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Capital Taxation During the U.S. Great Depression*

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ABSTRACT

Previous studies of the U.S. Great Depression find that increased taxation contributed little to either the dramatic downturn or the slow recovery. These studies include only one type of capital taxation: a business profits tax. The contribution is much greater when the analysis includes other types of capital taxes. A general equilibrium model extended to include taxes on dividends, property, capital stock, and excess and undistributed profits predicts patterns of output, investment, and hours worked more like those in the 1930s than found in earlier studies. The greatest effects come from the increased tax on corporate dividends.

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*Appendices, data, and codes are available at my website, http://www.minneapolisfed.org/research/sr/sr451.html. For helpful comments, I thank Roozbeh Hosseini, Ayse Imrohoroglu, Lee Ohanian, Ed Prescott, Martin Schneider, and conference participants at the Center for the Advanced Study in Economic Efficiency. For editorial assistance, I thank Kathy Rolfe and Joan Gieseke. The views expressed herein are those of the author and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

1. Introduction

Although there is no general agreement on the primary causes of the U.S. Great Depression—the sharp economic contraction in the early 1930s and the subsequent slow recovery—many do agree that fiscal policy played only a minor role. This conventional view is based on both empirical and theoretical analyses of the period. Although federal government spending notably increased during the 1930s, the data show that as a share of gross domestic product (GDP), it did not increase enough to have had a large impact (Brown, 1956). At the same time, income tax rates increased sharply, but taxes were filed by few households and paid by even fewer (U.S. Department of the Treasury, 1916–2010). Feeding estimates of spending and tax rates into a standard neoclassical growth model, Cole and Ohanian (1999) confirm that the impact of fiscal policy during the 1930s was too small to matter. Here, I challenge that conventional view.

My challenge is based on an examination of all types of taxation during the 1930s. As is standard, Cole and Ohanian (1999) and others limit their attention to taxes on wages and business profits. I look as well at taxes on capital stock, property, sales, excess profits, undistributed profits, and dividends. When these overlooked taxes are incorporated into the neoclassical framework, the model predicts patterns in aggregate data that are much closer to those in U.S. data than previous studies have found. A crucial factor for the model predictions is the tax treatment of capital income.[1] If tax rates on undistributed and distributed profits (i.e., dividends) are equated, then the impact of taxation is found to be small. If they are not assumed to be equal and are set at levels observed in the 1930s, then the impact of taxation is found to be large.

Perhaps surprisingly, given that capital taxation plays a central role in my analysis, a

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[1] Standard practice is to model capital taxes as taxes on profits. See, for example, business cycle studies of Braun (1994) and McGrattan (1994) and Great Depression studies in Kehoe and Prescott (2007).

key policy change in the decade is the increase in tax rates on individual incomes. But individual incomes include corporate dividends. Although few households paid income taxes in the 1930s, those who did earned almost all of the income distributed by corporations and unincorporated businesses. Thus, increasing the tax rate on dividends would naturally have had a significant effect on economic activity.

Besides including overlooked taxes, I extend the neoclassical growth model to allow for both tangible and intangible business investment (as do McGrattan and Prescott, 2010). I do this because the U.S. tax code allows businesses to reduce taxable income by expensing intangible investments like advertising expenditures, research and development (R&D), and labor devoted to building up businesses. I assume that part of intangible investment is financed by owners of capital and is expensed from corporate profits rather than capitalized. The remainder is financed by unincorporated business owners who are paid less than their marginal value product with the expectation of realizing future profits or capital gains.[2] Making the distinction between tangible and intangible capital explicit in the model allows it to better capture the actual effect of taxes.

And it does. My model predicts that higher taxes during the 1930s led to a dramatic decline in tangible investment, similar to that observed in the United States, with the primary cause being the rise of the effective tax rate on dividends. The pattern of investment is a steep decline in the early part of the decade, followed by some recovery and another steep decline in 1937. The primary cause of the second decline is the introduction of the undistributed profits tax. Overall, the model predicts 1929–1933 declines in GDP and hours worked that account, respectively, for 41 and 48 percent of the actual declines. These are improvements over the Cole and Ohanian (1999) model predictions—four times larger for GDP and three times larger for hours. The model also predicts correctly that equity values should have fallen by about 30 percent over the decade.

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[2] McGrattan and Prescott (2010) refer to the equity accumulated by business owners as *sweat equity.*

My model's quantitative results, especially for the early 1930s, do depend somewhat on how household expectations about future income tax rates are modeled, but sensitivity analysis shows that the main results are not overturned as I vary assumptions about expectations. The period was rife with institutional uncertainty. Major changes in the U.S. tax code were not enacted until the Revenue Act of 1932. However, as early as February 1930, President Herbert Hoover warned that large tax increases would follow if Congress enacted its proposed spending projects. Theoretically, anticipated tax increases on future distributions lead to immediate increases in current distributions and immediate declines in business investments and equity values. Regardless of the uncertainty, since tax rate increases are large, the effects on economic activity are too.

Although the results show that tax policy had a major impact on economic activity in the 1930s, it could not have been the only factor contributing to the large contraction and slow recovery of the 1930s. This is demonstrated, for example, by the initial consumption predictions, which do not line up well with the data. U.S. consumption fell sharply in the early part of the 1930s, yet both Cole and Ohanian's (1999) and my model miss that drop; the models actually predict an initial rise. Expectations of higher future capital tax rates imply a sharp initial increase in distributions of business incomes, accomplished by decreasing tangible investment. Increased distributions then lead, counterfactually, to increased consumption, which falls only when higher sales and excise taxes are imposed. Adding New Deal policies (as in the 2004 work of Cole and Ohanian) would help further account for the time series patterns in the later part of the decade. But we need other ways to account for the pattern of consumption in the early part.[3]

The paper is organized as follows. In Section 2, I review the evidence in support of the conventional view that fiscal policy played only a minor role in the Great Depression. In

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[3] Chari, Kehoe, and McGrattan (2007) apply a business cycle accounting exercise to the 1930s and show that models with frictions manifested primarily as efficiency wedges and labor wedges are needed to account for fluctuations in this period. The inclusion of intangible capital and taxes implies time variation in these key wedges, but they are not large enough; the model still cannot quantitatively account for all of the fluctuations.

Section 3, I redo the exercise of Cole and Ohanian (1999) with a version of the neoclassical growth model that is more suited to studying fiscal policy in the 1930s. I show that the results change dramatically, especially if taxes on dividends and undistributed profits are included separately in the analysis. Section 4 concludes.

2. The Conventional View

I begin by reviewing work in support of the conventional view that fiscal policy in the 1930s had only a small effect on economic activity.

The standard reference for those studying fiscal policy in the 1930s is the work of Brown (1956). His main conclusion is that "fiscal policy, then, seems to have been an unsuccessful recovery device in the 'thirties—not because it did not work, but because it was not tried" (p. 863).[4] Brown bases his conclusion on estimates of the impact of fiscal policy on aggregate demand, making assumptions about households' marginal propensity to consume and save.

As Brown's conclusion makes clear, the focus of his study is in assessing the positive role of fiscal policy in promoting a recovery from the Depression rather than in assessing its role in the downturn of the early 1930s. The lack of attention paid to the contraction in the early 1930s is probably due to the fact that major changes in tax policy—which would have had a negative effect—were not enacted until 1932, and even then, most Americans were not required to file tax returns.

In Table 1, I show the number of taxable individual income tax returns (Forms 1040 and 1041) filed in the years 1929 through 1939. To provide some sense of the magnitudes, I also list the midyear populations for this period. In 1929, for example, the population

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[4] In fact, Romer (2009) uses Brown's (1956) evidence when proposing greater fiscal stimulus during the 2008–2009 downturn. Brown's (1956) work is also a standard reference for those who study the impact of policy in the 1930s but abstract from changes in fiscal policy. See, for example, the work of Bernanke (1983) and Romer (1992).

