PECUNIARY INCENTIVES TO WORK IN THE U.S. DURING WORLD WAR II

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Pecuniary Incentives to Work in the U.S.
during World War II
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ABSTRACT

It is argued that changes in workers' budget sets cannot explain the dramatic increases in civilian work in the U.S. during World War II. Although money wages grew during the period, wartime after-tax real wages were lower than either before or after the war. Evidence from the 1940's also appears to be inconsistent with other pecuniary explanations such as wealth effects of government policies, intertemporal substitution induced by asset prices, unfulfilled expectations, and changes in the nonmarket price of time. Although untested and relatively undeveloped, nonpecuniary models of behavior are tempting explanations for wartime work.

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I. Introduction

As measured by labor force participation rates or average weekly hours, the 1940's were a period of large and rapid changes of civilian work activity in the United States. As shown in the dashed lines in Figure 1, civilian employment grew from 49 million in 1940 to 55 million in 1944 - while the "employment" by the armed forces had grown from less than 1 million to over 11 million (Kendrick 1961, Table A-VI; Conference Board 1950, p. 165). As shown by the solid line, increased labor force participation by women was an important contributor to the growth in employment; the female participation rate grew from 28% in 1940 to almost 37% in 1944 - an increase of about 5 million workers (Rupp 1978). The labor force participation of men was also substantially higher during the war and nearly all age groups of men and women contributed a large number of members to the labor force.[1]

Not only were there an unprecedented number of workers during World War II, but, on average, each worker worked more hours in 1944 than did prewar and postwar workers. Figure 1 displays average weekly hours as a dotted line for all civilian workers and as a dash-dot line for production workers in manufacturing. Hours per week for all civilian workers grew from 43.9 in 1940 to 47.0 in 1944 and then fell back to 42.0 in 1948 (Kendrick, Tables A-X & A-VI). A wide variety of industries experienced a wartime increase in hours, including mining, telephone communications, wholesale trade, railroads, furniture manufacturing, meat packing, paper products, and printing (CB, p. 340; BLS 1963). Some of these industries, such as wholesale trade and paper products, had even experienced a wartime *decrease* in employment due to the movement of workers to manufacturing industries.

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[1]Because some men were drafted and it is difficult to determine the age of military personnel, standard measures of the voluntary participation rates of men are difficult to construct. The Bureau of Labor Statistics (1945b) estimates that the extra wartime workers (including the military) came in roughly equal numbers from both genders. 40% of wartime labor force entrants were boys and girls aged 14-19 (roughly half of these were boys in the military), although their contribution to aggregate civilian manhours was somewhat less because of their greater propensity to work part time. 35% of entrants were men and women aged 20-44 and 20% were aged 45-54. 5% of wartime entrants, mainly men, were aged 65+.

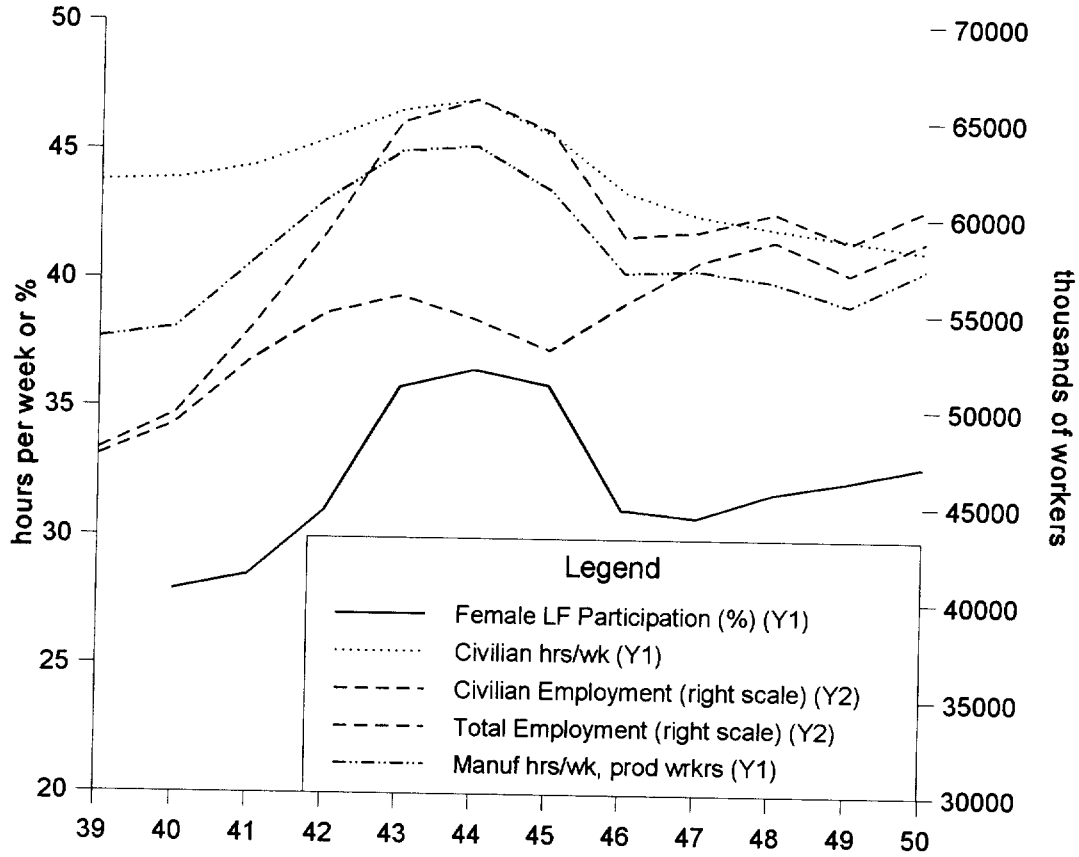

Figure 1 Components of Labor Supply, 1940-50

The dynamics of work during WWII can be seen in a broader historical perspective in Figure 2. In the 50 years since WWII, average weekly hours has never returned to its wartime level (BEA, various issues).[2] Female labor force participation did achieve levels of 37% and higher, but this was not until about 1960.[3] The high wartime participation of elderly men was a substantial interruption of a downward long term trend (http://www.bls.gov/). Moreover, the figure shows that WWII introduces a major interruption into the long run trends of these three series - interruptions whose magnitudes have not been paralleled since.

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[2]Prior to 1939, it is more difficult to obtain consistent measures of labor supply. For some studies of pre-1939 data, see Kendrik (1961) and Goldin (1990).

[3]The definition of labor force participation has changed during the postwar period, mainly with respect to the inclusion of younger women. The labor force participation rate of women aged 14 and older was 36.5% in 1944 (Rupp 1978, p. 188). Goldin (1990) reports of participation rate for women aged 15 and older of 35.1% in 1960. The participation rate in the same year for women aged 20 and older was 37.6% (Citibase series LHFP20).

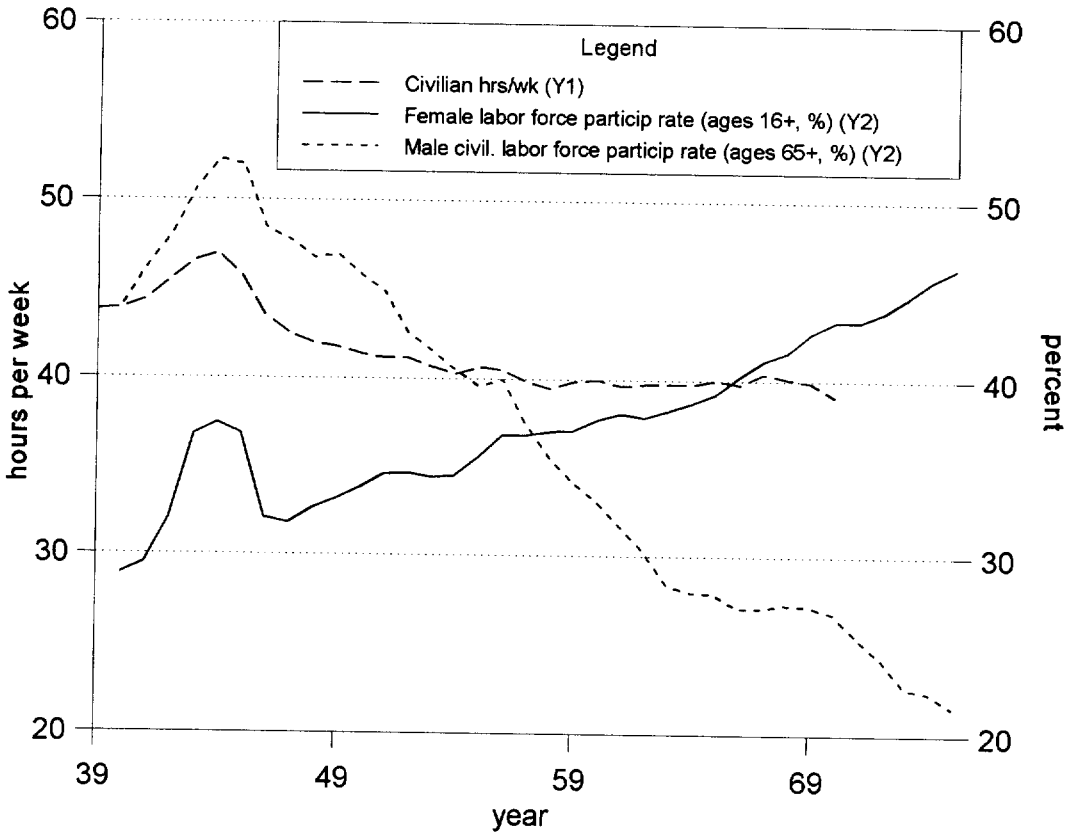

Figure 2 Hours per Week and Female Labor Force Participation, 1939-75

It seems to be fairly obvious that an explanation of these changes should begin with the war. For one thing, a massive reallocation of resources from private to public use occurred during the period 1942-1945 in the U.S. Total government expenditures reached almost 50% of GNP in 1943 and 1944 compared to 18% only three years earlier. Since real GNP grew at a 15% annual rate from 1940-1944, and fell 23% over the next two years,[4] even these GNP fractions understate the magnitude of wartime government activity. Military employment in 1944 totaled 11% of the population aged 16+ and 17% of the labor force (Council of Economic Advisers, various issues; Census Bureau 1975 series HS-904).

But what is the link between the war and the changes in work activity? Economics explains the mechanics of resource allocation in market economies with "price" and "wealth" effects. According to the

[4]The exact numbers depend on the method used to estimate national product and its deflator (see Kuznets (1945) and Rockoff (1978) for discussions), but the basic conclusion that wartime government spending and GNP were substantially higher is robust.

theory, a government affects the allocation of resources by changing its tax policy as well as the size and composition of its spending. The changes in tax and spending policies together with the adjustment of prices change the budget sets of agents in the economy which then motivate changes in behavior such as more work effort and more saving. The important - and powerful - hypothesis of economic analysis is that *only changes in budget sets can change behavior in a market economy.*

This paper argues that most dimensions of labor supply during the period - the dynamics of hours per worker and the dynamics of labor force participation - cannot be readily explained by changes in budget sets. The main reason for my result is the historically unparalleled Federal Individual Income Tax (IIT) changes which, according to the standard models, should have been a very important work disincentive for wartime work. Section II outlines the basic economic theory. Although wartime money wages and pre-tax real wages may have been abnormally high, Section III shows that several aggregate measures of after-tax real wages are at their lowest during WWII. Section IV presents a variety of evidence suggesting that the dynamics of the aggregate wage and tax measures are representative of micro-level wage changes, with perhaps the exception of single women. The possibility that, relative to expectations, wages and prices may have been high during WWII is considered in Sections V and VI. Section VII considers the possibility that the nonmarket value of time fell during WWII. Section VIII shows that several potential wealth effects of the wartime activity cannot explain the dynamics of work activity during the period. Rationing, involuntary unemployment, and liquidity constraints are three less elementary pecuniary explanations that are examined in Section IX. Changing discrimination is briefly analyzed in Section X. An appendix works out some theoretical implications of a particular dynamic model of consumption and labor supply.

II. An Outline of the Basic Economic Theory

The basic hypothesis of the standard economic analysis is that *only changes in budget sets can change behavior in a market economy.* This hypothesis holds in the static textbook model of the consumption-leisure choice, but it holds in a great many extensions of that model including the dynamic models of Ghez and Becker (1975), the dynamic discrete choice models of Blinder and Weiss (1976) or Heckman and MaCurdy (1980), or the dynamic stochastic general equilibrium models of Aiyagari et al (1992), Barro (1981b), Baxter and King (1993), Braun and McGrattan (1993), Hall (1980), and others.

A. Relative Labor Supply Function, Homothetic Time-Separable Case

The theory emphasizes four distinctions, distinctions which are an important guide for the empirical analysis: (1) labor supply vs. labor demand, (2) total vs. civilian work activity, (3) pre-tax vs. after-tax

wages, and (4) anticipated vs. unanticipated changes. General equilibrium models include analyses of both labor supply and labor demand as well as integrating the two with analyses of credit markets and the government budget constraint. Although there are many pieces of the standard general equilibrium models which I find to be inconsistent with the wartime experience, this paper focuses on only one of those pieces: the voluntary supply of labor. I denote the date t voluntary supply of labor, relative to trend, by n_t.[5] Since I seek to explain the abnormal wartime labor rather than the general level of labor supply during peacetime, I consider the ratio n_t/n_s, where t and s are two different dates such as a wartime year and a peacetime year, two wartime years, or two peacetime years. The basic theory explains n_t/n_s in terms of the budget sets of workers:

$$\frac{n_t}{n_s} = F\left(\frac{w_t}{w_s} e^{-\int_s^t r_v dv}, \theta_s, \theta_t, X_s, X_t, I_s, I_t - I_s \right) \quad t > s \tag{1}$$

$$\text{with} \quad F\left(1, \theta_t, \theta_t, X_t, X_t, I_s, 0\right) = 1 \quad \text{for any } \left(\theta_t, X_t, I_s\right)$$

w_t	=	date t after-tax real wage, relative to trend
r_v	=	date v instantaneous real interest rate, relative to "normal"
θ_t	=	other date t determinants of budget sets
X_t	=	date t demographic characteristics, relative to trend
I_t	=	information available as of date t
$I_t - I_s$	=	information that arrives between dates t and s

n_t, w_t, X_t are defined relative to trend and r relative to "normal" or "typical" real interest rates.[6] The dependence of the relative labor supply function F on the relative present value of date t and s wages is consistent with a time separable homothetic utility function. The assumption of $F(1,\theta_t,\theta_t,X_t,X_t,I_s,0)=1$ for any (θ_t,I_s,X_t) is a "stationarity" assumption: labor supply does not deviate from trend unless after-tax real

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[5] n_t can denote annual hours supplied by a family or it can denote a particular dimension of labor supply such as weekly hours, weeks per year, or the participation decision of a particular family member. See also subsection II.C.

[6] Removing trends from the economic variables places the least constraints on the basic theory (which would otherwise have to explain the trends too). Both data with and without trends are analyzed in empirical sections of the paper.

wages deviate from trend, real interest rates deviate from normal, demographic characteristics deviate from trend, or information changes.[7]

Two particularly relevant determinants of a worker's budget set is the after-tax real wage at dates s and t. The ratio of w_s and w_t is therefore included as the first argument of the relative labor supply function F, although w_t is discounted to reflect the possibility that workers may have opportunities to borrow or lend. w_t and w_s are supply prices and, under the assumption that any individual worker does not derive any benefit from paying taxes, are *net of any labor income tax payments.*

θ_t is a vector of other date t determinants of the budget set such as nonlinear wage and tax schedules, liquidity constraints, nonlinear savings technologies, insurance opportunities, or discrimination. X_t is a vector of demographic characteristics which affect the value of leisure at each date, such as household composition. I_s represents the information available about future wages, taxes, asset returns, liquidity constraints, and other variables constraining future choices. The inclusion of the term I_t - I_s reflects the fact that information might change between dates t and s and that could affect the ratio n_t/n_s. The shape of the function F is determined by the preferences of the worker.

B. Candidate Explanations from the Theory

Although a quite general specification of preferences may yield few predictions for the arguments and derivatives of the relative labor supply function F, one expects the relative wage w_t/w_s to increase relative supply. Supposing that leisure is a normal good, we also expect good (bad) news about lifetime resources to decrease (increase) labor supply at date t relative to date s. The effects of the other arguments of F are somewhat less obvious, but their inclusion in the relative supply function F suggests a number of potential "pecuniary" explanations for the increase in labor supply at the beginning of the war and/or the decrease at the end:

(i) wartime after-tax real wages were relatively high (ie, $\frac{w_t}{w_s} e^{-\int_s^t r_v dv} \neq 1$ for t war and s peace)

(ii) wartime real interest rates were higher than normal (ie, $\frac{w_t}{w_s} e^{-\int_s^t r_v dv} \neq 1$ for t war and s peace)

(iii) the beginning of the war was bad news about lifetime wealth while the end was good news (ie, $I_t \neq I_s$)

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[7]See the Appendix for a dynamic stochastic labor supply model consistent with our assumptions about the relative labor supply function F.

