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Capital Taxation During
the U.S. Great Depression[*]

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ABSTRACT _____

Previous studies quantifying the effects of increased taxation during the U.S. Great Depression find that its contribution is small, in accounting for both the downturn in the early 1930s and the slow recovery after 1934. This paper shows that this conclusion rests critically on the assumption that the only taxable capital income is business profits. Effects of capital taxation are much larger when taxes on property, capital stock, excess profits, undistributed profits, and dividends are included in the analysis. When fed into a general equilibrium model, the increased taxes imply significant declines in investment and equity values and nontrivial declines in gross domestic product (GDP) and hours of work. Of particular importance during the Great Depression was the dramatic rise in the effective tax rate on corporate dividends.

1. Introduction

Although there is little consensus about the main contributors to the large contraction of the first half of the 1930s and the slow subsequent recovery, there is some consensus that fiscal policy played only a minor role in the U.S. Great Depression. Empirically, it is argued that government spending relative to GDP did not rise sufficiently and that taxes were filed by very few households and paid by even fewer. (See, for example, Brown (1956) and the U.S. *Statistics of Income.*) Theoretically, it is argued that predictions of neoclassical theory for the impact of increased taxation and spending are too small to matter. (See, in particular, Cole and Ohanian (1999).)

In this paper, I challenge the view that the impact of all fiscal policies during the 1930s was small. Cole and Ohanian (1999) conclude that the impact was small in the early 1930s because effective tax rates on wages and profits did not change much. In the latter part of the 1930s, when rates did increase, their estimates show that it accounted for only a small part of the weak recovery in labor. I show that the overall conclusion that changes in taxes were too small to matter rests critically on their modeling of capital taxation, which assumes only taxation of profits.[1] The key policy change, however, was not an increase in the tax rates on corporate incomes (i.e., profits) but rather an increase in the tax rates on individual incomes, which include corporate dividends. Although few households paid income taxes, taxpayers that did earned almost all of the income distributed by corporations and unincorporated businesses.

Like Cole and Ohanian, I use a neoclassical growth model when estimating the impact of taxes on aggregate activity, but I extend the model they used to include taxes on property, capital stock, excess profits, undistributed profits, dividends, and sales in addition to taxes on profits and wages. I also allow for both tangible and intangible business investments (as in McGrattan and Prescott 2005) because the U.S. tax code allows businesses

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[1] This is a standard practice in the business cycle literature. See, for example, Braun (1994) and McGrattan (1994).

to reduce taxable corporate profits by expensing intangible investments like advertising expenditures and research and development (R&D).

The 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 most important factor being the rise in the effective tax rate on dividends. The pattern of investment shows a steep decline in the early part of the decade, followed by some recovery and another steep decline starting in 1937. The important factor in the latter period is the introduction of the undistributed profits tax. The model predicts a decline in GDP and hours between 1929 and 1933 that accounts for 40 percent and 47 percent of the actual declines, respectively. The model's predicted declines are roughly three times larger for GDP and two times larger for hours than those predicted by Cole and Ohanian's (1999) model.

The quantitative results, especially predictions for the early 1930s, do depend on how household expectations about future income tax rates are modeled. Major changes in the U.S. tax code were not enacted until the Revenue Act of 1932. However, as early as February 1930, President Hoover projected large tax increases if members of Congress enacted their proposed spending projects. Theoretically, anticipated tax increases on future distributions lead to increases in current distributions and therefore declines in business investments and equity values. Even with uncertainty about future rates built into the model, the fact that these tax rate increases are large means that the effects on economic activity are also large.

Although the results show that tax policy had a major impact on economic activity in the 1930s, they also show that it could not have been the only factor contributing to the large contraction and slow recovery of the 1930s. For example, patterns of consumption in the model do not line up well initially with their analogues in the data. Expectations of higher future capital tax rates imply a sharp initial increase in distributions of business incomes, accomplished by lowering both tangible and intangible investments. Increased

2

distributions lead counterfactually to increased consumption, which falls only when higher sales and excise taxes are imposed. Adding New Deal policies as in Cole and Ohanian (2004) would help in further accounting for the time series patterns in the second half of the 1930s, but that still leaves open the question of why U.S. consumption fell in the first years of the contraction.[2]

The paper is organized as follows. In Section 2, I review empirical and theoretical evidence used in support of the view that fiscal policy played only a minor role in the Great Depression. In 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 if we include taxes on dividends and undistributed profits in our analysis. Section 4 concludes.

2. Review of the Literature

In this section, I review some earlier work that has concluded that fiscal policy in the 1930s had only a small effect on economic activity.

A standard reference for those studying fiscal policy in the 1930s is Brown (1956) whose 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).[3] 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

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[2] Chari, Kehoe, and McGrattan (2007) use a business cycle accounting exercise during 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 enough; the model still cannot quantitatively account for all of the fluctuations.

[3] In fact, Romer (2009) uses Brown's evidence when proposing greater fiscal stimulus during the 2008–2009 downturn. Brown (1956) 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, Bernanke (1983) and Romer (1992).

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 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 tax-paying 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 tax-paying households.[4]

For the current study, the most relevant evidence about the impact of fiscal policy comes from Cole and Ohanian (1999), who compare deterministic steady states of a neo-classical growth model with government spending and tax rates set at 1929 levels versus 1939 levels. They choose these dates 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 1934–1939 recovery" (p. 7).

Here, I redo their exercise and reconfirm their finding—although with the full transition—in order to have a baseline simulation, one that is consistent with conventional wisdom about the impact of distortionary taxation in the 1930s.