Year	Taxable Returns, Forms 1040/1041 (millions)	Population at Midyear (millions)
1929	2.5	121.9
1930	2.0	123.2
1931	1.5	124.1
1932	1.9	124.9
1933	1.7	125.7
1934	1.8	126.5
1935	2.1	127.4
1936	2.9	128.2
1937	3.4	129.0
1938	3.0	130.0
1939	4.0	131.0

TABLE 1. NUMBER OF TAXABLE INDIVIDUAL INCOME TAX RETURNS AND MIDYEAR POPULATION, 1929–1930

was 122 million, but only 2.5 million individual income tax returns were filed. At that time, the typical household size was 3.3 persons, implying that only 6.8 percent of the U.S. population were members of taxpaying households. In 1935, the number of taxpayers had fallen to 2.1 million, while the population had risen to 127 million. In that year, there were 39.5 million households, and therefore only 5.3 percent of the population were members of taxpaying households. (See the work of Leven, Moulton, and Warburton, 1934, and Kneeland, 1938.)

The most closely related work to the current study is the analysis of Cole and Ohanian (1999) who, like Brown, write off fiscal policy's role in the Great Depression. Cole and Ohanian compare deterministic steady states of a neoclassical growth model with government spending and tax rates set at 1929 levels and 1939 levels. Cole and Ohanian choose these years because they are interested in accounting for the weak recovery in U.S. labor input, which was still well below trend in 1939. They find that the labor input predicted by the model is lower than trend by only 4 percent in 1939 and conclude that “fiscal policy shocks account for only about 20 percent of the weak 1934–39 recovery” (p. 12).

Here, I extend the analysis of Cole and Ohanian (1999) slightly by computing the entire equilibrium path for the period 1929–1939 and confirm their main finding. The equilibrium path of their model provides a useful benchmark for comparison to the model studied later that includes overlooked taxes and intangible capital.

The model Cole and Ohanian (1999) use is a standard neoclassical growth model with distortionary taxes on wages and profits. Given the initial capital stock k_0, the problem for the stand-in household is to choose consumption c, investment x, and hours worked h to maximize expected utility

$$E\sum_{t=0}^{\infty}\beta^t U\left(c_t,h_t\right)N_t \tag{2.1}$$

subject to the constraints

$$c_t + x_t = r_t k_t + w_t h_t + \kappa_t - \zeta_t \tag{2.2}$$

$$k_{t+1} = \left[\left(1-\delta\right)k_t + x_t\right]/\left(1+\eta\right), \tag{2.3}$$

where variables are written in per capita terms, $N_t = N_0(1+\eta)^t$ is the population in t, which grows at rate η, β is the time discount factor, and δ is the depreciation rate of capital. Capital is paid rent r_t, labor is paid wage w_t, and per capita transfers are given by κ_t. Taxes are summarized by the variable ζ_t in (2.2); below, I will specify a specific formula for ζ_t.

The aggregate production function is given by

$$Y_t = K_t^{\theta}\left(Z_t H_t\right)^{1-\theta}, \tag{2.4}$$

where capital letters denote aggregates and θ is capital’s share of output. The parameter Z_t is labor-augmenting technical change that is assumed to grow at a constant rate, $Z_t =$

$(1+\gamma)^t$. The firm rents capital and labor. If profits are maximized, then the rental rates are equal to the marginal products. The goods market clears, so $N_t(c_t + x_t + g_t) = Y_t$, where g_t is per capita government spending.

A standard practice in the business cycle literature is to assume that taxes are levied on capital and labor, with excess revenues rebated to households. Capital taxes are modeled as taxes on profits, and thus,

$$\zeta_t = \tau_{pt}\left(r_t - \delta\right)k_t + \tau_{ht} w_t h_t, \tag{2.5}$$

where τ_{pt} is the tax rate on capital income (that is, profits), and τ_{ht} is the tax rate on labor income.

In their analysis of the U.S. Great Depression, Cole and Ohanian (1999, p. 12) conclude that plausible estimates of the increase in the tax rates τ_{pt} and τ_{ht} are not large enough to have much of an effect in the 1930s. They use estimates of Joines (1981) and compare the deterministic steady state of the model with 1929 tax rates to the deterministic steady state of the model with 1939 tax rates. Joines' estimates of the tax rates on capital and labor are 29.5 and 3.5 percent, respectively, in 1929 and 42.5 and 8.3 percent, respectively, in 1939.

As do Cole and Ohanian (1999) and others in the business cycle literature, I use the tax rates on capital and labor estimated by Joines (1981)—namely, his MTRK1 and MTRL1—as inputs for τ_{pt} and τ_{ht}, along with a measure of detrended real government spending. Detrended spending is real government consumption divided by the population and the growth in labor-augmenting technical change $(1+\gamma^t)$. For the quantitative results that I report below, I assume that households have full knowledge of the path of spending and tax rates, but this assumption is not critical for the findings.[5]

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[5] Because the actual spending and tax rate paths are the expected future states, I use the low frequency trends of the observed time series. Doing this does not affect my findings for the basic growth model and helps in computing equilibria for the extended growth model described later. See the appendix for more details. See McGrattan (2010) for the results of a sensitivity analysis.

For my simulation, I use a flow utility function given by

$$U(c,h) = \log(c) + \psi \log(1-h),$$

where ψ is a parameter governing the disutility of work. To be consistent with Cole and Ohanian, I assume that the capital share θ is 0.33, the growth rate of the population η is 1 percent, and the growth rate of technology γ is 1.9 percent. Values of ψ, δ, and β are then set to ensure that 1929 levels of per capita hours, per capita real investment, and the per capita real capital stock in the model are consistent with U.S. data; this implies $\psi = 2.33$, $\delta = 0.05$, and $\beta = 0.984$. (In McGrattan 2010, I vary assumptions about parameters and household expectations and show that the variation hardly affects the results.)

In Figures 1–4, I plot this basic growth model's predictions for detrended real investment, per capita hours, detrended real GDP, and detrended real consumption from 1929 to 1939. To detrend investment, GDP, and consumption, I divide each series by population and growth in labor-augmenting technical change (that is, $(1+\gamma)^t$). The series are compared with U.S. time series that are detrended in the same way. The series are indexed so that 1929 equals 100. (See the appendix for more details on data construction and sources.)

As expected, the differences between the model's predictions and the U.S. time series are large. Between 1929 and 1933, investment falls only 16 percent in the model but 70 percent in the United States. The model predicts a 4 percent decline in per capita hours between 1929 and 1933, but the actual decline was 27 percent. For GDP, the model predicts a 3 percent decline between 1929 and 1933, but the actual decline was 34 percent. Model consumption rises initially, whereas in the data consumption falls. By 1933, model consumption is below trend by only 1 percent, and actual consumption is below trend by 25 percent. By 1939, economic activity in both the model and data are below trend, but the predicted differences are large. For example, U.S. hours are 21 percent below trend, but the model predicts that hours should have been only 4 percent below trend. This is what Cole and Ohanian (1999) found when doing steady state calculations. These large differences are consistent with the conventional view that fiscal policy had little to do with the dramatic contraction in these years.

3. An Extended View

I now consider an extension of the basic growth model that includes two factors necessary for studying U.S. tax policy in the 1930s. The first is a more comprehensive specification of taxes. The second is a distinction between tangible and intangible investments. Adding these overlooked factors, I demonstrate that the extended model better predicts the data of the 1930s.

3.1. The Extensions

First, I identify and justify the two overlooked factors to be included in the analysis.

The primary one is the inclusion of taxes on property, capital stock, excess profits, undistributed profits, dividends, and sales in addition to taxes on wages and ordinary profits.[6] At the beginning of the 1930s, the source of most government revenues was indirect business taxes on property, sales, and excise. Over the decade, as deficits grew at all levels of government, legislators increased tax rates, especially rates of individual and corporate income taxes and sales and excise taxes. Although the tax revenues on incomes never exceeded indirect business taxes, these taxes directly impacted almost all capital owners in the United States.

The other factor I add to the basic growth model is the distinction between tangible and intangible investments. In order to accurately assess the impact of taxes, especially taxes on capital income, it is important to take into account the fact that a significant

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[6] Brown (1949) shows that, when used in combination, the capital stock tax and the excess profits tax acted like a tax on corporate profits, which is how I model them.

amount of capital investment is expensed and thus nontaxable; these include investments in advertising, R&D, and organizational capital. As a trustee of the Museum of Science and Industry noted in 1936, with taxes rising, "many manufacturers have concluded that it will be better business judgment to spend money for business promotion, advertising, newspaper campaigns, technical research, etc., in which they get full benefit of each dollar in building up business" (*New York Times*, July 23, 1936). This shift from tangible to intangible investments is also evident in statistics on R&D employment. For example, Mowery and Rosenberg (1989) report that between 1933 and 1940, employment of scientists and engineers in two-digit manufacturing industries nearly tripled, rising from 10,927 to 27,777, and the number of scientific personnel per 1,000 wage earners doubled, rising from 1.93 to 3.67.

