented analysis formalizing Friedman's view (see Garfinkel, 1990; Lee and McKenzie, 1992; and Ross, 1994). In particular, these 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

[7] For instance, if all eligible individuals are required to serve, then issues regarding inequality and misallocation of labor across civilian and military uses become irrelevant.

[8] 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 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."

tax rates are negatively related to the use of conscription (after controlling for government spending).[9]

This paper differs from the recent literature in that it does not attempt to provide a positive theory for the use of conscription. Instead, the central objective of this paper is to quantify the welfare value of conscription in its fiscal policy role during a large event such as the U.S. WWII effort. Surprisingly, this has not yet been attempted in the literature. 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 human capital 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 policy. 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. The results indicate that the case for conscription is indeed strong: despite the fact that the war lasted only four years, the fiscal value of conscription is worth between 1.5% and 2% of consumption in perpetuity. Section 6 concludes.

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.

[9] 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.

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 ($d = 0$).[10] This amounts to assuming that the production technology for the government's peacetime defense services is identical to that for highways, dams, and privately produced output. Further, I assume that the per-period-hours a soldier spends in active duty is given exogenously. Hence, variation in military labor needs will be met solely through variation in $d\left(s^t\right)$.

In what follows, I first present the case in which all military personnel are conscripted. Though during WWII the military employed a mixed conscript/volunteer force, the discussion presented in Section I indicates that this simplification is not far from actual experience. The case of an all-volunteer military, which I consider as a counterfactual, is presented in a separate subsection.

2.1 Households

The representative household in the economy is composed of a unit measure of family members. Each family member has identical, time separable preferences over consumption and labor, with current utility given by:

$$U\left(c, h\right) = u\left(c\right) + v\left(h\right),$$

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 these members is drafted by the government for military service. In the military, each family member works a prespecified number of hours per period, $\bar{h}$. Given additive separability in preferences, the household chooses to allocate the same amount of consumption to 'draftees' and 'civilians'.

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

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

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

subject to:

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

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 rate. This fraction is treated as a policy variable by 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 household's first-order necessary conditions (FONCs) for $h\left(s^t\right)$, $k\left(s^t\right)$, and $b\left(s^t\right)$ are standard:

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

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

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

The first FONC indicates that the presence of a proportional labor tax drives a wedge between the marginal rate of substitution in (civilian) leisure-consumption and the real wage. The second states that (future) capital taxation drives a wedge between the current marginal value of consumption and the marginal utility weighted expectation of real capital returns. 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:

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

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

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

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

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.[11]

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 determined wage to induce the household to supply the required personnel in order to meet military demand. Given the fixity of per-period-hours each armed forces member must spend in the military, the household now has an additional choice variable at each s^t. 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:

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

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) $v\left(.\right)$ 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 $\phi w\left(s^t\right)$.

Without conscription, the condition $e\left(s^t\right)=d\left(s^t\right)$ for all s^t must hold in equilibrium. Also, 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:

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

[11] 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.

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 state-contingent (in particular, contingent on $h\left(s^t\right)$). Moreover, we see that conscription is a 'special case' of the all-volunteer case, in which the factor of proportionality, ϕ, is restricted to be constant.

Finally, it is straight-forward to show the following result:

Proposition 1 *For all $h\left(s^t\right) \in (0,1)$, $\varphi\left(s^t\right) \geq 1$. 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. Hence, for $\phi < 1$, conscription always confers a cost saving to the government in terms of military wage expenditures.

3. COMPETITIVE EQUILIBRIUM AND OPTIMAL POLICY

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

Definition 2 *Given initial values, k_{-1} and b_{-1}, and the stochastic 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:*

- *$\{c\left(s^t\right), h\left(s^t\right), k\left(s^t\right), b\left(s^t\right)\}$ solves the household's problem subject to the sequence of household budget constraints;*
- *$\{y\left(s^t\right), \tilde{k}\left(s^t\right), \tilde{h}\left(s^t\right)\}$ 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 at each state 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.

Before proceeding to the quantitative analysis, I present an analytical result regarding the determination of optimal policy under commitment. The policy problem for this economy is to find the fiscal 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 this policy as given.

For this economy, it is straightforward to determine the optimal military recruitment policy, summarized as follows.

Proposition 3 *If the government's intertemporal budget constraint, (10), is binding, then 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 in order 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, at least as characterized by this simple model economy. For instance, it is possible to show that in a stochastic setting, optimality dictates that the real value of government debt issuance falls at the outset of the war. This is made possible by a state-contingent capital income tax levy in the current model; more generally, this could also be achieved through state-contingent inflation or consumption taxes levied at the war's outset, for ex-

ample.[12] In contrast, real government debt grew throughout the duration of the war, and was only paid down afterward. Hence, in the quantitative analysis, I evaluate the fiscal value of conscription in the context of observed historical policy experience. That is, while determining the welfare value of conscription in the exact Ramsey context is interesting (and is the subject of ongoing work), it is arguably of secondary importance relative to the more 'realistic' setting considered in the following sections.

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* (i.e., with $\phi = 0$), and the second with an all-volunteer army (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 (federal, state, and local) government spending to GDP, 1929-68. In addition to WWII this period is marked by two shifts in the 'size of government', the first coinciding with the election of FDR, the second with the onset of the Cold War. During the 1933-9 and 1946-50 periods, government spending averaged 15.5% of GDP. In the build-up year of 1941, the government's share increased to 21% when real total spending increased 66% – and military equipment spending increased 16-fold – over the previous year, due to the passing of Lend-Lease and

[12] See Chari and Kehoe (1999) for additional discussion regarding the fact that only optimal 'wedges' are determined in the Ramsey framework, while details regarding implementation are model specific.

overall military mobilization. With the onset of the war, real 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 representing 1.8% of the population was 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 and capital income tax rates as constructed by Joines (1981). Both tax rates increased noticeably during the war. Between 1940 and 1945, the average labor tax rate increased from 9.1% to 19.7%, and the capital tax 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 increased throughout the war until it peaked at 108% of GDP in 1945. After the war, the debt was gradually paid off as taxes – and in particular, the labor tax rate – remained high.