The model Cole and Ohanian (1999) use is a standard growth model with distortionary

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[4] See Leven, Moulton, and Warburton (1934) and Kneeland (1938).

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

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 h to maximize

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

subject to the constraints

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

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

where variables are written in per capita terms and $N_t = N_0(1 + \eta)^t$ is the population in t. 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. 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 $N_t(c_t + x_t + g_t) = Y_t$ and $g_t = \zeta_t$, 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 (i.e., profits), and τ_{ht} is the tax rate on labor income.

In their analysis of the U.S. Great Depression, Cole and Ohanian (1999) 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. 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. In 1929, Joines' estimates of the tax rates on capital and labor are 29.5 and 3.5 percent, respectively. In 1939, Joines' estimates of the tax rates on capital and labor are 42.6 and 8.3 percent, respectively.

Like 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 taken from the U.S. national accounts. (See Table A.1 and Appendix A for details.) For the

quantitative results that I report below, I assume that households had full knowledge of the path of spending and tax rates, but this assumption is not critical for the findings. (In a separate appendix, I vary assumptions about household expectations and show that it hardly affects the results.)

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

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

and parameters that imply aggregate quantities consistent with the U.S. data in 1929, namely, $\psi = 1.92$, $\delta = 0.03$, $\beta = 0.97$, $\gamma = .02$, $\eta = .01$, and $\theta = .45$.

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

As expected, the differences between the model's predictions and the U.S. time series are large. Between 1929 and 1932, investment falls by 70 percent in the United States but by only 21 percent in the model. The model predicts a 4 percent decline in per capita hours between 1929 and 1932, but the actual decline was 27 percent. For GDP, the model predicts a 3 percent decline between 1929 and 1932, but the actual decline was 31 percent. In 1939, U.S. hours are 21 percent below trend, whereas U.S. GDP is 18 percent below trend; the model predicts 8 percent and 6 percent, respectively.

3. A Model Motivated by U.S. Policy

I now extend the basic growth model analyzed by Cole and Ohanian (1999) to include taxes on property, capital stock, excess profits, undistributed profits, dividends, and sales

in addition to taxes on wages and ordinary profits.[5] I also allow for investment in both tangible and intangible capital; both stocks were large, but the tax treatment was different and motivated shifts between them to avoid taxation. With these additions, I reexamine the impact of fiscal policy in the 1930s and find that it had a large impact on economic activity, especially investment and equity values, although it cannot be the only factor in accounting for the large contraction and slow recovery.

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 those on individual and corporate incomes and sales and excise. Although the tax revenues on incomes never exceeded indirect business taxes, they did directly impact almost all capital owners in the United States and do play an important role in the quantitative results below. The most important are higher taxes on dividends paid by individual shareholders and higher taxes on undistributed profits paid by corporations.

In order to accurately assess the impact of these taxes on capital income, it is important to take into account the fact that a significant amount of capital investment was expensed and thus nontaxable; these include investments in advertising, R&D, and organizational capital, which I collectively term *intangible investments*. 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, citing Dr. Caldwell, trustee of the Museum of Science and Industry). This shift from tangible to intangible investments is also evident in statistics on R&D employment. For example, Mowery and Rosenberg (1989) report that employment of scientists and engineers in two-digit manufacturing industries nearly tripled, rising from 10,927 to 27,777 between

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[5] 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 will model them.

1933 and 1940, and the number of scientific personnel per 1,000 wage earners doubled, rising from 1.93 in 1933 to 3.67 in 1940.

Next, I turn to a description of the extended model with additional taxes and intangible capital included.

3.1. Theory

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

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

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

Firms produce final output y using their intangible capital k_I, tangible capital k_T^1, and labor h^1. Firms produce intangible capital x_I—such as new brands, R&D, patents, etc.—using intangible capital k_I, tangible capital k_T^2, and labor h^2.

Note that k_I is an input to both sectors; it is not split between them, as is the case for tangible capital and labor. 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 McGrattan and Prescott (2010) for the aggregation theory underlying this technology.)

Given (k_{T0}, k_{I0}), the stand-in household maximizes

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

subject to

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

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

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

9

and nonnegativity constraints on investment, $x_{Tt} \geq 0$ and $x_{It} \geq 0$. As before, all variables are in per capita units, and there is growth in population 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 is denoted by w. As before, inputs are paid their marginal products.

Since capital taxation studied here affects only business activity, I assume that non-business output y_n less investment x_n is (exogenously) included with transfers to households κ_t. I also assume that hours h_t include hours in nonbusiness production, h_n. (See the time paths of nonbusiness activity in Appendix A, Table A.1.)

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

3.2. U.S. Tax Policy

Next, I modify the way taxes are modeled and rerun the numerical experiment done for the basic growth model. Specifically, I include three additional taxes on capital income—dividends, property, and undistributed profits—as well as taxes on consumption. In this case, the specific formula for ζ_t is given by

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

where τ_{kt} is the tax rate on property, τ_{pt} is the tax rate on profits, τ_{dt} is the tax rate on dividends, τ_{ut} is the tax rate on undistributed profits, τ_{ct} is the tax rate on consumption,

and τ_{ht} is the tax rate on labor income. Note that taxable income for the tax on profits is net of depreciation and property tax, and taxable income for the tax on distributions is net of taxes on profits, property, and undistributed profits.

In Appendix A, I describe in detail my estimates of U.S. spending and tax rates used as inputs in the numerical experiments. Here, I briefly describe the sources of the estimates used.

For government spending and the tax rate on wages, I use the same inputs as in the standard model. (See Table A.2.) 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}.[6]

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

The 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, they 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 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.