(iv) demographic changes (such as the absence of draftees from the home) shifted the demand for leisure (ie, $X_t \neq X_s$)

(v) consumption rationing shifted the wartime demand for leisure (ie, $\theta_t \neq \theta_s$)

(vi) wartime precautionary savings motives reduced the wartime demand for leisure (ie, $\theta_t \neq \theta_s$)

(vii) much of the peacetime unemployment is "involuntary" (ie, $\theta_t \neq \theta_s$)

(viii) discrimination constrained the voluntary choices of some potential workers, and that discrimination was different during wartime (ie, $\theta_t \neq \theta_s$)

Although perhaps not exhaustive, the list (i)-(viii) contains many of the explanations that might be derived from the standard economic model of labor supply.[8] The balance of this paper reviews available evidence from the 1940's and discusses how each of the explanations (i)-(viii) may or may not be consistent with the facts.

C. Margins of Labor Supply and "Kinks" in the Budget Constraint

The set of feasible choices of consumption and leisure at different dates can be nonlinear. A progressive labor income tax is one source of nonlinearities. Under some circumstances, overtime pay is also evidence of a nonlinear budget constraint.[9] Such nonlinearities are denoted θ_t above and, when they change over time, can cause the relative labor supply n_t/n_s to differ from one. Furthermore, changes in the nonlinearities have different predictions for the relative labor supply along different margins. For example, changes in employer overtime policies (to the extent they are associated with actual changes in the set of feasible consumption-leisure allocations) will differentially affect weekly hours by primary household workers and the participation decision of secondary household workers. Or a change in the progressivity of the labor income tax will differentially affect weekly hours, the participation decision of primary workers, and the participation decision of secondary workers.

D. Voluntary Labor Supply and Civilian vs Total Labor Force

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[8]Implications that can be derived from nonhomothetic or time inseparable models might also be added to the list, although such models are less often used in practice (see Goldin (1991) for one exception).

[9]Trejo (1991) shows that, when an overtime pay schedule is legislated by the government, overtime pay need not be evidence of a nonlinear budget constraint when employers and employees jointly contract over weekly hours and earnings.

Since the basic economic model clearly applies to *voluntary* labor supply and some young men were involuntarily drafted into military service, one has to be careful about measuring voluntary labor supply in the 1940s. One measure of labor supply that is faithful to the theory is civilian manhours as a fraction of available civilian manhours.[10] Another measure is the civilian manhours worked by individuals who were never involved with military service in the 1940s. Yet another measure is the labor force participation rate of the elderly. By any of the three measures, there was a dramatic increase in voluntary labor supply during the war. In 1944, for example, military employment was over 11 million people while civilian employment was 55 million - only slightly below the 1940-48 trend (CB, p. 165). This means that roughly 10 million civilians were employed who would not have been if military employment were zero and civilian employment followed its trend. As another example, consider the female labor force participation rate which grew from 28% in 1940 to almost 37% in 1944 (an increase of about 5 million female workers) and then returned to 31% in 1948. The labor force participation rate of men aged 65+ grew from 44.1 in 1940 to almost 52.3% in 1944 and then returned to 46.8% in 1948.

E. Expectations and the Dynamics of Voluntary Labor Supply

Although intertemporal tradeoffs may have important effects on decision-making, consumption, leisure, and savings decisions are made sequentially over time and may deviate from "plans" when new information arrives. "Unfulfilled expectations" are discussed in more detail in Sections V and VI, but even a cursory analysis of expectations suggests that a comparison of "war" and "peace" may be very different if the "peace" precedes the war rather than following it. Wars are presumably known to be of rather limited duration and thereby expected to be followed by peacetime conditions in the relatively near future, while citizens of the late 1930's may not have anticipated that such a large scale war was imminent. For this reason, wartime work and other variables are compared with *both* prewar and postwar measures. Although much of the data presented spans the entire period 1939-50, 1940, 1944, and 1948 are three benchmark years which receive particular attention in the paper.

Five other considerations also motivate my choice of the benchmark years 1940, 1944, and 1948. First, the war was fought for the entire year of 1944 (as compared to 1945) and, in terms of government spending and military employment, the 1944 level of activity was indicative of 1943 and 1945. Because the economic forces relevant for explaining the economic dynamics of the 1940's are not necessarily related

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[10]U.S. civilians worked voluntarily. They were not required by law to join the labor force or to work in a certain occupation or industry, although some additional paperwork was required to move out of 35 "essential" industries (Vawter 1983). Unlike some other countries the U.S. did not require women to register with a national employment agency or draft them into compulsory national services (Women's Bureau, August 1942 p. 5 and May 1994 p. 19)

to those forces determining long run trends, it is algebraically convenient that 1940 and 1948 are equally spaced on the timeline on either side of 1944. Second, to the extent that a Great Depression year is not typical of "peacetime" economic activity, 1940 and 1941 are the prewar years that are furthest from the depths of the Great Depression. 1941 has the disadvantage that, although war had not formally been declared, government spending had already begun to increase to wartime levels. Fourth, 1948 has advantages over 1946 and 1947 as a postwar benchmark year because wartime price controls had been removed and wartime government activity was largely complete. Fifth, 1940 and 1948 are the peacetime years closest to the war which did not have the extraordinarily high wartime marginal Federal IIT Rates.

F. Other Successes of the Basic Theory

Although I show that the basic theory cannot explain the extraordinary civilian work during WWII, it is true that the basic theory has successfully explained a variety of other behavior and that a number of economists claim that it can explain WWII as well. Ghez and Becker (1975) and others suggest that the basic theory can qualitatively explain variations in labor supply over the life cycle as a response to changes in the value of time while Hall (1991) and Mulligan (1995) suggest that the theory can explain both the direction and magnitude of intertemporal labor fluctuations over the life cycle, the seasonal cycle, the business cycle, and a variety of other temporary wage fluctuations. Modigliani and Sterling (1983) claim that the theory can explain cross-country differences in social security regulations and labor force participation of the elderly. As yet another example, Finis Welch (1997) explains changes over time in the level and cross-sectional distribution of annual hours worked by prime aged men by the changes in the level and cross-sectional distribution of wages.

Although there have been some results in the literature that seem inconsistent with the basic theory (eg., MaCurdy (1982) and some studies surveyed by Pencavel (1986), the peacetime empirical record is encouraging for those who conjecture that the theory might also explain WWII. Barro (1981b, 1993), Braun and McGratten (1993), and Ohanian (1997) work out a dynamic general equilibrium model to explain wartime work and other behavior in which high wartime real interest rates produce the change in worker's budget sets that motivate increases in labor supply early in the war and decreases at the end of the war. Braun and McGratten (1993), Friedman (1976, p. 207-8), Lucas and Rapping (1969, p. 25), and Puth (1988, p. 522) also explain the high wartime work activity with high wartime pretax real wages. Some economic historians such as Walton and Rockoff (1994, p. 560) or Puth (1988, p. 521) also use Keynesian models of unemployment to explain some of the changes in work activity. I intend to show that little or none of the evidence from this period is consistent with these and other pecuniary explanations derived from the basic theory.

III. Aggregated Measures of After-tax Real Wages

An explanation that would be harmonious with modern discussions of labor supply by labor and macro economists would be some combination of intratemporal and intertemporal substitution of work by households who enjoy temporarily high wages during the war period. The basic idea behind this explanation is that higher wages make leisure time during the war expensive relative to future leisure and perhaps also relative to current consumption. Indeed, wartime money wages were impressive relative to prewar wages: average hourly civilian compensation grew from \$0.57 in 1940 to \$0.98 in 1944 (Kendrick Table A-X; ERP 1988 Table B-24). Although impressive relative to the prewar figure, \$0.98 is not so impressive compared to the corresponding figure for 1948, \$1.39. When computed in 1940 dollars, however, wartime average hourly civilian compensation was \$0.78 in 1944 - almost as large as the \$0.81 in 1948 and well above the trend for the 1940's.

III.A. Wartime Tax Hikes

Although the real wages computed above may be relevant for the demand for labor, the standard theory predicts that voluntary labor *supply* depends on *after-tax* real wages. This prediction is troubling for wage-based explanations of WWII labor supply because the largest increase in marginal labor income tax rates (in terms of their effect on the marginal after-tax share of pretax earnings) in American history occurred in the early 1940s while the largest marginal tax rate cuts occurred in the late 1940's.[11] These tax changes overwhelm wartime increases in pretax real wages, at least as measured with aggregate data. According to the calculations of Barro and Sahasakul (1986), the average marginal labor income tax rate increased from 6.1% in 1940 to 25.5% in 1944 and then falling back to 18.3% in 1948.

Figure 3 displays after-tax hourly earnings of three categories of workers for the years 1939-48. Aggregate period t after tax wages for category i (w_{it}) are computed from money wages (W_{it}), the CPI (P_t), and the individual income and social security tax rules according to the formula below:

$$w_{it} = (1 - \bar{\tau}_t)\frac{W_{it}}{P_t} \quad , \quad \bar{\tau}_t \equiv \bar{T}_t^{IIT} + \Omega_t \tau_t^{ss}$$

where $\bar{T}_t^{IIT}$ is the weighted (by adjusted gross income) average across year t individual income tax payers of the marginal individual income tax rate, Ω_t is the sum of the year t wage and salary income that accrued

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[11] According to Barro and Sahasakul's (1986) measure of the average marginal labor income tax rate $\bar{\tau}_t$, the largest short-term percentage changes in the marginal after-tax share $(1-\bar{\tau}_t)$ occurred in the 1940's, swamping in magnitude even the well-known Kennedy and Reagan tax cuts.

to workers who earned below the social security tax ceiling (which was $3000 during this period) divided by year t AGI, and τ_t^{ss} is the employee component of the social security tax rate (which was .01 during this period). $\bar{\tau}_t$ can therefore be thought of as the federal marginal tax rate on a typical dollar of labor income.[12,13]

We see that, according to Figure 3, after-tax real wages of manufacturing production workers were *lower* in absolute terms (and even lower relative to trend) during the war years 1942-45 than in the few years immediately preceding and following the war. For example, the percentage change over the period 1940-44 in the after-tax real wage was -9.1% for production workers in 25 selected manufacturing industries and -3.2% for female production workers in the same 25 industries.[14] The decrease for all workers and female workers in 25 industries can be decomposed into a 36.7% (42.6% for females) increase in the money wage, 22.7% price inflation, and a 23.2% decrease in the after-tax share of earnings. From this backward-looking perspective, after-tax wages appear relatively *low* during the war - hardly a substitution effect story for why people worked so much during the war.

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[12]All tax rate data is from Barro and Sahasakul (1983, 1986).

[13]The employer component of the social security tax (0.01) is not included in the computation because it is assumed that the wage data is net of the employer contribution. The inferences drawn from the after-tax wage data should be insensitive to this assumption because the social security tax rate is small and is constant during the period (although the fraction of AGI to which the social security tax applies ranges from 48% in 1940 to 33% in 1945). Self-employed workers did not have to "contribute" to the Social Security system during this period.

[14]Census (1975) series D-830 and D-836. The 1940-44 change for production workers in all manufacturing industries (not shown in the Figure) was -3.3% (Mulligan 1995).

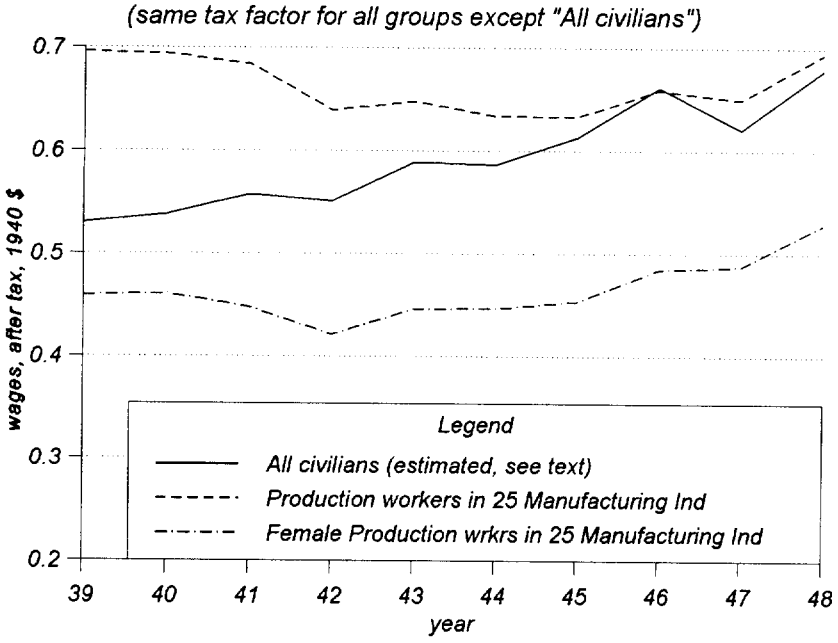

Figure 3 After-tax Wages, 1939-48
(average real hourly earnings multiplied by marginal tax factor)

The solid line in Figure 3 displays an estimate of the average hourly earnings of all civilians. It is computed as follows:

(i) Multiply wages and salaries, net of the compensation of military personnel, from the national income accounts by the same after-tax share shown above.
(ii) Add supplements to wages and salaries and subtract an estimate of the employer social security contributions (this is estimated using total compensation of employees as the tax base and $\Omega_t\tau_t^{ss}$ as the tax rate).
(iii) Add proprietor's income, multiplied by (1-average marginal I.I.T. rate).
(iv) Deflate using the official CPI and divide by civilian manhours.

This measure might be interpreted as the weighted average of individual after-tax wages, where an individual's after-tax wage is computed using the average marginal tax factor times his (or her) average hourly pre-tax earnings, and he contributes to the average according to the number of hours he worked during the year. The measure differs from the others in Figure 3 because it includes supplements to wages and salaries - a difference which has some effect on the dynamics of the series because there was some substitution of fringe benefits for wages during the war. The measure also captures any wartime movement of workers from low wage jobs to high wage jobs, although this effect may overstate the incentives to work if wartime workers are moving from pleasant and safe low wage jobs (eg., retail sales) to less pleasant and more unsafe high wage jobs (eg., manufacturing). Another reason that the measure overstates wartime incentives to work is that, because of a lack of data, I have not subtracted the fringe benefits of military personnel from the supplements to wages and salaries reported in the national accounts. Yet another bias

in this series is that, because of the wartime tax increases and the corresponding incentive to substitute for tax exempt fringes, wartime fringe benefits may not be valued dollar-for-dollar with after-tax income. Despite these biases, the measure only increases 8% between 1940 and 1944, and actually decreases by 3% relative to the 1940-48 trend. I argue below that even this backward-looking 8% increase may not be real.

Looking forward, after-tax real wages also appear low. Between 1944 and 1948, the after-tax real wage increased 9.1% for production workers in 25 selected manufacturing industries, 16.9% for female production workers in the same 25 industries, and 15% for all civilians.[15]

III.B. Reestimates of Wartime Inflation

Because Figure 3 uses U.S. government calculations of the CPI to deflate money wages, the figure probably understates the case that real wages were low during WWII. Attempts by the federal government to control prices gave an incentive for sellers to raise the effective price of their product in ways that are harder for the government to detect; deterioration of quality and suspension of quantity discounts are two ways that firms may have raised the effective price of their product without affecting government price inflation calculations. Price ceilings and rationing cause black markets to appear but black market prices are not included in official price indices. According to this argument, estimates of inflation over the period (1941-47) are correct (because price controls were not too important in the initial or final year), but estimates of inflation are understated for periods when price controls were instituted (1941-42, 1942-43, 1943-44, and 1944-45) and overstated for periods when price controls were removed (1945-46 and 1946-47). Robert Barro (1978, p. 608) offers estimates of the effective 1945 and 1946 price level based on the behavior of the money stock, arguing that inflation was overstated by 37% for the period 1945-47! Even if Barro has overstated his case and 10%, rather than 37%, is a more reasonable correction, that would change Figure 3 enough that the after-tax real wages would be 15-25% lower during the war years than during the 3 years before or the 3 years after.

Rockoff (1978) uses data on shortages and dwelling maintenance to obtain a measure of some portion of the understatement of WWII inflation. He estimates that CPI inflation between 1940 and 1945 was understated by 1% because landlords neglected maintenance in order to increase effective rents without violating rent controls. He adds this to estimates of the cost of meat and durables shortages and to Mitchell Committee (1945) estimates of concealed price increases to document a 5-7% understatement of 1940-45 CPI inflation.

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[15]The 1944-48 change for production workers in all manufacturing industries (not shown in the Figure) was 7.2% (Mulligan 1995).

Friedman and Schwartz (1982, Table 4.2) assume that an official implicit price index (computed by Kuznets) delivers the correct inflation rate for the five year period 1942-47, but that the official allocation of that inflation to the one year intervals 1942-43, 1943-44, ..., 1946-47 is incorrect because of price controls. Using the annual time series of nominal income to interpolate, Friedman and Schwartz estimate 20% inflation for the period 1942-44. For the two year period 1942-44, this is 8 percentage points more inflation than the Kuznet's index, 16 percentage points more inflation than the official GNP deflator, and 12 percentage points more inflation than the official CPI for all items.

Klein (1956) uses data on the average denomination of currency to obtain an estimate of German price inflation during WWII; a similar methodology can be used for the U.S.[16] Mulligan (1995) does so, using denomination of currency data to predict the GNP deflator for the years 1941-50. He shows that, as Klein predicts, the official GNP deflator is close to the predicted one for years when price controls were not in effect: 1941, 1947, 1948, 1949, and 1950. The official deflator lies below the predicted one for the price control years 1942-46, suggesting that the GNP deflator was understated by 25% in 1944.

All four methods of revising the official price level - Barro's demand for money forecast, Rockoff's reconstruction of components of the CPI, Friedman and Schwartz' nominal income interpolation, and Klein-style average denomination of currency forecasts - suggest that the official CPI was understated by 10% or more in 1944. It therefore appears that Figure 3 understates the fact that after-tax real wages were lower in 1944 than either before or after the war.

