1. The attached figure is from Claudia Goldin ("Labor Markets in the 20th Century," in Stanley Engerman and Robert Gallman, eds., The Cambridge Economic History of the United States, Vol. III, Cambridge: Cambridge University Press, 2000, pp. 549-623). It shows that average weekly hours fell from around 70 in 1830 and stood at about 48 hours on the eve of the Great Depression. Then, it suddenly dropped about 20 percent and remained roughly constant throughout the decade of the 1930s. Prescott (also attached) argues that this change in the ‘normal’ hours of work may have something to say about the economic convulsions of the 1930s. The substantive purpose of this question is to investigate this proposition at a quantitative level.

The technical purpose of this question is to explore the gains to be had by going from first order approximations to second order approximations (see the papers on this on the web site). This change in hours is quite large, and one might wonder whether linear approximations are likely to work very well for this type of analysis.

Here is the model economy. Preferences are given by:

\[ \sum \beta^t \left[ \log(c_t) - \frac{1}{2} h_t^2 \right], \]

where \( \zeta \) is a parameter which will change and \( \beta = 1.03^{-1} \). Here, \( c_t \) and \( h_t \) denote consumption and hours worked, respectively. The resource constraint is

\[ c_t + k_{t+1} - (1 - \delta)k_t \leq k^\alpha h^{1-\alpha} = y_t, \]

where \( \delta = 0.10 \) and \( \alpha = 1/3 \). The economy starts up in period \( t = 0 \), when \( k_0 \) is given.

(a) Work out the formulas for the steady state values of \( c, y, h \) and \( i \) for this economy. Verify that for this model,

\[ d\log(h) = -\frac{1}{2} d\log(\zeta). \]

That is, if \( \zeta \) goes from \( \zeta = 1 \) to \( \exp(0.4) \), so that \( d\log(\zeta) = 0.40 \), then the difference of the log of hours from the old to the new steady state is 0.20, or 20 percent. If you look at the data on total hours worked in the class handout, you will notice that by 1939 total hours worked seems to have stabilized at a level about 20 percent below where it was in 1929. The transition path to this seeming new steady state involves overshooting, with total hours worked being 25 percent below its 1929 level in 1933.

(b) Substitute out for consumption from the resource constraint in the intertemporal and intratemporal Euler equations. Linearize these equations, and get rid of hours worked using the linearized intratemporal equation, to end up with the following single Euler equation:

\[ a_0 \hat{k}_t - a_1 \hat{k}_{t+1} + \hat{k}_{t+2} = 0, \]

for \( t = 0, 1, 2, \ldots \) (I am assuming the economy started up in period \( t = 0 \)). Compute the value of \( \lambda \) that results in a non-explosive policy rule that solves the above equation, where

\[ \hat{k}_{t+1} = \lambda \hat{k}_t. \]

Find the corresponding policy rules for investment, consumption and employment:

\[ \hat{i}_t = \lambda_i \hat{k}_t \]
\[ \hat{h}_t = \lambda_h \hat{h}_t \]
\[ \hat{c}_t = \lambda_c \hat{c}_t. \]

Display \( \lambda_i, \lambda_h, \lambda_c \).
(c) Consider the following experiment. Up until $t = -1$, the economy was in a steady state with $\zeta = 1$. Suddenly, in the morning of $t = 0$, $\zeta = 1$ jumps to $\exp(0.4)$. People did not anticipate this ex ante and after the change occurs, people assume (correctly) that there will never be another change in $\zeta$ again. Since in period 0 the capital stock takes on its old steady state value, the economy finds itself 20 percent above the new steady state. Compute

$$
\log \left( \frac{i_0}{i_{-1}} \right), \quad \log \left( \frac{c_0}{c_{-1}} \right), \quad \log \left( \frac{h_0}{h_{-1}} \right),
$$

i.e., the impact effect, in percent terms, of the shock to $\zeta$. Do this computation using policy rules obtained by linearization about the new steady state. Display a graph with:

$$
\log \left( \frac{i_t}{i_{-1}} \right), \quad \log \left( \frac{c_t}{c_{-1}} \right), \quad \log \left( \frac{h_t}{h_{-1}} \right),
$$

for $t = 0, 1, 2, \ldots$ until things have settled down into the new steady state.