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

The most important tax for the quantitative results turns out to be τ_{dt} (column 2 of Table A.2), which is estimated as the average marginal tax rate on U.S. dividends. In Figure A.1, I plot the time series of this tax rate for the period 1913–2000. Figure A.2 shows this tax rate over the period 1929–1939, along with the surtax rate for the highest income bracket. The surtax rates are relevant for the calculation of marginal tax rates on dividend income. The plot shows that the effective rates used in simulating the model equilibrium are well below the highest surtax rates.

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

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 *Statistics of Income*. (See Appendix A for more details.)

In the model, as in the United States, the treatment of tangible and intangible income differs. This 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 capital is not expensed but intangible capital is. The asymmetric treatment also affects the incidence of the tax on dividends.

3.3. Expectations

When analyzing the standard model, I assumed that households had perfect foresight about the future paths of spending and tax rates. Even with this extreme assumption about expectations, the impact of fiscal policies was too small to justify inclusion in any analysis of the Great Depression era. In the extended model, with taxes on many different sources of capital income, expectations will play a more significant role. Here, I motivate

the parameterization used in the benchmark simulations and then later show how the predicted time series change as I change assumptions about household expectations.

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. It is assumed 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.2 and A.3. Notice that most transitional probabilities in Table 2 are zero (and therefore not printed). 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 future states.

The parameterization in Table 2 assumes that there is uncertainty in 1930–1931 and again in 1936–1937. The initial uncertainty about tax and spending policies does not get fully resolved until the U.S. Revenue Act of 1932 is enacted. Prior to that time, households are warned that spending bills in Congress cannot be financed out of current revenue streams. Headlines like "Hoover Warns Congress to Economize or be Faced by Tax Rise of 40 Percent" (*New York Times*, February 25, 1930) can be found throughout newspaper archives in 1930 and 1931. However, households are uncertain about the specifics of the final bill until 1932. At that point, they know that the revenue bill calls for large increases in marginal income tax rates on individuals.

Each subsequent year, a new revenue act was introduced. In 1933, the tax on capital stock and excess profits was introduced (via the National Industrial Recovery Act). In 1934, the main changes in policy were designed to prevent tax avoidance. In 1935, there were increases in surtaxes on individuals. The main change in 1936 was the introduction of the undistributed profits tax. This was likely to have been a surprise to most Americans,

13

Year	Next Period's Policy Like That of:										
	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

given that President Roosevelt did not propose this tax until a speech given in March of 1936. Congress went along with the proposal, and the law was passed soon thereafter and 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.

3.4. Model Predictions

In this section, I report on simulations of the model economy.

As before, I assume that the utility function is logarithmic and growth rates are given by $\gamma = .02$ and $\eta = .01$. Nonbusiness activities are set exogenously to be equal to U.S. levels. As noted earlier, the (detrended) paths of hours, investment, and output are shown in Table A.1. The remaining parameters are set so that aggregates in the model economy are equal to their U.S. analogues in 1929. This implies parameter values of $\psi = 2.1$, $\beta = .98$, $\delta_T = .035$, $\theta = .24$, and $\phi = .11$. The only parameter that cannot be set in this way is δ_I because the intangible depreciation rate and the share of intangible capital in production ϕ cannot be separately identified. Without loss of generality, then, I set $\delta_I = 0$.

Figures 5–8 show predictions of the extended model for investment, hours, GDP, and consumption, which are comparable to Figures 1–4 for the standard model. 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' 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 investment. The primary determinant for the fall is expectations about the future changes in the tax rate on dividends. In fact, with τ_{pt} and 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 in the case that nonnegativity constraints are not binding on investment:

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

where $\hat{\beta} = \beta/(1 + \gamma)$ and variables with hats are detrended by population and growth

15

in technology, $(1 + \gamma)^t$.[7] If tax rates on dividends are constant, then the terms $1 - \tau_{dt}$ and $1 - \tau_{dt+1}$ cancel. In this case, taxes on dividends have no effect if revenues are lump-sum rebated to households, because their budget sets do not change and their first-order conditions do not 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 change in reality. On the other hand, 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.

Figure 6 shows hours per capita for the 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. They recover subsequently in the model and by 1939 are roughly 4 percent below trend. In the data, hours are still well below trend—about 20 percentage points—by 1939. Thus, although the predictions in 1939 are similar to the standard model (Figure 2), the relative declines in the first part of the decade are significantly larger in the extended model. Overall, the results show that the impact of taxation is nontrivial, especially in the first half of the 1930s and in the 1937–1938 recession.

Figure 7 shows model GDP declines about as much as hours of work between 1929 and 1933. The predicted fall is about 40 percent of the actual decline in U.S. GDP. It is not greater in the model because households consume more as more capital income is distributed to households. In the United States, both consumption and investment declined, implying a larger decline in U.S. GDP.

Figure 8 shows the model's consumption path which is rising prior to 1932, whereas it fell continually between 1929 and 1933. The optimal response to high future capital taxes

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

is high current distributions of business income. Taxes on consumption do rise during the 1930s but not significantly until after 1932. The large deviation between theory and data cannot be resolved by introducing the type of financial frictions proposed by Bernanke and Gertler (1989).[8] 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. In the model studied here, there is another channel for spending, namely intangible investment, but its price is also affected negatively by expected increases in the tax rate on dividends.