Finally, Figure 2 displays two measures of private sector total factor productivity. The first is from Kendrick's (1961) treatment, and the second 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 are well characterized as displaying a common trend in annual 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 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 important 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). It should also 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 (almost certainly, during the initial depression years and during the war) appear in these TFP series.[13] To keep the policy analysis tractable these technology, government policy, and utilization considerations have been excluded from the model of Section 2. Variation in observed productivity are accounted for in the quantitative exercise via the exogenous process, $\{z(s^t)\}$.

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 values for $\beta = 0.95$ and $\alpha = 0.36$ are standard in the literature. As in McGrattan and Ohanian (2006), the depreciation rate is set to $\delta = 0.07$. The peacetime steady-state is specified such that $d_{ss} = 0$, $g_{ss}/y_{ss} = 0.155$, $\tau_{ss} = 0.083$, and $\theta_{ss} = 0.439$. The latter two

[13] 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 recovery phase of the depression.

values match the average values observed during 1936-40, while the former two values match the observations discussed above. The value of ψ is set so that in the peacetime steady-state $n_{ss} = 0.27$. The model produces predictions for the dynamics of government debt accumulation. Because of this, I introduce a lump-sum tax/transfer into the household and government budget constraints, solely for calibration purposes. This tax/transfer is specified as a constant (i.e. non-varying, non-state-contingent) value so that in the peacetime steady-state $p_{ss}b_{ss}/y_{ss} = 0.505$.

The state-of-nature 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 during 1942-45. In 1946, the economy exits the war, and the economy transits back to the peacetime steady-state. During the period of 1941-45, 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 to population ratio of 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 GDP ratio of Figure 1, panel A and Kendrick's (1961) measure of civilian hours worked, which is displayed below.[14] 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, 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.

[14] In their paper, McGrattan and Ohanian (2003) demonstrate that a reasonably specified, dynamic general equilibrium model is able to account for the dynamics of output, hours worked, and the real wage observed during WWII. Though the features of my model differ from theirs, the results presented below for the benchmark model confirm their conclusions.

Ex post, only the high productivity regime is realized in the simulations reported below. These postwar $z\left(s^t\right)$ values accord with the average values of detrended TFP during the 1929-40 and 1946-68 periods, respectively, in the Christensen and Jorgenson (1995) data, displayed as dashed lines in Figure 2.

Second, I allow for a one-time, unanticipated debt repudiation in 1946. The U.S. experienced a sharp spike in inflation in 1946. Inspection of nominal interest rates suggests that this inflation was largely unanticipated. Since bond returns were set in nominal terms, this inflation 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 a third of GDP. Since the model does not allow for this type of unanticipated 'lump-sum' taxation via inflation, I include a one-time 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 by the military during WWII does not exist.[15] During the initial months spent in training, enlisted personnel spent approximately 54 hours per week in drills and exercises. Once in action, official estimates and documentation of hours worked are no longer 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 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 reasonable lower bound for combat troops. Given this, I set per period military hours to $\bar{h} = 0.64$, 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

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

the military was 76% of that earned in the civilian economy during WWII. This also corresponds with independent data available for 1945, in which the ratio of (annual) basic pay plus allowances in the military to average earnings of non-military employees for that year was 0.766.[16] 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 economy, the military wage is 63% of the civilian wage.

The final elements to be specified for the benchmark model are the peacetime policy rules for capital and labor tax rates. I specify these rules as being functions of the log-deviation of inherited government debt from its peacetime steady-state value. These functions are specified so as to match the capital and labor tax rate series observed during 1946-49.

5. QUANTITATIVE RESULTS

5.1 Simulation results for the benchmark model

Figure 3 displays time series of key macroeconomic variables for the model and the U.S. data. The red line corresponds to the U.S. data and the blue line to the model. 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. In particular, 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

[16] It should be noted that this difference in pay is unlikely to reflect lower labor skill among members of the Armed Forces relative to the civilian sector. In fact, empirical evidence indicates that 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 on average 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' educational attainment of non-veterans.

adult population) as $\left(1-d\left(s^t\right)\right)h\left(s^t\right)$. For all growing variables, the figure displays time 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 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 two 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.[17] 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 model's simulated prediction 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 hence, the real wage. In the model, the return to working is further suppressed by the high labor tax rate which persisted after the war, and the running-down of the capital stock which occurred during the war. Taken together, these simulation results suggest that the U.S. WWII 'miracle' was not necessarily 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 the non-farm hourly compensation series constructed by McGrattan and Ohanian (2006). Though the exact timing in the model is shifted forward by a period, this figure indicates that the benchmark model is able to roughly replicate the experience for hours worked without predicting counterfactually large wartime gains in productivity and the return to work. Indeed, in order to match the historical observations for civilian hours, the maximal wartime value for $z\left(s^t\right)$ is 1.25, which is not too far outside the range of data in Figure 2. It is likely that a richer model including "government-owned, privately-operated" capital would reduce the values of $z\left(s^t\right)$ needed to replicate wartime hours worked. A substantial portion of government expenditures during the war was used to purchase GOPO capital which substituted for private capital in production (see Gordon, 1969; McGrattan and Ohanian,

[17] This close correspondence – as well as that for the consumption-output ratio, investment-output ratio, and after-tax real wages – corroborates McGrattan and Ohanian's (2006) view that variants of the neoclassical growth model are able to quantitatively account for the effects of large fiscal shocks.

2006). In the current model, government spending is simply "thrown into the ocean."

Panels E and F display the capital and labor tax rates, respectively. As discussed above, the model has been specified to match the U.S. 1941-9 data.[18] The model does a reasonable job of matching the market value of outstanding debt to GDP ratio observed during the war, displayed in Panel G. The correspondence in post-war 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 due to the model's underprediction for output after the war.

The final three panels display further successes of the model in its ability to match the 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 model does a good job of matching the U.S. data, though it slightly underpredicts the relative fall of investment (again, it is likely that the inclusion of GOPO investment would remedy this discrepancy). Taken as a whole, these results indicate that the current quantitative model represents a good laboratory with which to study the welfare value of conscription as fiscal policy.

To this end, I present two counterfactual *experiments* in the following subsections. The experiments differ in their specification for tax rates in response to the counterfactual modifications. For each experiment, two different *simulations* are performed – one with an all-volunteer army, 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 same policy rules used in the benchmark case. I call this *experiment A*. In the first

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

simulation, I feed the exogenous WWII variables through the version of the model without conscription. Since hiring an all-volunteer military involves greater wartime expenditure relative to the benchmark economy, this means accumulating more debt during the war. Given the specification of the fiscal rules, postwar taxes respond to the accumulated debt, and the counterfactual economy eventually converges to the same steady-state as in the benchmark case.

