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A CENTURY OF LABOR-LEISURE DISTORTIONS

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ABSTRACT

I construct direct measures of labor-leisure distortions for the American economy during the period 1889-1996, using a new method for empirically evaluating competitive equilibrium models and extending that method to some noncompetitive situations. I then compare measured labor-leisure distortions to proxies for potential restraints of trade: distortionary taxes and subsidies, labor market regulation, monopoly unionism, and search frictions.

Distortions have grown steadily over the century, with the exception of the Great Depression (when distortions were above trend), WWII (below trend), and the 1980's (below trend). Marginal tax rates are well correlated with labor-leisure distortions at low frequencies, but cannot explain Depression, wartime, or 1980's distortions. Monopoly unionism might explain a small part of the Depression distortions, and the decline of unions might explain some of the reduced distortions in the 1980's. In general, I find the decade-to-decade aggregate fluctuations in consumption, wages, and work to be hard to reconcile with simple quantitative models of labor supply and demand.

Casey B. Mulligan
Department of Economics
University of Chicago
1126 East 59th Street
Chicago, IL 60637
and NBER
c-mulligan@uchicago.edu

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I. Introduction

Explaining aggregate measures of behavior, especially measures of labor market activity, has for decades been one of the prime interests of macroeconomists, and others. Almost as old is the question of how much aggregate behavior might be explained by private sector impulses (in modern parlance: tastes, technology, market structure, and demographic shocks) rather than public sector impulses such as government regulations, taxes, and subsidies. Somewhat more recent are attempts to model private sector behavior as a dynamic competitive equilibrium, and Kydland and Prescott (1982) is one rather successful one.

While various explanations in the literature differ in a number of dimensions, a great many of them have two common conceptual ingredients: the marginal value of time (*MRS*) and the marginal product of labor (*MPL*). Furthermore, it is supposed that these two values are stable functions of relatively few variables, and are somehow equilibrated by the economic system. The approach in this paper is to separately measure *MRS* and *MPL* for the last century, and "test" whether they are related. In doing so, I resurrect some old puzzles (eg., "Why was employment low during the Depression?"), but also reveal a new puzzle. Most importantly, I usefully quantify both the old and new puzzles, and offer clear and quantitative suggestions how a more successful theory of the labor market might utilize these old concepts, *MRS* and *MPL*.

Some related calculations for the postwar period can be found in Parkin (1988) and Hall (1997), two macroeconomic studies of time-varying preferences. They compare the postwar time series behavior of the consumption-leisure ratio, which they interpret as one of two determinants of a representative consumer's marginal rate of consumption-leisure substitution, to the time series behavior of the average product of labor, which they interpret as the one determinant of the marginal product of labor. Their models do not allow for market distortions so, when these two series diverge, they say that there is evidence of a preference shift. Elsewhere (Mulligan 2000) I suggest that the Hall-Parkin calculations might instead be interpreted as indicators of labor market distortions, so the purpose of this paper is to explore whether the distortionary interpretation might be more appropriate for the U.S. 20th century time series.

Both trends and medium-term fluctuations are of interest here, and there are some variables that help explain both trends and fluctuations. But there are some forces, such as demographics, that mainly affect trends, and others, such as wars, that mainly affect fluctuations. While the methods used here can be used to define and study both trends and fluctuations, an empirical study of the forces relevant to both is too much for one paper, so I focus on the medium-term fluctuations. My analysis suggests that the largest of these fluctuations are the 1930's, the 1940's, and the 1980's. A byproduct of the analysis is time series of the quantity of labor market regulation, and the aggregate effects of monopoly unionism. A number of studies have suggested that regulation and unionism have noticeable aggregate effects, so these new time series are likely to be useful regardless of the theoretical approach to modeling the labor market.

II. The "Labor Equilibrium" Equation to be Examined

This paper is essentially a study of one important "labor equilibrium" equation from economic theory, the one that equates the marginal value of time (*MRS*) to the "after-tax" marginal product of labor (*MPL*):

$$MRS_t = (1 - \tau_t) MPL_t \tag{1}$$

where t indexes calendar time, and τ is the marginal "tax" rate. Equation (1) is implied by a huge class of models of the labor market including, but not limited to, various static general equilibrium models, various dynamic general equilibrium models such as the representative agent "real business cycle" models of King, Plosser, and Rebelo (1988) and Kydland and Prescott (1983), (partly) noncompetitive equilibrium models such as Wu and Zhang (2000), models with financial frictions, and models with discrete choice and/or heterogeneous agents such as Houthakker (1955) and Mulligan (2001a). Furthermore, I argue below that Equation (1) is readily extended to include models with employment search frictions.

III. Construction of the Direct Distortion Measures

III.A. Functional Forms From the Literature

The labor equilibrium equation (1) would be most powerful if MRS_t, MPL_t, and/or τ_t could be measured directly, independently, and without error. This is not the case, but many (including, but not limited to, the papers cited above) have supposed that MRS_t and MPL_t are stable and fairly simple functions of output, average consumption, average hourly earnings, and work hours.[1] In particular, a great many studies have assumed that the marginal product of labor is equal to employee compensation (plus a fraction of self-employment income) per manhour, or that *MPL* proportional to the average product of labor, as it would be if output Y_t were Cobb-Douglas in labor input L_t:

$$MPL_t \equiv \alpha Y_t / L_t \quad \text{or} \quad w_t / L_t \tag{2}$$

where α is the coefficient of proportionality, aka "labor's share," and w is employee compensation plus a fraction of self-employment income. Since the ratio of employee compensation to GDP are pretty constant over time, these two approximations are practically the same,[2] except during WWII when measured GDP increased 7 percentage points less than employee compensation. I use (employee compensation + 0.615*selfemployment income) per manhour as my proxy for marginal product, except prior to 1929 (which I do not have an employee compensation series) when I use 0.615*the average product of labor.

In some models of imperfect goods market competition, the marginal product of labor exceeds the real wage, the marginal revenue product of labor, and (labor's share*average product of labor). To the extent this is true, my analysis is of the wedge between marginal revenue product and *MRS*, without regards for the wedge between marginal product and real marginal

[1]Parkin (1988) and Hall (1997) is two exceptions from the macroeconomic literature, suggesting that the important determinants of *MRS* are unobserved preference parameters. Other exceptions from the macroeconomic literature are some of the studies of household production (eg., Benhabib et al (1991) or Ingram et al (1997)), which suggest that the mix of nonmarket time between leisure and household changes significantly from year to year.

[2]Some models of distortions (counterfactually?) imply that measured wage rates and labor productivity should diverge – see Appendix III.

revenue product. As suggested by Hall (1986), this neglected wedge is related to labor's share and, since labor's share of GDP is pretty constant over time, presumably does not vary nearly as much as the first wedge. With this in mind, I hereafter refer to the $\alpha Y/L$ as the average product of labor.

More than one function, but still relatively few, have been used in the macroeconomics literature to compute the marginal value of time. Two of those are:

$$MRS_t \equiv \theta \frac{c_t}{1 - L_t} \tag{3}$$

$$MRS_t \equiv \theta c_t \tag{4}$$

The first value of time function (3) derives from time separable log utility, as used by King, Plosser, and Rebelo (1988) and others. The second, equation (4), derives from the time separable and linear-in-labor utility function used by Hansen (1985) and others.[3]

Most of the literature cited has not been concerned with explaining behavior prior to 1929, and in doing so it may be desirable to consider a third value of time function (5) – one derived from a Stone-Geary modification of the log:

$$MRS_t \equiv \theta \frac{c_t - \gamma}{1 - L_t} \tag{5}$$

[3]Hansen's quasilinear utility function has the additional implication that labor is zero (or at its maximum feasible value) whenever θc is strictly greater (less) than $(1-\tau)MPL$. Hansen (1985,) derives $\theta c = (1-\tau)MPL$ as a condition of equilibrium (so that aggregate labor is interior), and my calculations offer some tests of whether this equality holds empirically.

where γ is a subsistence level of consumption and (5) presumes that c_t exceeds that level.

The methods use here make it quite easy to search for the best *MRS* function (in econometrics parlance, "estimate" the *MRS* function). Appendix IV looks at four other *MRS* functions, showing why at least two of (3), (4), (5) are prevalent in the literature for a good reason – they fit a century of aggregate data (relatively) well.

The methods used here also apply even when the labor equilibrium equation (1) does not hold for all, or even many, individuals. For example, consider an economy where individual labor supply must be either zero or one, and individuals differ in terms of their willingness to supply labor. In this case, (1) should be interpreted as equating the value of time for the marginal worker (which is different than the value of time for other workers) to his after-tax marginal product of labor. Of course, the identity of this marginal worker is likely to change over time, but all that is needed to apply the methods of this paper is for the marginal workers' value of time and marginal product be stable (and known) functions of a few measurable aggregate variables, as they are in Mulligan's (2001a) model. When using functional forms like (3) or (5), this simply means that an economy with more average consumption, or more aggregate labor, has a higher value of time for its marginal worker.

In other words, among the variety of interpretations and applications of equation (1), the application here is to data aggregated over time and across persons. Equation (1) might thereby be interpreted as describing the relationship between the "aggregate" supply and demand for labor – rather than any individual's willingness to supply or pay for labor services. In particular, "labor input" *L* is an aggregate of men and women, educated and uneducated, "hours" and "participation." At this level, the theory has little to say about the allocation of aggregate hours among various groups or various margins. I return in Section 7 to this point, and suggest that a less aggregate analysis would not help explain some of the major failures of equation (1) as applied to a century of aggregate data.

III.B. Data Sources

(2) and either (3), (4), or (5) can be used to compute time series for the marginal value of time and marginal product of labor. Or they can be used together to compute the marginal tax rate $\hat{\tau}$ implied by the functional forms and the labor equilibrium equation, as in equations (4)′

and (5)′:[4]

$$\hat{\tau}_t \equiv 1 - \frac{\theta}{\alpha}\frac{c_t}{Y_t}L_t \qquad (4)'$$

$$\hat{\tau}_t \equiv 1 - \frac{\theta}{\alpha}\frac{c_t - \gamma}{Y_t}\frac{L_t}{1 - L_t} \qquad (5)'$$

With a direct measure of the marginal tax rate, we can then test the labor equilibrium equation (1) by comparing measured marginal tax rates $\{\tau_t\}$ with those $\{\hat{\tau}_t\}$ implied by the quantity series $\{L_t, c_t/Y_t\}$ and the functional forms (2) - (5).

Hence, to compute times series for *MRS* and *MPL* we need four (per capita) time series: real consumption, real output or labor compensation, labor input, and leisure time (which is essentially three series if we restrict labor and leisure time to sum to one). We need one less series to calculate implied tax rates: labor input, leisure time, and the consumption-output ratio.

I measure the four series for the period 1889-1996. "Consumption" *c* is measured as NIPA personal consumption expenditures (1889-1928 from Kendrick (1961, Table A-IIb) and 1929-96 from BEA NIPA Table 1.01), and therefore includes import, sales, and excise taxes paid by consumers with their purchases (BEA 1990, p. 32).[5] Output *Y* is measured as GDP (same sources as *c*) and *w* as labor compensation (which is the sum of employee compensation and 0.615*proprietor's adjusted income, both from NIPA Table 1.14). Labor input is the product of total employment and hours per employee. The former is from Kendrik (1961, Table A-VI) through 1928, from Census Bureau (1975, series D-5 and D-15) 1929-58, and from the BLS series

[4](4)′ and (5)′ are the appropriate definitions when *MPL* is measured as a proportion of the average product of labor. *w* replaces αY in the formulas when *MPL* is measured as compensation per manhour.

[5]When necessary, these are converted to 1996 dollars by chaining together various GDP deflator series. As mentioned in the text, the deflator is irrelevant for computing implied tax rates as long as the relevant deflator is the same for personal consumption expenditures and GDP.

1959-96. Kendrick also estimates hours per employee, and reports its product with civilian employment (1961, Table A-X) through 1953. For the years 1954-88, I measure annual hours per employee as average weekly hours calculated by the Bureau of Labor Statistics (1988) from the Current Population Survey (plus 0.7, and times 52, to match Kendrick's annual hours series in 1953).

The series $\{L_t, c_t/Y_t\}$ are displayed in Figure 1 for the reader's reference. It is important to notice that there are four major changes in aggregate labor (including military labor) hours during the period:

(i) labor hours have fallen substantially: compare 1889-1929 with 1950-96,

(ii) labor hours were low during the Great Depression,

(iii) labor hours were high during WWII, and

(iv) labor hours rose in the 1980's

With the exception of (i), these changes are mainly due to changes in the fraction of people aged 15+ who are employed sometime during the year, rather than changes in hours per employee.

We see similar, although less dramatic, changes in the consumption-output ratio:

(i) c/Y is somewhat lower in the latter half of the century,

(ii) c/Y is relatively high during the Great Depression,

(iii) c/Y is low during WWII, and

(iv) c/Y rose in the 1980's

These changes drive the main calculations regarding the labor equilibrium equation, so I discuss them in some detail below as I present the calculations.