Figure 9 shows the patterns of both tangible and intangible investment. Notice that initially, both series fall as distributions are increased. The series are less correlated in the latter part of the decade when the rate on corporate profits increases and the undistributed profits tax is introduced. To see why, consider the (unconstrained) first-order condition for intangible capital:

$$\frac{q_t \left[(1 - \tau_{pt}) (1 - \tau_{dt}) \right]}{(1 + \tau_{ct}) \hat{c}_t} = \hat{\beta} E \left[\frac{(1 - \tau_{pt+1}) (1 - \tau_{dt+1})}{(1 + \tau_{ct+1}) \hat{c}_{t+1}} \{ r_{It+1} + q_{t+1} (1 - \delta_I) \} \right]. \qquad (3.7)$$

The expected return in (3.6) is different because the tax treatment is different. Intangible is expensed from the profits tax τ_p and is not affected by the undistributed profits tax.

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

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

where K_{Tt+1} and K_{It+1} are aggregate end-of-year capital tangible and intangible capital stocks, respectively. Prior to the introduction of the undistributed profits tax, the price

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[8] The patterns of model investment and consumption are close to those found by Chari, Kehoe, and McGrattan (2007) in an experiment where they choose the investment wedge to exactly fit the pattern of investment. The point was to show that this wedge alone cannot account for fluctuations during the 1930s.

17

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.

3.5. Sensitivity Analysis

In this section, I discuss the sensitivity of the results to the choice of the transition matrix governing household expectations. (See Table 2.)

Figure 11 shows the model's predictions of tangible investment for three different choices of household expectations. Recall that the benchmark is based on the transition matrix in Table 2. The series marked "Myopic, 1930–1931" assumes that households put 100 percent probability in 1930 of staying with 1930 policy and similarly for 1931. The transition matrix for 1932 and after is the same as in Table 2. The series marked "Perfect Foresight, 1930–1939" assumes that households have full knowledge of the path of spending and tax rates.

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 as much as in the benchmark. However, there is still a first-order effect on investment, which is much larger than the standard model prediction. If the households have perfect foresight, they react immediately and sharply to the news by setting tangible investment to zero. It is not shown, but intangible investment in this case also falls dramatically, close to 70 percent, in the first year.

Another interesting aspect of 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

18

rise in tangible investment between 1931 and 1935 with a dramatic fall when the tax is in effect.

In summary, the main conclusion that capital taxation played an important role during the Great Depression is not overturned as I vary assumptions about household expectations.

4. Conclusion

Many theories have been proposed for the large contraction of the 1930s and the slow recovery. 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. 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 standard growth model, imply a large drop in tangible and intangible 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 tax policy had large effects, it could not have been the only factor in accounting for the Great Depression. Predicted consumption counterfactually rises prior to 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.

TABLE A.1. NONBUSINESS ACTIVITY IN THE EXTENDED MODEL[a]

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

[a] The series for hours is the fraction of time spent in nonbusiness work. The series for investment and output are detrended and normalized by U.S. GDP in 1929. See Appendix A for further details.

Appendix A.

The main source for the data used in this study is the Bureau of Economic Analysis (BEA), which publishes the national accounts and fixed asset tables in the *Survey of Current Business* (available online at www.bea.gov). 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 *Survey of Current Business* of the Department of Commerce (1929–2010). GDP in the business sector is set equal to value added of corporations and nonfarm proprietorships. All components of GDP are deflated by the GDP deflator (in Table 1.1.9) and population at midperiod (Table 2.1).

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 leave out 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. *Non-business investment* is residually defined as investment less business tangible investment. *Government spending* is defined to be government consumption expenditures. (The real per capita nonbusiness investment and value added, which are divided by 1.02^t, are displayed in Table A.1. The real per capita government spending series, which is also divided by 1.02^t, is displayed in Table A.2. These are inputs in the numerical experiments.)

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 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 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 Department of Commerce (1975).

A.3. Market Value

The total market value of U.S. corporations is available from the Flow of Funds starting in 1945. Prior to that time, there is only information about subsets of stocks. Here, 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, their Figure 2.)

A.4. Tax Rates

To compute an equilibrium in the standard model (Section 2), I use estimates of marginal tax rates on capital and labor from Joines (1981), specifically MTRK1 and MTRL1 shown in Table A.1 (along with the government spending series defined above).

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.3. The profits tax is the statutory rate reported in the IRS's *Statistics of Income*, smoothed so that it is not simply a step function. (The smoothing algorithm is described below.) The source of the dividend tax is McGrattan and Prescott (2003), 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 IRS's *Statistics of Income.* A weighted average is computed using the fraction of dividend income per income group as the weighting factor. The time series for the period 1913–2000 is shown in Figure A.1. In Figure A.2, I show the rate for 1929–1939, along with the smoothed rate I use in computer simulations and the tax rate for the highest dividend income bracket.

TABLE A.2. SPENDING AND TAX RATES IN THE STANDARD MODEL

Year	Detrended Government Spending	Tax Rates on	
		Wages	Profits
1929	5.8	3.5	29.5
1930	6.1	3.6	27.8
1931	6.7	3.8	28.6
1932	7.1	4.9	33.1
1933	7.2	6.8	41.1
1934	7.8	7.5	41.0
1935	7.7	7.4	41.4
1936	8.2	8.0	46.2
1937	7.7	8.1	44.4
1938	8.2	8.3	41.4
1939	8.7	8.3	42.6

TABLE A.3. ADDITIONAL TAX RATES IN THE EXTENDED MODEL

Year	Tax Rates on			
	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.2 and includes taxes on profits, capital stock, and excess profits.