(d) Do the same experiment, working with a second order perturbation about the new state. Display graphs for investment, consumption and hours worked. Put the linearization and second order approximation on the same picture. Do they look similar? Was the second order perturbation worth the extra effort?

2. Sunspots! (maybe). Consider a Dixit-Stiglitz, type economy. Let preferences be given by

$$
\sum \beta^t \frac{c_t - \frac{1}{1+\gamma} h_t^{1+\gamma}}{1-\sigma}, \quad \sigma, \gamma > 0.
$$

The household owns the capital, $k_t$, and rents it out competitively. In addition, it works competitively for a wage rate, $w$. Its budget constraint is:

$$
c_t + k_{t+1} - (1 - \delta) k_t \leq r_t k_t + w_t h_t.
$$

The firm sector produces final goods, $y_t$. Market clearing for these goods requires:

$$
c_t + k_{t+1} - (1 - \delta) k_t \leq y_t.
$$

Final output, $y_t$, is produced by perfectly competitive firms, using the following linear homogeneous production function:

$$
y_t = \exp \left[ \int_0^1 \log y_{j,t} dj \right].
$$

The $j^{th}$ intermediate good is produced by a monopolist using the following production function:

$$
y_{j,t} = \left\{ \begin{array}{ll}
\frac{k_t^{\alpha} h_t^{1-\alpha}}{k_j^{\alpha} h_j^{1-\alpha}} - \phi, & \text{if } k_t^{\alpha} h_t^{1-\alpha} \geq \phi \\
0, & \text{otherwise.}
\end{array} \right.
$$

Here, $\phi$ is a fixed cost. The firm is a competitor in resource markets, where it takes the rental rate of capital, $r$, and the wage rate, $w$, as given. Its marginal cost (assuming it is producing a positive amount) is:

$$
s = \left( \frac{1}{1-\alpha} \right)^{1-\alpha} \left( \frac{1}{\alpha} \right)^{\alpha} r^{\alpha} w^{1-\alpha}.
$$

(a) The final good producer takes $p_{jit}$, the price of the $j^{th}$ intermediate good, as given. Derive the final good producer’s demand curve for the $j^{th}$ intermediate input. You may suppose that, in equilibrium, $y_{j,t} = y_{it}$, for all $i, j$. Show that the final good production function, the demand curves and the assumption that all intermediate good firms do the same thing implies $p_{jit} = 1$ for all $j$.

(b) Show that there is no positive profit-maximizing level of output for the intermediate good firm. For any price, quantity combination on the demand curve, it always increases profits by going to a point on the demand curve with lower output and a higher price.
(c) Now suppose that each monopolist is surrounded by potential monopolist-entrants. A potential monopolist will enter and displace the existing monopolist if the existing monopolist chooses a price, quantity pair that results in positive profits. So, in equilibrium monopolists make zero profits. Show that aggregate output can be written:

\[ y_t = \frac{1}{\mu_t} k_t^{\alpha_t} l_t^{1-\alpha_t}, \]

where \( \mu_t \) is the ratio of the price of the \( j^{th} \) intermediate good to its marginal cost. In equilibrium, when price is unity, \( \mu_t = 1/s_t \). (Hint: by homogeneity of the final output function and the fact that all intermediate good firms are in the same position, we have that \( y_t = y_{jt} \), for all \( j \). Cost minimization leads intermediate good firms to the following first order conditions:

\[ f_k = \lambda r, \quad f_l = \lambda w, \]

where \( \lambda \) is the positive Lagrange multiplier on output in the cost minimization problem and \( f_k, f_l \) denote the marginal products of capital and labor, respectively. It is easily verified that this multiplier corresponds to the firm’s marginal cost. Zero profits corresponds to \( y - rk - wl = \phi \).