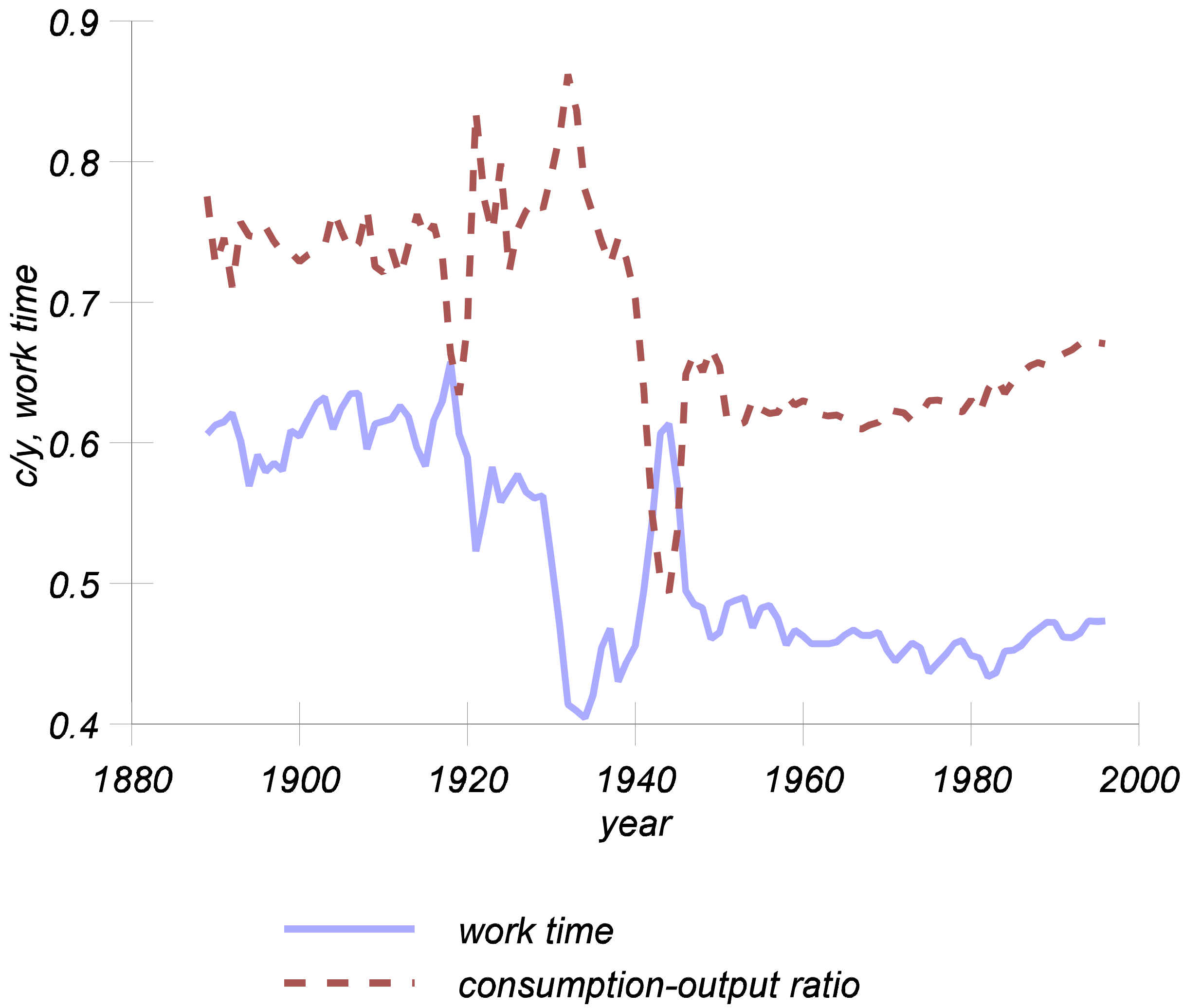

Figure 1 Primary Time Series Used to Simulate Tax Wedges

Two adjustments are made during wartime (1939-48)[6]. First, *MPL* is measured as civilian labor compensation[7] per civilian manhour, rather than labor compensation per (civilian + military) manhour. During WWII, military employment grew by a factor of 20 while military wages rates fell substantially, both in absolute terms and relative to civilian wages, which

[6]Results are quite insensitive to small changes in the definition of "war years" because these adjustments are trivial when the military is small, or there is a volunteer force.

[7]ie, the difference between labor compensation and military wages and salaries.

probably can not be attributed either to a reduced marginal product or to a reduced value of time for military personnel (that is why so many of them had to be drafted!). Hence, the wartime marginal product of labor is calculated from civilian data only.

I also adjust wartime consumption by excluding military personnel. In other words, rather than computing *c* as the ratio of aggregate personal consumption expenditures to the population aged 15+ (as I do for peacetime years), I compute wartime *c* as the ratio of civilian personal consumption expenditures to the civilian population aged 15+.[8] This adjustment slightly increases measured wartime consumption. If the required data were available, both of these adjustments could be for the entire century, but the adjustments would be trivial in any year where military personnel are few in number *or* are paid like civilians.

IV. Aggregate Distortions Displayed and Interpreted

IV.A. Functional Forms as Applied to the 20th Century Data

In order to compute the *MRS* and *MRT* using the formulas (2) - (5), numerical values must be assigned to the parameters α, θ, and γ. The literature often sets α at 2/3 and, in the log utility case, θ at 0.7 or 0.75 in order to match the levels of *MRS* and *MPL* with each other and with wage data for the postwar period. I do basically the same (α = 0.615; θ = 0.7 for log utility; θ = 0.0005 for quasilinear utility; and θ = 0.725, γ = 1000 1996 dollars for Stone-Geary utility) to match *MRS* and $(1-\tau)$*MPL* with each other and with wage and tax data (see Section V) for the period 1950-79, but notice from (4)′ and (5)′ that the calculated levels of *MRS* and *MPL* are irrelevant for testing the labor equilibrium equation (1), because only their ratio *MRS*/*MPL*, and its changes over time, affect the implied marginal tax rate and its changes over time.

Although the parameter θ affects neither the direction nor the magnitude of changes in implied marginal tax rates, the functional forms (3) - (5) do affect the magnitude of those changes and, to some degree, their direction. There are three relative dimensions on which to classify *MRS* functions: intertemporal separability, and the elasticities of *MRS* with respect to contemporaneous consumption and leisure. Barro and King (1984) have shown how the

[8]Civilian consumption is measured as the difference between aggregate personal consumption expenditures and one half of military wages (assuming that half of military wages are saved, paid in taxes, or paid to civilian family members).

intertemporal separability of preferences implies that consumption and leisure move in different directions only when the after-tax wage changes. For example, this implies that, in the absence of any wage change, *any* intertemporally separable utility function for which consumption and leisure are normal goods will produce simulated tax rates that fall in the 1980's – merely because consumption and leisure move in opposite directions.[9]

Functional forms such (3), (4), (5), and the *MRS* functions considered in Appendix IV are intertemporally separable, and in addition assume particular elasticities with respect consumption and leisure. Choice among these functional forms obviously affects the magnitude of implied rate changes, but it can also affect the direction of changes if consumption and leisure are moving together or if wages are changing while consumption and leisure move apart.

IV.B. Relative trends and fluctuations of *MRS* and *MPL*

Figure 2 displays the *MPL* series and two *MRS* series calculated using the formulas (2) - (5).[10] The *MPL* grows steadily,[11] although perhaps at a higher rate since 1929. All three of the *MRS* series are much less smooth than *MPL*. This includes noticeable year-to-year variation as well as three episodes of substantial medium term fluctuations:

(i) Both *MRS* series fall substantially during the Great Depression

(ii) Both *MRS* series rise substantially during WWII

(iii) Both *MRS* series rise substantially during the 1980's

[9]The methods used in this paper can be readily applied to any *MRS* function, including those not separable over time. Because my focus is on episodes with large and rapid changes in consumption and/or leisure, I have not made such calculations, and suggest that the main results are robust to more complicated *MRS* functions as long as there is a relatively strong weight on contemporaneous consumption and leisure.

[10]The *MRS* series based on quasilinear utility is omitted in order to avoid cluttering Figure 2, but is displayed in Figure 3 which is the focus of my analysis.

[11]Noted that various prewar data series are interpolated between Census years. In particular, sector output fluctuations are often used to interpolate sector employment fluctuations between Census years (eg., Lebergott 1964, p. 440). This tends to lead to too little variation in the output employment ratio for the interpolated years, and hence too little variation in my quantity-based *MPL* series.

Although not shown in Figure 2, (i) and (iii) can also be concluded from the Hansen *MRS* function. As I discuss below, the Hansen *MRS* series does not deviate from trend during WWII.

These conclusions are not sensitive to the exclusion of durables expenditures from the consumption series, because durables are a small and stable fraction of total consumption expenditure. Perhaps World War II is the exception, when durables spending fell relative to other consumption spending, but even then the exclusion of durables purchases from the consumption series results only in a slight upward revision of the *MRS* series during the war years.

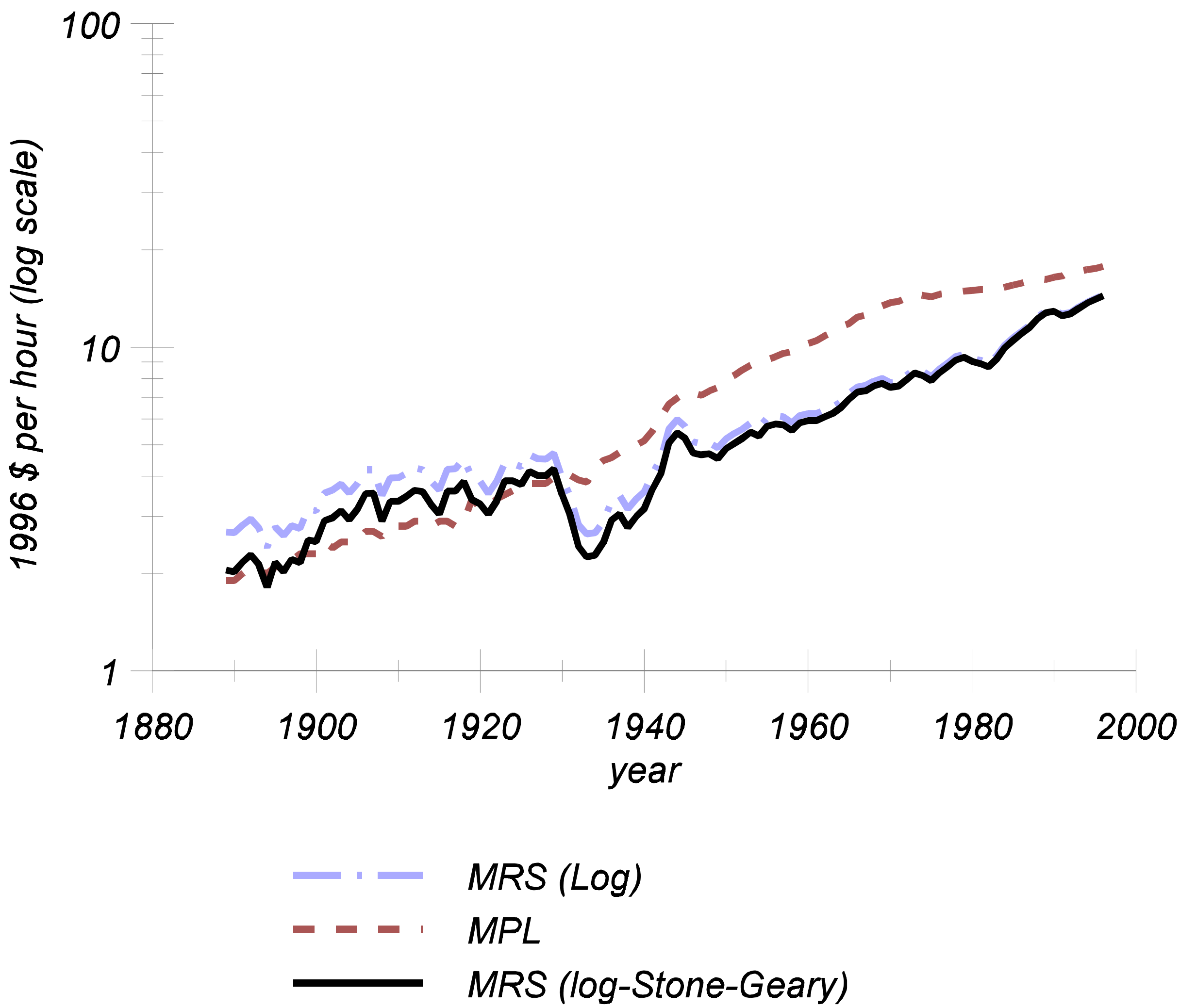

Figure 2 *MPL* and *MRS*

The statistical sources of (i)-(iii) are clear from Figure 1 and the formulas (3) - (5). The Great Depression, WWII, and 1980's changes in *MRS* derive in large part from the fluctuations in labor input. The consumption series mitigate, but do not erase, (i) and (ii) because consumption grows somewhat more than output during the Great Depression and less than output during WWII. The consumption series contributes to the 1980's increase in the *MRS* because consumption is growing more than output while labor input is increasing.

Comparing the *MPL* series with the *MRS* series, we see that the log and log-Stone-Geary *MRS* trend upward somewhat more slowly than the *MPL*. Not surprisingly, the Stone-Geary *MRS* grows more than the log *MRS* early in the century, and they are practically parallel later. Since the *MPL* grows steadily throughout the century, the *MRS* fluctuations (i) - (iii) are each relative to the *MPL*.

IV.C. Implied Marginal Tax Rates

If the labor equilibrium equation is to explain these different trends and fluctuations in *MPL* and *MRS*, it is with trending and fluctuating marginal tax rates. Hence the next step in my analysis is to compute the marginal tax rates implied by the labor equilibrium equation (1) and Figure 2. Figure 3 displays those implied tax rates for the log-Stone-Geary (solid line) and Hansen (dash-dot line) *MRS* functions. They fluctuate a lot from year-to-year because the *MRS* fluctuates relative to the *MPL*. They are much higher later in the century, partly because the *MRS* grows more slowly (which in turn derives from the drop in labor hours from early in the century) and partly because the consumption-output ratio has fallen.

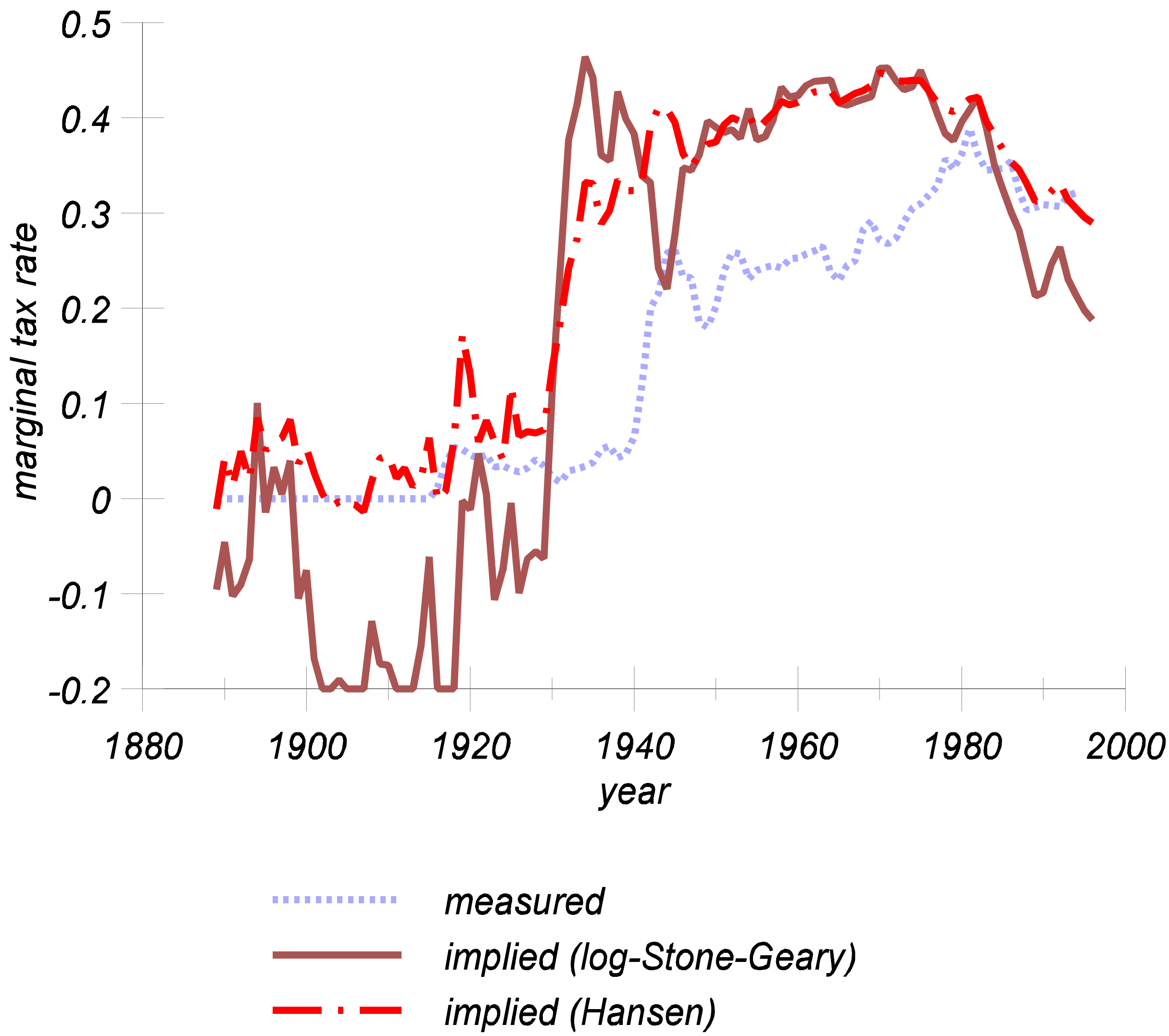

Figure 3 Marginal "Tax" Rates Implied by Labor Equilibrium, and Measured by Barro-Sahasakul

The implied tax rates are high during the Depression, and relatively low during the 1980's. Implied wartime tax rates are relatively low according to the log-Stone-Geary preferences – because leisure time declines so much relative to the *MPL* – and are relatively high according to the Hansen preferences because those preferences imply that the *MRS* is independent of the amount of leisure time, varying only with consumption. These various differences over time are very large – implied rates rise 25-50 percentage points 1929-34, change by 8-20 percentage points 1934-43 (falling 20 percentage points according to log-Stone-Geary, rising 8 points according to Hansen), and fall 10-20 percentage points 1979-96.