23
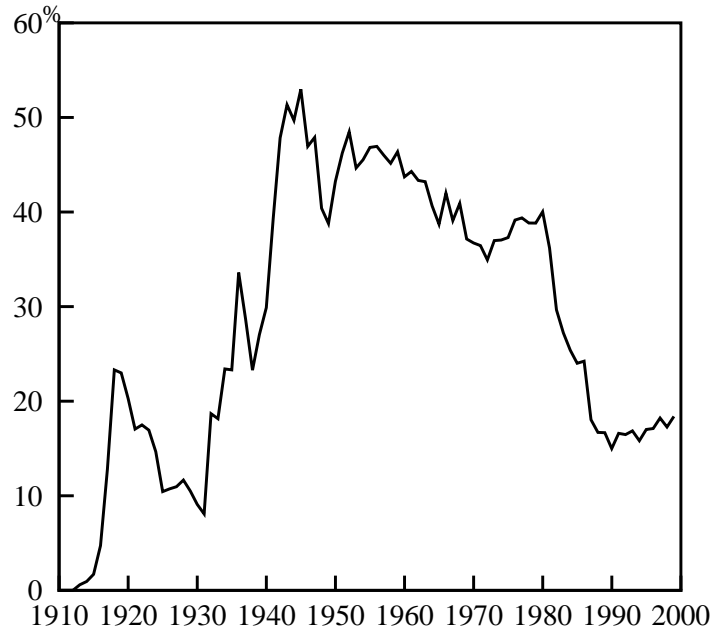
FIGURE A.1. AVERAGE MARGINAL TAX RATE ON
U.S. DIVIDENDS, 1913–2000
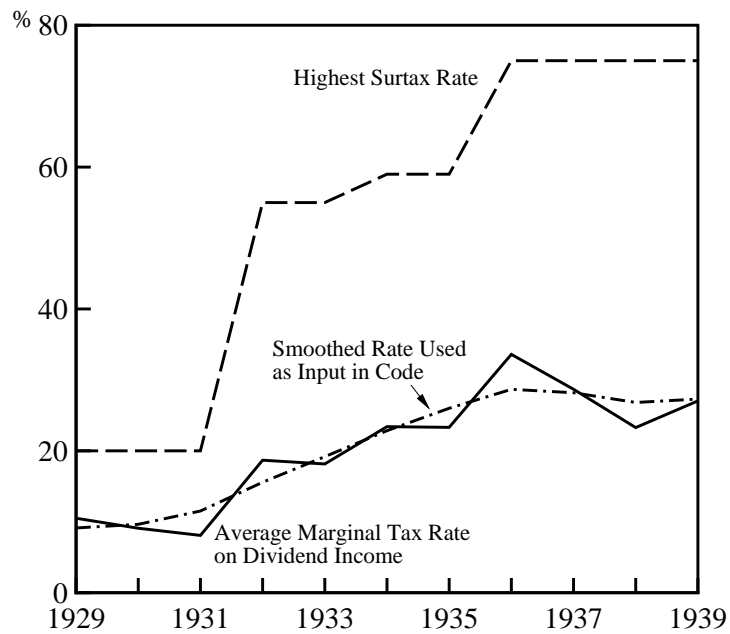
FIGURE A.2. AVERAGE MARGINAL TAX RATE ON U.S. DIVIDENDS
AND THE HIGHEST FEDERAL SURTAX RATE, 1929–1939

24

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.

All series in Table A.3 have been filtered using the algorithm proposed by Hodrick and Prescott (1997) with the value of their smoothing parameter (λ) equal to 1. An example of the smoothed series and the original series is shown in Figure A.2 for the tax rate on dividends.