Combine all these things.

(d) Notice that we now have a very simple model with countercyclical markups. Its equilibrium can be characterized by the household’s two Euler equations, the firm’s Euler equations, which specify \( f_k,t = \mu_t r_t, f_l,t = \mu_t w_t \), and the zero profit condition which pins down \( \mu_t \):

\[ \frac{1}{\mu_t} k_t^{\alpha_t} l_t^{1-\alpha_t} = k_t^{\gamma} l_t^{1-\gamma} - \phi. \]

Is there a unique steady state. Are there values of \( \sigma \) and \( \gamma \) for which it is indeterminate?
Figure 5: Hours of Work, 1830-1986

Sources and Notes:
Whaples (1990) for all four series: Weeks Report (1830-1880), Commissioner of Labor (1890-1903), Jones (1900-1957), and Owen (1900-1986). Weeks Report series is from U.S. Department of the Interior, Census Office (1883) is for scheduled hours among manufacturing workers. See Whaples for possible biases in the data. Commissioner of Labor series was computed by Leo Wolman from U.S. Commissioner of Labor (1905) and includes urban manufacturing and construction workers. Jones series is from Jones (1963) and is for manufacturing workers. Jones corrects for paid vacations, holidays, and sick leave. Owen series is from Owen (1976, 1988) and is for male non-students. The post-1940 Owen data are for all (private, non-agricultural) workers, not just those in manufacturing.
Some Observations on the Great Depression

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Abstract

The Great Depression in the United States was largely the result of changes in economic institutions that lowered the normal or steady-state market hours per person over 16. The difference in steady-state hours in 1929 and 1939 is over 20 percent. This is a large number, but differences of this size currently exist across the rich industrial countries. The somewhat depressed Japanese economy of the 1990s could very well be the result of workweek length constraints that were adopted in the early 1990s. These constraints lowered steady-state market hours. The failure of the Japanese people to display concern with the performance of their economy suggests that this reduction is what the Japanese people wanted. This is in sharp contrast with the United States in the 1930s when the American people wanted to work more.

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.
The prosperity of the 1920s in the United States was followed by the Great Depression in the 1930s. Will the prosperity of the 1980s and 1990s be followed by another great depression in the coming decade? This question is not that far-fetched. Depressions are not a thing of the past. The Japanese economy, for example, has been depressed for nearly a decade and is currently operating at a level far below trend. Argentina experienced a depression in the 1980s every bit as severe as the one experienced by the United States in the 1930s. The Brazilian economy is currently operating at a level well below trend and could fall even farther. Empirically, depressions are not a thing of the past, and only by understanding why depressions occurred in the past is there any hope of avoiding them in the future.

Given the importance of understanding depressions, I’m surprised that Harold Cole and Lee Ohanian (in an article in this issue of the Quarterly Review) are the first to study the Great Depression systematically from the perspective of neoclassical growth theory. I’m surprised because economists use growth theory to study economic growth and business cycle fluctuations quantitatively and to evaluate tax policies. Why hasn’t growth theory been used to study the Great Depression? Perhaps because economists are reluctant to use standard theory to study an event that historically was treated as an aberration defying an equilibrium explanation.

Cole and Ohanian examine the Great Depression from the perspective of growth theory and show that growth theory cannot account for the Great Depression as a 10-year economic event. In the process of documenting deviations from existing theory, they define what a successful theory of the Great Depression must explain. Their analysis led me to conclude that the key to defining and explaining the Great Depression is the behavior of market hours worked per adult. (Cole and Ohanian report this measure of labor input as total hours. Adult is defined as 16 years and older.) Briefly, market hours worked per adult (from here on, simply market hours) dipped to 72 percent of their 1929 level in 1934 and remained low throughout the 1930s. Even in 1939, market hours were still only about 79 percent of their 1929 level.