IV.D. Measured Wages and Hours Since 1970

Notice from Figure 2 that measured *MPL* rises since 1970, although at a slower rate than prior to 1970. This is true whether I measure *MPL* as labor compensation per manhour or as a proportion of the average product of labor. It has been pointed out (eg., Abraham, Spletzer, and Stewart 1999) that other aggregate measures of wage do not rise since 1970. Although a bit of the difference among series can be attributed to the inclusion of fringe benefits in my measures, which in theory ought to be included when measuring the *MPL*, many of the differences have not been explained. If in fact *MPL* grows less than I measure it, but the growth of *MRS* is measured correctly, then I overestimate the increase (or understate the decrease) in the implied tax rate since 1970.[12] I suggest below that it is puzzling that implied tax rates fall so much in the 1980's, and recognize these measurement problems only exacerbates the puzzle.

V. Potential Causes of Labor-Leisure Distortions

If the labor equilibrium equation (1) and the functional forms (2) - (5) are useful for explaining labor market trends and fluctuations, then ideally measured marginal tax rates – or labor market distortions more generally – should mimic the implied marginal tax rates in Figure 3. Have labor market distortions risen, and by as much, as implied marginal tax rates over the century? Do marginal tax rates increase by 40 or 50 percentage points during the Depression? Or fall 20 percentage points during the war? Or fall 10-20 percentage points during the 1980's? In order to answer these questions, I calculate "marginal tax rates" for the century by examining five potential sources of labor market distortions: federal labor income taxation, federal labor market regulation, sales taxes, transfer payments, and monopoly unionism. These marginal tax rate series are then compared with the implied marginal tax rates shown in Figure 3.

V.A. Federal Labor Income Taxes

Of course, taxes on labor income are expected to drive a wedge between *MRS* and *MPL*.

[12]If *MPL* grows less than measured because labor input grows more than measured, then measured growth of both *MPL* and *MRS* are wrong. This is yet another reason why implied tax rates might have growth less (or fell more) than measured – not only is *MPL* growth overstated, but *MRS* growth is understated because leisure growth is overstated.

I use Barro and Sahasakul's (1986) series on marginal federal personal income and payroll tax rates on labor income, as updated by Stephenson (1998) and Mulligan and Marion (2000). To a good approximation, this series uses disaggregated data on federal individual income tax returns to compute, for each calendar year, cross-return averages of the statutory marginal tax rates.[13]

Figure 3 displays the Barro-Sahasakul "measured" series (dotted line), together the those implied by labor equilibrium. The measured series is zero prior to 1917, because there was no federal personal income or payroll tax prior to that year. There is barely any increase during the Great Depression, and tremendous increases (from 7 to 26% 1940-44) and cuts (from 26 to 18% 1944-49) surrounding WWII. Marginal rates increase fairly steadily after 1949, with minor exceptions of the famous Kennedy and Reagan tax cuts.

The trend over from the 1890's to the 1970's is reasonably well explained by the labor equilibrium equation (1). Implied marginal tax rates grew from roughly 0 to 30% while the federal marginal tax rates grew from 0 to 25 or 30%. In other words, federal labor income taxes and the labor equilibrium equation can explain a majority of the difference in the long term trends of *MRS* and *MPL*.

Short and medium term fluctuations of the implied rates are poorly explained by the Barro-Sahasakul series. First, federal tax rates cannot explain why there were so many labor hours prior to 1930 (ie, why the workweek has been shortened) and hence why *MRS* is so high during that period. The shorter workweek has been explained as a wealth effect, which is partly captured by the Stone-Geary functional form (5) since consumption has risen more in real terms than has leisure time. There is substantial agreement in the literature that work hours per capita have declined (although see Schor's 1991 and Leete and Schor's 1994 dissenting view, and Stafford's 1992 and Juster and Stafford's 1992 reply), and that the decline is an income effect of some kind (eg., Hunt and Katz 1998, Owen 1979). The shorter workweek is also explained by

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[13] For example, a federal return in the 15% bracket, with labor income below the Social Security ceiling, filed in a year when the Social Security payroll tax rate was 7% on employee and employer, would be assigned a marginal tax rate of 27.1% (.271 = (.15+.07+.07)/(1+.07)) which, according to Barro and Sahasakul's (1983, also 1986 equation 6) model of taxes, is the wedge between *MRS* and *MPL* for the person filing that return.

Barro and Sahasakul use data on the ratio of personal income to AGI to make an adjustment to their series for nonfilers prior to 1947 who are presumed to face a zero marginal tax rate.

the Hansen functional form (4), but for very different reasons – consumption has risen less than has the marginal product of labor schedule.

Second, implied rates increase by 25 to 50 percentage points, depending on the pre-Depression benchmark year, during the Great Depression while there was hardly any increase in marginal federal labor income tax rates. Third, the implied rates derived from log and log-Stone-Geary functions proceed to fall by 20 or 30 percentage points during WWII while measured rates *rise* almost 20 percentage points. Fourth, the implied rates rise after the war while the measured rates fall. These departures of implied from measured tax rates is one way of numerically demonstrating the unexplained (by economists at least!) employment reduction during the Depression and (according to Mulligan 1998) the unexplained employment and hours increases during WWII.

According to the linear Hansen *MRS* function, the wartime *MRS* is low, and implied tax rate high, when compared either to the 1930's or the late 1940's. This is roughly consistent with the labor equilibrium equation (1) since the Barro-Sahasakul measured tax rates increase and fall during the 1940's much like the implied tax rates. However, the Barro-Sahasakul series increases 19 percentage points 1940-44 while the rates implied by Hansen preferences increase only 8 percentage points. Also, notice how the post decline in Hansen-implied rates occurs *prior to* 1948, while the postwar federal individual income tax cuts did not occur until 1948.

Fifth, both implied and measured tax rates fall in the 1980's and 1990's, but the implied decline (10-20 percentage points) is much greater than the measured decline (2-5 percentage points). The 1980's failure of the labor equilibrium equation (1) has not been examined in the literature, but we see in Figure 2 how the divergence between *MRS* and *MPL* is 15 percentage points or so, and hence of the same order of magnitude as the more well-known Depression and War episodes.

Figure 3 displays a measured average marginal labor income tax rate that weights each household (more accurately, each tax return) according to its adjusted gross income. If the labor equilibrium equation (1) is expected to hold at the individual level, then the average marginal tax rate that makes (1) hold in the aggregate is not necessarily an income-weighted average of household's tax rates. But aggregatation bias in the implied tax rates is unlikely to be important if tax rates, or at least changes in tax rates, do not vary substantially across households. Figure

4 provides some evidence on this point, by comparing measured marginal tax rates obtained by weighted households equally (dashed series), and according to their income (solid series).[14] We see how the return-weighted average is less than the AGI-weighted average, which derives from the fact that statuatory income tax rates tend to rise with income. But this has always been true, so the two series are essentially parallel, at least prior to 1986. After 1986, marginal rates were actually lower at the highest income so that the AGI-weighted average fell below the return-weighted average, a change which was reinforced by the growing inequality of incomes during the 1980's. The AGI-weighted average increased after 1992, approaching the return-weighted average, due to the Clinton Administration's lifting of the Hospital Insurance tax cap. As a result of these changes in the 1980's, the return-weighted series explains a lot less of the 1980's reduction in implied rates than does the AGI-weighted series.

State and local income taxes are not included in Barro and Sahasakul's measures (or those shown in Figure 4 below). Like the federal personal income tax, marginal state and local income tax rates vary across persons because the rates vary with the amount and composition of income and with place of residence. However, it seems that marginal state tax rates increase less with income than do federal rates, so that average and marginal rates are closer for the former. Since the state and local income tax revenue is less than two percent of GDP for this entire period,[15] perhaps the average marginal state and local income is never much more than 2 percent and therefore cannot explain more than a small fraction of the large changes shown in Figure 3.

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[14]The income-weighted average marginal tax rates are from Barro and Sahasakul (1986), as updated by Mulligan and Marion (2000).

[15]Census Bureau (1975, series Y-658) and Council of Economic Advisers (1996, Table B-82).

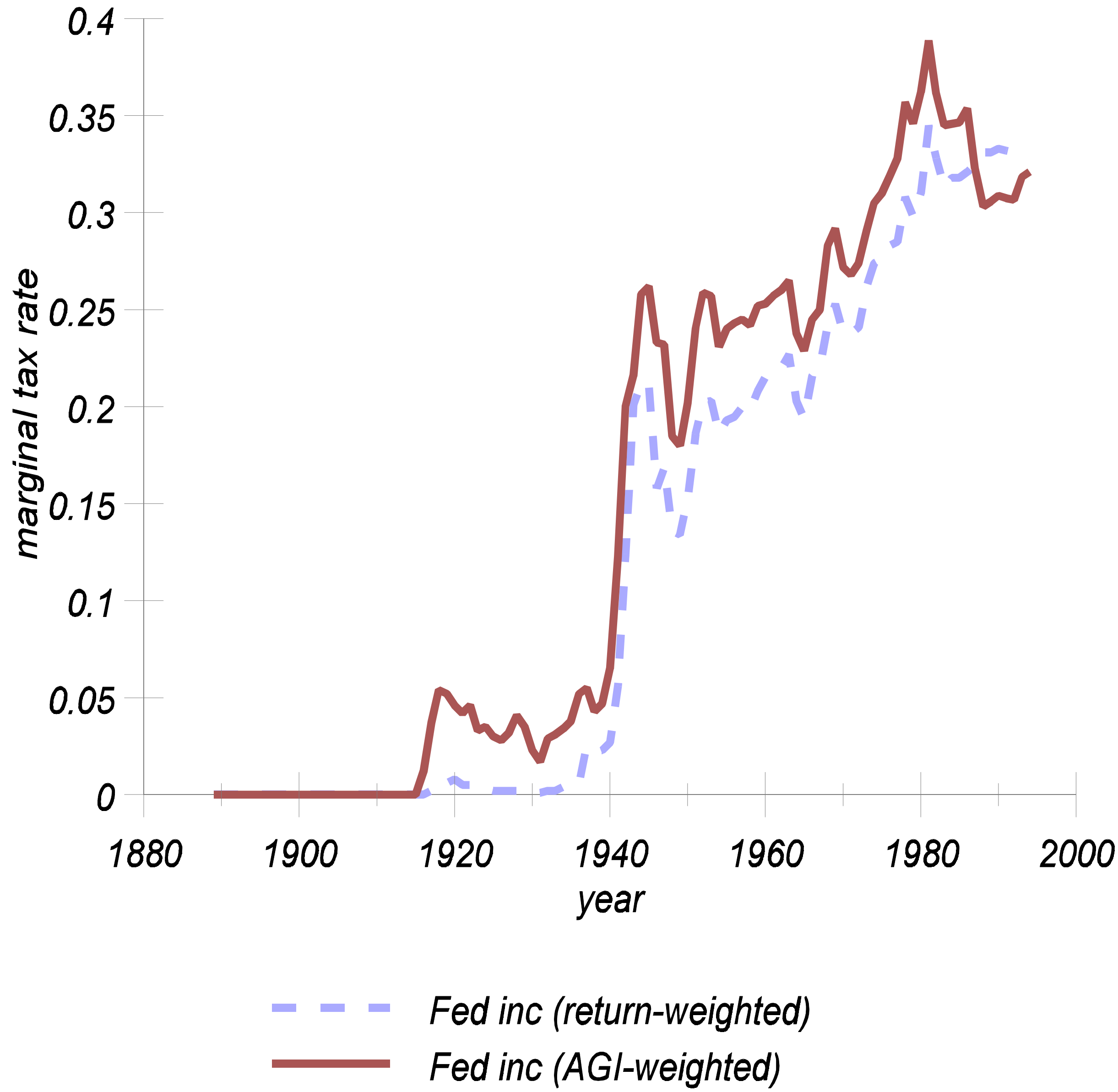

Figure 4 Marginal Tax Rates Calculated from Federal Income Tax Data

V.B. Sales Taxes and Consumption Regulations

Taxes on consumption expenditure also drive a wedge between *MRS* and *MPL*, with (in the absence of other distortions, consumers equate their *MRS* to $MPL/(1+\sigma)$, where σ is the marginal sales tax rate. However, given the assumed functional forms and the fact that my measure of consumption is inclusive of sales taxes, we may not expect sales taxes to drive a wedge between measured *MRS* and *MPL*. In particular, when average and marginal sales tax rates are equal, there is no measured wedge with the logarithmic or quasilinear function forms (3) and (4):

$$\theta \frac{c(1+\sigma)}{1-L} = MPL$$

or

$$\theta c(1+\sigma) = MPL$$

Notice that the LHS of each equation is the measured *MRS*, because they include the sum of consumption and sales tax revenue ($c(1+\sigma)$). I leave it to the reader to verify that the same analysis applies when there are also labor income tax distortions. On the basis of this result, sales taxes appear in my analysis only as they are included in personal consumption expenditures.

Consumption regulations can act like unmeasured sales taxes in the sense that they break the link between wages, consumption expenditure, and leisure implied by the labor equilibrium equation (1). One way of modeling this would be to have a utility depend on labor input L and a composite consumption good c that is a homogeneous function of the consumption of various products, and those various products are imperfect substitutes in terms of their contribution to the composite good. Regulating a binding maximum on the amount consumed of some of the products will, for a given wage, cause people to work less and spend less on consumption expenditure – just as would a sales tax. When the *MRS* is measured as a stable function of labor input and consumption expenditure, then the introduction of such a binding minimum drives a wedge between wage and measured *MRS*.