The results from this counterfactual are displayed in Figure 4. Panel A shows the difference in the military pay to government spending ratios between this case (green line) and the benchmark (blue line). As discussed, having the government hire an all-volunteer military involves greater labor compensation relative to the historical case with conscription. In 1945, the share of government spending dedicated to military pay peaks at 36% as opposed to 23% under conscription. The increased spending coupled with the 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 132% as opposed to 114% in the benchmark economy in 1945, and peaks at 158% as opposed to 119% 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 benchmark economy.

As a result of the higher tax rates, counterfactual postwar economic activity is depressed as the returns to working and capital accumulation are lower. In 1946, private sector output (panel E) in the counterfactual economy is 6.5% lower than in the benchmark economy, and in 1950 output is still 6.0% lower.[19] This depressed economic activity is particularly pronounced in investment. While investment is lower in the counterfactual economy relative to the benchmark during the war, it falls dramatically in 1946 due to the jump in capital tax rates. In that year, investment is approximately 40% lower than for the benchmark case, and in 1950 it is still 15% lower. The persistently high postwar tax rates generates a prolonged transition to steady state.

[19] Recall that private sector output, $y\left(s^t\right)$, includes both private and government consumption, and private investment.

The increased wartime spending and postwar taxation associated with the all-volunteer military results in lost welfare relative to the benchmark case. 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 infinite lifetime in order for it to be as well off as in the benchmark. In this case, I calculate this to be a consumption increase of 1.07% in perpetuity. However, this measure does not capture the full welfare value of conscription. This is because in the benchmark economy, conscripted military personnel are paid wages that are 63% of civilian wages, while it is in fact 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. Fiscal policy is specified as in the first counterfactual; that is, taxes are unchanged relative to the benchmark case during the war, and follow the benchmark policy rules afterward. Since wartime expenditures are minimized, this case provides a welfare gain relative to the benchmark. In particular, lifetime consumption would need to be increased by 0.78% in the benchmark economy in order for the household to be as well off as in the optimal conscription economy. Hence, given the tax rate specification of experiment A, the value of conscription from a fiscal perspective equals 1.85% 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 years 1941-5. This is done so that in the final year of the war, the market value of government debt is equal to that of the benchmark economy. Given that peacetime tax rates are specified as functions of inherited government debt, the postwar tax rates are (virtually) identical to those in the benchmark case.

Figure 5 displays the results from simulating the all-volunteer economy in this experiment. Again, the ratio of military pay to government spending is higher without conscription relative to the benchmark economy. As a result of the increased military spending, both tax rates must be increased by 17% during the build-up and war years; 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) in each of the war years by an average of approximately 4% compared to the benchmark case. 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 tax rate, investment is disproportionately affected relative to consumption.

Output in the counterfactual economy is lower than in the benchmark economy for 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 and investment are higher (and consumption lower) relative to the benchmark as the economy transitions to steady state.

Again, the increased wartime spending associated with the all-volunteer military results in lost welfare relative to the benchmark case, this time due primarily to the uneven distribution of tax distortions across time. In order to compensate the household, consumption would need to be increased by 0.90% in perpetuity relative to the benchmark economy. On the other hand, under the optimal conscription simulation, wartime taxes would be decreased by 20% relative to the benchmark in experiment B, representing a much smoother time profile for tax rates. As a result, lifetime consumption in the benchmark economy would need to be increased by 0.83% in order to make the household as well off as in the optimal conscription economy. Hence, under the tax policy of experiment B, the full value of conscription is equivalent to 1.74% of lifetime consumption.

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 distortions. 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 equivalent to between 1.5% and 2% of consumption in perpetuity, depending on the exact specification of tax rates in the counterfactual experiment.

This is a first step in the determination of optimal policy during a large fiscal event such as the U.S. WWII effort. Indeed, one possible extension is to solve for the Ramsey optimal tax rates when the government does and does not have the ability to institute a military conscription. Obviously, tax rates – and particularly capital tax rates – under the Ramsey plan would differ drastically from those observed historically (see Chamley, 1985; Judd, 1985; and Chari et. al., 1994). Hence, the quantitative value of conscription is likely to be smaller in this case, as the economy would be, in other respects, closer to the achievable second-best. As discussed in Section 3, this is the subject of ongoing work in this project.

Along similar lines, 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 non-linear consumption taxation which provides little in terms of tax revenue, but much in terms of expenditure saving), 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 general equilibrium analysis. These include issues such as conscription's effect on human capital accumulation (and the potential role for education subsidies), resource misallocation, and inequality discussed previously in the literature. In particular, in ongoing work, I am investigating the welfare implications of conscription in a life-cycle model with incomplete insurance across ages. It has often been argued that

those who served in WWII bore a disproportionately large brunt of the war cost: not only did they serve overseas during the war, they also paid for its cost afterward in the form of persistently high postwar taxes. An interesting question is to determine whether they would have preferred to earn less during the war, in exchange for higher postwar returns to work effort and capital accumulation that this would have afforded.

APPENDIX A

For Table 1, data for total military enrollment and casualties is from the U.S. Department of Veterans Affairs (2001). Data for war costs is from Nordhaus (2002).

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 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).

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 McGrattan and Ohanian (2006).

APPENDIX B

The following is the proof of Proposition 1:

Proof. For exposition, let $h \equiv h\left(s^t\right)$ and $\varphi(h)$ (or simply φ) $\equiv \varphi\left(s^t\right)$. 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 first characterize equilibrium in the conscription economy in primal form. This is a useful first step in deriving results on the optimal implementation of conscription. I show that 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, $\{c\left(s^t\right), h\left(s^t\right), k\left(s^t\right)\}$, must satisfy constraints (9) and (10). Furthermore, given ϕ, $\theta\left(s^0\right)$, and sequences $\{c\left(s^t\right), h\left(s^t\right), k\left(s^t\right)\}$ 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 $\beta^t\pi\left(s^t\right)u'\left(s^t\right)$, and sum over all s^t and t. Using (2) – (4) and the following transversality conditions:

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

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

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

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

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

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

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

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

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

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

is obtained from the government's budget constraint. ■

First, a similar result to Proposition 3 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).[20] 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 3, solving for the Ramsey equilibrium is equivalent to finding the allocation $\left\{c\left(s^t\right), h\left(s^t\right), k\left(s^t\right)\right\}$ 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:

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

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

Then 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 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 mimizing 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 - 1968

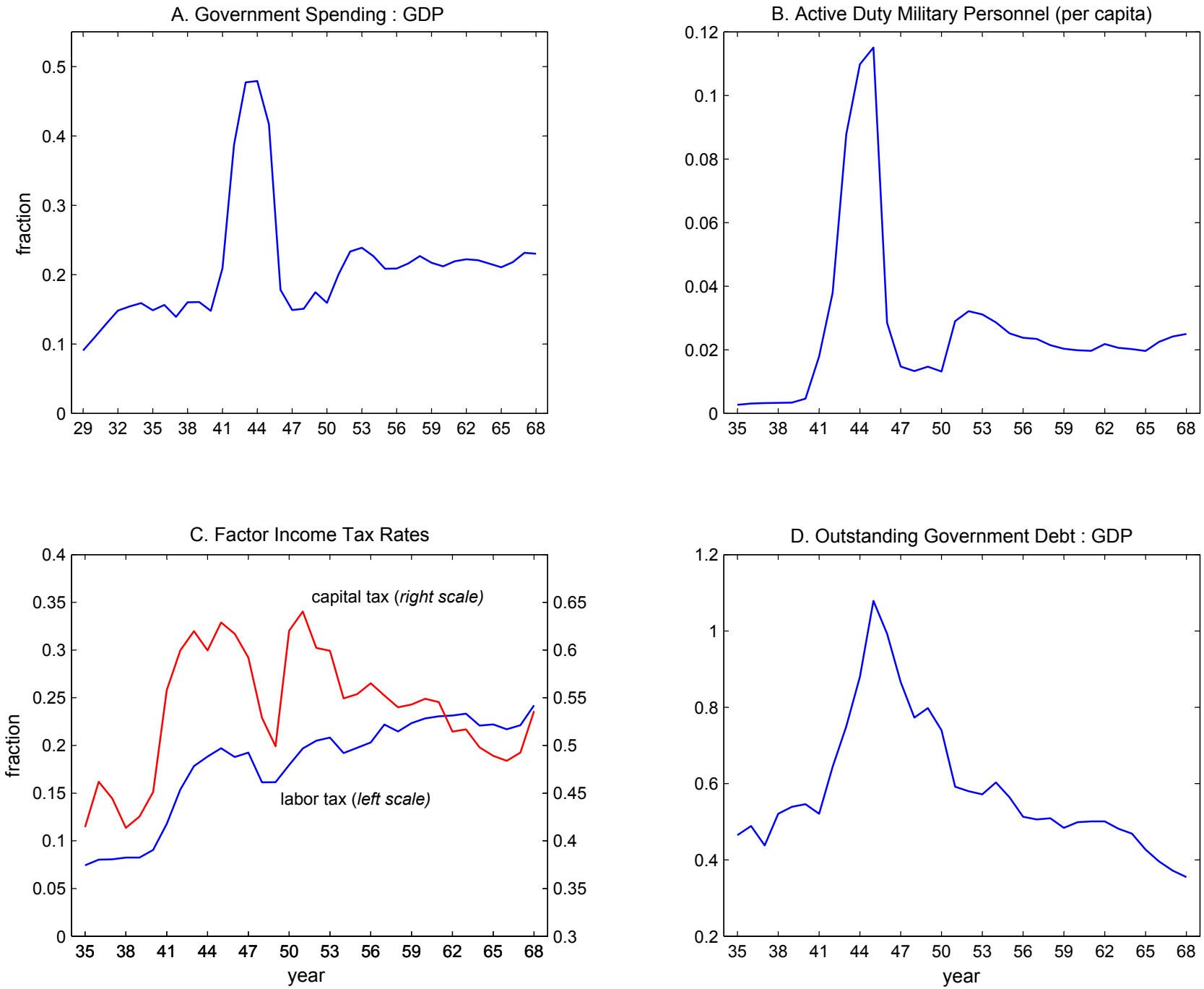

Figure 2. Detrended Private Sector TFP

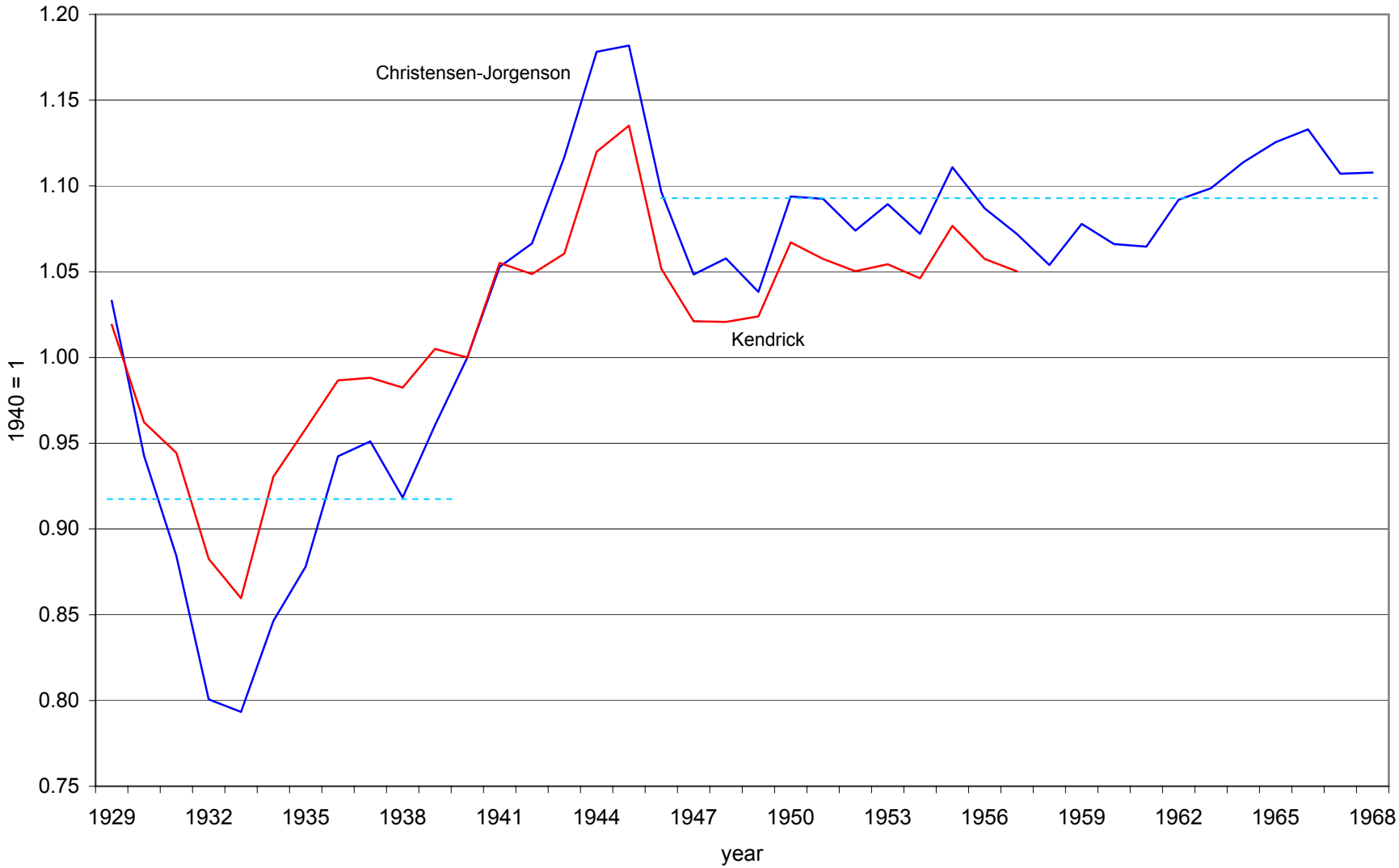

Figure 3. U.S. Data and Benchmark Economy (page 1)

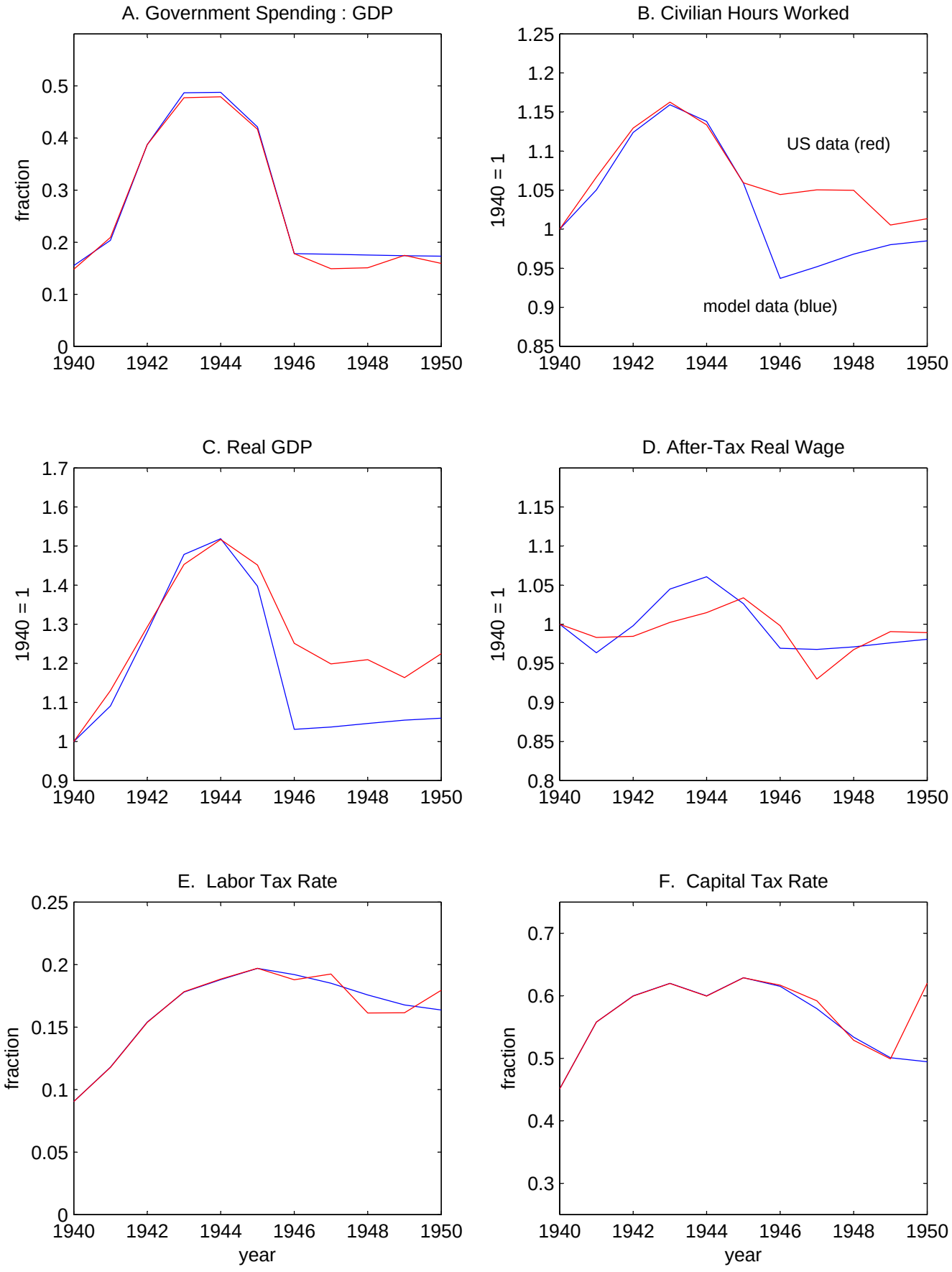

Figure 3. U.S. Data and Benchmark Economy (page 2)