IV. Disaggregated Measures of After-tax Real Wages

An important source of support for the main argument of this paper is evidence that after-tax real wages were lower than normal (or at best, normal) during WWII. However, the evidence in Figure 3 is aggregate data - constructed from average hourly earnings for a category of workers and from average marginal tax rates - and may therefore display different dynamics than did the after-tax wages for individual workers. Three sources of composition and aggregation bias are considered: (i) aggregation errors in average tax and wage measures, (ii) occupation and industry switching, and (iii) wages of labor force entrants that differ from those of existing female workers.

Not surprisingly, I find that average wage measures are subject to some composition bias. However, it is difficult to show that the magnitude of the bias is important or that composition biases are

[16]Gary Becker suggested to me that the Klein methodology might apply to the U.S.

much more serious than they are for peacetime business cycles, the life cycle, and other instances of temporary wage fluctuations which, by comparison, make the wartime episode look so anomalous.

IV.A. Aggregation Errors in Average Tax Measures

The average marginal tax rates computed by Barro and Sahasakul may, because of composition effects, be misleading. It is conceivable that aggregate measures of the marginal tax rate increased during the war while subsets of workers enjoyed a tax *cut* during the war and it was this subset that responded by working harder. However, it can be shown that nearly all workers were faced with a substantial tax hike during the war. Between 1940 and 1944, more citizens were required to file IIT tax returns (IRS 1944, p. 184). The amount of income exempt from tax was substantially reduced (both in nominal and real terms, IRS 1940, p. 267 and 1944, p. 387). The IIT system was "progressive" in both years in the sense that the marginal tax rate increased with taxable income. The lowest tax positive rate was 3 or 4 percent in both years, but only in 1944 were the higher tax brackets reachable by the majority of families. As a result of these provisions, the majority of persons in 1944 filing households were subject to marginal IIT rates of 20% or more while a majority of persons in 1940 filing households owed no tax. Figure 4 displays the cumulative fraction of persons in filing households with various marginal IIT rates in 1940 and 1994. In 1944, 85% of persons in filing households were in an individual income tax bracket of 20.7% or higher.[17] In 1940, on the other hand, 64% of persons in filing households had a zero marginal tax rate! These figures don't take into account the fact that many households did not even file a return in 1940. In that year the U.S. population was 132 million but only 34 million exemptions and dependents were claimed on individual income tax returns. By 1944, 111 million persons were claimed as exemptions or dependents when the civilian population was 127 million.[18] The number of returns filed more than tripled over the period.

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[17]Persons are computed from the number of exemptions and dependents reported on each return. According to the instructions for IRS forms 1040 and 1040a in 1940 and 1944, a dependent is any "person (other than husband or wife) under 18 years of age, or incapable of self-support because mentally or physically defective, whose chief support was received by the taxpayer" (IRS 1940, p. 267). See Mulligan (1995) for similar results for the cumulative distribution of returns and income.

[18]Military personnel were permitted to defer filing their return (IRS 1944, p. 390).

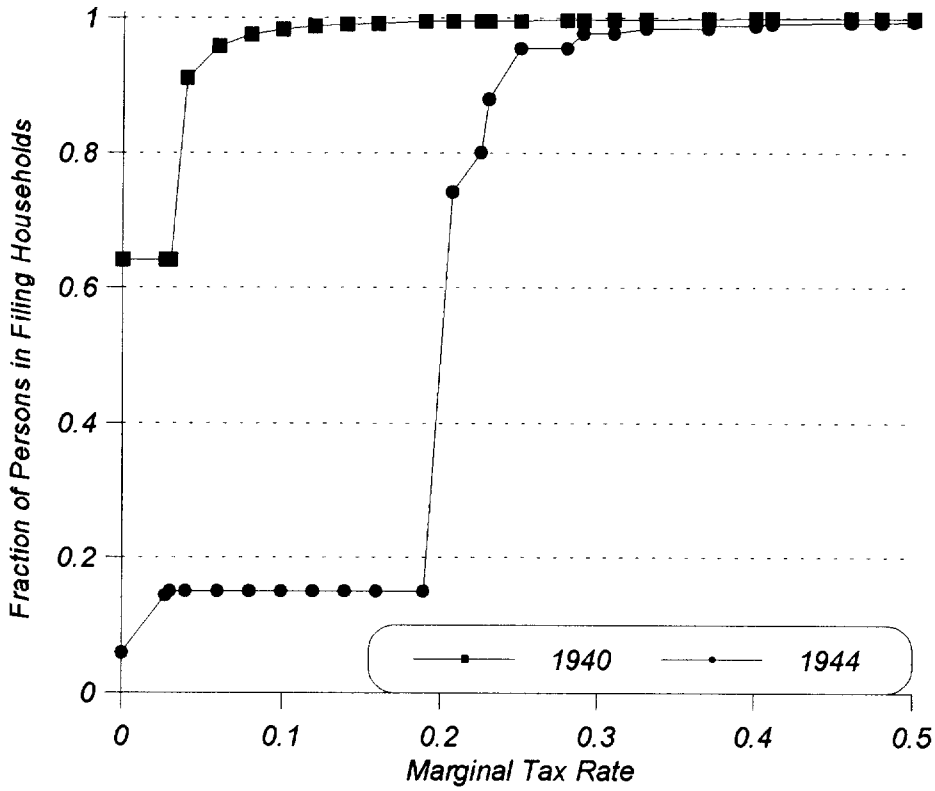

Figure 4 Cumulative Distribution of Marginal Federal Individual Income Tax Rates

(Source: IRS 1940, 1944)

That the WWII tax increase was "across the board" can also be seen in the agreement of various methods of calculating the average marginal tax rate. If we consider the federal income tax only, the AGI weighted arithmetic average of marginal tax rates grew from 5.6% in 1940 to 25.2% in 1944 while the unweighted average grew from 0.8% to 19.5%. The AGI weighted geometric average of marginal tax rates grew from 7.0% to 28.5% while the unweighted geometric average grew from 0.9% to 20.1% (Barro and Sahasakul (1983), Table 2).

Withholding of income taxes at the source began during WWII, so workers did not have to be familiar with Form 1040 to notice the extraordinary rate of income taxation. By the end of 1943, 20% of wages over an exemption amount were to be withheld by all employers (Federal Register 1943, p. 12269).[19]

The IIT tax cuts at the end of the war - the largest in history by some metrics - were also "across the board". The amount of exempt income was fairly constant in real terms, but tax rates were cut "across the board" by at least 4 percentage points. Barro and Sahasakul's (1983) computation of the average marginal Federal IIT rate fell from 25.2% in 1944 to 18.0% in 1948.

Finally, the massive wartime increase in Federal IIT collections shows that much of the wartime increase in labor supply must have been subject to the high wartime marginal rates. IIT collections were

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[19]If a person worked for most of the year, the exemption amount was roughly equal to the exemptions and standard deductions allowed on Form 1040. If a person worked for only part of the year, less income would be exempt from withholding than would be taxable at the end of the tax year.

less than 1% of GDP in 1940, increased to 15% of trend GDP in 1944 (10% of actual GDP), and then fell to 8% of GDP in 1948 (OMB 1996, Historical Table 2-1). These changes in tax collections are even larger than the substantial changes in marginal tax rates.

IV.B. Composition Errors Due to Occupation and Industry Switching

It is possible, for example, that the dynamics of individual wages were different from those shown in the two manufacturing series of Figure 3 because many civilian workers obtained high wartime wages by switching from low wage occupations and industries to high wage occupations and industries. To some extent, occupational and industrial shifts of this type did occur. Manufacturing's share of civilian employment rose from 22% in 1940 to 32% in 1944 and then fell back to 26% in 1948 (CB, p. 364; ERP 1988; Citibase series LHEM). This subsection provides three calculations that suggest that, although low-to-high wage job switching did occur at the beginning of the war, the switches do not significantly bias the two manufacturing series shown in Figure 3 as estimates of the dynamics of individual workers' wages.

As a first computation, consider the labor compensation numbers in the national accounts. Such an aggregate measure of the after-tax real wage is displayed as a solid line in Figure 3 and grows 17% faster than the average hourly earnings of production workers in manufacturing (shown in Figure 3) over the period 1940-44 and 4% faster over the period 1944-48. However, this more aggregate measure of the wage (after-taxes) still appears low during the war relative to the trend for the decade. Even with 1940 as a benchmark, the "all civilians" measure of the after-tax real wage (using the official CPI) is only 8.6% above normal. If the CPI is revised in a reasonable way, even this measure fails to be above normal in 1944.[20]

This first computation also corrects for two other biases in the manufacturing wage series. One potential bias (especially relevant for those who not switch into manufacturing) is that nonmanufacturing wages may have grown at a different - and probably slower - rate. Another bias is that the Conference Board disproportionately included large establishments and excluded some important employers of women in their collection of manufacturing wage data (Women's Bureau November 1944).

Aggregate compensation is not available separately for men and women, but the Women's Bureau (1945, 1946) surveys of wages of primarily female occupations in the health and telephone industries suggests that nonmanufacturing female wages grew more slowly. For example, the money wage rate of

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[20]Unlike the wage series shown in Figure 3, the national accounts measure takes into account changes in the importance of supplements to wages and salaries. To the extent that supplements to wages and salaries grew during the war because of government policies discouraging monetary compensation (eg., wage controls), workers may not value the supplements as much as monetary compensation.

nurses grew only 30% from 1940 to 1944 as compared to 43% for the female series used to construct Figure 3 (Women's Bureau *Bulletin* 203(3)).

As a second computation, we can assume (1) that all of the new manufacturing production workers were agricultural laborers in 1940 (or had 1940 wages that were no lower than agricultural laborers) and (2) that the wage of agricultural laborers fell relative to manufacturing production workers from 1940-44 (otherwise, why did the workers change industries?), then the growth rate of wages for a typical worker is no more than 4 percentage points higher than the growth rate of manufacturing production workers for the period 1940-1944 and is no less than 3 percentage points lower for the period 1944-48.[21] Not only does this "switching from nonmanufacturing to manufacturing" story fail to generate quantitatively important implications, but it leaves unexplained the impetus for switching from one job or industry to another at the beginning of the war and then switching back at the end of the war (remember that behavior changes in the standard model only when budget sets change).

Third, results from a March 1944 national longitudinal population and employment survey conducted by the Bureau of the Census and reported by the Labor Department's Women's Bureau show that employment shifts among broadly define occupational and industrial categories were quantitatively unimportant. Women in March 1944 were asked about their occupation and industry during the week before Pearl Harbor as well as their occupation and industry at the time of the interview. Table 1 displays, for each 1944 occupation, the December 1941 occupation of women in the labor force.

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[21]I compute the wage of a "typical worker" as the weighted average of manufacturing and nonmanufacturing wages, where the weights are manufacturing's share of civilian employment. Average hourly earnings in manufacturing in 1944 was $1.01. A straight-time wage rate of 0.96 is computed from the average hours in manufacturing (45.2). It is assumed that the typical 1944 nonmanufacturing wage is no less than $0.65, the 1944 straight-time wage rate for agricultural laborers.

Table 1: Prewar Activities of Female Wartime Workers - Occupations

		"Previous" Occupation (the week before Pearl Harbor, %)								
March 1944 Occupations	1000s	Professional ...	Proprietors, ...	Clerical & kindred	Sales	Craftsmen, ...	domestic service	Other services	Farm workers	OLF
Professional & semiprofessional	1480	72.97	0.09	0.88	0.56	0.34	0.24	0.38	0.22	24.32
Proprietors, managers, & officials	650	0.11	70.77	2.38	3.61	1.69	0.51	2.22	0.26	18.46
Clerical & kindred	4380	0.67	0.37	50.46	2.65	2.54	0.45	0.95	0.15	41.78
Sales	1240	0.68	0.00	1.31	41.13	1.77	0.64	1.97	0.07	52.42
Craftsmen, foremen, operatives, & laborers except farm	4920	0.65	0.20	1.09	1.64	41.87	4.06	3.43	0.53	46.54
Domestic service	1570	0.19	0.03	0.00	0.10	0.30	63.69	1.51	4.24	29.94
Other services	1650	0.09	0.15	0.19	1.18	2.28	9.22	42.42	0.23	44.24
Farm workers	560	0.24	0.25	0.00	0.00	0.76	2.31	0.00	60.71	35.71
Not classifiable	20									
All ILF	16450	7.03	2.99	14.05	4.62	13.71	8.50	5.95	2.73	40.43
OLF	34940	0.86	0.26	1.37	0.46	1.32	1.14	0.74	0.29	93.56

Notes: (1) "Previous" occupation refers to the occupation during the week before Pearl Harbor. Additional occupational switches that may have occurred between 12/41 and 3/44 are not reported in this data.
(2) OLF denotes "out of the labor force," ILF denotes "in the labor force."
Source: Women's Bureau (June 1944).

The table indicates that the majority of 1944 women in the occupations "craftsmen, foreman, operatives, and laborers (except farm)" were either in that occupation in 1941 or joined the occupation from out of the labor force. Only 7% of the women in that occupational category in 1944 were previously in "domestic services" or "other services." Very few 1941 female farm workers joined the "craftsmen, etc." category in 1944. At least for women, the important shifts were into and out of the labor force.

Table 2: Prewar Activities of Female Wartime Workers - Industries

		"Previous" Industry (the week before Pearl Harbor, %)							12/41 Nonemployment		
March 1944 Industries	1000s	Agriculture	Manuf.	Trans., ...	Trade	finance ...	domes. service...	Other	Housework	School	Other nonemployment
Agriculture	580	60.34	0.55	0.00	0.27	0.26	2.81	0.27	23.20	7.18	5.12
Manufacturing	5590	0.39	42.58	0.27	5.18	2.23	3.75	0.24	26.19	14.24	4.94
Transportation, Communication, Public Utilities	680	0.26	1.62	47.82	4.57	1.88	3.66	0.58	13.76	23.76	2.08
Trade (wholesale & retail)	3190	0.14	1.80	0.18	47.81	1.56	3.67	0.12	23.69	14.82	6.21
Finance, business, repair, professional	2680	0.25	1.52	0.24	2.45	61.05	2.54	0.75	15.42	12.62	3.16
Domestic, personal, recreational services	2660	2.71	0.50	0.23	1.50	0.63	62.41	0.07	18.70	6.77	6.47
Other (mining, construction, government, forestry, fishing)	1080	0.55	3.95	1.99	7.06	5.30	2.88	30.56	21.88	18.47	7.36
Not ascertainable	20										
All	16480	2.81	15.47	2.34	12.35	11.49	12.92	2.28	21.84	13.31	5.19

Notes: (1) "Previous" industry refers to the industry during the week before Pearl Harbor. Additional industrial switches that may have occurred between 12/41 and 3/44 are not reported in this data.
Source: Women's Bureau (June 1944).

Table 2 displays industrial changes by women between December 1941 and March 1944. The majority of women employed in manufacturing in 1944 were either employed in the manufacturing industry or out of the labor force in 1941. 9% switched to manufacturing from wholesale trade, retail trade, or domestic service. Only a very small portion of 1944 female manufacturing workers had been employed in the agricultural industry in 1941. During the war, all industries enjoyed a sizable flow of female employees who were not employed before the war; shifts into and out of the labor force vastly outnumber shifts among broadly defined industries.

IV.C. Wages of Labor Force Entrants

Because of the changing participation rates and the removal of some men from the civilian labor force, it is conceivable that the wages faced by any particular individual were higher during the war while an average of wages across civilian employees (or civilian earnings divided by civilian hours) is low during

the war.[22] This subsection assesses the magnitude of four different composition and aggregation effects: an increase in the proportion of women, entrance into the labor force of women with wages lower than those of prewar female workers, exit of soldiers, and changes in the amount of wage inequality.

Money wages for production workers are measured separately for men and women. That the influx of women tended to decrease the average wage of production workers more than any particular worker's wage declined (because women had lower wages than men) is consistent with the more rapid decline of the dashed line (all production workers in 25 industries) as compared to the dash-dot line (female subset only) in Figure 3. However, we see that even the women's series fails to display high wartime wages.

It is possible that women who became production workers in the 25 manufacturing industries during WWII had lower 1944 after-tax wages than women who were already in that sector in 1940 so that the women's series shown in the Figure is flat while in fact both prewar female workers and labor force entrants enjoyed a high wartime value of time. It is, of course, impossible to estimate the dynamics of the value of time for women who first entered the labor force during the war, but I can show that the wartime wages of prewar female workers were not particularly high. To do so, I use data from the Palmer (1954) survey to estimate the average wage of an women employed in 1944 conditional on her not being employed in 1940 and then revise the aggregate female series to reflect the dynamics of wages of women working both during and before the war.

Palmer (1954) surveyed workers in 1951 about their work histories during the 1940's. Some of her data is now in machine-readable form and can be easily used to make progress on the question "How do the wages of new wartime labor force participants compare to the wages of the other participants who were in the labor force before the war?" Goldin's (1991) Table 5 can be used to estimate the difference in wages between wartime women workers who worked in 1940 and 1950 and wartime women workers who worked in 1950 but not in 1940:[23]

$E(w_{1950} \mid$ female wartime worker, worked in 1940, worked in 1950) -

$E(w_{1950} \mid$ female wartime worker, did not work in 1940, worked in 1950)

$= 50.60 - 44.27 = 6.33$

This difference in 1950 weekly earnings is 13%. If we take this 13% as an estimate of the percentage difference between the 1944 hourly wages of female labor force entrants and female workers who had

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[22]Friedman (1976, p. 208) and Lucas and Rapping (1969) make this point. See Friedman for an illustrative example.