Consumption regulations are particularly relevant during WWII when a number of consumer goods were rationed to citizens (see Rockoff 1984 for one account). Hence, while we expect wartime income taxes to have reduced measured *MRS* relative to wages, we expect measured *MRS* to have fallen even further as the result of rationing. As mentioned above, we observe just the opposite during WWII – *MRS* grew more than *MPL* 1940-44 and grew less 1940-48.

V.C. Transfer Payments

Government transfer payments, such as those used by Social Security, welfare, and unemployment systems are also expected to affect the gap between *MRS* and *MPL*. Unfortunately (for the analyst), there are many transfer programs at the federal, state, and local levels that might be expected to drive a wedge, and the incentive effects of even one of those programs are complicated, heterogeneous, and changing over time. Indeed, a entire paper – or literature – might be devoted to the wedge created by *one* entitlement program in *one year*, for one *subset* of the population (eg., Feldstein and Samwick 1992 on 1990 Social Security benefit formulas and the working-aged population, Blinder, Gordon and Wise 1980 on 1977 Social Security benefit formulas and the population aged 62-69, or Fraker, Moffitt, and Wolf 1985 on 1981 AFDC). My approach is therefore to calculate an upper bound on the potential aggregate incentive effects to see if transfer programs *might* credibly explain the large tax wedge changes simulated from aggregate behavior.

Figure 5 displays as a solid red line government transfers (including those paid by federal, state, and local governments) as a fraction of labor income for the years 1929-96. Transfers have increased over the long term, from practically zero to almost 20% of labor income. Transfers increased slightly in nominal terms during the 1930's while nominal labor income declined, so Figure 5 shows an increase in the transfer-labor income ratio. The transfer-labor income ratio was relatively high between WWII and the Korean War.

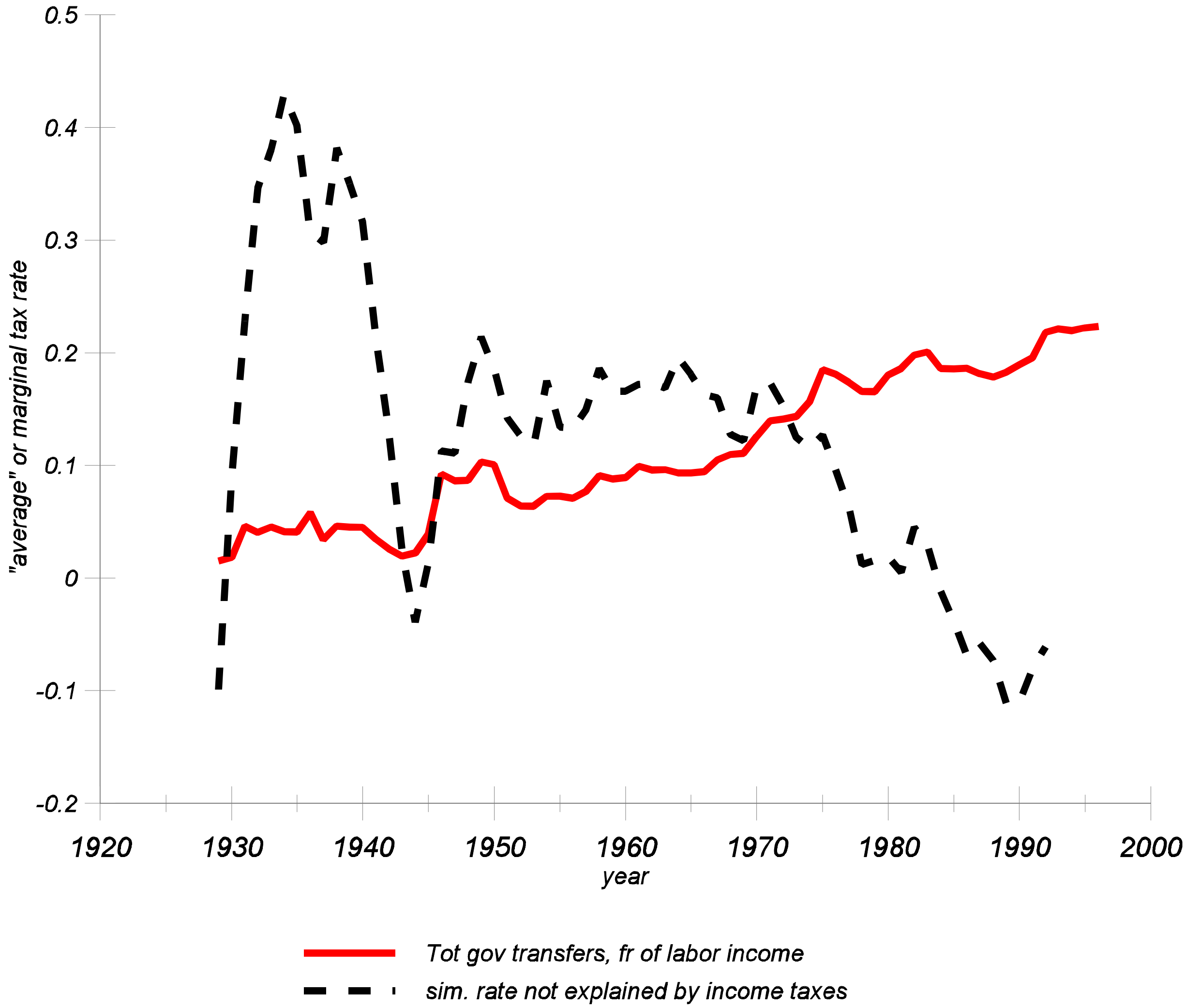

Figure 5 Spending on Transfer Programs vs Simulated Tax Rates, 1929-96

While calculating the average marginal tax rate implicit in the portfolio of federal, state, and local transfer programs is very difficult, the transfer-labor income ratio shown in Figure 5 is probably an upper bound on a more thorough and more accurate calculation of that rate. To see this, consider first a hypothetical example, and then a particular transfer programs. As a hypothetical example, suppose that we have $N+M$ individuals, with the ith earning w_i in the absence of a transfer program. When the program is in place, it pays w_i *only* to those types $i \in [N+1,N+M]$ who choose not to work. Obviously, the marginal tax rate is zero for $i \leq N$ and 1 for the others and, since the no work benefit is so generous, no $i > N$ works. The average marginal rate, weighting each person i by his potential earnings, is:

$$\tau = \left(\sum_{i=N+1}^{N+M} w_i \right) \Big/ \left(\sum_{i=1}^{N+M} w_i \right)$$

Since the ratio of transfers to labor income is no less than $\left(\sum_{i=N+1}^{N+M} w_i \right) \Big/ \left(\sum_{i=1}^{N} w_i \right)$, this ratio is an upper bound on the weighted average marginal rate.

This claim is also consistent with evidence from the Social Security old age pension and survivor program. This program only pays benefits to those aged 62 and over (except widows and widowers, who may be eligible as early as age 60) spent $289 billion in 1995, or 6.4% of labor income.[16] Since the population aged 62 and over is 20% of the population aged 16+, the marginal tax rate from the benefit formula is less than or equal to zero for those less than 62,[17] and the average marginal tax rate from the benefit formula is well less than 50% for those aged 62+,[18] the program's contribution to the economy-wide average marginal rate is well less than 10%, and hence less (or at least not much more) than the program's economy-wide "average rate" of 6.4%.

Figure 5 displays as a dashed line the simulated tax rate minus the measured labor income tax rate (shown as a solid line in Figure 4), which I interpret as that part of the simulated tax wedge that is unexplained by income tax policy. With its solid red line as an upper bound on the composite marginal rate from transfer programs, Figure 5 suggests that transfer programs may have contributed to the growing gap between *MRS* and *MPL* between 1929 and 1970,

[16]OMB (1998, Table 13.1).

[17]Of course, marginal rates from the tax side of the program are positive, but these are counted in my federal labor income tax calculations. Feldstein and Samwick (1992) suggest that marginal rates from the *benefit* side of the program are *negative* for many of those less than 62.

[18]For some of those aged 62+, the marginal tax rate is essentially zero (see Blinder, Gordon and Wise 1980 for a similar analysis of earlier law), 33% for others, and 50% for still others. Using a different definition of "marginal", Diamond and Gruber calculate an average marginal rate from the benefit side of the program of about 20% for men aged 62-69.

although probably less than 20 percentage points. The Figure suggests that, during the 1930's, simulated tax rates increased by an order of magnitude more than did the rates from transfer programs, so that transfer programs cannot be an important part of an explanation of Depression labor markets.[19] To put it quite simply, how could Depression transfer programs simultaneously have large disincentive effects and not spend much money at a time when a lot of people were not employed?

V.D. Federal Labor Market Regulation

Labor market regulations are varied. Some may have no effect because the regulations require workers and employers to do things that they would already do, or because the regulations are not enforced. Others may lower the marginal product of labor schedule (or raise it?), perhaps by restricting (or helping?) firms from using the most efficient production process. But of particular interest for my study are regulations that drive a wedge between *MRS* and *MPL*. In this regard, there are three categories of regulation of particular interest:

(a) regulations affecting the monopoly power of labor unions

(b) regulations fixing worker compensation, or requiring it to exceed some minimum

(c) regulations mandating the provision of various fringe benefits to workers

I defer my analysis of monopoly unionism until the next section. According to the textbook analysis, a binding minimum wage is one example of a regulation driving a wedge between *MRS* and *MPL* because it puts some people out of work – a movement down the aggregate labor supply schedule – and moves employers up their *MPL* schedule (aka, labor demand curve). Mandatory fringe benefits, if they affect the composition of worker consumption,[20] also affect the relationship between labor costs, work hours, and consumption expenditure. However,

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[19]After the 1930's, Figure 5 displays some positive high-frequency correlations between transfer "tax rates" and unexplained simulated rates, which are consistent with the hypothesis that transfer programs drive a wedge between *MRS* and *MPL*. However, notice that transfer programs tend to grow in size in response to nonemployment, so that fluctuations in the *MRS* might cause fluctuations in measured transfer "tax rates" rather than the other way around.

[20]ie, the mandated benefits exceed the amount workers would demand in the absence of regulation. See, for example, Summers (1989) for some analysis of this point.

Appendix II shows how the direction of the effect of mandatory fringe regulation depends on whether the costs of the fringes are included in consumption expenditure, how consumption of the fringe good affects the marginal rate of substitution between work and nonfringe goods, and whether the mandatory minimum varies with earnings. For example, regulating an increase in the consumption of a good that lowers the disutility of work (such as work place safety?) could *increase* *MRS* relative to *MPL* as calculated above. Regulating an increase in the fraction of earnings saved for retirement is a case in which regulation looks more like a labor income tax, reducing *MRS* relative to *MPL* as calculated above.

Determining the direction of a particular regulation's effect on the wedge between *MRS* and *MPL* is difficult, let alone accurately quantifying the wedge created by the large and varied portfolio of federal regulation. However, recall from Figure 3 that the changes in implied tax rates to be explained are quite large – on the order of 10 percentage points or more for the entire labor force. Hence, even a rough qualitative analysis of federal labor regulation can reveal whether labor market regulation and its changes over time are a viable explanation. It is such a qualitative analysis that I present here.

Figure 6 displays as a dashed line the number of labor market regulations in effect in each year since 1910, as listed and dated by the Center for the Study of American Business' 1981 *Directory of Federal Regulatory Agencies*.[21] For the reader's convenience, tax rates implied by log-Stone-Geary utility, net of those "explained" by income taxes,[22] are graphed as a dotted line in the Figure. According to the dashed line, there is a growth in labor market regulation over the century, and that may explain why the postwar implied marginal tax rates grew somewhat more than the measured sales and marginal federal labor income tax rates. There was a growth in labor market regulation in the 1930's that may have increased the wedge between *MRS* and *MPL* but, at least according to the dashed line, even more growth in regulation was found in the 1960's and 1970's when we did not see nearly such a divergence of *MRS* and *MPL* as in the 1930's.

[21] I make one addition to the list – the 1933 National Recovery Act, which CSAB presumably did not include on its list since it is no longer in affect at the time of their writing.

[22] ie, the solid line in Figure 3 minus the dash-dot line in Figure 4.

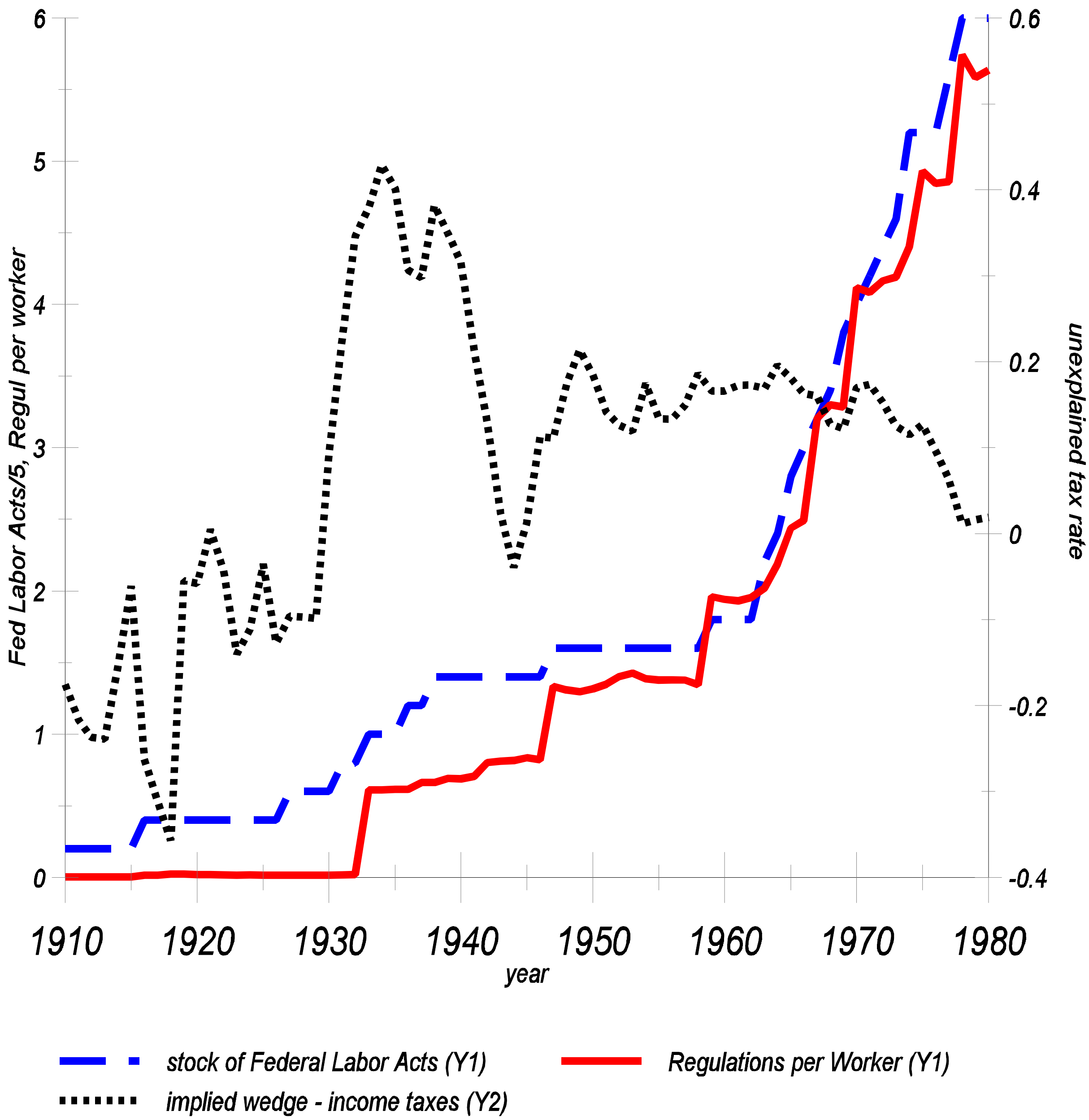

Figure 6 Labor Market Regulation 1910-1980

Of course, all regulations count equally in computing the dashed line, and there is no adjustment for the fact that some regulations do not drive a wedge between *MRS* and *MPL*, but rather decrease the *MPL* (or have no effect on either *MRS* or *MPL*). Nor is there an adjustment for the differential importance of various regulations (eg., the 1910 Mine Safety Act counts the same as the Civil Rights Act), or for the differential impact over time of any single regulation (eg., the minimum wage is presumably less important when the real minimum wage is low).