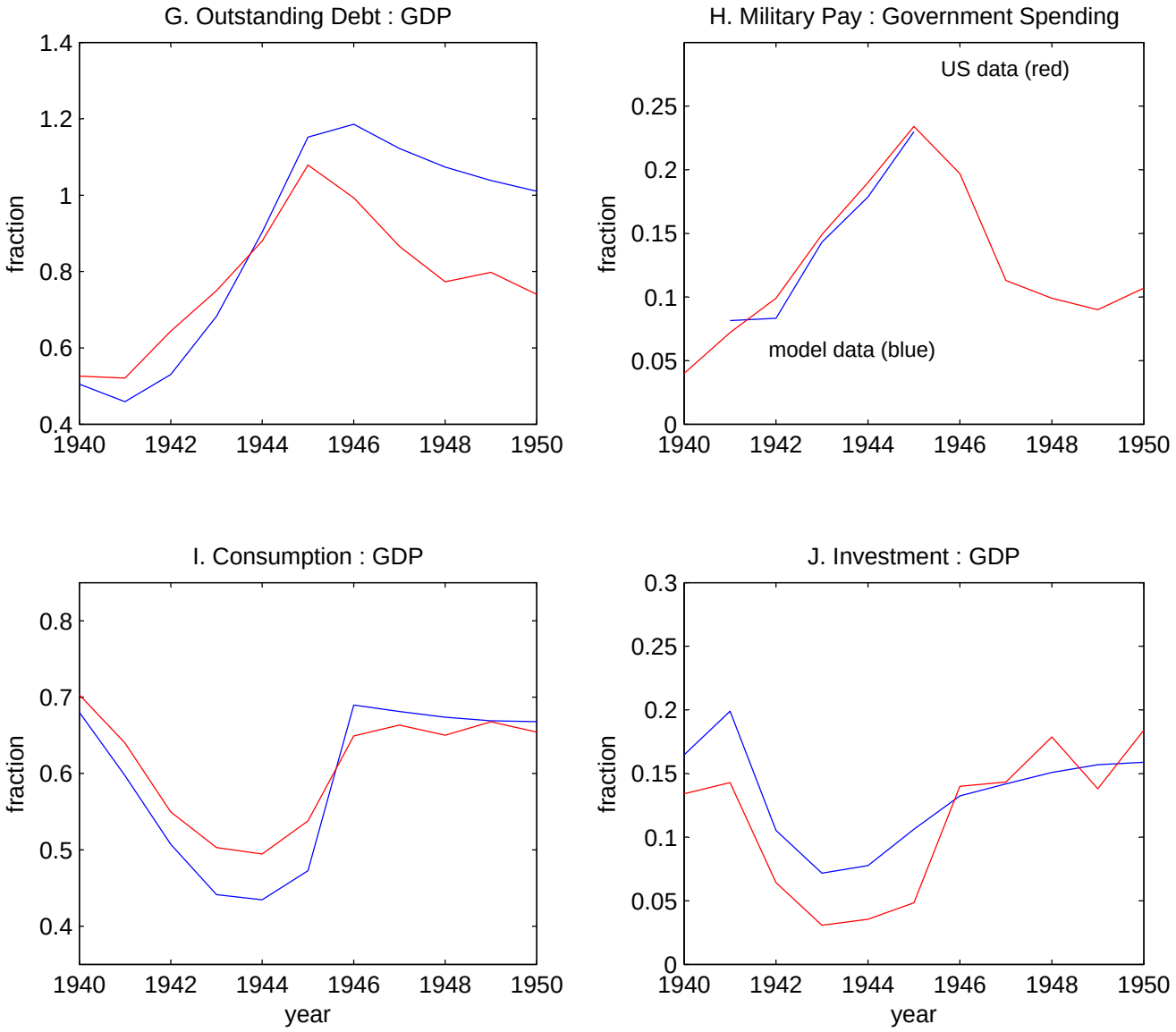

Figure 4. Benchmark Economy and Counterfactual Experiment A (page 1)