[23]If it is assumed that Goldin's "years living in area" variable is no more than one or two years different for women who entered the labor force during the war, her Tables 3, 5, and 7 can be used to compute the difference in average log wages in the two samples of 0.13.

worked in 1940, the average 1944 wage for all working women understates the average 1944 wage for working women who also worked in 1940 by 3.6%.[24] The reason for this relatively small composition bias is that, although an unprecedented number of women joined the labor force during the war, a sizeable majority of female wartime workers were not recent labor force entrants.

My calculation assumes that the 1950 percentage wage gap is equal to the wartime wage gap, but the gap may have narrowed between 1944 and 1950 as the new entrants gained tenure on their job or as relatively low wage wartime entrants dropped out of the labor force. I cannot calculate the magnitude of this effect but point out that, because a sizeable majority of female wartime workers were not recent labor force entrants, wartime entrants would have to have earned wages in 1944 that were 42% less than those of existing workers in order for the composition error to be as much as 10%.

Another reason to doubt the hypothesis that aggregate wartime after-tax wages substantially overstate individual after-tax wages is the fact that the 12 million soldiers were young men, and young men tend to have lower wages than the typical worker. According to the 1950 Census Public Use Micro Sample, WWII veterans who worked in 1949 earned a wage that was about 3% lower than other members of the 1949 male workforce who were 16 years or older in 1944. Military service in 1944 appears to amount to a removal of low wage workers from the civilian labor force which tended to *increase* aggregate measures of the wage relative to individuals' wages.[25]

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[24]The growth of wages of women working before and during the war ("incumbents") is computed according to:

$$\frac{w^{inc}_{1944}}{w^{inc}_{1940}} = \frac{\bar{w}_{1944}/\bar{w}_{1940}}{e^{-\delta} + (1 - e^{-\delta})\alpha_{1944}}$$

where w^{inc} denotes the wage of incumbents, $\bar{w}_t$ denotes the average wage of workers at date t, α_t is the fraction of date t workers that are incumbents, and δ is the percentage gap between the date t wages of incumbents and entrants. The calculation assumes that all women who worked in 1940 also worked in 1944. To the extent that there was exit from the female labor force between 1940 and 1944, 3.6% is an overstatement of the composition error. The calculation uses female employment numbers of 13.825 and 19.170 million in 1940 and 1944 from Goldin (1990, Table 5.5).

[25]Using Kendrick's (1961) estimates of civilian and military employment of 54.7 million and 11.4 million, military service increased the average civilian wage in 1944 by about 0.5% relative to individuals' wages. Increased participation by low wage male civilians might offset this 0.5% a little bit, but not by much because the overwhelming flow to or from the male civilian labor force was the recruitment of military personnel (eg., the male civilian labor force was 6 million smaller in 1944 than in 1941 or 1946).

IV.D. Changes in the variance of wages

Changes from 1940-44 and 1944-48 in the variance of real wages could generate a scenario where mean after-tax real wages were constant while some workers enjoyed substantial gains while others suffered substantial losses. Different elasticities of labor supply with respect to the after-tax real wage at different points of the wage distribution could then generate changes in aggregate work. However, even though pre-tax wages became more equal over the 1940's, it does not seem that the evolution of the variance of wages between 1940 and 1948 was so nonmonotonic as to generate an increase in work activity between 1940 and 1944 and then a corresponding decrease between 1944 and 1948.[26]

IV.E. Nonlinear Consumption-Leisure Tradeoffs

The marginal tax rate and average hourly earnings say a lot about the incentives to work, but a worker's ability to trade consumption for leisure or leisure at different points in time cannot be exhaustively described by these two numbers. There was at least one important source of nonlinearities in the budget sets of workers: the progressivity of the IIT system and perhaps another, overtime pay.

As compared to 1940, 1944 pre-tax real wages were relatively high. As compared to 1948, 1944 pre-tax real wages were perhaps somewhat above trend. This fact, together with the strong progressivity of the IIT system meant that the wartime incentives to earn the first few dollars of *family* income were relatively high. However, the high wartime tax rates took effect at fairly low incomes so that, after taxes, a single worker household working 40+ hours per week did no better in 1944 than in 1940.[27] A two worker household did even worse after taxes. According to the standard economic model, the wartime progressivity of the tax system therefore meant that: (1) wartime part-time work was encouraged relative to full-time work for single-earner households (especially low wage single-earners), (2) wartime participation by secondary earners was discouraged relative to work by primary earners (especially low wage primary earners). Although participation rates of prime aged civilian men did not increase

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[26]See Goldin and Margo (1992) for a study of the inequality in the 1940's. The Conference Board (1954) reports that the percent of income after-taxes held by the top 5% fell from 23% in 1940 to 17% in 1944 and then increased to 18% in 1948. Pre-tax inequality may have fallen monotonically between 1940 and 1948 - the Conference Board (1954) reports that 48% of pre-tax money income was received by the top quintile, as compared to 49% in 1944. Another measure of pre-tax inequality, the ratio of the pre-tax average hourly earnings of skilled and semi-skilled workers to that of unskilled workers in manufacturing is 1.35, 1.38, 1.28 in 1940, 1944, 1948, respectively.

[27]See Mulligan (1995) for the details of this calculation and a graphical display of a family's consumption-leisure tradeoffs. It calibrates gender-specific wages from average hourly earnings of manufacturing production workers. Mulligan calculates that wartime tax policy introduced an large "kink" in the household's budget constraint at 33 hours per week for the household's first earner.

substantially, it is true that the participation rates of teenagers[28] and single women aged 20-44 increased more than that of married women aged 20-44 (Women's Bureau, June 1944). However, prediction (1) seems at odds with the weekly hours and female labor force participation series displayed in Figure 1 as well as the long wartime hours of teenagers (Bureau of Labor Statistics, January 1945). Furthermore, the peacetime participation rates of primary workers were already too high (with the exception of teenagers) for them to contribute substantially to aggregate wartime labor supply along the participation margin. At least half of the increased wartime aggregate labor supply came from longer hours and increased participation by secondary workers - precisely those margins most discouraged by the progressive wartime IIT system.

Because of the longer hours worked by wartime workers, overtime time pay was certainly more common which might mean that the marginal incentive to work long hours (although probably not the decision to participate in the labor force) is higher than measured by average hourly earnings. But, if overtime policies are constant over time (ie, the definition of overtime and the overtime premium) are constant over time, overtime cannot explain the increased wartime work hours. Rather, it is the increased work hours that explains the overtime.

Trejo (1991) argues that overtime pay schedules are imposed by the government and that they only affect employment and hours decisions when minimum straight-time wage laws are binding. Since statutory minimum wages were not indexed to inflation and inflation was relatively high during the war, one might expect that minimum wage laws were not as important during the war as compared to 1940 or 1948,[29] which means that overtime laws were least likely to encourage long hours during wartime. Even if overtime could explain the longer hours worked by wartime workers, it cannot explain the increased wartime labor force participation of civilian men and women.

IV.F. A Quantitative Summary on Evidence on Wages

Although no *single* measurement issue can explain wartime work, can a combination of them? Table 3 quantitatively reviews the evidence on wage changes during the 1940's. The first row displays the

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[28]Although they may live with their parents, unmarried teenagers could file their own return as a single person. Even at their lower rates of pay, working more that 20 hours per week in 1944 would put them in the 20.7% IIT bracket or the 20% withholding bracket. Thus, wartime tax increases were an important disincentive for long work hours by teenagers.

[29]Because the number of workers covered by minimum wage laws has increased slowly over time, Welch (1978) estimates that minimum wage restrictions were least effective in the 1940's. Changes in the dollar amount of the federal minimum hourly wage took effect in October 1939 (to $0.30 from $0.25) and October 1945 (to $0.40 from $0.30).

growth rate of money wages for two categories of workers and two time periods. The first four columns pertain to the period 1940-44 and the second four pertain to 1944-48. Women's money wages in 25 manufacturing industries grew 43% in the first period and 37% in the second period. Men's wages grew more slowly in the two periods - 40% and 26%. The second row subtracts official estimates of inflation, 23% and 30%, from the growth rate of wages. Four CPI revisions are reported in the text so the third row subtracts an additional 10% from the real wage growth estimates in row two; 10% is probably a conservative revision. Row four adds the rate of change of the after-tax share of wages. That share fell by 23% in the first period because of the massive increases in individual income tax rates in the early 1940's. Some tax cuts after the war led to an increase in the after tax share.

Individual incentives did not necessarily change according to the growth rate of average after-tax real wages because the averages in 1940, 1944 and 1948 are averages across different groups of people. Two sources of composition bias were the temporary inflow of women and the temporary outflow of soldiers during the war. Subsection IV.C estimates that female wartime labor force entrants had relatively low wages so that their entrance into the workforce depressed average female wages by 4%. Soldiers also had low wages relative to men who remained civilians; their exit increased average wages by about 1%.

Table 3 begins with the growth rate of average hourly earnings for a particular job, rather than for a typical worker. To what extent did the wages of a typical worker evolve differently than the average wage of production workers in manufacturing? Subsection IV.B addresses this question in three ways, and offers liberal estimates of the magnitude of the bias of wage growth of a typical worker - no more than 4 percentage points faster for the period 1940-44 and no more than 3 percentage points slower for the period 1944-48. Row 7 of the Table therefore adjusts the growth rates of wages by .04 and -.03.

Table 3: A 7-Part Estimate of the Effect of World War II on After-tax Wage Growth

	1940-44				1944-48			
	women		men		women		men	
	partial	cumul.	partial	cumul.	partial	cumul.	partial	cumul.
1. Money earnings per hour, 25 manufacturing industries	.43	.43	.40	.40	.37	.37	.26	.26
2. Official CPI Inflation (-)	.23	.20	.23	.17	.30	.07	.30	-.04
3. CPI revisions (-)	.10	.10	.10	.07	-.10	.17	-.10	.06
4. Income tax factor (+)	-.23	-.13	-.23	-.16	.09	.26	.09	.15
5. Composition Effects - Labor Force Entrants (+)	.04	-.09	0	-.16	-.04	.22	0	.15
6. Composition Effects - Military Service (+)	0	-.09	-.01	-.17	0	.22	.01	.16
7. Composition Effects - Jobs vs. Workers (+)	.04	**-.05**	.04	**-.13**	-.03	**.19**	-.03	**.13**

Notes (1) Each row is an adjustment to the rows above. A left-hand column displays the row's adjustment. A right-hand column accumulates the adjustments from the rows above.
(2) Official Price Inflation is the growth rate of the CPI for all items.
(3) Three CPI revisions are reported in the text, with 10% is entered in the Table as a conservative average of the three revisions.
(4) Income tax factor is the growth rate of $(1-\tau)$ where τ is the average marginal tax rate computed from Barro and Sahasakul (1986).
(5) Composition Effects - Labor Force Entrants is computed for women only and, based on the Palmer (1954) survey, assumes that female labor force entrants earned 13% less than female employees who also worked in 1940.
(6) Composition Effects - Military Service is computed for men only and, based on the 1950 Census PUMS, assumes that WWII veterans earned 3% less in 1940 than men who were civilian employees in 1944.
(7) Composition Effects - Jobs vs. Workers see footnote 21 and the corresponding text for the details of the computation.
(8) All growth rates are computed as log differences

Overall, the table reports a growth rate of after-tax real wages of -5% for women and -13% for men during the period 1940-44 - a period when labor supply grew substantially. During the second period - when labor supply by both genders fell - the seventh row of the table reports after-tax real wage increases of 19% for women and 13% for men. If one performs the calculations in Table 3 using the "all civilians" wage estimate shown in Figure 3, after-tax real wages (corrected for a 10% CPI revision and the first two composition effects in the table) fall by 1% over the period 1940-44 and increase by 25% over the period 1944-48. Although Table 3 is not the only way to aggregate the variety of measurement biases considered in this section, it suggests that any reasonable accumulation of adjustments would still fail to show that wartime after-tax wages were high relative to 1940 or high relative to the 1940-48 trend.

V. Unfulfilled Expectations about Wages and Taxes

It turns out that money wages, pre-tax real wages, and after-tax real wages were relatively high after the war. If workers had perfect foresight about after-tax wages, it made little financial sense to work more than normal during the war. But perhaps workers expected after-tax wages to fall after the war?[30] Admitting that foresight is not perfect, this section discusses the expectations that would have been required to produce extraordinary wartime work and whether such expectations are consistent with survey evidence, stock market performance, or even plausibility.

Expectations may have been "regressive" in the sense that workers expected after-tax wages to return to the levels of, say, 1940. However, Figure 3 suggests wartime after-tax wages were low even from this backward-looking perspective. An important reason for this was the high wartime tax rates. Did workers expect tax rates to remain constant or to return to prewar levels? The temporary language of the wartime tax hikes - "normal" taxes were distinguished from "defense" or "victory" taxes on Form 1040 (IRS, various issues) - suggest the latter while in fact neither happened although, as measured by their affect on the after-tax real wage, the biggest IIT tax cuts in U.S. history were at the end of the war.

Accept for the moment the *qualitative* aspects of the "unfulfilled expectations" story. Might the substitution effects produced by such expectations be large enough to produce the extraordinary levels of wartime work? As a starting point, consider individual decision makers who maximize a time additively separable utility function defined over consumption and work effort (n) at each date subject to a present value budget constraint. Assume:

(i) tastes for leisure do not deviate from trend

(ii) precautionary motives for delaying leisure are sufficiently weak

In this setup, plans for labor supply obey:[31]

$$E\left[\ln \frac{n_{1944+t}}{n_{1944}}\right] = \sigma E\left[\ln\left(\frac{(1-\tau_{1944+t})\, w_{1944+t}/P_{1944+t}}{(1-\tau_{1944})\, w_{1944}/P_{1944}}\right)\right] - \sigma(r-\rho)t \qquad (2)$$

[30]See, for example, page 26 of the April 9, 1946 *New York Times* for 54 famous economists who predicted a depression after the war.

[31]The equality (2) is derived in the Appendix.

where σ is the intertemporal elasticity of substitution and E is the expectations operator. r and ρ are the average real yield to maturity and rate of time preference, respectively between dates 1944 and 1944+t. Assume for the moment that $r \leq \rho$ (the possibility $r > \rho$ is examined at length in the next section).

For example, consider hours of work in 1944 - which is shown as 47 hours per week in Figure 1. If workers expected wages to return to some "normal" level by year (1944+t) and hours worked during year (1944+t) is planned to be less than or equal to 40, the LHS of equation (2) is less than or equal to ln(40/47) = 0.16. If we take the most generous estimate of an intertemporal elasticity that has been found with other data, 0.75, then the unfulfilled expectations story implies that workers expected at least a 22% decline in real after-tax wages![32] An expectation of a 22% decline turned out to be a tremendous mistake - actual after-tax real wages increased by about 10-15%.

There is some evidence that WWII workers were not dramatically concerned about a recession after the war. The Federal Reserve Board and the Department of Agriculture conducted 814 interviews in Birmingham, AL and Douglas County, IL during January and February of 1945. Only 29% of respondents cited "hard times" or a "rainy day" as their reason for holding liquid assets.[33] 54% held liquid assets for other purposes such as old age or the purchase of specific assets. The 29% figure can be compared with 30% of respondents to the Federal Reserve Board's 1989 Survey of Consumer Finances who claimed that "emergencies, rainy days, unexpected needs, security/independence or reserves in case of unemployment" was their "most important reason for saving".[34]

Another piece of evidence that suggests that wartime expectations of postwar economic performance were not too bleak is the performance of the stock market. Stock returns were -32% over the period 1939-42, but negative stock returns of this magnitude are not surprising in light of the massive increases in corporate income taxes during the early 1940's. Stock returns were 61% over the years 1942-45. At least from capital's perspective, prospects looked much better in 1945 than in 1939.

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[32]To my knowledge, the largest published estimate of the intertemporal elasticity of substitution (IES) of labor supply is 0.74, obtained by Ghez and Becker (1975) using synthetic cohort data. (I exclude Lucas and Rapping (1969) because they use the WWII data without taking labor income tax changes into account). Runkle (1991) found an IES of consumption of 0.75 for a subset of PSID households who had a substantial amount of savings in liquid form. Many labor economists seem to believe that the IES for labor supply is much closer to zero (eg., Pencavel (1986) or Abowd and Card (1989)). Hall (1991), on the other hand, argues that all of the empirical estimates are biased downward.

[33]Board of Governors (1945).

[34]Among the same respondents to the 1989 survey, 24.5% expected the U.S. economy to be better over the next five years, 27.6% expected it to be worse, and 47.9% expected it to be about the same (Board of Governors 1992, author's compilation).

VI. Intertemporal Substitution Induced by Asset Prices

VI.A. Theory

To a good approximation, post Pearl Harbor work activity followed the following pattern: work was abnormally high in 1942, 1943, 1944, and the first half of 1945.[35] Work activity returned to peacetime levels in the second half of 1945. In other words, the *growth rate* of work was high at the beginning, "normal" during, and negative at the end of the war. If, as of 1942, this basic pattern and its exact timing were anticipated, we see from equation (2) that dynamic labor supply models such as Lucas and Rapping (1969), Barro (1981, 1993) and Hall (1980) could explain this behavior in the face of constant preferences and constant after-tax real wages by very high instantaneous real interest rates at the time when work activity returns to peacetime levels and basically "normal" real interest rates at other times during the war and during the postwar period.[36] According to this "asset price hypothesis" (hereafter APH), the very high real interest rates at the end of the war make workers willing to experience a rapidly changing level of work activity over time even though after-tax wages are not changing. The normal interest rates make workers willing to experience an unchanging level of work (unchanging at a high level during the war and unchanging at a lower level after the war). When fully anticipated, this dramatic time pattern of instantaneous real rates should show up in the wartime term structure of real rates with basically normal short term average yields to maturity and very high medium term average yields (where "medium terms" are the terms maturing immediately after the war) and high long term average yields. One related pattern of average yields-to-maturity is displayed in Figure 6 as "YTM (rising hazard)" (the "normal" real interest rate is assumed to be 2 percent per year for the purposes of Figure 6).