Figure 6's solid line reports an attempt to remedy one or two of these problems, by weighting each act by estimates of the number of employees affected, as explained in Appendix I. The solid line suggests that labor regulation reached its modern order of magnitude with the 1933 National Industrial Recovery and 1935 Wagner Acts which, for the purpose of calculating the solid line, we assume affects all nonagricultural nonsupervisory employees (compare this the previous regulations which applied only to miners, federal employees, longshoremen, and construction workers on federally funded projects). Nevertheless, the solid line suggests that labor regulation growth was as rapid, and probably more rapid, in the 1960's and 70's than in the 1930's because, with the exception of the 1933 NIRA, 1935 Wagner Act, and 1938 Fair Labor Standards Act (FLSA, affecting any medium-sized or large firm engaged in interstate commerce) the 1930's Acts only applied to specific industries while several 1960's and 1970's acts were much more comprehensive.[23] Also notice that two of these Acts (1935 and 1938) came after the large wedge appears between *MRS* and *MPL* (which was quite large by 1933). It may be argued that, while a number of 1960's and 1970's regulations covered a lot of employers, none was so important as the 1933 National Recovery Act, the 1935 Wagner Act or 1938 FLSA. The importance of the Wagner Act is quantified in part below in the context of monopoly unions.

Figure 7 highlights two of the three labor regulation categories mentioned above – mandatory fringe and minimum compensation. Each of the series weight regulations according to estimates of the number of workers affected. The solid series includes all labor regulations regardless of category, and is identical to the solid series in Figure 6. The dashed (dotted) series include only mandatory fringe (minimum compensation) regulation. We see that both of those two regulation categories experienced much more growth in the 1960's and 1970's because of a growing number of broadly applicable regulations – including the Civil Rights Act and other discrimination regulation among the minimum compensation regulations[24] and OSHA and

[23]For example, the 1931 Davis-Beacon Act applied only to construction employees working on federally funded projects and the 1936 Walsh-Healy Act applied only to federal government contractors, while the 1963 Equal Pay Act, Title VII of the 1964 Civil Rights Act, the 1967 Age Discrimination in Employment Act, the 1972 Equal Employment Opportunity Act applied to a huge number of industries and employers.

[24]I include these regulation in the minimum compensation categories because, among other things, they may require employers to hire minorities at terms undesirable to the

ERISA among the mandatory fringe regulations – than in previous decades. Also notice how, although included in the "minimum compensation" category and passed in 1938, the FLSA does not have much of an effect on the series shown because the Department of Labor Estimates that few workers are affected.[25]

employer.

[25]The main reason few workers are thought to be effected, especially in the early years, is that few industries were covered.

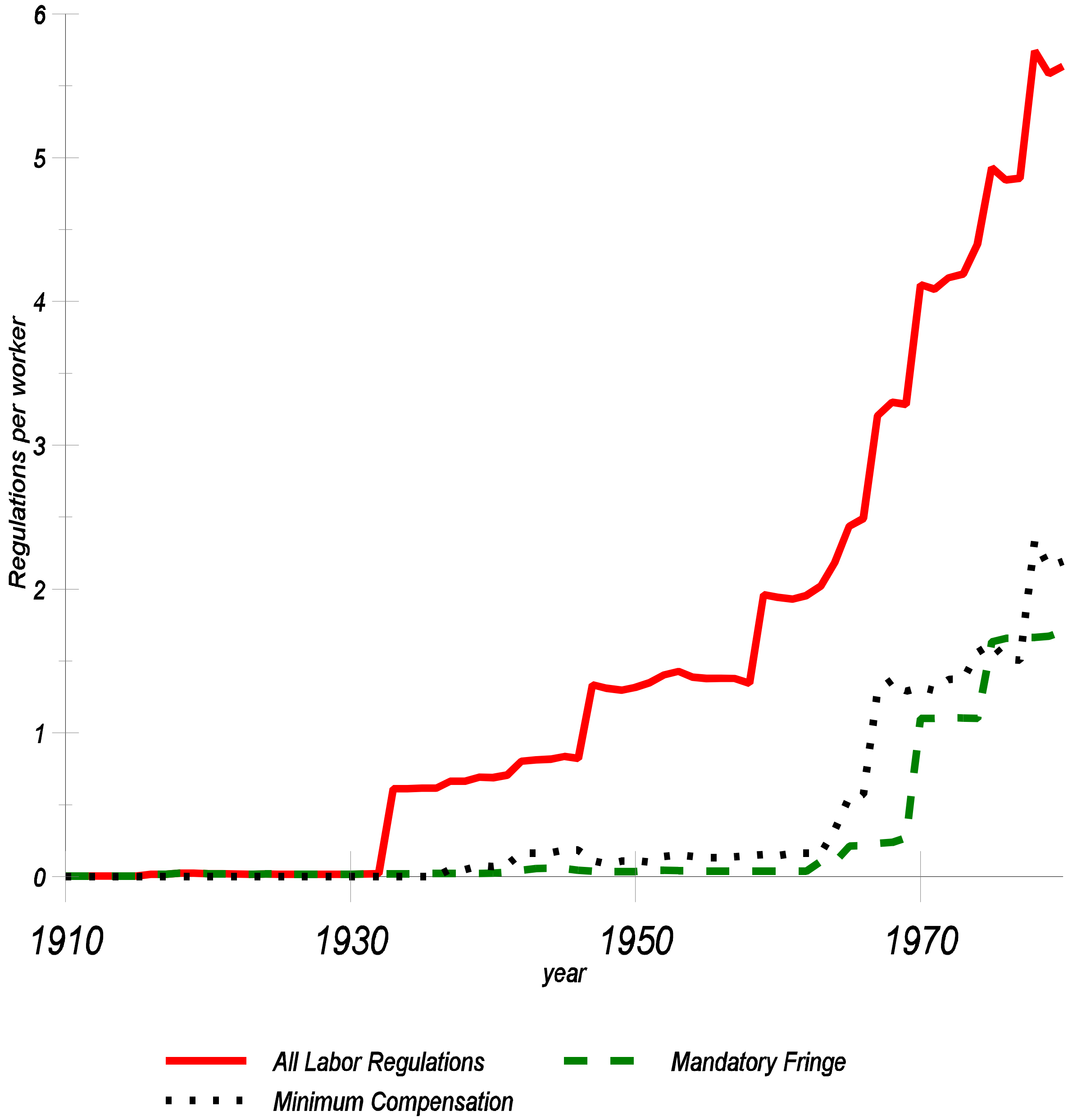

Figure 7 Two Categories of Labor Market Regulation 1910-1980

V.E. Monopoly Unionism

Textbook monopoly unions, by definition, deliberately drive a wedge between *MRS* and

MPL in order to raise member incomes.[26] The size of this wedge is *related* to the "relative union wage gap", the percentage gap between a typical union worker and an observably otherwise similar nonunion worker, often measured in the labor economics literature. My approach is to use the estimates from that literature to quantify the potential contribution of monopoly unionism to the gap between *MRS* and *MPL* as measured in the aggregate.

Lewis (1963, 1986) surveys much of a large literature attempting to estimate the union wage gap for various industries. He stresses (1986, pp. 9, 187) that wage gaps vary a lot from industry to industry, and are typically overestimated because union workers are expected to have more unmeasured human capital than nonunion workers (so that measured wage gaps are only part monopoly union power, and part human capital differences). With these caveats in mind, I construct Table 1 below by reproducing and extending Lewis' (1963) Table 50, reporting by time period the relative wage gap for the "typical" unionized worker.

[26]Other plausible union models have unions raising the payments from employers to employees, but not in a way that distorts the labor-leisure margin (eg., Leontief 1946, and applications by Barro 1977 and MaCurdy and Pencavel 1986). If the latter union model is correct, then we immediately conclude that unions are not contributing to the wedge between *MRS* and *MPL*. However, all of these models imply that unions create a gap between *MPL* and the measured wage, and therefore between *MRS* and the measured wage. See Appendix IV for more details.

Table 1: Union Relative Wage Gaps by Time Period		
	parameter values	
time period	lower estimate	upper estimate
1923-29	0.15	0.20
1931-33	0.25	
1939-41	0.10	0.20
1945-49	0	0.05
1957-58	0.10	0.15
1967-70	0.12	0.16
1971-79	0.13	0.19

Table lists the difference between the typical union wage and the nonunion wage of observationally similar workers, as a fraction of the nonunion wage.
Source: Lewis (1963, Table 50 and 1986, p. 9)

Notice in particular that the union wage gap is about twice as large during the Great Depression (see also Lewis 1963, pp. 4f).

The measured wage gap need not be exactly the percentage wedge between *MRS* and *MPL* in the union sector. But it is perhaps a reasonable first estimate of that wedge – and would be identical to the wedge in the case that the wedge is zero in the nonunion sector, and the value of time (*MRS*) is the same in both sectors.[27] With this, and Lewis' (1986, p. 9) overestimation caveat, in mind I use the "lower" wage gaps reported in Table 1 as estimates of the *MRS*/*MPL* wedges in the union sector.

My calculations of implied tax wedges are for the entire economy, and not just the union sector. How much can monopoly unionism affect the average tax wedge? Assuming the

[27]The wedge is one minus the ratio of union sector *MPL* to union sector *MRS* which, under these assumptions, is the same as one minus the ratio of union sector wage to union sector *MRS*, which equals one minus the ratio of union sector wage to nonunion sector *MRS*, which is the same as one minus the ratio of union sector wage to nonunion sector wage.

monopoly union wedge is zero for nonunion workers, the size of the monopoly union wedge for the average worker is the product of the union wedge and union density (ie, the fraction of the labor force that is unionized[28]). Using Rees' (1989 Table 1)[29] time series, we see from the dashed line in Figure 8 that union density increased somewhat during the 1930's – reaching 18% – while the largest increases during the century were after the Depression. Union density has declined since the 1950's (see also Freeman and Medoff 1984, Figure 15-1), and perhaps that decline accelerated in the late 1970's and 1980's.

[28]Public sector union members are included. Their contribution to the national union density is small (5% in 1960; Rees 1989, p. 181), but growing steady over the period (Freeman 1986; Rees 1989 p. 181 says that 29% of union members in 1983 were public sector employees). Since 1983, the fraction of union members working in the public sector has grown further, to 44% by 2001 (BLS 2002).

[29]I use Census Bureau (1975, series D-17, 1900 value) to fill in Rees' missing nonagricultural employment for the year 1897, and then Census Bureau (1975) series D-167, 170 and BLS series LFU40000000, LFU11102000000 to convert Rees' ratio to nonagricultural employment to a ratio to the entire labor force.

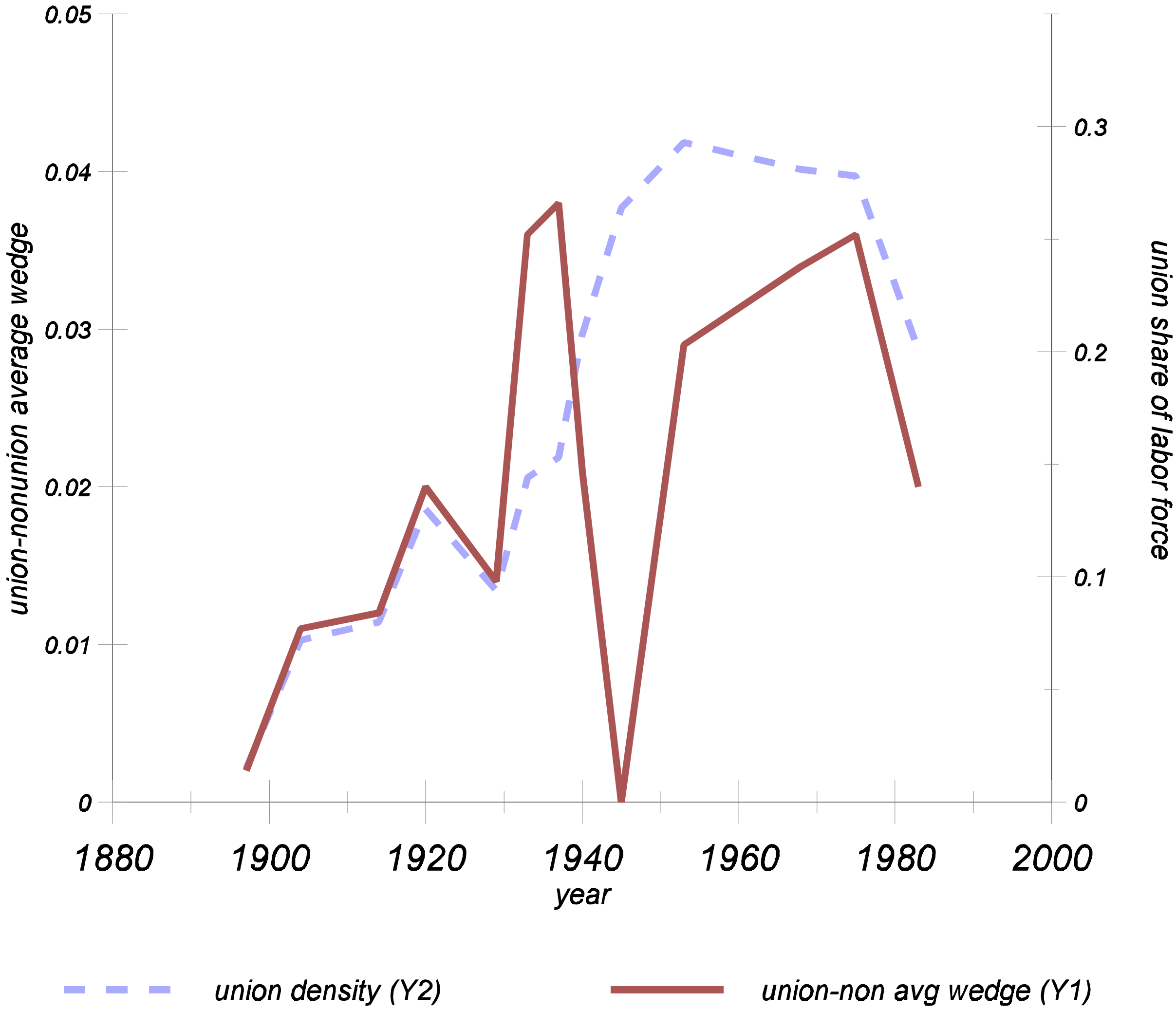

Figure 8 Union Density and Induced Wedges 1897-1983

The solid line in Figure 8 illustrates how changes in union density might affect the time series for the economy's average monopoly union wedge. The solid line assumes a nonunion sector wedge of 0, a union sector wedge of 15% prior to 1923, a union sector wedge equal to the "lower" gap estimates reported in Table 1 for the years 1923-79, and a union sector wedge of 0.10 after 1979. The solid line suggests that monopoly unionism should have created a wedge of 2 percentage points by 1920, which is not readily seen in the implied wedge series graphed in Figure 3. Union membership growth during the Depression, and especially the assumed growth in the union sector wedge, added another 2 percentage points to the economy average wedge in the 1930's, and might thereby explain a *small* part of the Depression's implied tax wedge shown in

Figure 3. However, even though it is assumed that the union sector wedge declines dramatically after the Depression, the post-Depression growth in union membership implies that (with the exception of the war) the economy-average wedge is pretty stable until the 1980's. The 1980's decline in union membership reduces the wedge by 1 or 2 percentage points, and can thereby explain some but not all of the 1980's reduction in the implied tax wedge. Finally, since 1930, monopoly unionism may have added a percentage point to the tax wedge.