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, 2 percentage points have been added to the smoothed statutory profits tax in the years 1933–1939. 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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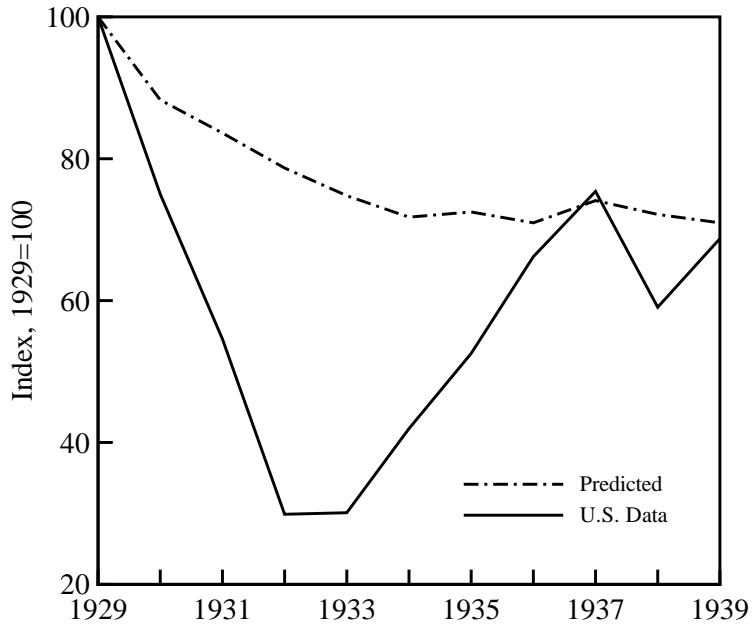
FIGURE 1. DETRENDED REAL INVESTMENT IN THE UNITED STATES
AND THE STANDARD GROWTH MODEL, 1929–1939
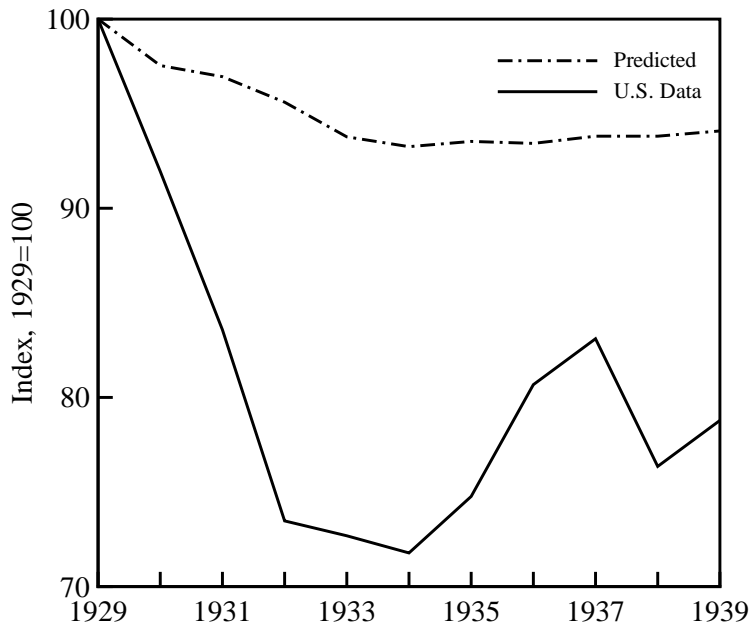
FIGURE 2. HOURS PER CAPITA IN THE UNITED STATES AND THE
STANDARD GROWTH MODEL, 1929–1939
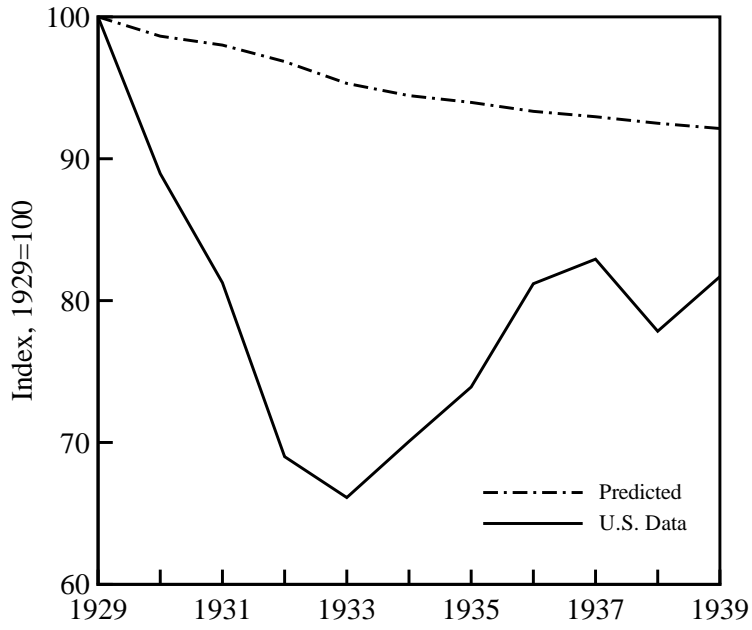
FIGURE 3. DETRENDED REAL GDP IN THE UNITED STATES
AND THE STANDARD GROWTH MODEL, 1929–1939
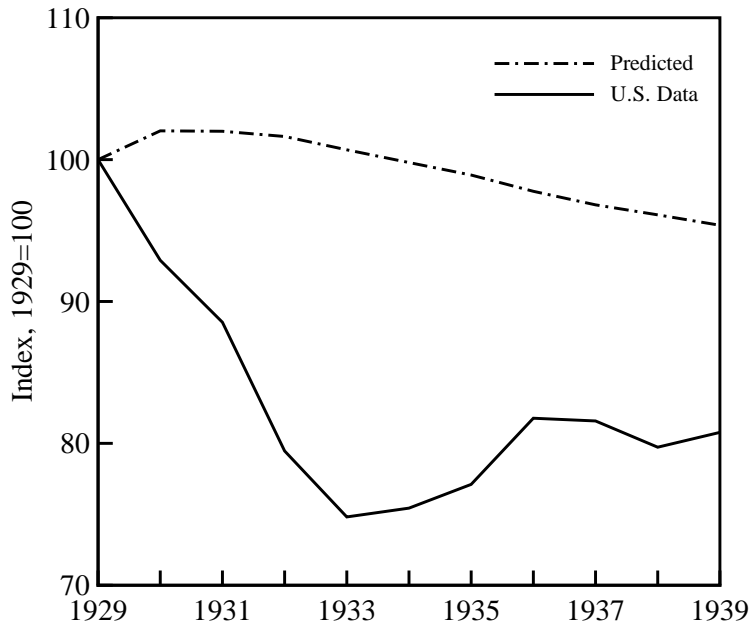
FIGURE 4. DETRENDED REAL CONSUMPTION IN THE UNITED STATES
AND THE STANDARD GROWTH MODEL, 1929–1939
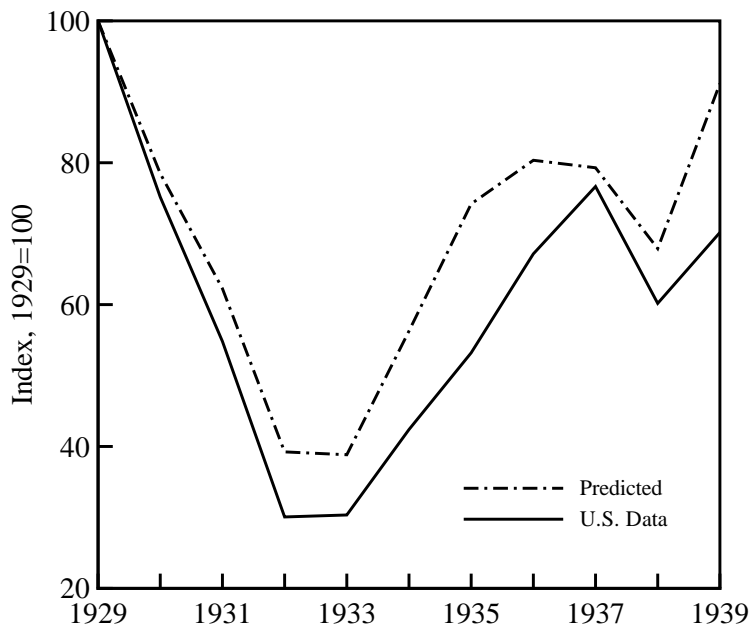
FIGURE 5. DETRENDED REAL INVESTMENT IN THE UNITED STATES
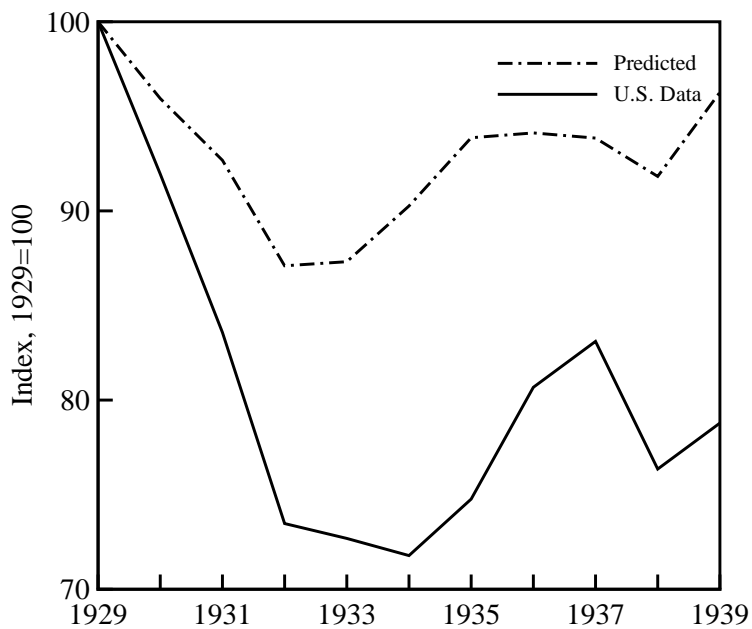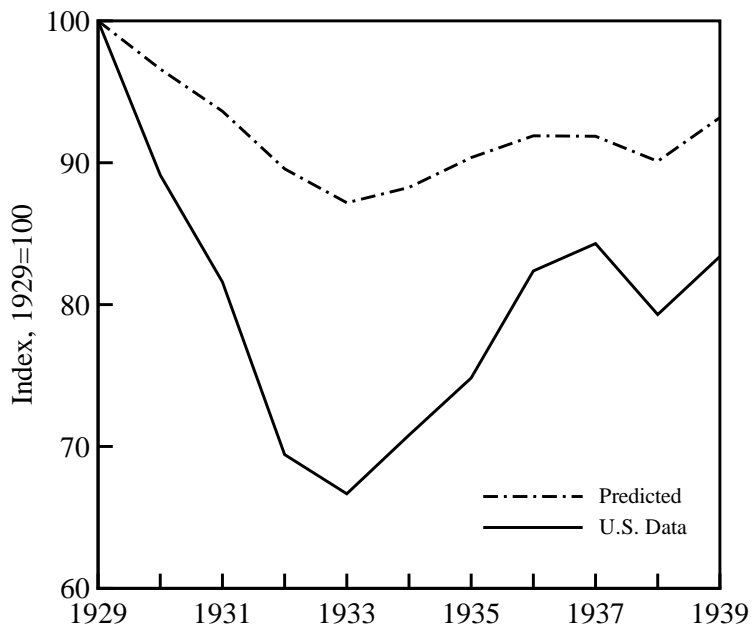AND THE MODEL WITH INTANGIBLE CAPITAL, 1929–1939