3.2. The Basic Setup

Now I describe how the basic growth model must be changed to accommodate my extensions.

The aggregate production technology is now characterized by two aggregate production relations:

$$y_t = \left(k_{Tt}^1\right)^\theta \left(k_{It}\right)^\phi \left(Z_t^1 h_t^1\right)^{1-\theta-\phi} \tag{3.1}$$

$$x_{It} = \left(k_{Tt}^2\right)^\theta \left(k_{It}\right)^\phi \left(Z_t^2 h_t^2\right)^{1-\theta-\phi}, \tag{3.2}$$

where θ is the tangible capital share of output and ϕ is the intangible capital share of output. Firms produce final output y using their tangible capital k_T^1, intangible capital k_I, and labor h^1. Firms produce intangible capital x_I—such as new brands, R&D, and patents—using tangible capital k_T^2, intangible capital k_I, and labor h^2.

Note that k_I is an input to both sectors; it is not split between them, as tangible capital and labor are. A brand name is used both to sell final goods and services and to develop new brands. Patents are used by the producers and the researchers. (See the work of McGrattan and Prescott, 2010, for the aggregation theory underlying this technology.)

Given initial stocks of tangible and intangible capital (k_{T0}, k_{I0}), the stand-in household maximizes

$$E \sum_{t=0}^{\infty} \beta^t \left[\log c_t + \psi \log(1 - h_t)\right] N_t$$

subject to several constraints:

$$c_t + x_{Tt} + q_t x_{It} = r_{Tt} k_{Tt} + r_{It} k_{It} + w_t h_t + \kappa_t - \zeta_t$$

$$k_{T,t+1} = \left[(1 - \delta_T) k_{Tt} + x_{Tt}\right] / (1 + \eta) \tag{3.3}$$

$$k_{I,t+1} = \left[(1 - \delta_I) k_{It} + x_{It}\right] / (1 + \eta) \tag{3.4}$$

and nonnegativity constraints on investment, $x_{Tt} \geq 0$ and $x_{It} \geq 0$. Here, as before, all variables are in per capita units, and population grows at rate η. The relative price of intangible investment and consumption is q; the rental rates for tangible and intangible capital are denoted by r_T and r_I, respectively; and the wage rate for labor, w. As before, inputs are paid their marginal products.

Since the capital taxation studied here affects only business activity, I assume that nonbusiness output y_{nt} less nonbusiness investment x_{nt} is (exogenously) included with transfers to households κ_t. I also assume that hours h_t include hours in nonbusiness production h_{nt}. (See the time paths of nonbusiness activity in the appendix, Table A.2.)

As do McGrattan and Prescott (2010), I assume that intangible investment is financed partly by the owners of capital and partly by the suppliers of labor; the distinction matters because the tax treatment of capital and labor is different. Let χ denote the fraction of intangible investment financed by shareholders. In this case, the amount $\chi q x_I$ is financed by owners of capital and is therefore expensed from accounting profits rather than capitalized. The amount $(1 - \chi) q x_I$ is sweat investment which is financed by business owners who devote uncompensated time to building up their businesses.

GDP in this economy is the sum of private consumption, tangible investment, public consumption, and nonbusiness investment; in per capita terms, GDP is $c + x_T + g + x_n$. Gross domestic income (GDI) is the sum of capital income less expensed investment, $r_T k_T + r_I k_I - \chi q x_I$, labor income less sweat investment $wh - (1-\chi) q x_I$, and nonbusiness capital income $y_n - wh_n$.

3.3. Taxes

Next, I modify the way taxes are modeled by including three additional taxes on capital income—property, undistributed profits, and dividends—as well as taxes on consumption. The formula for per capita taxes paid by households then becomes

$$\begin{aligned}
\zeta_t = \tau_{ct} c_t + \tau_{ht} \left(w_t h_t - (1-\chi) q_t x_{It} \right) + \tau_{kt} k_{Tt} + \tau_{ut} \left((1+\eta) k_{T,t+1} - k_{Tt} \right) \\
+ \tau_{pt} \{ r_{Tt} k_{Tt} + r_{It} k_{It} - \delta_T k_{Tt} - q_t x_{It} - \tau_{kt} k_{Tt} \} \\
+ \tau_{dt} \{ r_{Tt} k_{Tt} + r_{It} k_{It} - x_{Tt} - q_t x_{It} \\
- \tau_{kt} k_{Tt} - \tau_{ut} \left((1+\eta) k_{T,t+1} - k_{Tt} \right) \\
- \tau_{pt} \left(r_{Tt} k_{Tt} + r_{It} k_{It} - \delta_T k_{Tt} - q_t x_{It} - \tau_{kt} k_{Tt} \right) \},
\end{aligned} \tag{3.5}$$

where τ_{ct} is the tax rate on consumption, τ_{ht} is the tax rate on labor income, τ_{kt} is the tax rate on property, τ_{ut} is the tax rate on undistributed profits, τ_{pt} is the tax rate on profits, and τ_{dt} is the tax rate on dividends. Note that taxable income for the tax on profits is net of depreciation and property tax, and taxable income for the tax on dividends is net of taxes on profits, property, and undistributed profits.

For my numerical experiments, I again need to choose time series for spending and tax rates in the model. Here, I describe those choices briefly. (In the appendix and in McGrattan 2010, I describe them in more detail.)

For government spending and the tax rate on wages, I use the same inputs as in the basic growth model analyzed by Cole and Ohanian (1999). (See the appendix, Table A.1.)

Table A.3 shows the additional taxes used in simulating the extended model, namely, time series for τ_{pt}, τ_{dt}, τ_{kt}, and τ_{ct}.[7]

I replace the tax rate on profits used in the standard model by an estimate of the tax rate on normal business profits plus an estimate of the effective rate due to the capital stock tax in combination with the excess profits tax. For normal business profits, I use the statutory corporate income tax rate.

These changes are motivated by the actual U.S. tax system. A tax on capital stock and excess profits was in effect in 1933 and subsequent years and, according to Brown (1949), was effectively a tax on profits. Companies had to declare a value for their capital stock, and a tax was assessed on that value. To avoid having companies declare a capital value that was too low, the government used an excess profits tax as a penalty. For example, in 1934, if profits exceeded 12.5 percent of the declared capital stock value, companies paid a 5 percent tax on the excess profits. To avoid this penalty, companies tended to declare a high value for capital and paid roughly 2 percent of profits because of this tax in addition to their normal tax bill. (See the work of Brown, 1949.) For this reason, the tax rate listed in Table A.3 is an estimate of the normal tax on profits plus an additional 2 percent that is indirectly assessed through the capital stock tax.

The tax on dividends τ_{dt} (the second column of Table A.3) is estimated as the average marginal tax rate on U.S. dividends. This rate is a weighted average across income groups of the additional tax assessed on an additional dollar of dividend income.

Also included in the analysis are taxes on property and consumption, which yielded the bulk of government revenues during the entire decade of the 1930s. These are shown in the last two columns of Table A.3. Estimates of these rates are constructed from taxes on imports and production. in the national income and product accounts (NIPA).

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[7] For the extended model, household expectations are modeled as a probability distribution over observed spending and tax rates for the years 1930–1939. Given that they are the basis of expectations, I filter the actual series and use only the low frequencies. See the appendix for more details.

For the tax on undistributed profits, τ_{ut}, which was in effect for the years 1936–1938, I use an effective rate of 5 percent. This estimate yields revenues that are in line with revenues reported in the U.S. Treasury's *Statistics of Income*.

In the model, as in the United States, the treatment of tangible and intangible income differs, as can be seen from the formula (3.5). Taxes on property and undistributed profits are levied on tangible capital and tangible net investment. For the purposes of taxation of profits, tangible investment is not expensed, but intangible investment is. The asymmetric treatment also affects the incidence of the tax on dividends.