Lewis (1986) survey only studies data up to 1979 and I assume, as do many in the the "wage structure" literature (eg., Bound and Johnson 1992, DiNardo, Fortin and Lemieux 1996), that Lewis' estimated union wage gap applies as to 1989 as well as 1979 even while union membership declined in the 1980's. If unions wage gaps also declined in the 1980's, then unions' contribution to the wedge declined more than shown by the solid lines. For example, if union wage gaps were largely eliminated during the 1980's, then there would be essentially no union wedge by the end of the 1980's and we can calculate from Figure 8 that the 1980's reduction in monopoly unionism would explain a 3.6 percentage point reduction in the implied tax wedge. 3.6 percentage points from the decline of monopoly unions is similar in magnitude to the effects of 1980's income and sales tax cuts (5 percentage points), but together these two sources of distortions still explain less than half of the 20 percentage point reduction in 1980's implied tax rates.

V.F. Rigid Money Wages in the 1930's

Between 1929 and 1933, the GDP deflator fell 30% 1929-33, and the CPI 28%.[30] One interesting hypothesis is that wages do not "adjust" as well when prices are falling. Perhaps this is especially applicable to the 1930's (although labor compensation per manhour also fell 30% from 1929-33)? If so, one might expect – as in the analysis of Barro and Grossman (1971) – that rigid money wages would drive a wedge between the *MRS* and *MPL*.

However, the timing and magnitude of such rigidities are difficult to measure *independently* of the average product and consumption series shown in Figure 2. This sets the "rigid wage" hypothesis apart from the public finance distortions (whose magnitude and timing

[30]BEA NIPA Table 701, line 4.

were independently measured using IRS tax rules and return data) and the monopoly union distortions (whose magnitude and timing were independently measured using union density and Lewis's comparisons of union and nonunion sectors). Are there direct measures of wage rigidity for the 1930's? Or are there "flexible wage" sectors that could be compared with "rigid wage" sectors?

According to one special case of the "rigid wage" hypothesis (and one suggested by Lewis, eg., 1963 pp. 5f), wages are rigid only in the union sector, in which case wage rigidity can be measured independently of average productivity by comparing wages in union and nonunion sectors. This is what Lewis does, and his results are transformed into a wedge between *MRS* and *MPL* in the previous section. In other words, rigid wages may only be another interpretation of the calculations I interpreted above as "monopoly union."

V.G. Employment Search Frictions

The above discussion views unemployment as leisure – either intentional (as in the textbook model of labor supply) or unintentional (as in rigid wage models like Barro-Grossman). According to a third view, embodied in search models like those of Mortensen (1982), Hosios (1990), Pissarides (2000), and others, unemployment indicates frictions in the process of matching workers to jobs, and those frictions do not result from taxes or rigid wages by themselves. Quite literally, "technology" – the matching technology – is a determinant of unemployment in those models. If we view unemployment as itself a "shock" to the economic system, rather than a choice made by labor suppliers in response to productivity shocks, taxes, etc., how much of the gap between *MRS* and *MPL* remains unexplained?

In order to answer this question and begin to understand some implications of my calculations for search models, let the year t unemployment rate u_t be a technological parameter representing the fraction of leisure foregone that cannot be employed in the production process. The utility function in such a model is thereby a function $u\left(c_t, 1 - \frac{L_t}{1-u_t}\right)$, with unemployment having the effect of increasing the marginal disutility of work because u additional units of leisure must be foregone in order to supply (1-u) units of labor to the production process.[31] Following the notation above, *MRS* is the marginal rate of substitution in the function u, and the labor "equilibrium" equation becomes:

$$MRS_t = (1 - \tau_t)(1 - u_t) MPL_t \qquad (1)'$$

In other words, unemployment in search models can add to the wedge between marginal product and marginal rate of substitution, and that wedge is determined at least in part by the matching technology rather than tax policies or the technology of production. With functional forms for the production and utility functions, and a time series for the unemployment rate, we can calculate the labor market distortion that is neither "explained" by measured marginal tax rates or by measured unemployment rates. The formula for the unexplained distortion is:

$$\text{unexplained distortion} = 1 - \frac{MRS_t}{(1 - \tau_t)(1 - u_t) MPL_t}$$

where *MRS* depends on consumption and time out of the labor force. The solid series in Figure 9, measured on the left scale, displays the unexplained distortion assuming Cobb-Douglas production and log-Stone-Geary. As a reference, the dashed series is from Figure 5, and also measured on the left scale.

[31]Here we assume that the unemployed have the same disutility of work as those working, as compared to the assumption above (and in textbook labor supply models) that the unemployed have the same disutility of work as those out of the labor force.

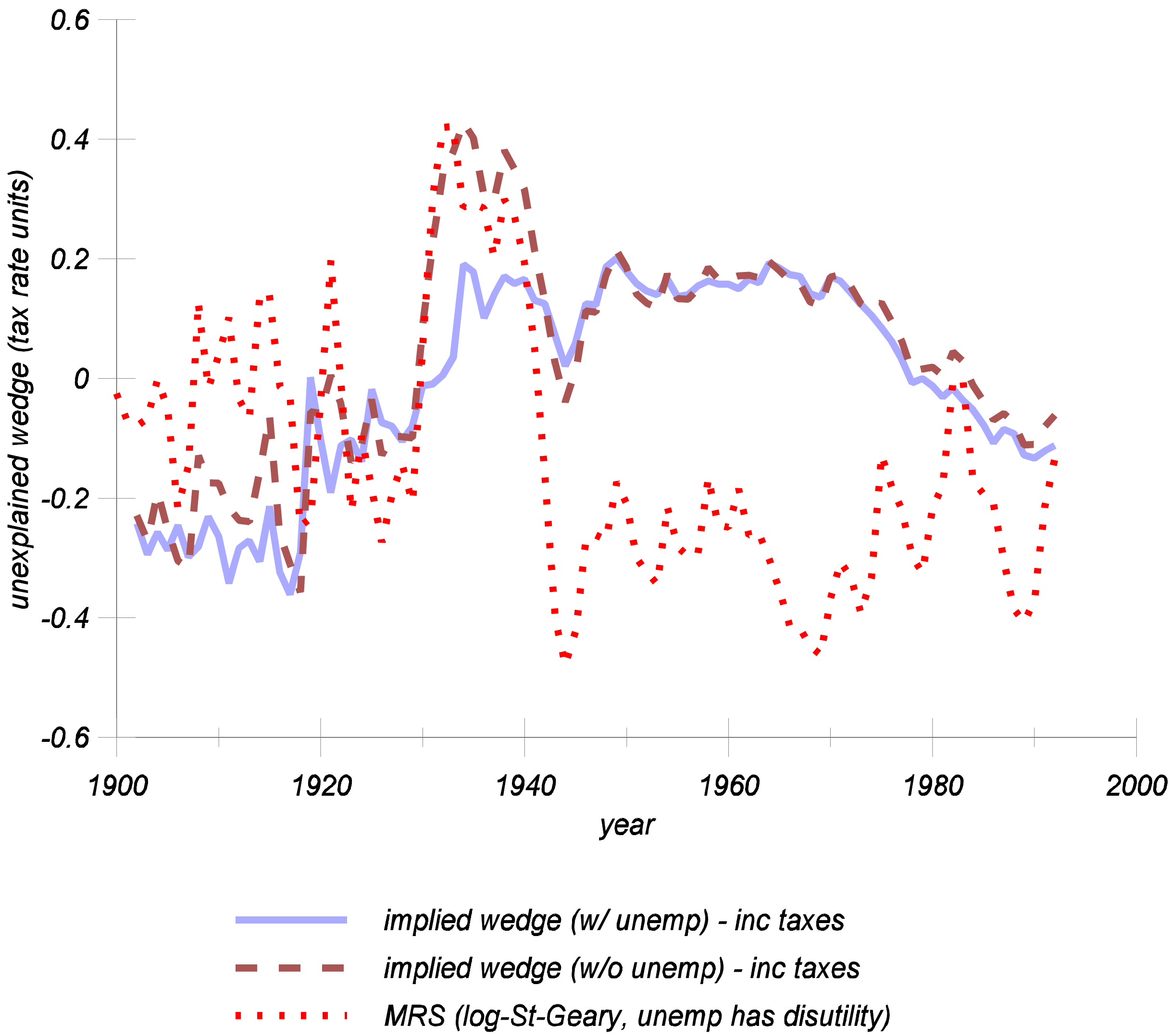

Figure 9 Unemployment as a Measured Distortion

Comparing the solid and dashed series, we see how the unexplained distortion is the same in the 1930's as in most of the postwar period, so the most of the aggregate *MRS-MPL* gap between the 1930's and 1950-70 is associated taxes or with the unemployment rate.[32] The story is different

[32]The unemployed rate affects the solid line in two ways. The first is its appearance in the denominator of the unexplained distortion formula above. The other is its effect on the *MRS* function when it is calculated using leisure hours that exclude the time of the unemployed, rather than including it as the previous calculations. Figure 9's dotted line shows this second effect because it is calculated by subtracting (in logs) the log-Stone-Geary *MRS* series from Figure 2 from the series revised using the unemployment series. We see

looking backwards from the 1930's as, say, the 1920's has significantly less labor market distortions that are not explained by taxes or unemployed. The two series also show how calculations of the unexplained distortion are, outside the 1930's, insensitive to the treatment of unemployment.

Figure 9 shows how unexplained distortions are essentially the same in the 1930's as in most of the postwar years, so that aggregate work hours have a stable relationship with a relatively few aggregate variables (namely, consumption, unemployment, and after-tax wages) during that period. This finding gives us some guidance as to modeling aggregate behavior, but I would be greatly exaggerating to say that consumption and work hours fluctuations were fully explained. First of all, while the textbook model is perhaps too extreme to view the time of the unemployed to be entirely leisure time, the calculations behind Figure 9's solid line are at the other extreme, with none of the time of the unemployed substitutable with leisure. Second, I have not offered an explanation if why the unemployment rate fluctuates from year to year. It may even be the case that the kinds of regulatory and tax policies discussed above are the reason why unemployment is as high as observed, and why it fluctuates over time. Nonetheless, my calculations show that whatever model ends up fitting these data will produce the same kinds of aggregate relationships between consumption, work hours, after-tax wages, and unemployment rates as does the simple and familiar aggregate Cobb-Douglas model.

VI. Summary and Conclusions

Using quantity data and functional forms from the literature, I calculate time series for the marginal value of time (*MRS*) and marginal product of labor (*MPL*). According to the labor equilibrium equation, $MRS = (1-\tau)MPL$, where τ is a wedge driven between *MRS* and *MPL* by tax policy, regulatory policy, monopoly unionism, and other labor market distortions. I use the *MRS* and *MPL* series to calculate the marginal tax rates implied by the labor equilibrium equation (namely, the implied rate is $1 - MRS/MPL$), and compare them with tax-equivalent

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that most of the effect of treating unemployment as a labor market distortion derives from it's effect on the calculated *MRS* adding, for example, about 0.8 percentage points more to the *MRS* in the 1930's than it does to the postwar years.

measures of marginal tax rates, regulatory policy, the monopoly power of unions, and unemployment.

My calculations are designed to inform those who construct theories of the labor market. In particular, the calculations show when and how there is a stable relationship, of the kinds predicted by many applications of the "labor equilibrium equation," between aggregate consumption, aggregate work hours, wages, and various measures of labor market distortions. Such aggregate relationships are of substantial interest because they are implied by a large number of aggregate and microeconomic models of the labor market, and are verified empirically in other applications of aggregative economic theory.[33] Some conclusions that can be made from my calculations are summarized below by historical time period.

VI.A. Work Hours Prior to 1929

Labor input is high prior to 1929 – even higher than one would expect in the absence of labor income taxes. This shows up in my calculations as a negative implied tax rate derived from the log utility function. Stone-Geary preferences can partly "explain" high labor input during this period as an income effect, as has been suggested in the literature. But even with the Stone-Geary preferences, implied rates are often negative prior to 1929, so the labor equilibrium equation is not fully successful at explaining the reduction in hours from the beginning of the century.

VI.B. Trends 1929-80

Implied rates have increased from roughly 0 in 1929 to 40% in 1980. Marginal federal labor income tax rates have increased almost this much, labor regulation has probably contributed to the tax wedge, and union density has increased, so the labor equilibrium equation explains the 1929-80 secular trend pretty well. Explaining the direction and magnitude of this trend is probably the most remarkable achievement of the rather simple aggregate application of equation (1).

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[33]E.g., stable relationships are seen in among a few aggregate measures of monetary behavior (eg., Friedman and Schwartz 1982), and measures of credit market behavior (Mulligan 2001b).

Table 2 displays the accounting in some more detail, assuming the *MRS* function (3). The left panel simulates the change in the implied marginal tax rate, $\Delta \hat{\tau}$, which is approximately the difference between $\Delta \ln MPL + \Delta \ln (1\text{-}L)$ and the growth of consumption. The implied tax rate increases over this period because, in effect, "expenditure" on leisure time (ie, $(1\text{-}L)MPL$) has grown more rapidly than expenditure on consumption,[34] and the difference is about 37 percentage points over the 1929-96 period.