By focusing on the entire decade of the 1930s, Cole and Ohanian shift the nature of the question from

Why was there such a big decline in output and employment between 1929 and 1933?

to

Why did the economy remain so depressed for the entire decade?

In particular, in the 1934–39 period, why didn’t the economy recover from its depressed level? Cole and Ohanian show that the standard conjectures put forth to explain the Great Depression are not consistent with observations. In the last half of the 1930s, there were no banking crises. There was no deflation. There was a large increase in the money supply and a corresponding drop in the interest rate, just as the demand-for-money relation predicts. There was growth in total factor productivity. So why were market hours still 21 percent below their 1929 level in 1939? Given the considerable evidence against technology, monetary, or banking explanations, I am led, as Cole and Ohanian are, to the view that there must have been a fundamental change in labor market institutions and industrial policies that lowered steady-state, or normal, market hours.

**Growth Theory**

Before I explain why I think the behavior of market hours is the key to explaining the Great Depression, a brief review of growth theory is in order. The now-textbook theory includes two basic decisions. One is the consumption-investment decision, in which investment is roundabout consumption. That is, investment in more machines, office buildings, and factories today enhances future production possibilities, permitting greater consumption in the future. This feature of the production technology provides a way to transform consumption today into consumption in the future. Less consumption and more investment today can increase consumption in the future. The other decision is the labor-leisure decision. (Leisure is shorthand for productive time allocated to nonmarket activities and not leisure in the conventional sense of the word.) More labor and less leisure today results in more market output today. This added output can be used for greater consumption today or for greater investment today, which permits greater consumption in the future.

With growth theory, if technology advances smoothly and there are no changes in market distortions, the economy grows at a steady rate with constant shares of output being allocated to consumption and investment and a constant fraction of time being allocated to the market. The theory predicts the consequences of changes that affect the constraints people face. Such changes would include, for example, a change in the tax system, a change in technology, a change in the price of imported goods relative to domestically produced goods, or a change in regulations or laws.

Growth theory without the labor-leisure decision was developed to account for secular growth. With the natural extension to include the labor-leisure decision, the theory has proved successful in accounting for phenomena other than what it was designed to explain. For example, the theory predicts well the behavior of the U.S. economy during World War II. (See Braun and McGrattan 1993.) This surprised a lot of economists, because the general view was that patriotism was needed to explain employment and output behavior during World War II. This successful prediction of the consequences of a large public finance shock is reassuring for the theory.

Another dramatic empirical success of growth theory is in the study of business cycle fluctuations. The developers of growth theory thought the theory would be useful for studying long-term growth issues but that a fundamentally different theory would be needed for studying business cycle fluctuations. Once the implications of growth theory were derived, however, business cycle fluctuations turned out to be what the theory predicts. (See Prescott 1986.) The theory can answer such business cycle questions as, How volatile would the economy be if total factor productivity—growth shocks were the only disturbance?

The Great Depression and business cycles are similar in that both include variations in output accounted for in large part by variations in labor input to production. The Great Depression and business cycles are fundamentally different in terms of magnitude and persistence. The Great Depression was nearly an order of magnitude bigger than typical business cycles and lasted a decade rather than a
year or two. However, magnitude and persistence are not the fundamental difference. To explain the fundamental difference, I’ll first explain what business cycles are.

Essentially, business cycles are responses to persistent changes, or shocks, that shift the constant growth path of the economy up or down. This constant growth path is the path to which the economy would converge if there were no subsequent shocks. If a shock shifts the constant growth path down, the economy responds as follows. Market hours fall, reducing output; a bigger share of output is allocated to consumption and a smaller share to investment; and more time is allocated to leisure. Over time, market hours return to normal, as do investment and consumption shares of output, as the economy converges to its new lower constant growth path. The level of the new path is lower, not the growth rate along the path.