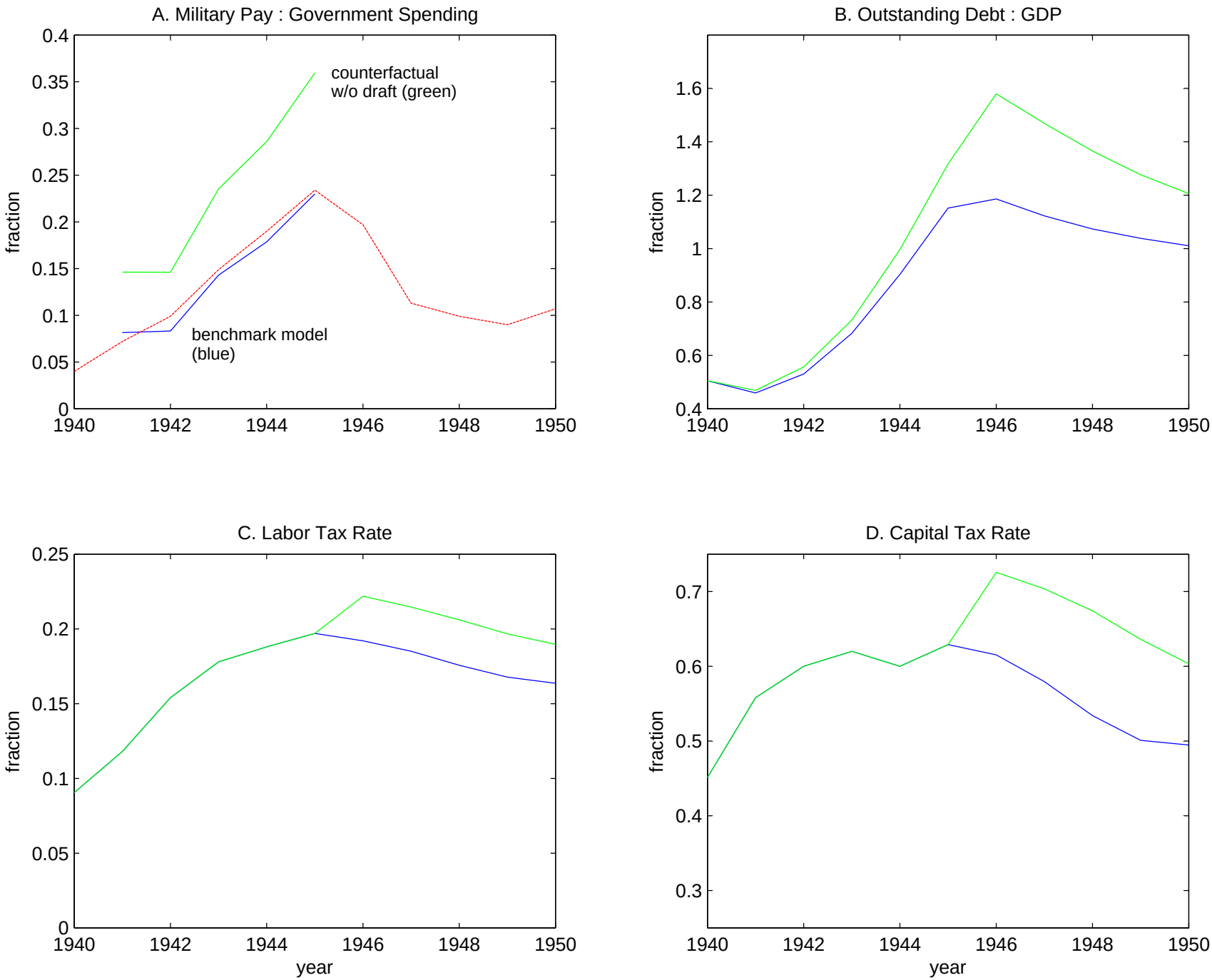

Figure 4. Benchmark Economy and Counterfactual Experiment A (page 2)

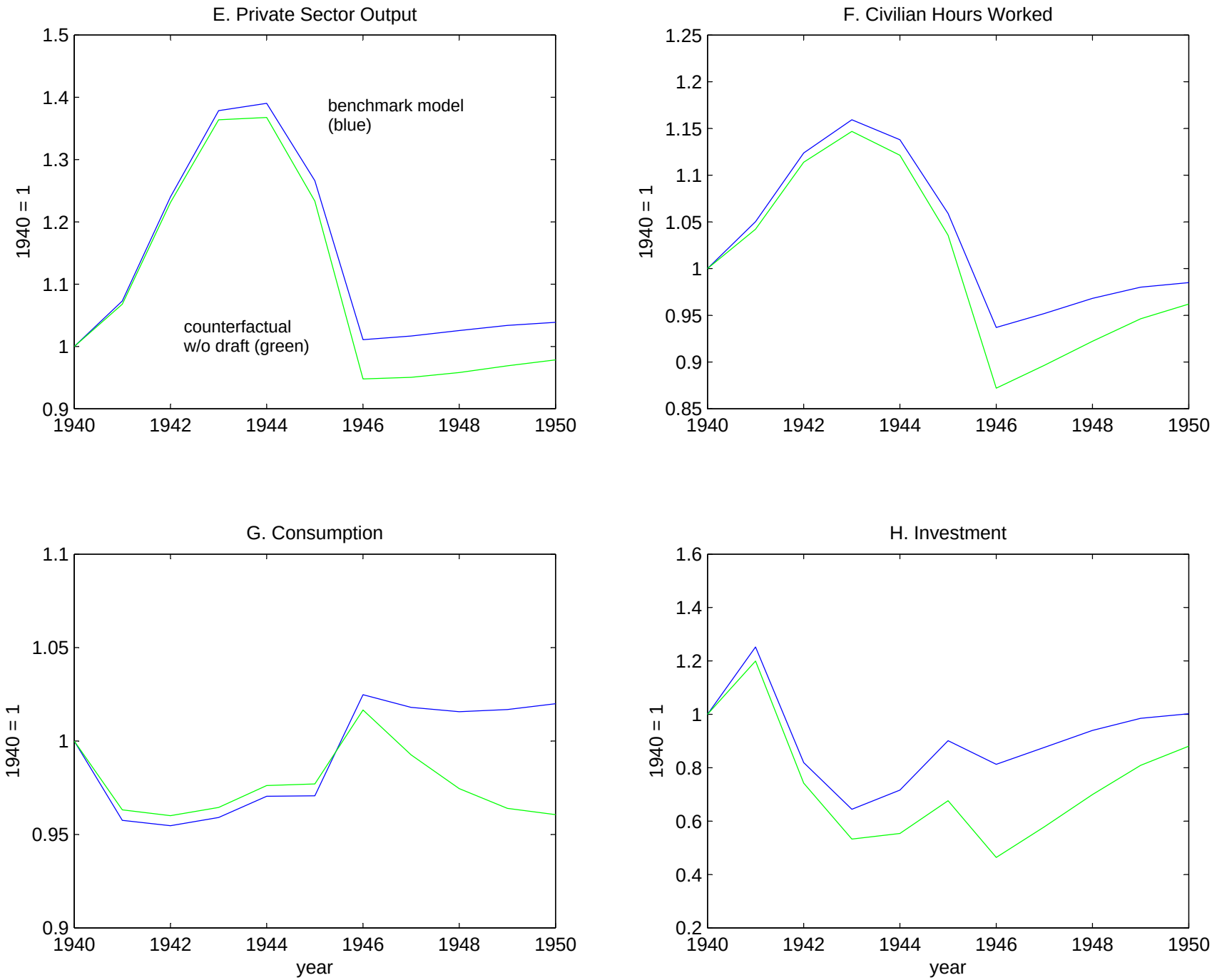

Figure 5. Benchmark Economy and Counterfactual Experiment B (page 1)