Table 2: Accounting for 1929-96 trends with log utility

	behavior	1929-80	1929-96		restraints of trade	1929-80	1929-96
(1)	$\Delta \ln MPL$	1.328	1.499	(4)	Δ federal PIT	0.327	0.286
(2)	$\Delta \ln (1\text{-}L)$	0.194	0.107	(5)	Δ state PIT	0.014	0.017
(3)	$\Delta \ln c$	0.870	1.232	(6)	Δ unions	0.011	?
(1)+(2)-(3)	$\approx \Delta \hat{\tau}$	**0.569**	**0.374**	(7)	Δ transfers	?	?
				(8)	Δ regulation	?	?
				(4)+(5)+(6)+(7)+(8)	$\Delta \tau$	**0.352+?**	**0.303+?**

Notes: Δ denotes changes over time; "PIT" = personal income tax

Table 2's right panel reports estimates of "restraints of trade" in the labor market, reported as tax rate equivalents. Item (4) is Barro and Sahasakul's average federal marginal tax rate from the Personal Income and Social Security taxes. Item (5) is an estimate of average marginal state personal income tax rates and sales (both federal and state) tax rates. Items (6)-(8) provide for tax rate equivalent measures of wedges created by unions, transfer payments and regulation. As discussed in the text, numerical estimates of (6)-(8) are presumably positive (and small in the case of unions), but are difficult to calculate more precisely. Hence the last row of

[34] The 1929-96 0.107 log point growth in leisure time corresponds to a 0.092 log point reduction in labor hours, which in turn can be decomposed into 0.104 and -0.196 log point increases in "employment" and "hours per employee," respectively.

the Table reports that the measured tax rate τ grows by at least 30 percentage points over the 1929-96 period. Since behavior, together with log utility and the labor equilibrium equation, suggests that restraints of trade have grown by 37 percentage points 1929-96, log utility and the labor equilibrium equation do quite a good job of explaining behavior during the period.

If we use the Stone-Geary utility function, which better fits the pre-1929 data, then the accounting is the same as in Table 2, except that $\Delta \ln c$ is replaced by $\Delta \ln (c-\gamma)$. For $\gamma = 1000$ 1996 dollars per adult, $\Delta \ln (c-\gamma)$ is 0.957 and 1.338 for 1929-80 and 1929-96, respectively. Expenditure on nonsubsistence consumption also grows less than "expenditure" on leisure time, so tax rates implied by Stone-Geary utility also increase over time. Subtracting the former from the latter, we have that $\Delta \hat{\tau}$ is approximately 0.489 and 0.251, respectively.

VI.C. The Great Depression

Implied tax rates rise dramatically in the early 1930's and persist for the decade. None of this increase can be attributed to federal labor income taxes, because only a small minority of the 1930's population was liable for such taxes. Sales, custom, and excise taxes increased during the 1930's, but the revenue involved is much too small for these tax increases to add more than a a percentage point or so to the wedge between *MRS* and *MPL*.

Labor regulation and the effects of monopoly unionism probably did grow in the 1930's and in this sense explain some, but only a small minority, of the Depression wedge.[35] However, these explanations imply that the wedge would grow (beyond any growth due to income taxation) after the 1930's whenever labor regulation or the effects of monopoly unionism grew. Instead, Figure 3 shows how implied tax rates grew together with, rather than in excess of, marginal federal labor income tax rates, even during the period 1940-55 when union density almost doubled and during the period 1960-80 when labor regulation grew at least as much as it did in the 1930's.

Measuring the effects of regulation and unionism is a tricky business, and future research can undoubtedly improve on my efforts. Regardless of what that research shows, one contribution of my analysis is to reformulate the old question "Why was employment low

[35]The major labor regulations occurred late enough that they probably do not explain the wedge prior to 1935.

during the Depression?" as "What drove a 40% wedge between marginal product and value of time?". As Mulligan (2000) argues, this reformulation can direct those searching for explanations away from those that do not create significant tax wedges (eg., productivity shocks, shocks to international trade) towards those that might.

If we view unemployment as a shock to the system, rather than as a response to productivity or policy shocks, then we see much less of a (peacetime) departure between *MRS* and *MPL* since 1930 that cannot be explained by income taxes. Hence, while my calculations suggest that labor productivity shocks cannot explain much of the 1930's labor market behavior, shocks to the productivity of job search might. Of course, the question remains as to the source of those shocks and, given the unemployment measures, what is the source of the remaining 1930's divergence of *MRS* and *MPL*.

VI.D. WWII

Federal tax rates grow from practically zero to more than 20% during WWII, and this should have caused *MRS* to grow much less than *MPL* during that period. Consumption rationing should have added to the measured wartime wedge. Instead, the log-Stone-Geary functional form suggests that *MRS* grew much more, and the Hansen functional form suggests that *MRS* grew only slightly less. In other words, WWII leisure time is lower (or consumption higher) than implied by the labor equilibrium equation. Also, both functional forms imply substantial changes in *MRS* relative to *MPL* between 1944 and 1947, while measured tax rates did not really change until 1948.

VI.E. Leisure and Consumption Since 1980

Perhaps my more novel finding is that the value of time grew much more than the marginal product of labor during the 1980's, to such an extent that implied "tax" wedges were reduced by 20 percentage points. The Reagan administration claimed to have policies reducing the wedge between *MPL* and *MRS* – such as reducing marginal federal personal income tax rates, taking a tough stance against unions, and resisting nominal minimum wage increases – so perhaps wedge reductions were to be expected. Wedge reductions during the Reagan administration are some evidence of empirical success of the labor equilibrium equation, especially since that equation successfully predicts wedge increases prior to 1980, although it appears that the 20 percentage point reduction is more than one would expect based on tax records and observations of union behavior. Average marginal federal labor income tax rates were reduced by five percentage points, or less. My calculations suggest that the decline of monopoly unionism contributed to reduced wedges, but no more than 3 percentage points, so much of the 1980's behavioral changes remain unexplained.

VI.F. What About Unobserved Preference Shifts?

Shifts in the *MRS* function have also received some attention in some disaggregated time series studies of female labor supply, retirement, and the changing composition of labor input between employment and hours. These shifts are real, but the relevant questions here are (a) whether these shifts show up in the aggregate, given that some of them are in opposite directions, and (b) whether they are relevant for the decade-to-decade changes emphasized here. It is doubtful that the Depression or the changes in the 1980's were caused by the same forces responsible for a century of increase female labor force participation, a century of decreasing labor force participation among older men.

My approach is to assume that the equilibrium condition $MRS = (1-\tau)MPL$ is indeed testable, an assumption consistent with so many models in the literature that have *MRS* as a stable function of a few aggregate observables. My assumption fails, of course, in models like those of Parkin (1988) or Hall (1997) where there are enough unobserved determinants of preferences. Without direct measures of the causes of market distortions, or of the taste parameters, it is impossible to determine whether a deviation between measured *MRS* and *MPL* is due to a distortion or a preference shift. But we do have measures of taxation and other indicators of distortionary public policy, and I believe that many of the "taste shifts" indicated by Hall are in fact changes in distortions. For example, Hall (1997, Figure 8) shows a "shift in preferences" away from leisure during the 1980's. But the 1980's were a time when federal government was cutting marginal tax rates, and private sector unions were on a dramatic decline, so my Section V interprets a large part of the 1980's changes as reductions in labor-leisure distortions.

I do not want to suggest that all gaps between measured *MRS* and *MPL* are distortions rather than preference shifts. Indeed, the results above suggest that some apparently large gaps between *MRS* and *MPL* are not readily explained by measures of restraints of trade. As I have argued elsewhere (Mulligan 1998), World War II may be the strongest case for the tastes interpretation. Figure 3 shows how, during the war, people acted as if either: (a) there was a labor-leisure taste shift, or (b) there were markedly smaller distortions than in the 1930's or 1950's. I see no indication that taxes, unionism, and other potential causes of distortions were reduced enough in the 1940's, and at least casual empiricism suggests that patriotism and other taste changes were significant.

Figure 3 also shows how people acted in the 1930's as if there were either huge labor market distortions or a big shift in tastes. I and many others are tempted to search for and model causes of labor market distortions, but at this point I must admit that the available measures do not indicate that taxes, unionism, or regulation were unusual enough during the 1930's to serve as significant and plausible explanations of 1930's behavior. Whether the Depression labor market will ultimately be explained by tastes or market distortions is still an open question.

VII. Appendix I: Quantifying Labor Regulation

I proceed in three steps in order to quantify 20th Century labor market regulation. First, I obtain a list of labor regulations and their dates of enactment from The Center for the Study of American Business' 1981 *Directory of Federal Regulatory Agencies*. To that list I add the 1933 National Industrial Recovery Act, which is no longer in affect today but was potentially important at the time of its enactment. The list is shown in Tables A-1 and A-2 below, and is the basis of the series in Figures 6 and 7:

Table A-1: Labor Regulations 1910-60

Year	Act	Industries/Workers Affected
1910	*Mine Safety*	metal and nonmetal mines
1916	*Federal Employees Compensation*	Federal and Postal employees
1927	*Longshoremen's and Harbor Worker's Compensation*	Maritime workers, employees of government contractors overseas
1931	Davis-Bacon	Construction employees working on federally funded projects (est. as construction employment*federal employment/total employment)
1933	**National Industrial Recovery** (through 1935)	same as NLR (below)
1935	**National Labor Relations (Wagner Act)**	All employers involved in interstate commerce, except air, rail, agriculture, and gov't (employees est. as private nonsupervisory workers)
1936	Public Contracts (Walsh-Healy Act)	Federal government contractors
1938	Fair Labor Standards	Employees of firms involved in interstate commerce which meet volume amounts. (employees affected est. as Dept of Labor report of workers affected by federal minimum wage)
1947	**Labor-Management Relations (Taft Hartley)**	Same as Wagner Act
1959	**Labor-Management Reporting and Discolsure**	Same as Wagner Act

Notes: (1) Source is CSAB (1981, pp. 103-5), plus 1933 NRA
(2) **boldface type denotes union protective legislation**
(3) *italics type denotes "mandatory fringe" legislation*, such as mandatory minimum safety conditions, mandatory health or disability insurance, etc.
(4) underline type denotes mandatory minimum compensation legislation

Table A-2: Labor Regulations 1960-80

Year	Act	Industries/Workers Affected
1963	Equal Pay	Same as FLSA, times fraction of employment that is female
1963	*Farm Labor Contractor Registration*	agricultural workers
1964	Civil Rights (Title VII)	Same as FLSA, times fraction of employment that is non-white
1965	Executive Order 11246	Extension of Civil Rights and Equal Pay Acts to Government contractors
1965	*Service Contract*	Government contractors
1966	*Federal Metal and Nonmetallic Mine Safety*	metal and nonmetal mines
1967	Age Discrimination in Employment	Same as FLSA
1968	Consumer Credit Protection	Same as FLSA
1969	*Coal Mine Health & Safety (Black Lung)*	Coal mines
1969	*Construction Safety*	Employees of privately funded construction contracts
1970	*Occupational Safety and Health*	All employees except state or federal government employees
1971	Postal Reorganization	Postal employees
1972	Equal Employment Opportunity	Same as Civil Rights
1973	Rehabilitation	Federal contractors
1974	**Health Care Institutions**	nonsupervisory health industry employees
1974	*Employee Retirement Income Security*	Private sector employees with benefit plans
1974	Vietnam Era Veterans Readjustment	Federal contractors (affected employees estimated as federal contractor employees*Vietnam veterans/total employment)
1977	*Federal Mine Safety and Health Amendments*	Coal, metal, and nonmetal mines
1977	*Black Lung Benefits Reform*	Coal miners
1978	Pregnancy Discrimination	Same as Equal Pay
1978	Civil Service Reform	Federal employees

Notes: (1) Source is CSAB (1981, pp. 103-5), plus 1933 NRA
(2) **boldface type denotes union protective legislation**
(3) *italics type denotes "mandatory fringe" legislation*, such as mandatory minimum safety conditions, mandatory health or disability insurance, etc.
(4) underline type denotes mandatory minimum compensation legislation

The second step in the analysis is to make some determination of the types of workers affected by each Act, which I have done based on CSAB's description of each Act and report in the last column of the Tables. The number of workers of each type is found from bls.gov, Council of Economic Advisers (1996), and Census Bureau (1975), and used to construct the weighted series shown in Figures 6 and 7.

Third, I make an attempt to separate those Acts that are more likely to drive a wedge between *MRS* and *MPL*. Regulations supposed to protect unions are an obvious candidate, and are indicated in bold in the Tables. Regulations that dictate part of an employee's compensation package for employees can also be expected to drive a wedge to the extend that they distort that package. For example, an Act such as OSHA may require employers to provide safety at a cost that exceeds the value of safety to workers and thereby drive a wedge between *MRS* and *MPL*. Such "mandatory fringe" legislation is indicated in italics in the two Tables, and are the basis for the dashed series shown in Figure 7. "Mandatory minumum compensation" legislation mainly dictates the rate of pay, or a minimum rate of pay, for workers; the relevant acts are underlined in the Tables.

VIII. Appendix II: Consumption Regulation and Measured Marginal Rates of Substitution

@ available upon request @

IX. Appendix III: The Union Relative Wage Effect and Aggregate Distortions

Suppose that, at any date t, employment occurs in two sectors: the "union sector" (in amount L_t^u) and the "nonunion sector" (in amount L_t - L_t^u). In the nonunion sector, wages w_t equal marginal product. Wages in the union sector are w_t^u, and may (or may not) exceed the marginal product in that sector. One model of the union wage effect is in the spirit of Leontief (1946), where union employment is set so that the marginal product of labor is w_t, but union employees are paid more than w_t. Here there is no labor-leisure distortion; in the Cobb-Douglas case the aggregate consumption-leisure ratio would move together with the average product of labor (which, in turn, is proportional to w_t) regardless of the fraction of employment that occurs in the union sector and of the amount by which union wages exceed marginal product. However, *measured* wages exceed w_t, so the measured wage time series would be different from both the consumption-leisure ratio and the average product of labor.[36]

A second model is Dunlop's (1944), or the textbook monopoly model, where the union wage equals marginal product in that sector, and the union wage effect occurs because union employment is too low. The *MRS* equals *MPL* only in the nonunion sector, and therefore is less than the average wage $\bar{w}_t$ and the average marginal product. If we equate the representative household's *MRS* to the nonunion *MPL*,[37] then (in the absence of other distortions) the simulated tax rate is just the product of union density (L_t^u/L_t) and the union relative wage effect $(w_t^u - w_t)/\bar{w}_t$:

$$\tau_t^* = 1 - \frac{MRS_t}{\bar{w}_t} = \frac{\bar{w}_t - w_t}{\bar{w}_t} = \frac{L_t^u}{L_t}\frac{w_t^u - w_t}{\bar{w}_t}$$

This is the formula I use to construct Figure 8. The same formula applies even if unions are not distortionary as in Leontief's model, except that it is a formula for the *measured distortion* based on *measured wages*. The true distortion would be zero in Leontief's model, and so would the measured distortion if *MPL* were measured rather than wages. In other words, both models predict that an increase in union density or an increase in the union relative wage effect will increase the gap between *MRS* and measured wages. Only the Dunlop model predicts that these would increase the gap between *MRS* and *MPL*.