If the exact timing of the war and temporal pattern of instantaneous real interest rates were not known with certainty, then the dynamic labor supply model can generate high wartime labor supply with instantaneous real interest rates that are very high in wartime periods when the hazard rate of ending the

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[35]1942 measures of labor supply were substantially above postwar levels, although not as high as those for 1943, 1944, and the first half of 1945.

[36]Such a pattern of real interest rates would occur in an economy without capital in which the timing of high wartime government spending coincided with the high wartime work activity. A similar pattern would also be observed in an economy with capital, but in which an irreversible investment constraint were binding during the war (so that the equilibrium instantaneous real interest rate could exceed the marginal product of capital). See Barro (1987b). This pattern might not occur in the models of Aiyagari et al (1992) and Baxter and King (1993), but the labor supply side of their models is the same as Barro's: wartime work must be motivated by high wages or interest rates, or by wealth effects.

war is high and rates that are "normal" in periods when the hazard rate is near zero.[37]

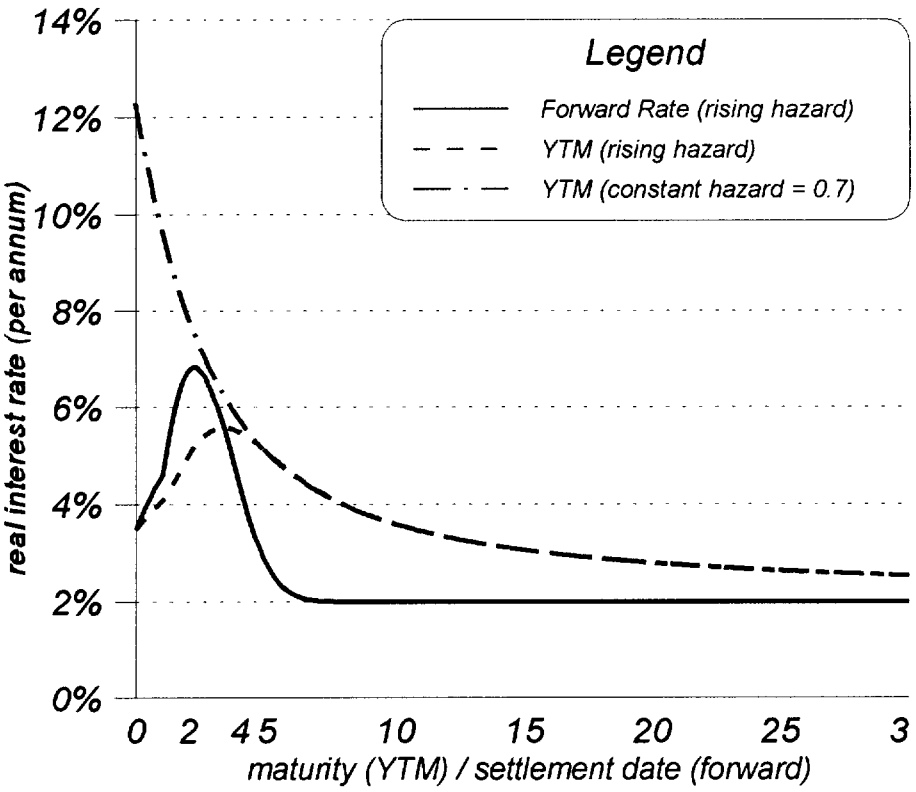

Figure 6 Real Interest Rates According to the APH

The APH also has predictions about the magnitude of wartime real interest rates. Let ν denote the logarithmic gap between wartime and postwar labor supply, σ the intertemporal substitution elasticity, ρ the normal level of real interest rates (measured in percent per annum), and $\eta(t)$ the instantaneous hazard rate (measured at annual rates) of ending the war at date t. The instantaneous wartime real interest rate at date t is:[38]

$$r(t) = \rho + \eta(t)\left(1 - e^{-\nu/\sigma}\right)$$

With $\sigma \leq 1$, and $\nu = .16$,[39] the instantaneous real interest rate is at least 10 annual percentage points above normal when the instantaneous hazard $\eta(t)$ is at least 0.7. Or consider a bond with time to maturity M

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[37]The perfect foresight model sketch above is just a special case of the variable hazard rate model: the hazard rate is infinite at the known end of the war and zero during other wartimes and during peacetime.

[38]This formula is consistent with consumption asset pricing with time separable expected utility or with risk neutral asset pricing. See the Appendix for a derivation.

[39]A constant hazard of 0.7 for one year implies that the war will end with probability one half in the next year.

which is known to mature after the war: its average yield to maturity is $\rho + \nu/(\sigma M)$.[40] When the war is known to end within the next six months (although not exactly when within that six month period), and with $\sigma \leq 1$ and $\nu = .16$, the average yield to maturity on a six month bond is at least 32 annual percentage points above normal.

The model also has predictions for the term structure of real interest rates. Let $r_M(t)$ denote the date t average yield to maturity on a risk free bond with maturity M. If the hazard rate $\eta(t)$ is constant, then yields to maturity fall with maturity as graphed as "YTM (constant hazard = 0.7)" in Figure 6 with the parameters $\sigma = 1$ and $\nu = .16$ and a "normal" interest rate of 0.02. If the hazard rate is rising, then the average yield to maturity can rise and then fall with maturity, as in the special case of perfect foresight and as shown in Figure 6 as "YTM (rising hazard)". Since hazard rates must be low and rising with distance into the future early in the war (the major military campaigns are just beginning) and high and fairly constant later in the war, the model predicts an inverse u-shaped sloping term structure of real interest rates $r_M(t)$ early in the war and a high and downward sloping term structure of real interest rates later in the war.[41]

Suppose there is news about the duration of the war. "Good news" about the duration of the war means an increase in the function $\eta(t)$, and probably a flattening of its slope with t while "bad news" means a decrease in the function $\eta(t)$, and probably a steepening of its slope with t. Thus good news should raise short term real rates in absolute terms and relative to long term rates. The good news may actually lower long term forward rates.[42]

Unfortunately, there was not a market for inflation indexed government bonds in the 1940's, so the predictions of the model for the level or term structure of real interest rates can only be indirectly tested with data on stock prices, nominal interest rates, and corporate investment.

VI.B. Evidence from Stock Prices

Consider corporate equity as a claim on the earnings of the corporation, which would be valued according to the appropriately discounted present value of wartime and peacetime earnings. If corporate earnings grew at a constant rate over time, then the qualitative and quantitative predictions of the APH for

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[40]All "bonds" discussed here are zero coupon bonds. In the empirical analysis that follows, coupon bonds are "stripped" and the corresponding zero coupon yields are reported.

[41]My analysis presumes that forward interest rates can help predict future spot rates. See Fama (1988), Robertson (1992), and others for some tests of this presumption.

[42]The average yield-to-maturity at maturity M is, by definition, related to the forward rates f(t) on $t \in [0,M]$ according to $y(M) = {}_0\int^M f(t)dt$.

stock prices are straight-forward. With a constant hazard rate $\eta(t)$, wartime stock prices are below normal and jump up at the end of the war. With a rising hazard rate, wartime stock prices are below normal and falling until the end of the war when they jump up. Moreover, the constant growth rate model predicts that "bad news" about the duration of the war - a decrease in the hazard $\eta(t)$ - actually increases stock prices.[43]

As cited in Section V, wartime stock prices may have been somewhat below normal. However, this possibility would not confirm the APH because there are certainly other factors - such as the extraordinary rates of wartime corporate income taxation - that might depress wartime stock prices.[44] In fact, we see in Table 4 that wartime stock price-earnings ratios were not abnormal. Even if real interest rates were low and known to remain low, wartime stock prices would be somewhat low because after-tax wartime corporate earnings were somewhat low. "Good" news about the duration of the war could thereby increase stock prices because that news is also good news about the duration of wartime corporate income taxation. The net effect of news about the duration of the war on stock prices therefore depends on: (1) the relative price of a unit of wartime and peacetime corporate earnings and (2) the relative quantity of wartime and peacetime earnings. If the percentage gap between the quantity of wartime and peacetime earnings is greater than the percentage gap in the prices of a unit of wartime and peacetime earnings, then good news about the duration of the war would increase stock prices.

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[43]Because of the scarcity of resources during war, wartime corporate earnings are highly valued. "Good news" means that fewer earnings are wartime earnings and thereby highly valued.

[44]Federal Corporate Income Tax receipts were nearly 8% of actual GDP (and a larger fraction of trend GDP) in 1944 and 1945 (Office of Management and Budget 1996). The same receipts were 1% and 4% of GDP in 1940 and 1948, respectively. As a postwar average, these receipts have been about 3% of GDP.

Table 4: Stock Price-earnings Ratios by Decade			
Period	average PE ratio	Period	average PE ratio
1910's	11.1	1950's	11.1
1920's	12.4	1960's	17.2
1930's	17.9	1970's	11.8
1941-45	**11.1**	1980's	11.0
1946-49	9.9		
Source: Standard and Poor Composite Price and Earnings Indices from Shiller (1989)			

Empirically, "good" and "bad" news are not clearly associated with stock price changes in one direction or another. Table 5 studies 11 wartime events,[45] which are classified according to good news and bad news. Stock returns are measured over the two trading days surrounding the event. For our purposes, perhaps the most promising events are the dropping of the atomic bombs on Hiroshima and Nagasaki. The extreme secrecy of the atomic project makes the best case that the dropping of the bombs was in fact news for the financial markets. Furthermore, it soon became clear that the use of the bombs signaled, if not caused, a rapid end to the war. The first bomb was dropped on August 6th at 8:15a Japanese standard time, which in New York was in the early evening of Sunday August 5. President Truman announced in the U.S. the use of the bomb on the morning of Monday August 6 and, by the close of trading that day, the *New York Times*' index of 50 railroad and industrial stocks had fallen 0.17% relative to its closing value for Friday August 3. The index fell another 1.21% the following day. The market rose 2.1% with the announcement on Thursday of the Nagasaki bomb, with a net change of the index for the week of +0.42%. Since the standard percentage deviation of daily stock index changes was roughly 0.9 during the war, news about the duration of the wartime does not seem to have an economically or statistically significant affect on stock prices. This basic conclusion is confirmed by the results for the other 9 wartime events reported in Table 5.

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[45]We first chose the events from a WWII timeline compiled by "The History Place" according to our impression as to importance of those events for relaying information about the duration of the war. Second, we classified the events as either "good news" or "bad news". Third, we then found data on stock returns associated with those events. Pearl Harbor is excluded because it conveys information both about the beginning and the end of the war.

Table 5: Stock returns and news about the duration of the war

dates		event	classification	stock return, %
event	stock return			
12/7/41*	12/6-12/9	bombing of Pearl Harbor	bad news	-6.08
1/11/42*	1/10-1/13	Japan invades Dutch Borneo, Timor, Celebes	bad news	1.62
2/15/42*	2/14-2/17	Singapore Falls to Japan	bad news	-2.22
3/10/42*	3/10-3/12	Fall of Rangoon to Japan	bad news	-2.15
5/6/42*	5/6-5/8	Philippines surrendered to Japan	bad news	1.32
6/6/42	6/5-6/8	end of the Battle of Midway	good news	0.95
2/9/43*	2/9-2/11	Allies capture of Guadalcanal	good news	0.36
8/25/44*	8/24-8/28	Liberation of Paris	good news	-0.41
3/7/45	3/6-3/8	Allies cross the Rhine	good news	-1.76
5/8/45	5/7-5/9	V-E day	good news	-0.96
8/6/45	8/3-8/7	1st atomic bomb dropped	good news	-1.38‡
8/9/45	8/8-8/10	2nd atomic bomb dropped	good news	1.63
		Average bad news (w/o Pearl Harbor) (standard error)†		-0.36 (0.63)
		Average good news (standard error)†		-0.20 (0.47)
		Average (good news - bad news) (standard error)†		-0.02 (0.38)

*First reported in the following day's newspaper.
†standard error is the standard deviation of daily stock returns in the days surrounding (but not including) these events (0.89), divided by the square root of half the number of observations
‡The first atomic bomb was announced in the U.S. on the morning of 8/6 and, by the close of trading on that day, the stock index fell 0.17%. The index fell another 1.21% on the following day. The total change in the index from 8/3-8/10/45 was +0.42%.
Source: *New York Times*, various issues.

The finding that news about the duration of the war is not systematically associated with stock price changes suggest that the percentage gap between the quantity of wartime and peacetime earnings is roughly

equal to the percentage gap in the prices of a unit of wartime and peacetime earnings. On the other hand, the fairly normal wartime PE ratios suggest that the percentage gap between the quantity of wartime and peacetime earnings was somewhat greater. How low then were wartime corporate earnings? According to national accounts data for the period 1929-65, pretax wartime corporate earnings were abnormally high. But wartime corporate income tax payments were high too so, depending how one estimates the trend, wartime after-tax corporate earnings were between 5 and 8 percent below trend. Thus Tables 4 and 5 are consistent with the prediction of the APH that peacetime cash flows are priced more cheaply than wartime cash flows, although the stock price evidence suggests that the price difference is at most 5-8% different from "normal."

VI.C. Evidence from the Level and Term Structure of Nominal Interest Rates

Since there were no indexed government bonds traded in the U.S. during the 1940's, we have no direct observations on the level and term structure of "risk-free" real interest rates. The differences between the level and term structure of nominal government bond rates and the corresponding risk free real rates might be attributed to the risks of inflation and other forms of government default. These differences can be tough to estimate over long horizons, but we might expect that actual and expected inflation nearly coincide over very short horizons. In this case, one can derive a formula for the instantaneous wartime date t nominal interest rate R(t):

$$R(t) = \rho + \pi(t) + \eta(t)\left(1 - e^{-v/\sigma}\right)$$

where $\pi(t)$ is the wartime inflation rate at date t. Thus the APH predicts high wartime short term nominal interest rates for two reasons: (1) wartime inflation is generally higher than peacetime inflation and (2) the possibility that the war might end in the short term, as represented in the formula by $\eta(t)(1-e^{-v/\sigma})$. Furthermore, holding constant the rate of inflation, short term wartime nominal interest rates should be especially high during periods when the likelihood of ending the war in the short term is high ("especially high" as compared to contemporaneous long term rates, or to peacetime short term rates, or to wartime short term rates during other periods of the war). It is clear that from Figure 7 that these predictions of the APH are far from the actual U.S. experience - wartime short term rates were extraordinarily low as compared to peacetime rates or even as compared to wartime long term average yields to maturity.

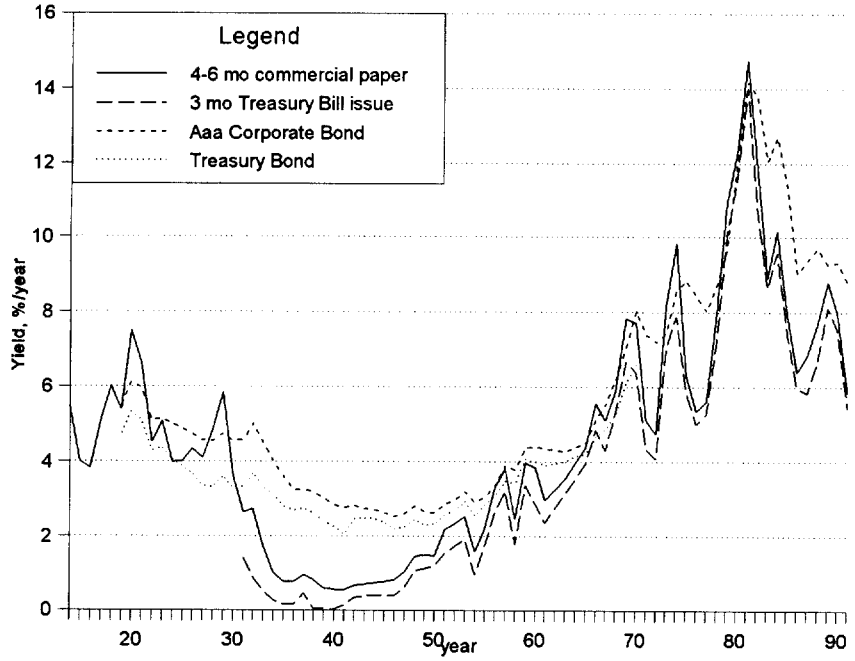

Figure 7 Nominal Interest Rates 1914-91
(Source: Council of Economic Advisers, various issues)

It is tougher to make inferences about the term structure of real interest rates - for which the APH has predictions - from the term structure of nominal rates because of the difficulty in determining the contribution of long term expected inflation to long term nominal rates.