3.4. Expectations

Before I simulate the time series for the extended model, I need to describe households' assumptions about future government spending and taxes. When analyzing the basic growth model, I made an extreme assumption that households had perfect foresight of rising taxes to get the maximal effect, but I found that even in the extreme case, the impact of fiscal policies was too small to matter. In the extended model, with taxes on many different sources of capital income and investments that are tax deductible, expectations will play a more significant role. Thus, here I detail my assumptions about expectations, at least for my initial *benchmark* simulation.

Table 2 summarizes the benchmark parameterization of the process governing fiscal policy. The table is a transition matrix with the current state, call it s_t, taking on values listed in the rows of the table and the future state listed in the columns. In other words, the states are the years 1929 through 1939. A current state of "1930" means that fiscal policy in this state is the same as it was in the United States in 1930. I assume that spending and tax rates are functions of s_t, for example, $\tau_{dt} = \tau_d(s_t)$, and the functions are read off Tables A.1 through A.3. Notice that most transitional probabilities in Table 2 are zero (and so not listed). Transiting from the 1930 state, the only possible states for 1931 are fiscal policies equivalent to U.S. policies observed in 1929, 1930, and 1931. Households are assumed to put 1/3 weight on each of those possible future states.

The parameterization in Table 2 assumes that there is uncertainty in 1930–1931 and again in 1936–1937 because of actual U.S. events. The initial uncertainty about tax and spending policies early in the decade was not fully resolved until the U.S. Revenue Act of 1932 was enacted. Before then, households were warned that spending bills in Congress could not be financed out of current revenue streams. Newspapers throughout 1930 and 1931 included headlines like "Hoover Warns Congress to Economize or be Faced by Tax Rise of 40 Per Cent" (*New York Times*, February 25, 1930). But households were not sure if the government would raise taxes during a depression, as the following excerpt indicates.

> Some, who were pessimistically inclined, believed it would be necessary to recommend to the next Congress even higher taxes for 1931 than those carried in the 1928 revenue law, in order to avert a serious deficit at the end of the fiscal year 1931. The more general belief, however, is that the 1928 rates will be permitted to stand even if a deficit results, as it is felt that a move to increase taxes would further accentuate the economic depression which is given much concern. It was indicated at the Treasury that Secretary Mellon felt it was too early to talk with definiteness about the tax situation but that he would go into a full discussion of the subject . . . in his annual report in Congress in December. (*New York Times*, August 22, 1930)

Households remained uncertain about the specifics of the final bill until it was enacted and signed in 1932. Then they knew that individuals faced large increases in marginal income tax rates.

For several years thereafter, new revenue acts were introduced. In 1933, it was a tax on capital stock and excess profits (part of the National Industrial Recovery Act). In 1934, the main policy changes were designed to prevent tax avoidance. In 1935 increases in surtaxes on individuals were made. The main change in 1936 was the introduction of the undistributed profits tax. This change was likely to have surprised most Americans, since

	Next Period's Policy Like That of:										
Year	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
1929	1										
1930	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$								
1931	$\frac{1}{3}$		$\frac{1}{3}$	$\frac{1}{3}$							
1932					1						
1933						1					
1934							1				
1935							1				
1936								$\frac{1}{2}$	$\frac{1}{2}$		
1937									$\frac{1}{2}$	$\frac{1}{2}$	
1938											1
1939											1

Table 2. Transition Matrix for Benchmark Model Simulation

the tax was not proposed until a speech by President Franklin D. Roosevelt in March 1936. Congress went along with the proposal, and the law was passed soon thereafter and made applicable to income during the entire calendar year. In modeling expectations, I have chosen parameters in the transition matrix of Table 2 consistent with the 1936 law being a completely unanticipated change. After that, there is uncertainty about the permanence of the undistributed profits tax, which is modeled as a 1/2, 1/2 probability on staying with the same policy (1936) or transiting to the next year (1937). This is done for 1937 as well, since there was uncertainty about whether it would continue. In 1938, it was clear that the undistributed profits tax would be eliminated.

3.5. Model Predictions

Now I quantify the parameters of the extended model economy and rerun the numerical experiment done earlier for the basic growth model. I report the results of this simulation and compare them with those of the basic growth model as well as to what actually happened in the U.S. economy in the 1930s. In essence, this exercise demonstrates that capital taxation did indeed play a significant role in the U.S. Great Depression, both in the deep contraction and in the slow recovery.

For my simulations, I assume, as before, that the utility function is logarithmic and growth rates are given by $\gamma = 0.019$ and $\eta = 0.01$. The time series for nonbusiness activities are set exogenously to be equal to U.S. values. (As noted earlier, the detrended paths of nonbusiness hours, investment, and output are shown in Table A.2.) The parameter χ, which governs the fraction of expensing done by capital owners, is set equal to 0.5 as in McGrattan and Prescott (2010). I have no independent evidence for this parameter and therefore check the implications for varying it below.

The remaining parameters are set so that aggregates in the model economy are equal to their U.S. analogues in 1929. Specifically, I use values from U.S. data for real GDP, real consumption, real tangible business investment, real tangible business capital, and per capita hours. This implies parameter values of $\psi = 2.053$, $\beta = 0.98$, $\delta_T = 0.0357$, $\theta = 0.236$, and $\phi = 0.113$. Because the intangible depreciation rate and the share of intangible capital in production ϕ cannot be separately identified, I normalize δ_I to 0 and show in McGrattan (2010) that this choice is made without loss of generality.

Figures 5–8 show the extended model's predictions for investment, hours, GDP, and consumption, which are comparable to the basic growth model's in Figures 1–4. A comparison of Figures 1 and 5 shows that disaggregating the capital tax rates makes a big difference for the model's prediction of measured investment (which is the sum of tangible investment and nonbusiness investment). With the Joines' (1981) tax rate on profits only, investment declines very gradually. With different rates on profits, dividends, and property, the model predicts an immediate and sharp fall in measured investment $(x_T + x_n)$, much like that in the U.S. economy. The primary determinant for the fall is expectations about the future changes in the tax rate on dividends. In fact, with the tax rate on profits τ_{pt} and property τ_{kt} set equal and fixed to 1929 levels, the picture changes little. The reason for the large decline is that households anticipate large changes in the effective return to capital.

To see this, consider the households' intertemporal first-order condition for tangible capital when nonnegativity constraints are not binding on investment:

$$\frac{(1+\tau_{ut})\,(1-\tau_{dt})}{(1+\tau_{ct})\,\hat{c}_t} = \hat{\beta} E_t\Big[\frac{(1-\tau_{dt+1})}{(1+\tau_{ct+1})\,\hat{c}_{t+1}}\{(1-\tau_{pt+1})\,(r_{Tt+1}-\delta_T-\tau_{kt+1})+1+\tau_{ut+1}\}\Big], \quad (3.6)$$

where expectations are conditioned on the state s_t, $\hat{\beta} = \beta/(1+\gamma)$, and variables with hats are per capita series detrended by technology growth; for example, $\hat{c}_t = c_t/(1+\gamma)^t$.[8] If tax rates on dividends are constant, then the terms $1-\tau_{dt}$ and $1-\tau_{dt+1}$ cancel. If revenues are lump-sum rebated to households, then taxes on dividends have no effect because neither budget sets nor first-order conditions change. Similarly, if households have myopic expectations—by which I mean that every period they think the current tax rates they are facing will be in place forever—then tax rates on dividends have no effect even if they do actually change. However, if households put some probability on changing rates, then the terms $1-\tau_{dt}$ and $1-\tau_{dt+1}$ do not cancel and the effective rate of return to capital is affected. With tax rates rising, effective rates of return are falling.[9]

Figure 6 shows hours per capita for the extended model and the U.S. data. The pattern for the model is similar to the pattern of investment. Hours fall about 13 percent between 1929 and 1933 in the model and about 27 percent in the United States. Thus, the model accounts for 48 percent of the actual decline. Hours recover subsequently in the model and by 1939 are roughly 5 percent below trend. In the data, hours are still

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[8] Intuition for the actual simulation is complicated by the fact that negativity constraints do bind in many states of the world.

[9] In a study of the U.S. Jobs and Growth Tax Relief Reconciliation Act of 2003, Chetty and Saez (2005) provide empirical evidence that cuts in dividend taxes have large and immediate effects on payout policies of firms with high levels of taxable noninstitutional ownership.

well below trend—about 20 percentage points—by 1939. Thus, although the predictions in 1939 are similar to those of the basic growth model (Figure 2), the relative declines in the first part of the decade are significantly larger in the extended model—on the order of three times larger.