FIGURE 6. HOURS PER CAPITA IN THE UNITED STATES AND THE
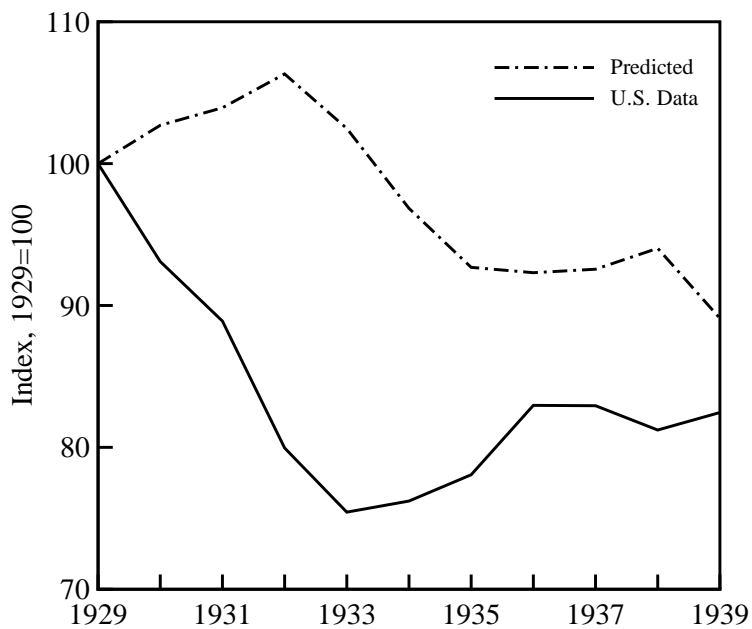MODEL WITH INTANGIBLE CAPITAL, 1929–1939