One relevant consideration is the possibility that a dramatic postwar deflation was anticipated. Although no such deflation occurred after WWII, postwar deflations following wartime inflation were not without historical precedent. In the period surrounding the first World War, double-digit (at annual rates) wartime inflation continued for 19 months after the war and was then followed by a 10-20% drop in the price level over the period June 1920- March 1922.[46] Larger deflations immediately followed the Civil War, the War of 1812, and probably the Revolutionary War.[47]

With this in mind, I make three alternative adjustments to the term structure of nominal interest rates to compute a term structure of real interest rates:

(i) Assume that adjustments for expected inflation are similar at all horizons

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[46]*Historical Statistics*, series E-135; Bureau of Labor Statistics (www.bls.gov). Even after the post-WWI deflation, the price level was still substantially higher than it was throughout WWI.

[47]Goldin (1980). Barro (1987b) shows that, among the four wars with wartime inflation fought by Britain over the period 1700-1930, deflations followed two of them. Unlike the case of WWII (and perhaps consistent with the APH hypothesis), nominal interest rates on government bonds were high in most of these American and British wars. See Grossman (1990) for a discussion of the factors that may have prevented a postwar WWII deflation.

(ii) Assume that adjustments for expected inflation are equal to the (smoothed) inflation actually experienced.[48]

(iii) Assume that a postwar deflation, if it were to occur at all, would occur before 1950 and that subsequent inflation would be less than wartime inflation

Assumption (i) allows us to compute the shape of the term structure of real interest rates (although not the level) directly from the shape of the term structure of nominal interest rates. The level and term structure of real forward rates is computed according to assumption (ii) by subtracting actual inflation from the term structure of nominal forward rates. Assumption (iii) is the weakest assumption, but it only permits the computation of very long term forward rates. According to the APH and assumption (iii), the very long term forward nominal rates should be less than short term nominal rates because: (1) the postwar deflation is irrelevant for the very long term forward rates (ie, settlement dates after 1950), (2) postwar inflation is less than wartime inflation, and (3) short term real rates are no less than long term forward real rates.

The solid and long-dashed lines in Figure 8 display the level and term structure of nominal forward rates quoted in February 1943 and August 1945. For example, rates up to two years forward were less than one percent per annum in February 1943. Further forward rates were between one and three percent per annum. In August 1945, the level and term structure of forward nominal rates were pretty similar to those in February 1943, with very slightly higher near forward rates and slightly lower further forward rates.[49] These nominal rates are inconsistent with the predictions that short term wartime nominal rates are high relative to peacetime rates or relative to very long term forward rates. Nor do we see an important difference in the level or shape of the term structure of forward nominal rates as quoted early and later in the war. Such differences are predicted by the APH if assumptions (i) or (iii) are correct.

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[48]The official CPI jumps up at the end of the war upon the removal of price controls. A more realistic measure of 1940's inflation is to assume that inflation was constant during the war years rather than occurring almost entirely in 1946 as measured by the official CPI.

[49]The level and term structure of nominal forward rates were very similar in February and August of 1945. Nor did there appear to be any change in rates in response to the news of the Hiroshima and Nagasaki atomic bombs (*Chicago Journal of Commerce*, various issues).

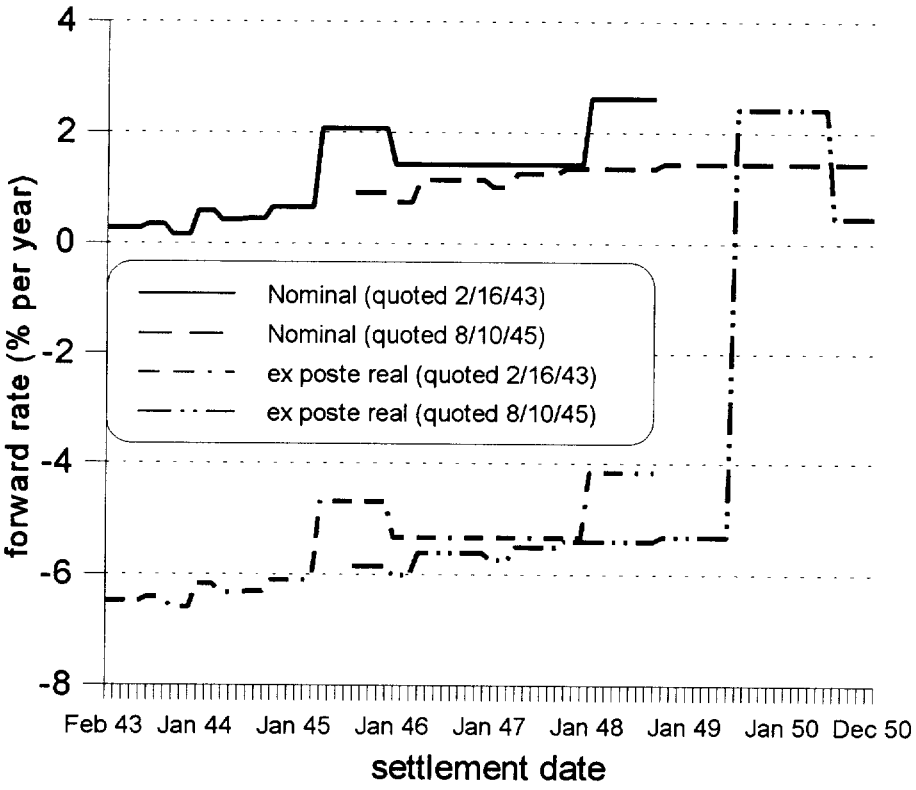

Figure 8 Forward rates during WWII

The dash-dot and dot-dash lines in Figure 8 display the level and term structure of ex poste real forward rates as quoted in February 1943 and August 1945. They are computed by subtracting ex poste CPI inflation (smoothed during the war years) from the nominal forward rates. Most forward real rates computed in this way are extraordinarily low. Nor do we see any evidence that short or medium term forward real rates are higher than very long term forward rates.

When combined with an anticipated postwar deflation, the APH also predicts a dramatic drop in short term nominal interest rates immediately after the end of the war. First, one expects real interest rates to return to normal. Second, inflation might be expected to return to normal. Third, if previous wars are typical, investors might expect a reduction in the price level sometime after the end of the war. Figure 7 does not display such a drop in short term nominal rates in the years immediately following the war.

Regardless of the particular assumptions one makes about expected inflation, peace hazards, and postwar deflation hazards, there are two fairly robust prediction of the APH for nominal interest rates. First, wartime short term rates should be high. Second, long term forward nominal rates should be less than short term rates. The reason is threefold: (a) wartime investors reasonably expected inflation long after the war and after any postwar deflation to be less than wartime inflation, (b) real rates would fall back to normal after the war, and (c) any default risk associated with the war is a risk born mainly during the war years and the first few postwar years. We see in Figure 8 that in fact short term forward nominal rates were less than both wartime long term forward nominal rates and peacetime short term rates.

VI.D. Evidence from Private Investment

According to the national accounts, private investment was extraordinarily low during the war. This finding may be evidence of high real interest rates, although business investment was not abnormally high after the war when real interest rates presumably returned to normal.[50] There are also other explanations for low wartime private investment. For example, an important fraction of the labor force had joined the military so, in the absence of any additional civilian work activity, the same capital stock meant a high capital-labor ratio. Additional labor was available at fairly normal wage rates.[51] Investment goods may have been very expensive or even unavailable as, by law, many manufacturing plants produced military equipment. Finally, government investment may have substituted for private investment (Braun and McGratten 1993). Even if there were no other reasons for low private investment, using the evidence on private investment to explain high wartime civilian labor supply begs the question of this paper - "what were the pecuniary *incentives* for civilians to work?" Workers and firms may have behaved *as if* real interest rates were high, but what motivated them to behave in this way?

VI.E. Summary of Asset-Pricing Results

The observed level and term structure of nominal government bond rates do not suggest that "high real interest rates" were an important pecuniary incentive for wartime work. Wartime stock price levels and changes may be consistent with somewhat high real interest rates, although not high enough to motivate more than a small fraction of the extraordinary wartime civilian work activity. If wartime after-tax real wages were in fact low, then even high real interest rates may not be enough to motivate wartime work.

Although asset prices motivate behavior in many of the modern macro models, the failure of asset prices to explain much (or any) civilian behavior during World War II may not be especially surprising given the failures of asset prices to explain much peacetime behavior - as documented by Hansen and Singleton (1983), Hall (1988), Mehra and Prescott (1985), and others. Another peacetime anomaly that is crucial for several of the predictions derived in this section is the failure of the expectations hypothesis - the term structure of nominal interest rates does not seem to be closely related to the term structure of expected inflation (see, for example Backus et al, 1989).

For clarity of exposition and because previous sections show that wartime after-tax wages were

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[50]The average ratio of gross private domestic investment to GDP for the years 1946-50 was 0.163, as compared to 0.156 for the years 1951-94 (U.S. Council of Economic Advisers, various issues). Postwar consumer durables purchases will extraordinarily high.

[51]Of course, the wage rate relevant for a firm's input demand is different than those shown in Table 3 because taxes and fringe benefits must be paid.

not abnormally high, this section derives results under the assumption that the wartime expected path for after-tax real wages neither encouraged nor discouraged wartime work. If in fact wartime wages were abnormally *low*, then the patterns of asset prices described here must be even more extreme in order to outweigh the disincentive effects of low wartime wages. It has also been assumed for clarity that interest and dividends are not taxed by the IIT when in fact the wartime inflation and IIT rate hikes increased the rate of taxation of interest and dividends by the IIT. If workers expected at least some of the increase to persist after the war, then patterns of pre-tax asset returns described here must be even more extreme in order to outweigh the work disincentive effects of high expected capital income tax rates.

VII. Changes in the Nonmarket Price of Time

Another change in budget sets that may not be detected in wage data is a decrease in the nonmarket price of time during the war. The availability of market goods, which appears to decrease during the war because of rationing and price controls, may affect the nonmarket price of time. Personal consumption expenditures were only 40% of GNP in 1944 as compared to 65% in 1940 and 61% in 1948. Real per capita consumption expenditures were below trend in 1944, growing only 6% from 1940-44 as compared to 14% for the four year period 1944-48.[52] If consumption and leisure were complements, an exogenous temporary decrease in consumption could temporarily increase labor supply even though the wage was temporarily low. However, evidence on the choices of families over the life cycle indicate that consumption and leisure are substitutes, not complements (eg., Ghez and Becker (1975)). In fact, rationing may cause nonmarket time to be more productive because waiting in lines and making personal (and often illegal) contacts with suppliers becomes an important part of the process of obtaining consumption goods.[53]

Perhaps the nonmarket time of husband and wife are complements. A removal of the husband from the home by, say, a military draft, would therefore decrease the household's demand for the wife's nonmarket time even if the after-tax wage in the market had not changed. I find five pieces of evidence against the "husband-wife team" hypothesis, but little evidence that tends to support it.

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[52](ERP 1988, Table B-2). The calculations use the official CPI. In the likely case than the official CPI understated the inflation from 1940 to 1944 by 10% or more, then real consumption expenditures per capita fell during those four years.

[53]Rockoff (1984) reports that, according to a survey in the 1970's of the war generation, "more people remembered [rationing and black markets] than remembered any other feature of the homefront..." (p. 174).

First, civilian employment increased despite the transfer of men to the military sector. In other words, more than one civilian became employed during the war for every military person. The husband-wife team story, on the other hand, predicts that civilian employment would fall significantly because not every soldier is married and many soldier's wives were already employed before the war.

A national longitudinal population and employment survey conducted by the Bureau of the Census and reported by the Labor Department's Women's Bureau offers a second piece of evidence against the husband-wife team hypothesis (Women's Bureau, June 1944).[54] As suggested by the husband-wife team hypothesis, the March 1944 labor force participation rate of women whose husbands were absent from the home and in the armed forces were substantially higher than that of married women with husbands at home (52% versus 19%). However, the same women were also very likely to be working in 1941 - their participation rate was 38%, as compared to 16% for women who would be married with husbands at home in March 1944. Although the wartime increase in the labor force participation rate of these women was higher than that of women married with husbands present in 1944, it was less than the increase among women who were single in 1944 and similar to that of women aged 45+ in 1944 (the vast majority of whom were not married to soldiers).

Third, a relatively small change in a group's participation rate can have an important impact on aggregate labor supply if the group is large. Conversely, even large changes in the participation rates of a small group has a small affect on aggregate labor supply. According to the same longitudinal study, only 600,000 (9.3%) of the 6.7 million women who entered the labor force between December 1941 and March 1944 were married with husband absent in the armed forces in March 1944. The other 91% of wartime female labor force entrants were single (2.9 million), widowed or divorced (0.6 million), married with husband present (2.4 million), or married with husband absent and not in the armed forces (.2 million).[55]

Goldin's (1990, p. 177) analysis of cross-section data is quite consistent with the longitudinal results reported above:

> The number of working women during World War II increased most among those older than 45 years. From March 1940 to July 1944, the peak of the wartime employment of

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[54]An interview was conducted in March 1944, with longitudinal information obtained by asking respondents about their activities during the week before Pearl Harbor.

[55]The Women's Bureau report indicates that only 2.6 million women were married to men who were absent in the armed forces in March 1944. The 1950 Census PUMS, on the other hand, indicates that 4.3 million women were married to men who were absent in the armed forces in 1944. However, because both sources agree on the age distribution of these women, it seems reasonable to assume that the Women's Bureau accurately reports the distribution of female labor force entrants across marital status groups even though the absolute numbers may be inaccurate.

women, those 45 to 64 years increased in numbers by 165% and those over 64 years by 197%; in contrast, those 25 to 44 years old increased by 128%.

According to the 1950 Census, 85% of the women married to military personnel in 1944 - or about 4.8 million women - were between the ages of 20 and 44.[56] But this is exactly the age group that shows the smallest labor supply response during the war! Less than one million the women married to military personnel in 1944 were less than 20 years old or more than 44 years old. Because Goldin shows that more than 3 million women joined the workforce during the war who were not in the 20-44 age group in 1944, soldiers' wives cannot explain much of the increase in aggregate female labor force participation during the war.[57]

A fourth reason to doubt the "husband-wife team" hypothesis is that estimates from other data indicate that the nonmarket time of husband and wife are substitutes. For example, Smith (1977) has found that the growth of wages of one spouse over the life cycle is associated with growth of the labor supply of that spouse and a fall in the labor supply of the other spouse - a finding that is inconsistent with a home production function that has husband's and wife's time as complements. Time diary studies seem to indicate that, weighted by time intensity, there are more at-home activities for which the time of husbands and wives are substitutes than those for which they are complements. For example, the presence of children substantially increases the home time of wives but is not related to the home time of husbands (eg., Juster and Stafford (1991) and Hill and Stafford (1974)).[58]

Fifth, the husband-wife team hypothesis cannot explain the substantially increased hours of civilian men and increased participation rates of unmarried teenagers during the war because their home situation was relatively unaffected by the draft. In fact, a general equilibrium model could predict that the increased participation of soldier's wives would, via a movement along a stable labor demand schedule, lower the equilibrium wage which would encourage husbands and wives in civilian households and single people to work fewer hours and participate less.

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[56]About 1 million women who were married to a WWII soldier in 1944 cannot be identified in the 1950 Census because they died, the soldier died, or the two were divorced or separated.

[57]It cannot be argued that the 1.6 million young labor force entrants were daughters of soldiers. According to the 1950 Census PUMS, there were at most 1.2 million soldiers who had might have been married in 1930. Even if *all* of these soldiers had a daughter in the 14-19 age bracket and *every* daughter was employed in 1944, this accounts for less than 1 million.

[58]Evidence of complementarities seems to found more frequently in recent time diary studies, such as Hill (1985).

VIII. Wealth Effects

According to the folklore of the 1930s, it is hard to believe that Americans felt poorer during WWII than they did before it. Nevertheless, this section seriously considers the hypothesis that the government spending and other wealth effects of WWII were adverse, thereby decreasing the demand for nonmarket time.

The performance of the stock market during the period suggests that adverse wealth effects were of no greater magnitude than can occur during peacetime. Stock returns were -32% over the period 1939-42, but negative stock returns of this magnitude are not surprising in light of the massive increases in corporate income taxes during the early 1940's. Stock returns were 61% over the years 1942-45. At least from capital's perspective, prospects looked much better in 1945 than in 1939.

Forcible conscription is an adverse wealth effect for the draftee and his family. Wages are foregone during the period of conscription while the probability of death is increased. One expects that such wealth effects would be reflected most in the behavior of young women who were married to the draftees. This prediction is true to some extent, but the findings of the previous section show that this cannot explain much aggregate labor supply because only a small fraction of wartime female labor force entrants were married to soldiers.

If the budget sets of teenagers, prime aged men, older men, and older women were as strongly linked to those of draftees as are those of draftees' wives (eg., because of perfectly altruistic linkages), then a "draftee wealth effect" story predicts a fairly uniform increase in hours and labor force participation across age and gender groups. In fact, we do observe important wartime labor supply increases among many types of people.