I’ve just described the response of the economy to a single shock. In fact, the economy is continually hit by shocks, and what economists observe in business cycles is the effects of past and current shocks. A bust occurs if a number of negative shocks are bunched in time. A boom occurs if a number of positive shocks are bunched in time. Business cycles are, in the language of Slutzky (1937), the “sum of random causes.”

The fundamental difference between the Great Depression and business cycles is that market hours did not return to normal during the Great Depression. Rather, market hours fell and stayed low. In the 1930s, labor market institutions and industrial policy actions changed normal market hours. I think these institutions and actions are what caused the Great Depression.

**Declines in Market Hours**

Cole and Ohanian report that market hours declined 21 percent between 1929 and 1939. Given this change in normal market hours, growth theory predicts the behavior of investment and employment that occurred in the 1930s. In particular, the theory predicts an extended period of a low investment share of output in response to this change in market hours. In the 1929–39 period, net investment—new production of capital goods less capital goods consumed in the process of production—was close to zero. Growth theory also predicts that during the early periods after changes have reduced normal market hours, employment will be below the new lower normal level. The U.S. economy in the 1930s conforms well to these predictions of the theory.

Growth theory, however, does not explain why normal market hours changed so much during the 1930s in the United States. My view is that the explanation of why market hours changed is the explanation of the Great Depression.

Perhaps examining the data for other countries will help explain the change in market hours in the United States during the 1930s. The problem is that good data on market hours for most countries between World War I and World War II do not exist or are difficult to obtain. One country for which the needed data are available is France. (See the Appendix.)

Like the U.S. economy, the French economy boomed during the 1920s and experienced a depression in the 1930s. As in the United States, market hours in France declined about 22 percent between 1929 and 1939, while trend-corrected productivity did not change. However, there is one important difference between the U.S. and French economies in the 1930s. Output in the United States declined more than 25 percent between 1929 and 1933, while output declined less than 15 percent in France. The French experience is more in line with the prediction of growth theory. The difference between the French and U.S. experiences indicates that some factor or factors not present in the French economy must have disrupted the U.S. economy in the early 1930s. This difference is of the business cycle variety because it was not highly persistent. This business cycle disruption to the U.S. economy in the early 1930s, though interesting and important, is a second-order factor. I think Cole and Ohanian are right that the big question is, Why were market hours still so low in 1939?

These observations on the Great Depression suggest that examining the behavior of other economies on the dimension of market hours is in order. I am not concerned with temporary low (high) employment associated with convergence of the capital stock down (up) to its constant growth path, which is what business cycles are all about. I am concerned with highly persistent differences in normal market hours.

The difference between the 1929 U.S. economy and the 1939 U.S. economy is not unparalleled. In the 1939 U.S. economy, market hours are about 21 percent lower than market hours in the 1929 U.S. economy. Trend-corrected total factor productivity is about the same in both economies. The difference between these economies is very similar to the difference between the current French and U.S. economies. Currently in France, market hours are 25 percent lower than market hours in the United States, while output per hour is essentially the same in both countries. This observation implies that France is now in a depression.

In fact, France is very concerned with its current low employment and perceives it as a problem. French economists are not arguing that France can solve its low employment problem by spending more or printing more money. Virtually all agree that the French employment problem is due to features of France’s labor market institutions and industrial policies. Exactly what the problems are and what needs to be done are the questions that need to be answered if France is to solve its low employment problem.

Spain has an even bigger employment problem. Market hours in Spain today are 40 percent lower than market hours in the United States, while output per hour is essentially the same as in both countries. (See the Appendix.) I think these comparisons establish that labor market institutions and industrial policies can have large consequences for normal market hours.