31

FIGURE 7. DETRENDED REAL GDP IN THE UNITED STATES AND THE
MODEL WITH INTANGIBLE CAPITAL, 1929–1939

FIGURE 8. DETRENDED REAL CONSUMPTION IN THE UNITED STATES
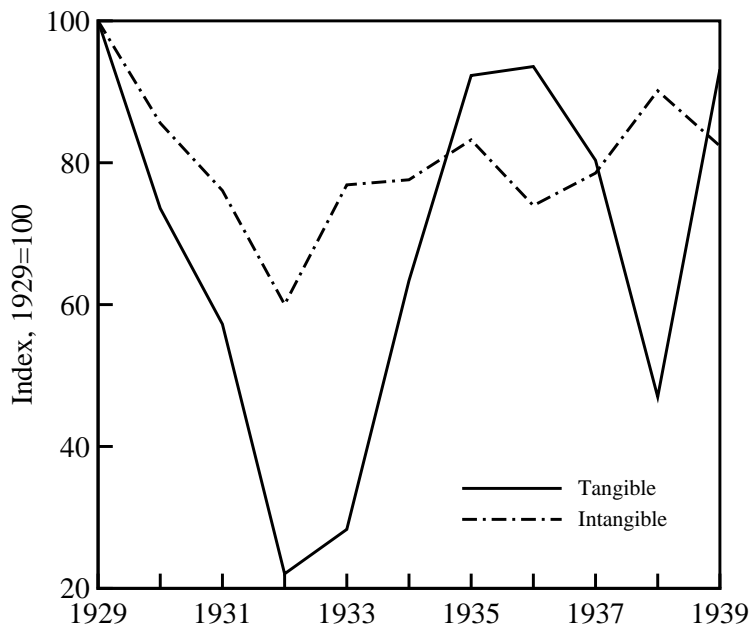AND THE MODEL WITH INTANGIBLE CAPITAL, 1929–1939

32

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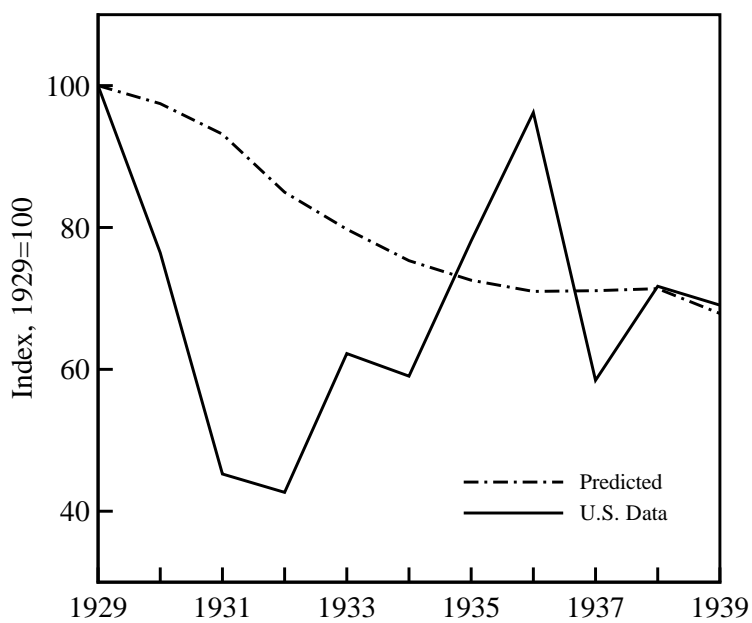IN THE MODEL WITH INTANGIBLE CAPITAL, 1929–1939

FIGURE 10. DETRENDED REAL MARKET VALUE OF THE NEW YORK STOCK EXCHANGE
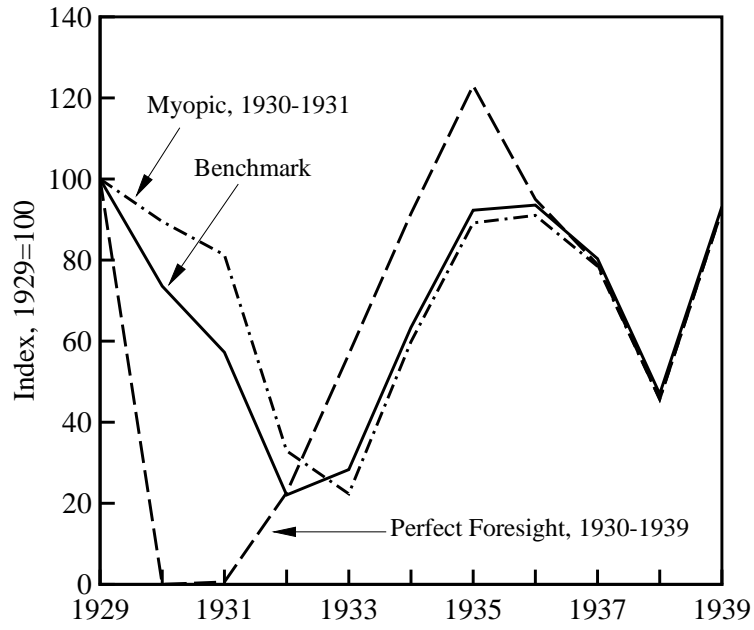AND THE MODEL WITH INTANGIBLE CAPITAL, 1929–1939

33

FIGURE 11. DETRENDED REAL TANGIBLE AND INTANGIBLE INVESTMENT
IN THE MODEL WITH INTANGIBLE CAPITAL, 1929–1939