Even if altruistic linkages spread the wealth effects beyond the immediate families of the soldiers, there are a few other problems with a "draftee wealth effect" story. First, only the increased probability of death and increased government spending are net adverse wealth effects; conscription instead of a volunteer army is merely a transfer from draftees to taxpaying civilians. Second, wealth effects should be spread across all goods yet consumption at all dates and future leisure failed to decline. Perhaps the adverse draftee wealth effect at the beginning of the war was offset by a premature end of the war or a surprisingly low casualty rate,[59] but, in order for such a positive wealth effect to be almost as large as the adverse wealth effect at the beginning of the war (so that consumption and leisure return to normal levels), the expected losses from death, wounding, and government spending had to be many times larger than the

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[59]Veterans did enjoy fairly generous benefits after the war, but cannot be a net wealth effect because it is a transfer from Americans to Americans.

actual losses. Third, the spreading of wealth effects across family members will tend to reduce the behavioral impact of a wealth shock. It therefore seems unlikely that a wealth effects story can simultaneously explain the quantitative dynamics of work activity (ie, the initial increase and the final decrease). Nor is it clear that labor supply motivated by shocks to distant family members can be considered to be "financially" motivated without more information about how resources are allocated among extended family members.[60]

IX. Rationing and Other Restrictions on Voluntary Trade

Hitherto, standard price theory has been the source of potential pecuniary explanations for work activity during the war years. However, a substantial amount of research in macro and labor economics has concentrated on forces which sometimes fail to be readily amenable to more elementary price theoretic reasoning, but might be classified as pecuniary forces nonetheless. These forces include rationing, involuntary unemployment, and liquidity constraints. The object of this section is not to promote or criticize these forces as explanations of human behavior broadly defined, but I do question their relevance for explaining work in the U.S. during WWII.

Wartime consumers were prohibited by law in the United States from purchasing all of the consumer goods that they may demand at going prices. Moreover, the laws did not go unnoticed by consumers.[61] Rationing appears to have affected the consumption behavior of households. It is difficult to argue, however, that consumption rationing encouraged households to work in the marketplace. Rationing may have an effect on labor supply if utility functions (or household production functions) are nonseparable in consumption of market goods and leisure. However, a consumption ration can encourage labor supply in this way only if the leisure and the consumption of market goods are strong complements. There is little evidence for such a strong complementarity.[62]

The concept of "involuntary employment" begins with the idea that the actual quantity of work may fall short of the amount desired at "the going wage." One might argue that, at going wages, workers

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[60]Bernheim and Bagwell (1988), Altonji et al (1992), and others argue that the extended family model of responses to wealth effects has several counterfactual predictions for peacetime behavior.

[61]See, for example, the citation in footnote 53.

[62]Consumer durables were affected the most by rationing. It is not clear that a lack of automobiles or refrigerators would strongly discourage nonmarket time and encourage market work.

wanted to work as much and as hard in 1940 as they did in 1944 but that employers were unwilling or unable to hire them. After all, the civilian unemployment rate in 1940, 14.6%, was quite high (ERP 1988, Table B-32). There are at least three problems with the involuntary unemployment explanation of the dynamics of work activity during the 1940's. First, it cannot explain the postwar reduction in work in the face of rising after-tax wages because hours worked and female labor force participation returned to prewar trends while the unemployment rate did not. The civilian unemployment rate was less than 4% in 1946, 1947 and 1948 - hardly an indication of substantial involuntary unemployment. A second problem is that any Keynesian-style unemployment seems to have disappeared by 1942 - when the civilian unemployment rate was 4.7% - yet a large fraction of the wartime increase in hours worked and female labor force participation would not occur until 1943 and 1944.[63] Third, the number unemployed in 1942, 2.7 million, is dwarfed by the 8-10 million people who would enter the civilian labor force by 1944.

Some may argue that the intertemporal substitution model of consumption and labor supply is not the best explanation of consumer behavior because many consumers are unable to borrow or must borrow at very high interest rates. Households, according to the liquidity constraint story, will tend to consume their income. A corollary to this is that consumers must "work in order to eat". Did civilians worked so hard just to meet basic consumption needs? I see two problems with this argument. First, in order to produce large responses of aggregate work activity, it requires that a majority of households lack liquid assets *and* that they fail to accumulate them. This implication of the liquidity constraints explanation follows from a single observation: a household with liquid assets or one that is accumulating liquid assets has the option to delay work without affecting its consumption stream.[64] Because after-tax real wages were below normal (or, at best, normal) during the war and because the intertemporal smoothing of leisure is desirable, a household with liquid assets or that is accumulating liquid assets would not choose to work more than normal during the war. This implication seems to be rejected by the available data. According to a survey of consumers by the Bureau of Labor Statistics about (among other things) their savings behavior, 49% of urban households purchased government bonds and defense stamps in the first three

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[63]Although their discussions reveal that they had some training in Keynesian economics, writers for the Bureau of Labor Statistics report that Keynesian unemployment was unimportant in 1942: "In 1941 and early 1942 it became increasingly clear that unless taxes, savings, or some other form of deferred purchasing power could drain off the excess funds, prices were likely to give rise to an inflationary spiral..." (U.S. Dept. of Labor, BLS, 1942, p.1).

[64]"Precautionary" consumers might effectively be liquidity constrained even though they are holding liquid assets, but precautionary motives would have to increase during wartime to explain extraordinary wartime work. Although there are several studies of the potential importance of precautionary motives for delaying consumption (eg., Carroll (1997)), I am unaware of an empirical study showing that precautionary motives for delaying leisure are important.

months of 1942.[65] Of course, some additional households may have purchased liquid assets other than government securities. By 1945, 78% of households held some liquid assets.[66] A second problem with a liquidity constraints explanation of labor supply is that it predicts that consumption and work should be positively correlated over time, yet per capita consumption was normal or below normal during the war while work activity was above normal.

X. Changing Discrimination in the Workplace

It is often argued by economists and historians that the removal of men from the civilian workforce permits women to overcome gender discrimination in the workplace (eg., Greenwald (1980, pp. 234-9) and Goldin (1990, p. 177)). In some models, such as Becker (1957) where men dislike working with women, there is a wartime shift in the demand for female labor which shows up as *a higher wage* for women, which then motivates more women to work. But the point of the previous sections is that high wartime after-tax wages were not an important motive for wartime work.

Changing discrimination might be modeled as a shift in the supply of women, perhaps because women do not like working with men. Or perhaps discrimination against women somehow affects employment opportunities for women without affecting wages. Or perhaps discrimination interacts with unionization in the workplace as in Becker (1957, p. 62). To the extent that these forms of discrimination do not rely on higher after-tax wages to motivate wartime participation by women, they can explain the increased wartime participation of women who were victims of prewar discrimination (especially married women - see Goldin (1990)). However, such discrimination probably cannot explain many other components of aggregate labor supply such as the increased participation of single women, older men, or the increased weekly hours by all workers. Nor is it clear why the segregation of men and women achieved by the military draft (which presumably caused the change in discrimination) was not implemented by the private sector during peacetime, so that peacetime employers could enjoy a larger pool of potential workers.

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[65]Even for households with less than $500 of annual income in 1942 ($500 was the 8th percentile of the household income distribution), purchases averaged $16.45 (U.S. Dept. of Labor, Bureau of Labor Statistics, 1945a, pp. 190-1)

[66]U.S. Federal Reserve, Board of Governors (1946b, p. 717).

XI. Concluding Remarks

Several pecuniary motives for work during WWII are considered: wage induced substitution of leisure for consumption, wage induced intertemporal substitution, wealth effects of government spending and the draft, and changes in nonmarket production opportunities. Empirical support for many of these motives cannot be found because after-tax wages do not appear to be temporarily high during the war period. The primary force working against wage motives is the massive across-the-board income tax increases that occurred during the war. 95-100% of marginal earnings were disposable income for workers in 1940, but workers in 1944 kept only 75-80% of their marginal earnings. The apparently low level of real interest rates during the War also works against intertemporal substitution explanations.

Due to the progressivity of the income tax system, teenaged single men and women were least affected by the wartime tax increase and might explain a fraction of the extraordinary wartime labor force participation. Otherwise, wartime work - both participation and hours - is largely unexplained, joining the growing list of failures of the standard economic approach to explaining important behavior. Section X briefly discusses the possibility that changing discrimination might explain some female labor force participation but, due to the lack of theoretical models and relevant data, discrimination and other nonpecuniary explanations such as patriotism are neither confirmed or rejected. Some additional research questions include: can the same nonpecuniary motives be used to explain wartime and peacetime behavior? Does the presence of nonpecuniary motives influence recommendations for government policy? Is the wartime experience a success story for central planning?

Appendix

An Intertemporal Model of Labor Supply

This appendix outlines an intertemporal model of labor supply whose parameters have been estimated (with peacetime data) in the labor economics literature. Examples are Altonji (1982,1986), and MaCurdy (1981, 1983, 1985).

Consumers/workers are uncertain about future wage and tax rates. For every possible realization of their life history $\omega \in \Omega$, they cannot violate a present value budget constraint:

$$\sum_{t=0}^{T} e^{-rt}\left[c_{it}(\omega) - (1-\tau_{it}(\omega))\, n_{it}(\omega)\, W_{it}(\omega)/P_t(\omega)\right] = A_{i0}$$

where $c_{it}(\omega)$ is the age t consumption of worker i when the state of nature is ω. Similarly, $n_{it}(\omega)$ and $W_{it}(\omega)$ denote labor supply and the pre-tax money wage rate. $P_t(\omega)$ is the price level at age t. Labor income is taxed at a flat rate $\tau_{it}(\omega)$, which can vary over time and across workers. A_{i0} is worker i's initial assets. Assets earn a constant rate of return r per unit time.

Uncertainty and the revelation of information over time is modeled with the filtered probability space $(\Omega,\mathcal{F},F,\pi)$. Each state of nature ω has unconditional probability $\pi(\omega)$. The filtration F on Ω is assumed to be increasing and the stochastic processes W_{it}, P_{it}, and τ_{it} are assumed to be adapted to it.

Consumption and work effort are assumed to evolve as if workers choose functions $c_{it}(\omega)$ and $n_{it}(\omega)$ that are adapted to the filtration F with the objective of maximizing the expected value of an intertemporally and intratemporally separable utility function:

$$\sum_{\omega\in\Omega}\pi(\omega)\left(\sum_{t=0}^{T}e^{-\rho t}\left[v(c_{it}(\omega)) - \gamma_{it}\frac{\sigma}{\sigma+1}n_{it}(\omega)^{(\sigma+1)/\sigma}\right]\right) \qquad \textbf{(A-1)}$$

$\rho > 0$ is a constant rate of time preference and $\sigma > 0$ is a constant intertemporal elasticity of substitution. The function v(c) is assumed to be increasing and concave.

The first order conditions of this model can be used to derive an expression for the expected life-cycle rate of growth of labor supply:

$$E_t \ln\frac{n_{i,t+s}}{n_{i,t}} = -\sigma\ln\frac{\gamma_{i,t+s}}{\gamma_{i,t}} - \sigma(r-\rho)s + \sigma E_t \ln\frac{(1-\tau_{i,t+s})W_{i,t+s}/P_{t+s}}{(1-\tau_{i,t})W_{i,t}/P_t} + \sigma[E_t\ln(E_{t+s}\lambda) - \ln(E_t\lambda)] \qquad \textbf{(A-2)}$$

where E_t denotes expectations conditional on $\mathcal{F}_t$, the tth element of the filtration F. $\lambda(\omega)\pi(\omega)$ is the LaGrange multiplier on the state ω budget constraint.

Equation (A-2) says that labor supply can be expected to fall between ages t and t+s for four reasons: (i) a decrease with age in the willingness to substitute consumption for leisure, (ii) the interest rate is higher than the rate of time preference, (iii) after-tax real wages are expected to fall, or (iv) precautionary motives for delaying leisure are sufficiently strong. The magnitude of the intertemporal labor supply response depends on the parameter σ, which has been estimated in the labor supply literature. If we assume that the effects of shifts in the age distribution from year 1944 to year 1944+t are negligible, that precautionary motives are sufficiently weak, and that the real interest rate in 1944 is less than or equal to the rate of time preference, the equation (A-2) implies the inequality (2) in the text.

Equation (A-2) can also be used to derive a formula for ex poste (rather than expected) labor supply at date t+s as a function of date t expectations and forecast errors about those expectations. Furthermore, given the log-linearity of (A-2), an appropriate definition of trends can deliver that results that only forecast errors, deviations of tastes (γ) from trend, deviations of after-tax real wages from trend, deviations of interest rates from "normal," or deviations of precautionary motives from "normal" can produce deviations of labor supply from trend.

Asset Pricing

Although agents in the model are risk averse, the "risk neutral" asset pricing formulas discussed in section VI can be derived in a special case. For that special case to obtain, we need to assume that equilibrium leisure and the after-tax real wage are constant during war, constant during postwar peace (but not necessarily equal during war and peace) and that the only wartime uncertainty is about the ending date of the war. If we define $\Pi_\tau(t)$ to be the probability of war at date t condition on war at date $\tau \leq t$ and ν and ω the logarithmic gaps between wartime and postwar labor supply and wages respectively then, in order for workers to willingly choose this stochastic process for leisure, the equilibrium wartime date τ price of an asset paying one unit of consumption with certainty at date $t \geq \tau$ must be $e^{-\rho(t-\tau)}\left[1 + \Pi_\tau(t)\left(1 - e^{-\omega - \nu/\sigma}\right)\right]$. By using the first order condition that the marginal rate of substitution of consumption and leisure at any date and any contingency is equal to the corresponding after-tax real wage, one can obtain this asset pricing formula as in other consumption-based asset pricing models (eg., Lucas (1978)) which then can be used to price bundles of such securities such as corporate equities.

Precautionary Motives

The inequality (2) is derived under the assumption that "precautionary motives for delaying leisure" are sufficient weak. This assumption does *not* rule out the possibility that precautionary saving, as defined in the recent economics literature, is important. For there to be a precautionary savings motive in this model, all that is required is that $v''' > 0$.

Because of its assumptions about relationships of the second and third derivatives of the intratemporal utility function, the functional form (A-1) utilized in the empirical intertemporal substitution literature implies that there is a precautionary motive for delaying leisure. For two reasons, I do not think that this consequence of the functional form should be taken seriously. First, the functional form was, in all likelihood, chosen by authors of empirical papers because it implies that work is a bad, the intertemporal elasticity of substitution is constant, and perhaps because workers are risk averse (in the sense that they prefer to smooth labor supply over states of nature). None of these ideas are *necessarily* linked to

precautionary motives to delay leisure, even though the functional form (A-1) does link them. A second reason to discount the precautionary motives in the model is that there is (to my knowledge) no empirical evidence that precautionary motives for delaying leisure are important.[67]

Another reason to neglect precautionary motives in the derivation of the inequality (2) is that they are quantitatively insignificant in this model. To see this, suppose that the intertemporal elasticity of substitution of consumption is equal to σ and that the distribution of year (1944+t) consumption can be approximated as a log-normal. Under these two assumptions, the precautionary term in (A-2) - the final term in square brackets - is equal to the $\text{var}(\ln c_{1944+t})/(2\sigma)$. For $\text{sd}(\ln c_{1944+t}) \leq .2$ (ie, as much as a 14% chance that c_{1944+t} will be at least 20% below its expected value) and $\sigma = 0.75$, the precautionary term is less than 0.03 in magnitude - only a small fraction of the -0.16 labor supply growth to be explained.

Generalizations of the Model

This model abstracts from some of the forces considered in the text - such as nonseparabilities between consumption and leisure and labor supply decisions that are made jointly by husbands and wives - but the inequality (2) probably still applies in a "more realistic" model. Suppose, for example, that the home time of husbands and wives are substitutes in home production. Then, conditional on a drop in female labor supply between year 1944 and year 1944+t, this is a force towards male labor supply *growth* over the period - the inequality (2) still holds. If consumption and work do not enter the utility function in a separable way, then the magnitude of the intertemporal labor supply response will be a weighted average of the intertemporal elasticity σ and an intratemporal substitution elasticity (see for example Ghez and Becker (1975) for a derivation). However, according to the nonseparable model, it is just this weighted average than has been estimated in the labor literature. So the inequality (2) and the quantitative discussion of it in the text still goes through - the only difference is that σ is no longer the utility parameter displayed in the expression (A-1).

If consumption and work do not enter the utility function in a separable way and consumption is rationed in 1944, then the inequality (2) still applies when consumption and leisure are substitutes. This is because consumption will grow more than it would without rationing (when (2) applies) which means than leisure will grow less. Life-cycle data from peacetime suggest that in fact consumption and leisure are substitutes (Ghez and Becker, 1975).

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[67]For theoretical discussions of precautionary motives in dynamic stochastic choice problems and of empirical evidence for precautionary motives for delaying consumption, see Deaton (1992) and Dynan (1993).

References

Abowd, John M. and David Card. "On the Covariance Structure of Earnings and Hours Changes." *Econometrica*. 57(2), March 1989: 411-45.

Aiyagari, S. Rao, Lawrence J. Christiano, Martin Eichenbaum. "The Output, Employment, and Interest Rate Effects of Government Consumption." *Journal of Monetary Economics*. 30(1), October 1992: 73-86.

Akerlof, George A. "A Theory of Social Custom, of Which Unemployment may be One Consequence." *Quarterly Journal of Economics*. June 1980: 749-75.

Altonji, Joseph G. "The Intertemporal Substitution Model of Labour Market Fluctuations: An Empirical Analysis." *Review of Economic Studies*. 49(5), 1982: 783-824.

Altonji, Joseph G. "Intertemporal Substitution in Labor Supply: Evidence from Micro Data." *Journal of Political Economy*. 94(3), Part 2, June 1986: S176-S215.

Altonji, Joseph G., Fumio Hayashi, and Larry Kotlikoff. "Is the Extended Family Altruistically Linked? Direct Tests Using Micro Data." *American Economic Review*. 82(5), December 1992: 1177-98.

Backus, D.K., A.W.Gregory and S.E.Zin. "Risk premium in the Term Structure: Evidence from Artificial Economies." *Journal of Monetary Economics*. 24, 1989: 371-99.