Figure 7 shows that the model predicts GDP to decline about as much as hours of work between 1929 and 1933. The predicted fall is about 41 percent of the actual decline in U.S. GDP—a magnitude that is roughly four times larger than the fall predicted by the basic growth model (Figure 3).

The decline in model GDP is not greater because households consume more in the early part of the decade. Figure 8 shows the model's consumption path, which is rising prior to 1932, whereas consumption actually fell continually between 1929 and 1933. The optimal response to high future capital taxes is high current distributions of business income.[10] Taxes on consumption do rise during the 1930s, but not significantly until after 1932.

The extended model has another channel for spending, namely, intangible investment, but its price is also affected by expected increases in tax rates. Figure 9 shows the extended model's patterns of business tangible and intangible investments. Notice that initially, tangible investment falls as distributions are increased while intangible investment remains flat. The path of intangible investment depends critically on the amount of expensing done by capital owners (χ). To see why, consider the (unconstrained) first-order condition for intangible capital:

$$\frac{q_t[\chi\,(1-\tau_{pt})\,(1-\tau_{dt})+(1-\chi)\,(1-\tau_{ht})]}{(1+\tau_{ct})\,\hat{c}_t}$$
$$=\hat{\beta}E_t\Big[\frac{1}{(1+\tau_{ct+1})\,\hat{c}_{t+1}}\{(1-\tau_{pt+1})\,(1-\tau_{dt+1})\,r_{It+1}$$

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[10] The large deviation between consumption patterns in theory and data cannot be resolved by introducing the type of financial frictions proposed by Bernanke and Gertler (1989). Taxes on dividends have the same impact on economic activity as the agency costs in their model. Both impact the price of capital, leading to declines in investment and increases in consumption.

$$+ (1-\delta_I)\, q_{t+1}[\chi\,(1-\tau_{pt+1})\,(1-\tau_{dt+1}) + (1-\chi)\,(1-\tau_{ht+1})]\}\Big]. \quad (3.7)$$

If intangible capital is financed by capital owners ($\chi = 1$), then the returns on both types of capital are affected in the same way by the change in the tax rate on dividends (that is, $(1-\tau_{dt+1})/(1-\tau_{dt})$). If intangible capital is financed by owners deferring compensation ($\chi = 0$), then the relevant tax rate for expensing is τ_{ht}. The benchmark simulation has $\chi = 0.5$ and, as is clear from Figure 9, the time series for intangible and tangible investments are negatively correlated, implying some substitution between them.

Variation in intangible investment also enhances the model's ability to match up with U.S. data because it generates movements in efficiency and labor wedges, as called for by Chari, Kehoe, and McGrattan (2007). The efficiency wedge is the ratio of GDP to $(K_T + K_n)^{1/3} H^{2/3}$, where $K_T + K_n$ is the sum of aggregate tangible capital in the business and nonbusiness sectors and H is total hours of work. The labor wedge is the ratio of the marginal rate of substitution between leisure and consumption $\psi c/(1-h)$ and labor productivity measured as GDP divided by hours of work. Chari, Kehoe, and McGrattan (2007) show that these wedges varied a lot during the 1930s, which is puzzling for standard neoclassical theory. Using U.S. data to measure these wedges, I find that the efficiency wedge falls about 15 percent between 1929 and 1933 and then recovers by 1936, and the labor wedge falls close to 30 percent between 1929 and 1933 remains low throughout the decade. Performing the same exercise in the model, I do find that both wedges vary over the decade because intangible investment and capital vary. However, the movements in intangible investments are not large enough to generate movements in the model wedges comparable to those found in the data. The efficiency wedge constructed from the model time series falls only 2 percent between 1929 and 1933 before recovering. The labor wedge rises at first and then falls roughly 11 percent over the decade.

Another important consequence of the increase in tax rates on dividends is the decline in equity values. In Figure 10, I show the model's prediction for the time series for the (detrended) real equity value, which in this case is equal to

$$V_t = (1 - \tau_{dt})\left[(1 + \tau_{ut})\, K_{T,t+1} + (1 - \tau_{pt})\, q_t K_{I,t+1}\right],$$

where $K_{T,t+1}$ and $K_{I,t+1}$ are aggregate end-of-year tangible and intangible capital stocks, respectively. Prior to the introduction of the undistributed profits tax, the price of tangible capital is one minus the tax rate on dividends. A rise in the tax rate from 10 percent to 30 percent implies a 22 percent decline in the price of capital. If the tax proceeds are rebated to households, then the government becomes a shareholder owning 22 percent of the business, and the capital stock is not permanently changed. For shareholders facing the highest surtax rate (75 percent), the impact on their equity values would be large.

Overall, the results show that the extended model's predictions for the impact of taxation are greater than those of the basic growth model. And the impact is nontrivial, especially for tangible investment and hours of work.

3.6. Sensitivity Analysis

Finally, I investigate the sensitivity of the extended model results to the choice of household expectations (as detailed in Table 2) and several parameters related to intangible investment for which I have little independent evidence. I now vary these assumptions to see if that significantly changes the results about capital taxation's role in the 1930s. It does not.

I compute the model's equilibrium for three alternative assumptions about household expectations. One is the benchmark used in the initial simulation. A second is to assume that in 1930, households put the probability of staying with 1930 policy at 100 percent; the same can be said for 1931. The transition matrix for 1932 and after is the same as in Table 2. I call this *Myopic, 1930–1931.* The third alternative is to assume perfect foresight, that households have full knowledge of the path of spending and tax rates. I call this *Perfect Foresight, 1930–1939.*

As is clear in Figure 11, the model's predictions of tangible investment do seem different for the different assumptions. If households place no probabilistic weight on the higher tax rates of the 1930s, as is true in the myopic example, then tangible investment does not fall initially as much as it does in the benchmark. However, there is still a first-order effect on investment and one much larger than the basic growth model prediction. If households have perfect foresight, then they react immediately and sharply to the news by setting tangible investment to zero. It is not shown in the figure, but intangible investment in the perfect foresight case also falls dramatically, roughly 50 percent, in the first year.

Another difference worth noting about the perfect foresight case is the reaction to news about the undistributed profits tax. In the benchmark simulation, this tax is completely unanticipated. In the perfect foresight case, it is completely anticipated. Thus, there is a sharp rise in tangible investment between 1931 and 1935, with a dramatic fall when the tax is in effect.

In McGrattan (2010), I rerun the experiments using different values for the fraction of expensing done by shareholders (χ) and the depreciation rate on intangible capital (δ_I). The model's predictions are close to indistinguishable from those shown in Figures 5 through 10.

Overall, the sensitivity analysis shows that varying assumptions about household expectations and parameters related to intangible investment does not overturn the main conclusion that capital taxation played a significant role in the Great Depression.

4. Conclusion

Many theories have been proposed for the large contraction of the 1930s and the slow recovery thereafter. Absent in the theories of Friedman and Schwartz (1963), Bernanke and Gertler (1989), Cole and Ohanian (2004), and many others is any role for fiscal policy in this decade. This paper challenges the conventional view that fiscal policy played little or no role. Tax rates on dividends rose significantly during the decade and, when fed into the basic growth model, imply a large drop in tangible investments and equity values. In the later part of the 1930s, tax rates on undistributed profits were introduced and led to another dramatic decline in tangible investment.

Although the results show that capital taxation during the U.S. Great Depression had large effects, it could not be the only overlooked factor in the analysis of the period. According to model simulations, predicted consumption counterfactually rises before 1932, with households anticipating some increases in income taxes and sales taxes. This deviation is also evident in standard theories of financial frictions and remains a challenge for those interested in accounting for the dramatic contraction in the early 1930s.

Appendix

The main source for the data used in this study is the U.S. Department of Commerce, Bureau of Economic Analysis (BEA), which publishes the U.S. national accounts and fixed asset tables in the *Survey of Current Business* (available online at www.bea.gov), SCB hereafter. In this appendix, I provide details on the data used and the necessary adjustments that are made to make the model accounts consistent with the U.S. accounts.

A.1. National Accounts and Fixed Assets

The main components of GDP are found in Table 1.1.5 of the national income and product accounts (NIPA) from the SCB (1929–2010). GDP in the business sector is set equal to value added of corporations and nonfarm proprietorships.