X. Appendix IV: The Sensitivity of Implied Tax Rates to the Frisch Labor Supply Elasticity

Consider a *MRS* function of the form:

[36] Since *measured* labor's share of GDP is so constant since 1929, it seems that the rise and fall of unions cannot be described according to Leontief's model, or that the gap between average and marginal labor product has evolved in such a way as to cancel the labor share effects of unions' rise and fall.

[37] As it would be in a household labor supply model where only some family members can be employed in the union sector.

$$MRS_t \equiv \theta\left(\frac{c_t - \gamma}{1 - L_t}\right)^{1/\eta}$$

where η is a constant Frisch labor supply elasticity. $\eta = 1$ is the function (5) considered in the main text, and the corresponding implied tax rates received the most attention in my analysis.

But how sensitive are the results to η? To answer this question, observe the Figure below which graphs implied tax rates for $\eta = 0.5$, $\eta = 2/3$, $\eta = 1.5$, and $\eta = 2$.[38] For reference, the dotted line is the Barro-Sahasakul (AGI-weighted) measured marginal tax rate.

[38]Here θ is adjusted with η to match the overall level of implied and measured tax rates. γ is \$1000 per adult in all four cases.

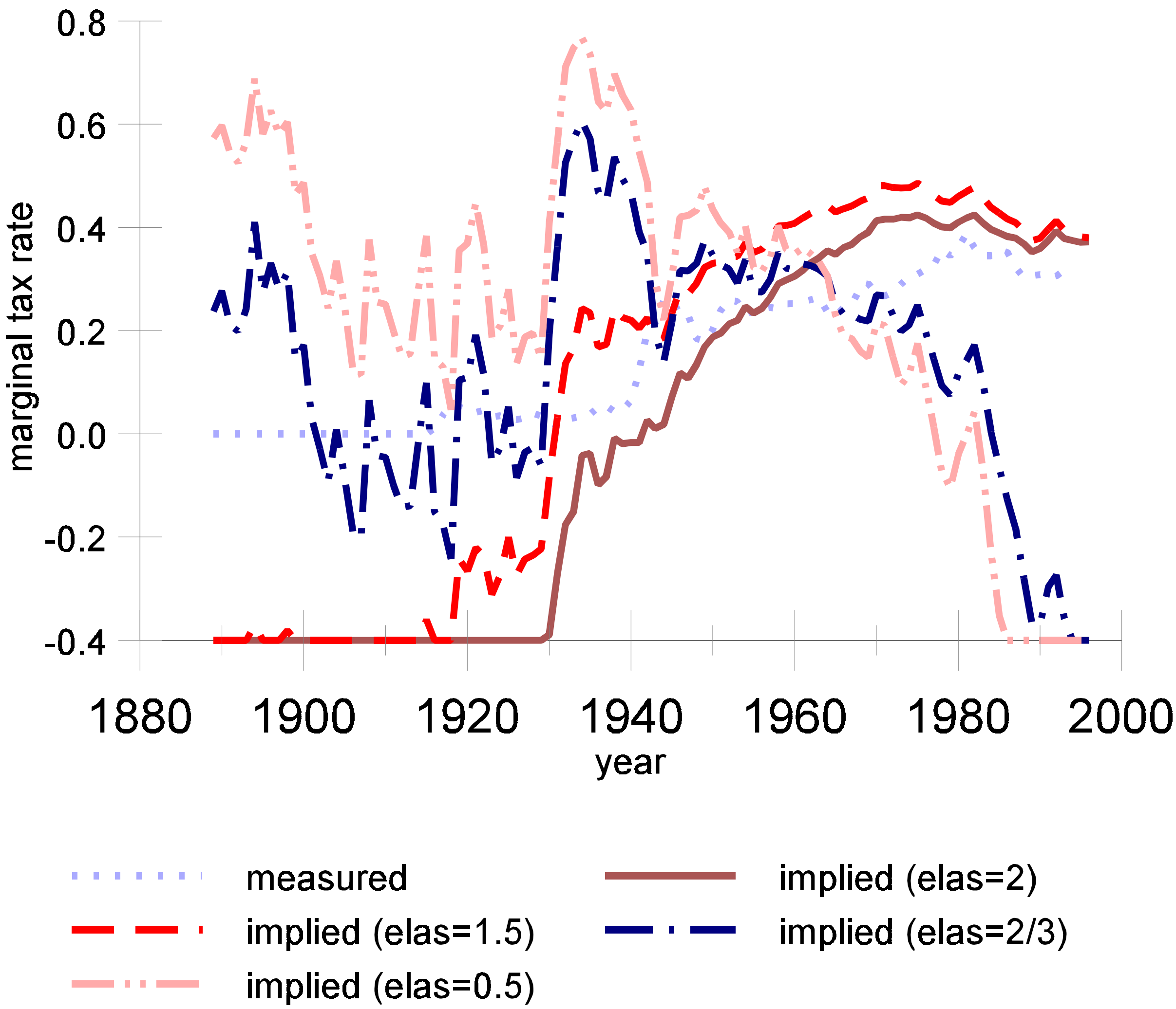

Figure Sensitivity of Implied Rates to Frisch Elasticity

We see that implied tax rates are quite sensitive to η – so sensitive that some of the series need to be truncated to make the graph readable. But notice that, *regardless* of η:

(d) implied rates rise substantially 1929-33

(e) implied rates fall 1940-44, or at least do not rise like measured rates

(f) implied rates rise 1940-48

(g) implied rates fall in the 1980's

Hence the main conclusions in the text are robust to η, except perhaps it could be argued with a large η that measured and implied rates fall by the same magnitude in the 1980's. Moreover, none of the η's different from one can explain the postwar or century-long trends in measured tax rates – a result that is consistent with the accounting shown in Table 2.

XI. References

Abraham, Katherine G., James R. Spletzer, and Jay C. Stewart. "Why Do Different Wage Series Tell Different Stories?" *American Economic Review*. 89(2), May 1999: 34-39.

Barro, Robert J. "Long-Term Contracting, Sticky Prices, and Monetary Policy." *Journal of Monetary Economics*. 3(3), July 1977: 305-16.

Barro, Robert J. and Herschel I. Grossman. "A General Disequilibrium Model of Income and Employment." *American Economic Review*. 61(1), March 1971: 82-93.

Barro, Robert J. and Robert G. King. "Time Separable Preferences and Intertemporal Substitution Models of Business Cycles." *Quarterly Journal of Economics*. 99(4), November 1984: 817-39.

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.

Blinder, Alan S., Roger H. Gordon, and Donald E. Wise. "Reconsidering the Work Disincentive Effects of Social Security." *National Tax Journal*. December 1980: 431-42.

Bound, John and George Johnson. "Changes in the Structure of Wages in the 1980's: An Evaluation of Alternative Explanations." *American Economic Review*. 82(3), June 1992: 371-92.

Bowen, William G. and T. Aldrich Finegan. *The Economics of Labor Force Participation*. Princeton, NJ: Princeton University Press, 1969.

Center for the Study of American Business. *Directory of Federal Regulatory Agencies*. 3rd edition, 1981.

DiNardo, John, Nicole M. Fortin, and Thomas Lemieux. "Labor Market Institutions and the Distribution of Wages: A Semiparametric Approach." *Econometrica*. 64(5), September 1996: 1001-44.

Douglas, Paul Howard. *The Theory of Wages*. New York: Macmillan, 1934.

Dunlop, John T. *Wage Determination under Trade Unionism*. New York: Macmillan, 1944.

Feldstein, Martin and Andrew Samwick. "Social Security Rules and Marginal Tax Rates." *National Tax Journal*. 45(1), March 1992: 1-22.

Freeman, Richard B. and James L. Medoff. *What Do Unions Do?* New York: Basic Books, 1984.

Friedman, Milton and Anna Jacobson Schwartz. *Monetary Trends in the United States and United Kingdom: Their Relation to Income, Prices, and Interest Rates, 1867-1975*. Chicago: University of Chicago Press, 1982.

Fraker, Thomas, Robert Moffitt, and Douglas Wolf. "Effective Tax Rates and Guarantees in the AFDC Program, 1967-82." *Journal of Human Resources*. 20, Spring 1985: 251-63.

Goldin, Claudia. "Maximum Hours Legislation and Female Employment: A Reassessment." *Journal of Political Economy*. 96(1), February 1988: 189-205.

Hall, Robert E. "Market Structure and Macroeconomic Fluctuations." *Brookings Papers on Economic Activity*. II, 1986: 285-322

Hall, Robert E. "Macroeconomic Fluctuations and the Allocation of Time." *Journal of Labor Economics*. 15(1), Part 2 January 1997: S223-50.

Hansen, Gary D. "Indivisible Labor and the Business Cycle." *Journal of Monetary Economics*. 16(3), November 1985: 309-27.

Hosios, Arthur J. "On the Efficiency of Matching and Related Models of Search and Unemployment." *Review of Economic Studies*. 57(2), April 1990: 279-98.

Houthakker, Hendrik S. "The Pareto Distribution and the Cobb-Douglas Production Function in Activity Analysis." *Review of Economic Studies*. 23, 1955: 27-31.

Hunt, Jennifer and Katz, Lawrence F. "Hours Reductions as Work-sharing." *Brookings Papers on Economic Activity*. I, 1998: 339-381.

Ingram, Beth F., Narayana R. Kocherlakota and N. E. Savin. "Using Theory for Measurement: An Analysis of the Cyclical Behavior of Home Production." *Journal of Monetary Economics*. 40(3), December 1997: 435-456.

Juster, F. Thomas and Frank P. Stafford. "Changes over the Decades in Time Spent at Work and Leisure; An Assessment of Conflicting Evidence." International Association for Research in Income and Wealth Conference paper, Flims, Swi, 1992.

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

King, Robert G., Charles I. Plosser and Sergio T. Rebelo. "Production, Growth and Business Cycles: I. The Basic Neoclassical Model." *Journal of Monetary Economics*. 21(2), March 1988: 195-232.

Kydland, Finn E. and Edward C. Prescott. "Time to Build and Aggregate Fluctuations." *Econometrica*. 50(6), November 1982: 1345-70.

Lebergott, Stanley. *Manpower in Economic Growth: The American Record since 1800*. New York: Economics Handbook Series, 1964.

Leete, Laura and Juliet B. Schor. "Assessing the Time-Squeeze Hypothesis: Hours Worked in the United States, 1969-89." *Industrial Relations*. 33(1), January 1994: 25-43.

Leontief, Wassily W. "The Pure Theory of the Guaranteed Annual Wage Contract." *Journal of Political Economy*. 54(1), February 1946: 76-79.

Lewis, H. Gregg. "Hours of Work and Leisure." *Proceedings of the Industrial Relations Research Association*. vol 9, 1956: 196-206.

Lewis, H. Gregg. *Unionism and Relative Wages in the United States*. Chicago: University of Chicago Press, 1963.

Lewis, H. Gregg. *Union Relative Wage Effects: A Survey*. Chicago: University of Chicago Press, 1986.

Leveson, Irving F. "Reductions in Hours of Work as a Source of Productivity Growth." *Journal of Political Economy*. 75(2), April 1967: 199-204.

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: 186-91.

MaCurdy, Thomas E. and John H. Pencavel. "Testing Between Competing Models of Wage and Employment Determination in Unionized Markets." *Journal of Political Economy*. 94, Part 2, 1986: s3-s39.

Mortensen, Dale T. "Property Rights and Efficiency in Mating, Racing, and Related Games." *American Economic Review*. 72, 1982: 968-79.

Mulligan, Casey B. "Pecuniary Incentives to Work in the United States during World War II." *Journal of Political Economy*. 106(5), October 1998: 1033-77.

Mulligan, Casey B. "A Dual Method of Empirically Evaluating Dynamic Competitive Equilibrium Models with Distortionary Taxes, Including Applications to The Great

Depression and World War II." Working paper, University of Chicago, October 2000.

Mulligan, Casey B. "Aggregate Implications of Indivisible Labor." *Advances in Macroeconomics*. 1(1), 2001a, Article 4.

Mulligan, Casey B. "Capital, Interest, and Aggregate Intertemporal Substitution During the 20th Century." Paper presented at the Joint Invited Session in Econometrics and Economic Theory at the 2001 European Meeting of the Econometric Society. August 2001b.

Mulligan, Casey B. and Justin G. Marion. "Average Marginal Tax Rates Revisited: Comment." Working paper, University of Chicago, August 2000.

Owen, John D. *Working Hours*. Lexington, MA: DC Heath and Company, 1979.

Pissarides, Christopher A *Equilibrium Unemployment Theory*. 2nd edition. MIT Press, 2000.

Parkin, Michael. "A Method for Determining Whether Parameters in Aggregative Models are Structural." in Karl Brunner and Bennett T. McCallum, eds. *Money, Cycles, and Exchange Rates: Essays in Honor of Allan H. Meltzer*. Carnegie-Rochester Conference Series on Public Policy, 29, Autumn 1988: 215-52.

Prescott, Edward C. "Some Observations on the Great Depression." *Federal Reserve Bank of Minneapolis Quarterly Review*. 23(1), Winter 1999: 25-31.

Rees, Albert. *The Economics of Trade Unions*. Chicago: University of Chicago Press, 1989.

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

Romer, Christina. "New Estimates of Prewar Gross National Product and Unemployment." *Journal of Economic History*. 46(2), June 1986: 341-352.

Schor, Juliet B. *The Overworked American*. New York: Basic Books, 1991.

Stafford, Frank P. "Review of 'The Overworked American'". *Journal of Economic Literature*. 1992: 1528f.

Stephenson, E.F. "Average Marginal Tax Rates Revisited." Journal of Monetary Economics. 41, 1998: 389-409.

Summers, Lawrence H. "Some Simple Economics of Mandated Benefits." *American Economic Review*. May 1989: 177-83.

United States Council of Economic Advisers. *Economic Report of the President*. Washington, DC: U.S. Government Printing Office, 1996.

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 Economic Analysis. *Personal Consumption Expenditures*. Washington : U.S. Dept. of Commerce, Bureau of the Economic Analysis, June 1990.

United States Office of Management and Budget. *Historical Tables, Budget of the United States Government, Fiscal Year 1998*. Washington, DC: Government Printing Office, 1998.

Weir, David R. "The Reliability of Historical Macroeconomic Data for Comparing Cyclical Stability." *Journal of Economic History*. 46(2), June 1986: 353-365.

Wu, Yangru and Junxi Zhang. "Endogenous Markups and the Effects of Income Taxation: Theory and Evidence from OECD Countries." *Journal of Public Economics*. 77(3), September 2000: 383-406.