Barro, Robert J. "Unanticipated Money, Output, and the Price Level in the United States." *Journal of Political Economy*. 86(4), August 1978: 548-80. Reprinted in Robert E. Lucas, Jr. and Thomas J. Sargent, eds. *Rational Expectations and Econometric Practice*. Minneapolis: University of Minnesota Press, 1981.

Barro, Robert J. "Output Effects of Government Purchases." *Journal of Political Economy*. 89(6), December 1981: 1086-1121.

Barro, Robert J. "Government Spending, Interest Rates, Prices, and Budget Deficits in the United Kingdom, 1701-1918." *Journal of Monetary Economics*. 20(2), September 1987: 221-47.

Barro, Robert J. *Macroeconomics*. New York: John Wiley, 1993.

Barro, Robert J. and Chaipat Sahasakul. "Measuring the Average Marginal Tax Rate from the Individual Income Tax." *Journal of Business*. 56, October 1983: 419-52.

Barro, Robert J. and Chaipat Sahasakul. "Average Marginal Tax Rates from Social Security and the Individual Income Tax." *Journal of Business*. 59(4), October 1986: 555-66.

Barsky, Robert B. and Jeffrey A. Miron. "The Seasonal Cycle and the Business Cycle." *Journal of Political Economy*. 97(3), June 1989: 503-34.

Baxter, Marianne and Robert G. King. "Fiscal Policy in General Equilibrium." *American Economic Review*. 83(3), June 1993: 315-34.

Becker, Gary S. *The Economics of Discrimination*. Chicago: University of Chicago Press, 1957.

Becker, Gary S. "The Rational Formation of Preferences." Cambridge, MA: Harvard University Press, forthcoming, 1996.

Bernheim, B. Douglas and Kyle Bagwell. "Is Everything Neutral?" *Journal of Political Economy*. 96(2), April 1988: 308-38.

Blinder, Alan S. and Yoram Weiss. "Human Capital and Labor Supply: A Synthesis." *Journal of Political Economy*. 84(3), June 1976: 449-72.

Braun, R. Anton and Ellen McGrattan. "The Macroeconomics of War and Peace." Paper presented at the University of Chicago Money and Banking Workshop, May 18, 1993.

Carroll, Christopher D. "Buffer-Stock Saving and the Life Cycle/Permanent Income Hypothesis." *Quarterly Journal of Economics*. 112(1), February 1997: 1-55.

Conference Board, The. *Economic Almanac for 1950*. New York: National Industrial Conference Board, 1950.

Conference Board, The. *Economic Almanac for 1953-54*. New York: National Industrial Conference

Board, 1954.
Constantinides, George. "Habit Formation: A Resolution of the Equity Premium Puzzle." *Journal of Political Economy*. 98(3), June 1990: 519-43.
Deaton, Angus. *Understanding Consumption*. Oxford: Clarendon Press, 1992.
Dynan, Karen E. "How Prudent are Consumers?" *Journal of Political Economy*. 101(6), December 1993: 1104-1113.
Fama, Eugene F. "Term Structure Forecasts of Interest Rates, Inflation, and Real Returns." University of California at Los Angeles Anderson Graduate School of Management Finance Working Paper 5-88, January 1988.
Frank, Robert. "If Homo Economicus Could Choose His Own Utility Function, Would He Want One with a Conscience?" *American Economic Review*. 77, September 1987.
Friedman, Milton. *Price Theory: A Provisional Text*. New York: Aldine de Gruyter, 1976.
Friedman, Milton and Anna J. Schwartz. *Monetary Trends in the United States and the United Kingdom: Their Relation to Income, Prices, and Interest Rates, 1867-1975*. Chicago: University of Chicago Press, 1982.
Ghez, Gilbert R. and Gary S. Becker. *The Allocation of Time and Goods over the Life Cycle*. New York: Columbia University Press (for the NBER), 1975.
Goldin, Claudia. "War." in Glenn Porter, ed. *Encyclopedia of American Economic History: Studies of the Principal Movements and Ideas*. New York: Charles Scribner's Sons, 1980: 935-57.
Greenwald, Maurine Weiner. *Women, War, and Work: The Impact of World War I on Women Workers in the United States*. Westport, CT: Greenwood Press, 1980.
Goldin, Claudia. "The Role of World War II in the Rise of Women's Employment." *American Economic Review*. 81(4), September 1991: 741-56.
Goldin, Claudia. *Understanding the Gender Gap*. New York: Oxford University Press, 1990.
Goldin, Claudia and Robert A. Margo. "The Great Compression: The Wage Structure in the United States at Mid-Century." *Quarterly Journal of Economics*. 107(1), February 1992: 1-34.
Greenwald, Maurine Weiner. *Women, War and Work. The Impact of World War I on Women Workers in the United States*. Westport, CT: Greenwood Press, 1980.
Grossman, Herschel I. "The Political Economy of War Debt and Inflation." in Haraf, William S. and Cagan, Phillip, eds. *Monetary Policy for a Changing Financial Environment*. AEI Studies, no. 495 Washington, D.C.: AEI Press, 1990: 166-81.
Hall, Robert E. "Labor Supply and Aggregate Fluctuations." *Journal of Monetary Economics*. 12(6), Supplement Spring 1980: 7-33.
Hall, Robert E. "Intertemporal Substitution in Consumption." *Journal of Political Economy*. 96(2), April 1988: 339-57.
Hall, Robert E. "Substitution over Time in Consumption and Work." in Lionel W. McKenzie, and Stefano Zamagni, eds. *Value and Capital Fifty Years Later*. New York: New York University Press, 1991: 239-67.
Hansen, Lars Peter and Kenneth J. Singleton. "Stochastic Consumption, Risk Aversion, and the Temporal Behavior of Asset Returns." *Journal of Political Economy*. 91(2), April 1983: 249-65.
Heckman, James J. and Thomas E. MaCurdy. "A Life Cycle Model of Female Labour Supply *Review of Economic Studies*. 47(1), January 1980: 47-74.
Hill, C. Russell and Frank P. Stafford. "Allocation of Time to Pre-School Children and Educational Opportunity." *Journal of Human Resources*. 9, Summer 1974: 323-41.
Hill, Martha S. "Patterns of Time Use." in F. Thomas Juster and Frank P. Stafford, eds. *Time, Goods, & Well-Being*. Ann Arbor, MI: Survey Research Center Institute for Social Research, University of Michigan, 1985.
Joines, Douglas H. "Estimates of the Effective Marginal Tax Rates on Factor Incomes." *Journal of Business*. 54(2), April 1981: 191-226.
Juster, F. Thomas and Frank P. Stafford. "The Allocation of Time: Empirical Findings, Behavioral

Models, and Problems of Measurement." *Journal of Economic Literature*. 29, June 1991: 471-522.

Kendrick, John W. *Productivity Trends in the United States*. Princeton: Princeton University Press, 1961.

Klein, John J. "German Money and Prices 1932-44." in Milton Friedman, ed. *Studies in the Quantity Theory of Money*. Chicago: University of Chicago Press, 1956.

Klein, John J. "Price-Level and Money-Denomination Movements." *Journal of Political Economy*. 1960: 369-78.

Kuznets, Simon. *National Product In Wartime*. New York: National Bureau of Economic Research, 1945.

Lucas, Robert E., Jr. "Asset Prices in an Exchange Economy." *Econometrica*. 46(6), November 1978: 1429-45.

Lucas, Robert E., Jr. and Leonard A. Rapping. "Real Wages, Employment, and Inflation." *Journal of Political Economy*. 77(5), September 1969. Reprinted in Robert E. Lucas, Jr., ed. *Studies in Business Cycle Theory*. Cambridge, MA: M.I.T. Press, 1981.

Lucas, Robert E., Jr. and Leonard A. Rapping. "Unemployment in the Great Depression: Is There a Full Explanation?" *Journal of Political Economy*. 80(1), January 1972. Reprinted in Robert E. Lucas, Jr., ed. *Studies in Business Cycle Theory*. Cambridge, MA: M.I.T. Press, 1981.

MaCurdy, Thomas E. "An Empirical Model of Labor Supply in a Life Cycle Setting." *Journal of Political Economy*. 88(6), December 1981: 1059-85.

MaCurdy, Thomas E. "A Simple Scheme for Estimating an Intertemporal Model of Labor Supply and Consumption in the Presence of Taxes and Uncertainty." *International Economic Review*. 24(2), June 1983.

MaCurdy, Thomas E. "Interpreting Empirical Models of Labor Supply in an Intertemporal Framework with Uncertainty." in Burton Singer and James J. Heckman, eds. *Longitudinal Analysis of Labor Market Data*. New York: Cambridge University Press, 1985.

Mehra, Rajnish and Edward C. Prescott. "The Equity Premium: A Puzzle." *Journal of Monetary Economics*. 15(2), March 1985: 145-61.

Modigliani, F. and A. Sterling. "Determinants of Private Saving with Special Reference to the Role of Social Security - Cross-Country Tests." in F. Modigliani and R. Hemming, eds. *The Determinants of National Saving and Wealth*. London: MacMillian, 1983: 24-55.

Moffitt, Robert. "An Economic Model of Welfare Stigma." *American Economic Review*. 73(5), December 1983: 1023-1035.

Montgomery, James D. "Revisiting Tally's Corner: Mainstream Norms, Cognitive Dissonance, and Underclass Behavior." *Rationality and Society*. 6(4), October 1994: 462-88.

Mulligan, Casey B. "On Intergenerational Altruism, Fertility, and the Persistence of Economic Status." PhD Dissertation, Department of Economics, University of Chicago, August 1993.

Mulligan, Casey B. "The Intertemporal Substitution of Work: What Does the Evidence Say?" University of Chicago, Population Research Center Discussion Paper Series #95-3, February 1995.

Mulligan, Casey B. and Xavier Sala-i-Martin. "U.S. Money Demand: Surprising Cross-Sectional Estimates." *Brookings Papers on Economic Activity*. 2:1992.

New York Times, various issues.

Ohanian, Lee E. "The Macroeconomic Effects of War Finance in the United States: World War II and the Korean War." *American Economic Review*. 87(1), March 1997: 23-40.

Palmer, Gladys L. *Labor Mobility in Six Cities: A Report on the Survey of Patterns and Factors in Labor Mobility, 1940-1950*. New York: Social Science Research Council, 1954.

Peltzman, Sam. "The Growth of Government." *Journal of Law and Economics*. 23, October 1980: 209-87.

Pencavel, John. "Labor Supply of Men: A Survey." in Orley Ashenfelter and Richard Layard, eds. *Handbook of Labor Economics*. Amsterdam: North Holland, 1986.

Pollak, Robert A. "Human Capital and Preferences." Working paper, University of Washington, April

1994a.

Pollak, Robert A. "For Better or Worse: The Roles of Power in Models of Distribution within Marriage." *American Economic Review*. 84(2), May 1994b: 148-52.

Puth, Robert C. *American Economic History*. 2nd edition. Chicago: Dryden Press, 1988.

Robertson, Donald. "Term Structure Forecasts of Inflation." *Economic Journal*. 102(414), September 1992: 1083-93.

Rockoff, Hugh. "Indirect Price Increases and Real Wages during World War II." *Explorations in Economic History*. 15(4), October 1978: 407-20.

Rockoff, Hugh. *Drastic Measures: A History of Wage and Price Controls in the United States*. New York: Cambridge University Press, 1984.

Romer, Paul M. "Preferences, Promises, and the Politics of Entitlement." Working paper, University of California at Berkeley, September 1994.

Rotemberg, Julio J. "Human Relations in the Workplace." *Journal of Political Economy*. 102(4), August 1994: 684-717.

Runkle, David. "Liquidity Constraints and the Permanent Income Hypothesis: Evidence from Panel Data." *Journal of Monetary Economics*. 27(1), February 1991: 73-98.

Rupp, Leila J. *Mobilizing Women for War: German and American Propaganda 1939-45*. Princeton, NJ: Princeton University Press, 1978.

Smith, James. "Family Labor Supply over the Life Cycle." *Explorations in Economic Research*. 4(2), Spring 1977: 205-76.

Sumner, Scott B. "The Transactions and Hoarding Demand for Currency." *Quarterly Review of Economics & Business*. 30(1), Spring 1990: 75-89.

Trejo, Stephen J. "The Effects of Overtime Pay Regulation on Worker Compensation." *American Economic Review*. 81(4), September 1991: 719-40.

United States Council of Economic Advisers. *Economic Report of the President*. Washington, DC: U.S. Government Printing Office, February 1988.

United States Council of Economic Advisers. *Economic Report of the President*. Washington, DC: U.S. Government Printing Office, February 1994.

United States, Department of Commerce, Bureau of the Census. "Labor Force, Employment, and Unemployment in the United States, 1940 to 1946." *Current Population Reports, Labor Force Bulletin*. Series P-50, No. 2, 1947.

United States, Department of Commerce, Bureau of the Census. *Historical Statistics of the United States, Colonial Times to 1970*." Bicentennial edition. Washington : U.S. Dept. of Commerce, Bureau of the Census, 1975.

United States, Department of Commerce, Bureau of the Census. *Census of Population, 1950 [United States]: Public Use Microdata Sample*. ICPSR study #8251, 1984.

United States, Department of Commerce, Bureau of Economic Analysis. *Long Term Economic Growth 1860-1970*. Washington, DC: Government Printing Office, 1973.

United States, Department of Commerce, Bureau of Economic Analysis. *Survey of Current Business*. Washington, DC: Government Printing Office, various issues.

United States Department of Labor, Bureau of Labor Statistics. "Family spending and saving in wartime." *U.S. Bureau of Labor Statistics Bulletin*. no. 822. Washington, DC: U.S. Government Printing Office, 1945.

United States Department of Labor, Bureau of Labor Statistics. "Teen-age Youth in the Wartime Labor Force." *Montly Labor* Review. 60, January 1945: 6-17.

United States Department of Labor, Bureau of Labor Statistics, Cost of Living Division. "Spending and saving of the nation's families in wartime." *U.S. Bureau of Labor Statistics Bulletin*. no. 723. Washington, DC: U.S. Government Printing Office, 1942.

United States Department of Labor, Bureau of Labor Statistics. *Employment and Earnings Statistics for the United States, 1909-62*. Bulletin 1312, Part 1. Washington, DC: U.S. Government Printing

Office, 1963.
United States Department of Labor, Women's Bureau. *Your Questions as to Women in War Industries.* Women's Bureau Bulletin no. 194. Washington, DC: U.S. Government Printing Office, August 1942.
United States Department of Labor, Women's Bureau. *British Policies and Methods in Employing Women in Wartime.* Women's Bureau Bulletin no. 200. Washington, DC: U.S. Government Printing Office, May 1944.
United States Department of Labor, Women's Bureau. *Changes in Women's Employment During the War.* Women's Bureau Special Bulletin no. 20. Washington, DC: U.S. Government Printing Office, June 1944.
United States Department of Labor, Women's Bureau. *Women's Wages in Wartime.* Washington, DC: U.S. Government Printing Office, November 1944.
United States Department of Labor, Women's Bureau. *The Outlook for Women in Occupations in the Medical Services.* Women's Bureau Bulletin no. 211. Washington, DC: U.S. Government Printing Office, 1945.
United States Department of Labor, Women's Bureau. *The Woman Telephone Worker.* Women's Bureau Bulletin no. 207. Washington, DC: U.S. Government Printing Office, 1946.
United States Department of the Treasury, Internal Revenue Service. *Statistics of Income.* various issues.
United States Department of the Treasury. *Annual Report.* Washington, DC: U.S. Government Printing Office, various issues.
United States Department of the Treasury. *Combined Statement of Receipts and Expenditures.* Washington, DC: U.S. Government Printing Office, various issues.
United States Department of the Treasury. *Monthly Statement of United States Currency and Coin.* Washington, DC: U.S. Government Printing Office, various issues.
United States Department of the Treasury. *Treasury Bulletin.* Washington, DC: U.S. Government Printing Office, various issues.
United States Federal Reserve, Board of Governors. "Surveys of Liquid Asset Holdings." *Federal Reserve Bulletin.* 31(9), June 1945: 865-71.
United States Federal Reserve, Board of Governors. "A National Survey of Liquid Assets." *Federal Reserve Bulletin.* 36(6), June 1946a: 574-81.
United States Federal Reserve, Board of Governors. "A National Survey of Liquid Assets Distribution According to Income." *Federal Reserve Bulletin.* 36(7), July 1946b: 716-22.
United States Federal Reserve, Board of Governors. "National Survey of Liquid Assets Distribution According to Income." *Federal Reserve Bulletin.* 36(8), August 1946c: 844-55.
United States Federal Reserve, Board of Governors. "1989 Survey of Consumer Finances, Public Use Data Tape." September 18, 1992.
United States Office of Defense Mobilization. *Meeting Defense Demands.* 2nd Quarterly Report to the President. Washington, DC: Government Printing Office, July 1, 1951.
United States Office of Management and Budget. *Historical Tables, Budget of the United States Government, Fiscal Year 1996.* Washington, DC: Government Printing Office, 1996.
Vawter, Roderick L. *Industrial Mobilization: the Relevant History.* Fort Lesley J. McNair, Washington, D.C.: National Defense University Press, 1983.
Walton, Gary M. and Hugh Rockoff. *History of the American Economy.* 7th edition. Fort Worth, TX: Dryden Press, 1994.
Welch, Finis. *Minimum Wages: Issues and Evidence.* Washington, DC: American Enterprise Institute for Public Policy Research, 1978.
Welch, Finis. "Wages and Participation." *Journal of Labor Economics.* 15(1), Part 2, January 1997: S77-103.