A.1.1. Components of GDP

Consumption is defined to be personal consumption expenditures on nondurables and services, adjusted to include consumer durable services and to exclude sales tax. (Details of these adjustments are described below.) *Investment* is defined to be the sum of gross private domestic investment, government investment, net exports, and personal consumption expenditures on durables after subtracting sales taxes. *Business tangible investment* is defined to be the part of investment made by corporations and nonfarm proprietors. *Nonbusiness investment* is residually defined as investment less business tangible investment. *Government spending* is defined to be government consumption expenditures. All components of GDP are deflated by the GDP deflator (in Table 1.1.9) and population at midperiod (Table 2.1). The series are then divided by the growth in labor-augmenting technical change $(1+\gamma^t)$.

Components of GDP treated exogenously and used as inputs to the computation are also filtered using the algorithm proposed by Hodrick and Prescott (1997). I set their smoothing parameter (λ) equal to 1. The detrended and filtered government spending series is shown in Table A.1. The detrended, filtered nonbusiness investment and output are shown in Table A.2. In McGrattan (2010) I plot all of the smoothed inputs along with the original time series.

A.1.2. Adjustments to Accounts

Two adjustments are made to GDP and its components to make them consistent with the model accounts: sales taxes are subtracted and services for consumer durables and government capital are added.

Sales Taxes. Unlike the NIPA, the model output does not include consumption taxes as part of consumption and as part of value added. I therefore subtract sales and excise taxes from the NIPA data on taxes on production and imports and from personal consumption expenditures, since these taxes primarily affect consumption expenditures.

Fixed Asset Expenditures. I treat expenditures on all fixed assets as investment. Thus, spending on consumer durables is treated as an investment rather than as a consumption expenditure and moved from the consumption category to the investment category. The consumer durables services sector is introduced in the same way as the NIPA introduces owner-occupied housing services. Households rent the consumer durables to themselves. Specifically, I add depreciation of consumer durables to consumption of fixed capital of households and to private consumption. I add imputed additional capital services for consumer durables to capital income and to private consumption. I assume a rate of return on this capital equal to 4.1 percent, which is an estimate of the return on other types of capital. A related adjustment is made for government capital. Specifically, I add imputed additional capital services for government capital to capital income and to public consumption.

A.2. Hours Per Capita

The primary source of the hours series is the work of Kendrick (1961), Table A-X, total manhours. Nonbusiness hours are the sum of hours in the government and farm sectors. Business hours are total hours less nonbusiness hours. For per capita hours, I divide the manhours series by the population age 16 and over. The population series is Series A39 of the *Historical Statistics* of the U.S. Department of Commerce (1975).

A.3. Market Value

The total market value of U.S. corporations is available from the Federal Reserve Board's Flow of Funds starting in 1945. Before then, we have data only on subsets of stocks. Here,

Table A.1. Spending and Tax Rates in the Basic Growth Model

Year	Detrended Government Spending	Tax Rates on Wages	Tax Rates on Profits
1929	5.8	3.3	28.1
1930	6.2	3.6	28.6
1931	6.7	4.2	30.4
1932	7.1	5.2	34.0
1933	7.4	6.3	38.4
1934	7.7	7.2	41.1
1935	7.9	7.6	42.9
1936	8.0	7.9	44.2
1937	8.1	8.1	43.9
1938	8.3	8.3	43.1
1939	8.6	8.5	43.2

I use the market value of companies listed on the New York Stock Exchange (NYSE), available in the *Survey of Current Business: Annual Supplements* (1932–2000). As McGrattan and Prescott (2004) show, fluctuations in the total market value and the NYSE market value track each other closely in the post-1945 period. (See, in particular, that study's Figure 2.)

A.4. Tax Rates

To compute an equilibrium in the basic growth model (Section 2), I use estimates of marginal tax rates on capital and labor from the work of Joines (1981), specifically MTRK1 and MTRL1 shown in Table A.2 (along with the government spending series defined above). As with the other exogenous inputs, I filter these rates using the method of Hodrick and Prescott (1997). (See McGrattan 2010 for figures of the filtered and unfiltered series.)

In the second series of numerical exercises (Figures 5–11), I use the Joines (1981) MTRL1 for the tax on labor income, but I do not use MTRK1 for capital income. Instead, I include different rates for profits, dividends, and property. These rates are reported in

Table A.2. Nonbusiness Activity in the Extended Model

Year	Hours	Investment	Output
1929	7.4	15.0	36.3
1930	7.3	12.3	34.1
1931	7.2	9.9	32.6
1932	7.1	7.8	31.2
1933	7.0	7.0	30.4
1934	7.1	7.6	30.3
1935	7.2	9.1	31.0
1936	7.2	10.6	31.9
1937	7.2	11.8	32.3
1938	7.1	12.5	32.5
1939	7.0	13.4	32.6

Table A.3. Additional Tax Rates in the Extended Model

	Tax Rates on			
Year	Profits[a]	Dividends	Property	Consumption
1929	11.1	9.1	1.4	2.7
1930	11.8	9.6	1.6	3.0
1931	12.5	11.5	1.7	3.6
1932	13.2	15.6	1.8	4.5
1933	15.6	19.2	1.8	5.6
1934	15.7	22.8	1.8	6.6
1935	16.0	26.0	1.7	7.0
1936	16.7	28.7	1.7	7.1
1937	17.9	28.2	1.7	7.1
1938	19.9	26.8	1.6	7.2
1939	22.2	27.3	1.6	7.3

[a] This rate replaces the rate in Table A.1 and includes taxes on profits, capital stock, and excess profits.

Table A.3. All have been filtered. The profits tax rate that I use is the statutory rate reported in the U.S. Treasury's *Statistics of Income*.

The capital stock tax and excess profits tax are treated in combination like a tax on business profits, as suggested by Brown (1949). In Table A.3, two percentage points have been added to the smoothed statutory profits tax in the years 1933–1939.

The source of the dividend tax is the 2003 work of McGrattan and Prescott, who compute an average weighted marginal tax rate. In other words, a tax rate on dividend income is computed using data for each income group from the *Statistics of Income*. A weighted average is computed using the fraction of dividend income per income group as the weighting factor.

In the last two columns of Table A.3 are property and consumption tax rates constructed from NIPA data on taxes on production and imports. To construct a rate for the property tax, I divide the property tax revenues for corporations and nonfarm proprietors by the sum of the capital stocks of corporations and nonfarm proprietors. To construct a rate for the tax on consumption, I divide the sales and excise tax revenues by the measure of consumption defined above.

Finally, the undistributed profits tax is set equal to 5 percent in the years 1936 through 1938. This rate implies a ratio of revenues for the undistributed profits tax relative to the total corporate profits taxes in the model that is roughly equal to the ratios reported in the *Statistics of Income*.

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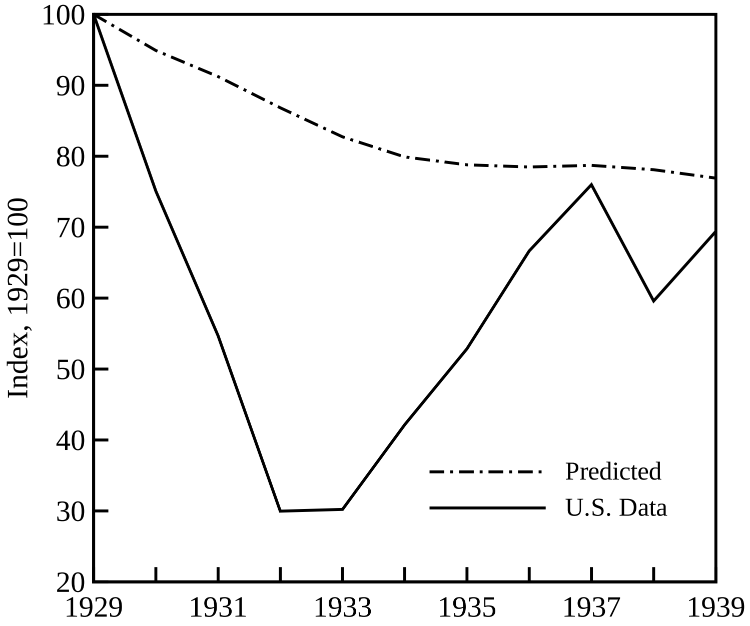