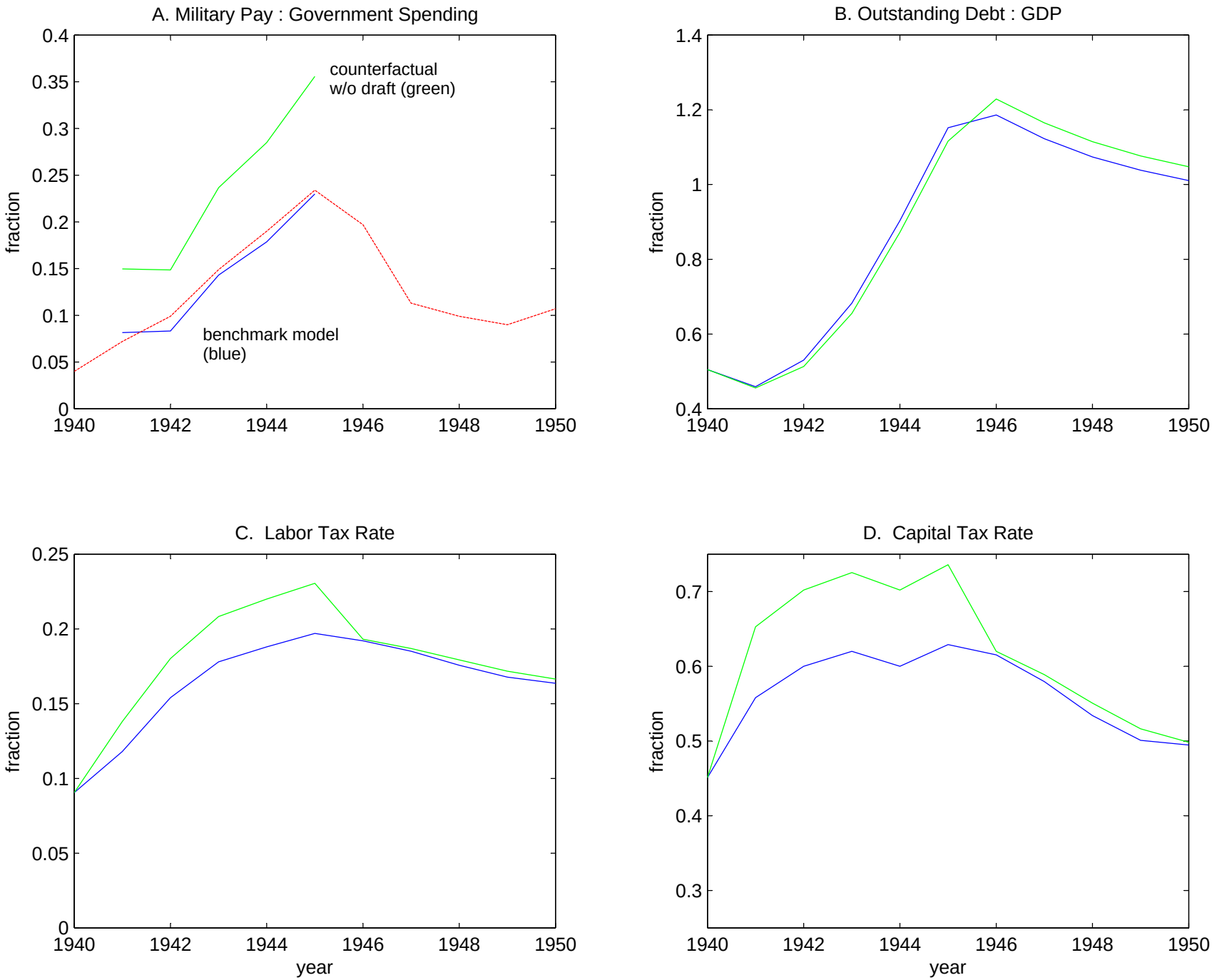
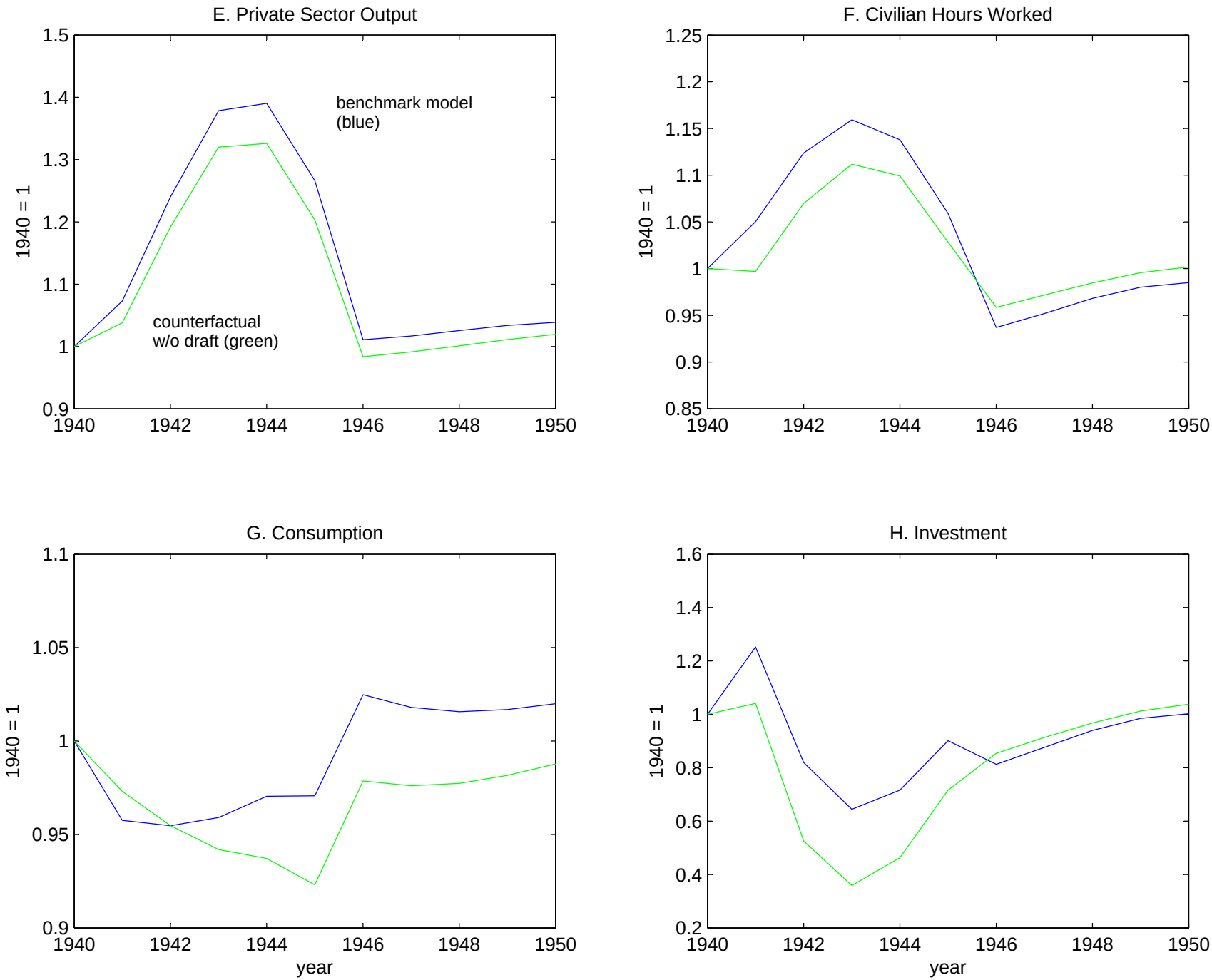
Figure 5. Benchmark Economy and Counterfactual Experiment B (page 2)