Figure 1. Detrended Real Investment in the United States and the Basic Growth Model, 1929–1939

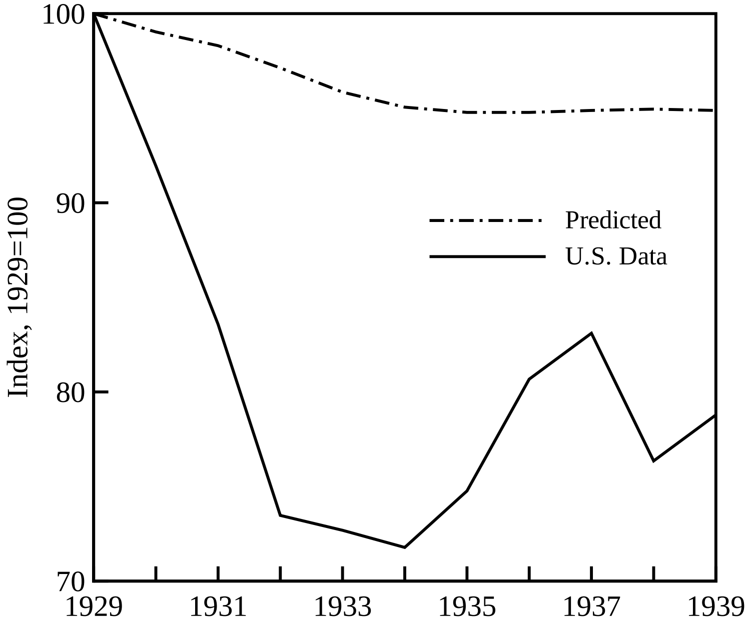

Figure 2. Hours Per Capita in the United States and the Basic Growth Model, 1929–1939

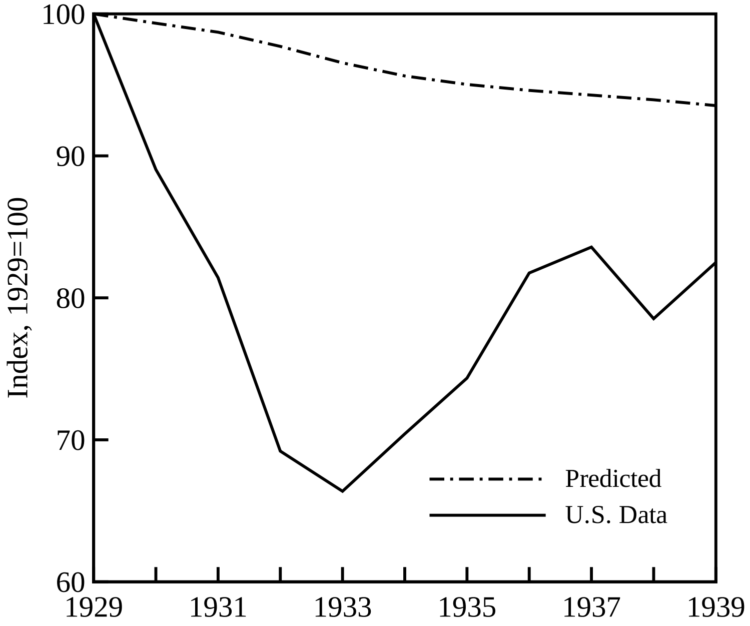

Figure 3. Detrended Real GDP in the United States and the Basic Growth Model, 1929–1939

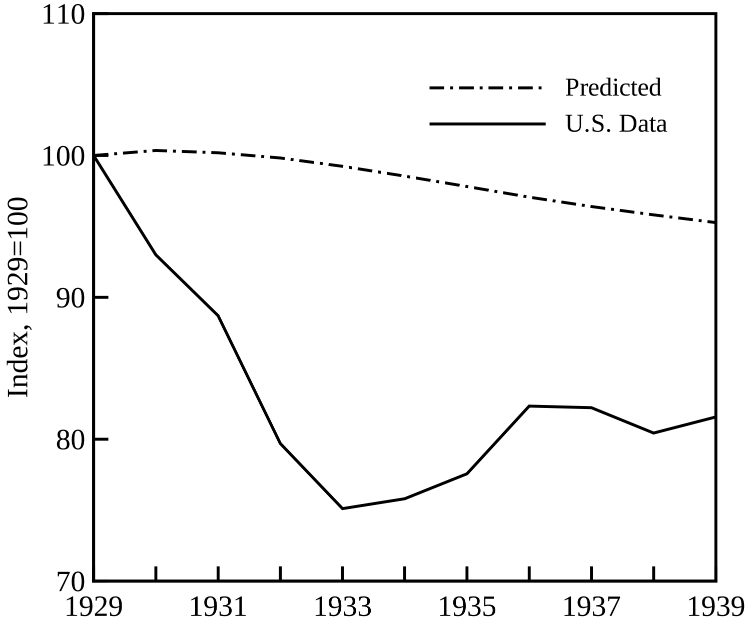

Figure 4. Detrended Real Consumption in the United States and the Basic Growth Model, 1929–1939

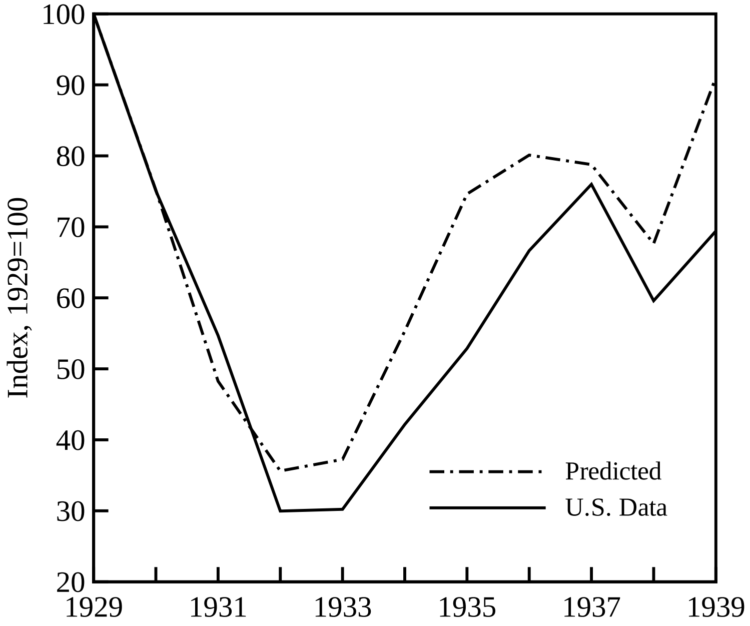

Figure 5. Detrended Real Investment in the United States and the Extended Growth Model, 1929–1939

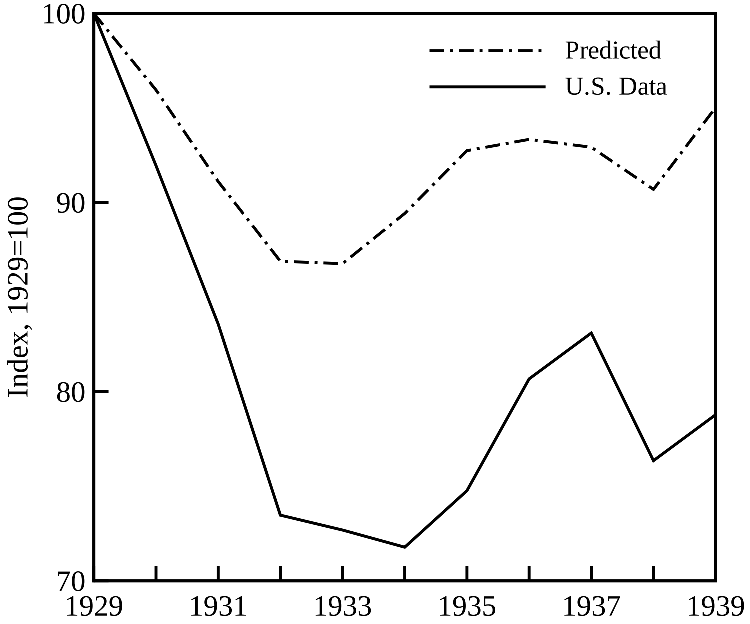

Figure 6. Hours Per Capita in the United States and the Extended Growth Model, 1929–1939

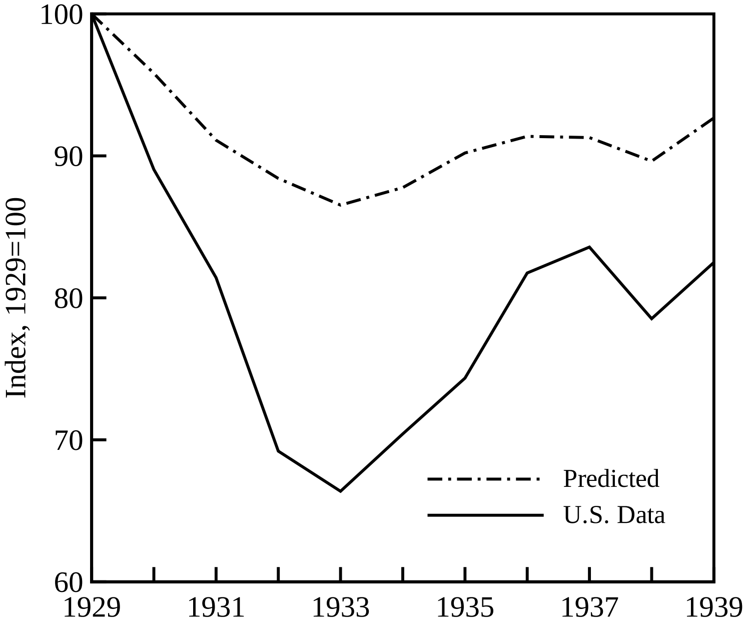

Figure 7. Detrended Real GDP in the United States and the Extended Growth Model, 1929–1939

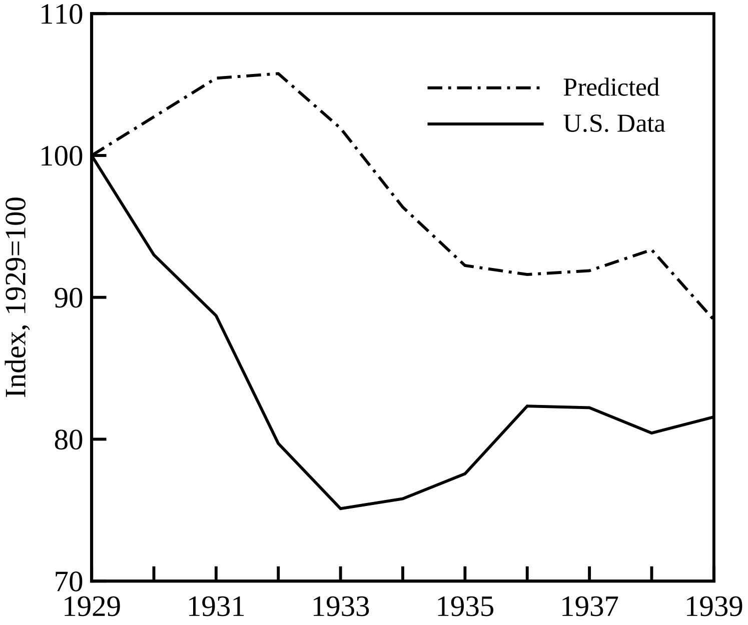

Figure 8. Detrended Real Consumption in the United States and the Extended Growth Model, 1929–1939

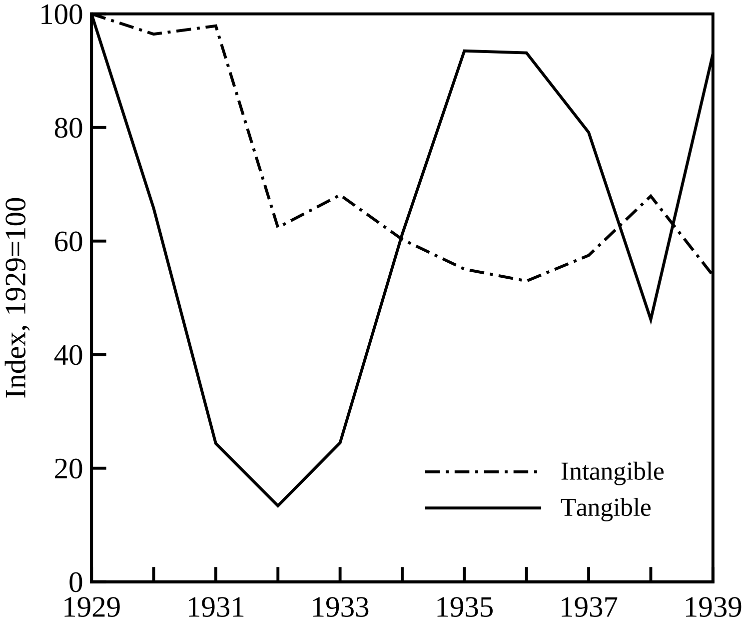

FIGURE 9. DETRENDED REAL TANGIBLE AND INTANGIBLE INVESTMENT IN THE EXTENDED GROWTH MODEL, 1929–1939

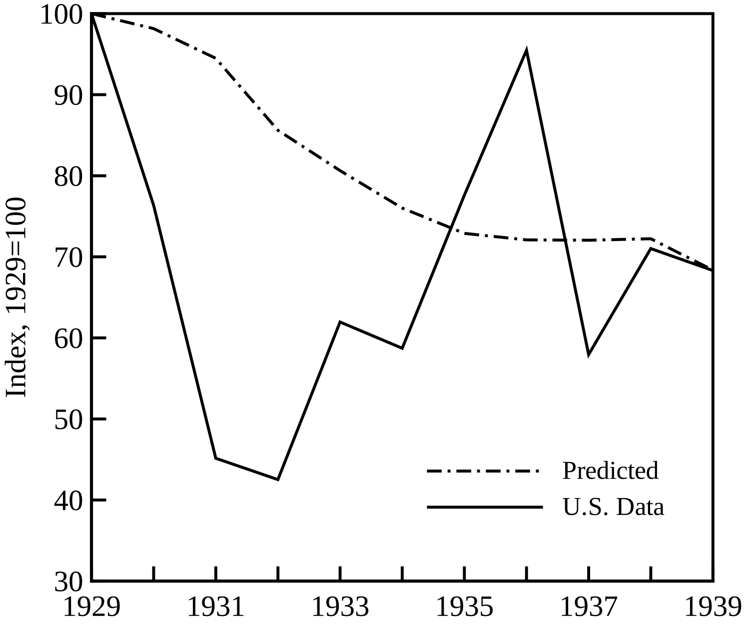

FIGURE 10. DETRENDED REAL MARKET VALUE OF THE NEW YORK STOCK EXCHANGE AND THE EXTENDED GROWTH MODEL, 1929–1939

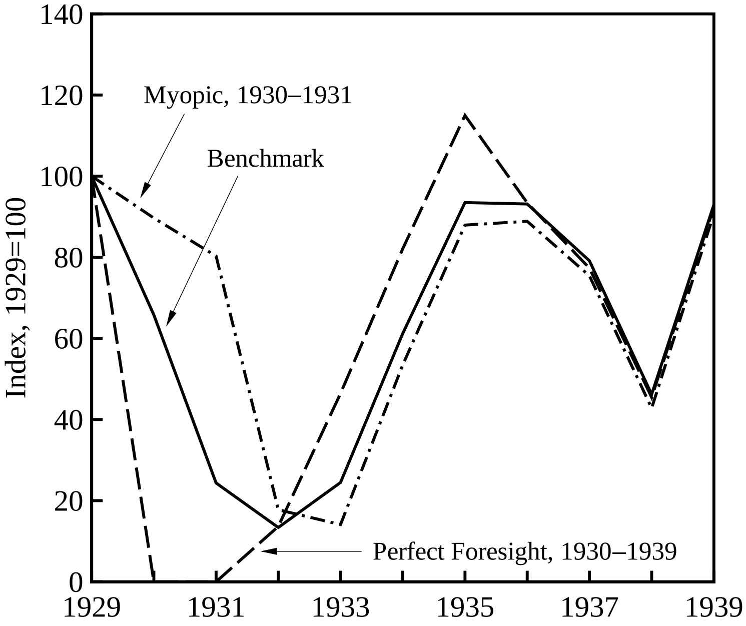

Figure 11. Detrended Real Tangible Investment in the Extended Growth Model, 1929–1939