After the 1930s, market hours increased only gradually in the United States. Apparently, many of the changes that lowered steady-state market hours persisted. Only in the 1980s did market hours return to their 1929 level. The accompanying table reports market hours at 10-year intervals from 1929 to 1979 in the United States. It’s interesting that market hours in 1949 are only slightly higher than market hours in 1939, while the investment share of output had returned to normal. Growth theory predicts the return of the investment share to normal, because by 1949, the economy had essentially converged to its new lower constant growth
An Application of Growth Theory: Japan in the 1990s

The depressed Japanese economy is a topic of concern today in Washington and other capitals throughout the world. U.S. and European top government officials are making an abundance of recommendations as to what Japan should do. Most of these recommendations are not based on established theory or even a careful examination of the data from the perspective of growth theory. An application of growth theory to the current situation in Japan might be useful in understanding the Great Depression in the United States.

The current situation in Japan is as follows. Output per adult in Japan is well below trend—exactly how far is hard to say. If the growth rate that characterized the 1980s had continued in the 1990s, output is now about 20 percent below trend. (See the Appendix.) Contrary to what others have suggested, I don’t think the principal reason for this low level of output is that the Japanese banking system is in need of reform. I think the principal reason is that Japan chose to reduce market hours. In the early 1990s, the workweek in Japan was reduced by law first from 48 hours to 44 and then from 44 hours to 40. These reductions are important in accounting for the 12.5 percent decline in market hours in Japan in the 1990-97 period. Even with these reductions, market hours in Japan are still high by international standards. In 1997, market hours were 10 percent higher in Japan than in the United States.

Given the change in Japanese law and the resulting drop in normal market hours, growth theory predicts the almost stagnant output of the Japanese economy in the 1990s. This reduction in market hours lowered the marginal product of capital, making investment unprofitable. Given the lack of profitable domestic investment opportunities, the Japanese began saving by investing abroad. This explains Japan’s large trade surpluses. The fact that the Japanese people do not appear to be that upset about the performance of their economy suggests that perhaps what has happened in Japan in the 1990s is what the Japanese people wanted.

The Japanese economy in the 1990s is not as depressed as the U.S. economy was in the 1930s. Market hours in Japan in the 1990s have fallen only half as much as market hours fell in the United States during the Great Depression. More importantly, the reduction in market hours in Japan in the 1990s was the stated objective of policy. In the 1930s in the United States, the concern was that people were working too little. In the early 1990s in Japan, the concern was that people were working too much. Policy changes reflected that concern.

Once data are available for the late 1990s, I’ll be interested to see if my conjecture about the Japanese economy is correct. That is, are market hours the key to explaining the depressed Japanese economy? Moreover, are changes in market institutions and industrial policies the key to explaining changes in market hours?
Appendix
Data Sources

France
http://www.insee.fr

GDP and Employment: *OECD Main Economic Indicators*, September 1998, p. 122

Data Series: http://www.cepii.fr/SERLONG.HTM

Japan
GDP 1990: *OECD Main Economic Indicators*, December 1994, p. 118

GDP 1997: *OECD Main Economic Indicators*, January 1998, p. 76

PPP 1990: *OECD Main Economic Indicators*, October 1998, p. 223

PPP 1997: *OECD Main Economic Indicators*, October 1998, p. 223

Population: http://www.stat.go.jp/1602.htm#jf02-02

Employment: http://www.stat.go.jp/1603.htm#jf03-05

Hours: http://www.stat.go.jp/1603.htm#jf03-08

Spain
GDP, Hours, Population, and Employment:
Contabilidad Nacional de España, Instituto Nacional de Estadística
http://www.ine.es

United States
Population: http://www.census.gov

GDP for 1919: Romer 1989

GDP for other years: U.S. Department of Commerce,
*Survey of Current Business*, August 1997

Hours 1919–39: Kendrick 1961

Hours 1949–79:
Nonagricultural Hours: U.S. Department of Commerce,
*Survey of Current Business*, August 1997

Yearly Market Hours Worked per Adult*
United States, 1929–79

<table>
<thead>
<tr>
<th>Year</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1929†</td>
<td>1,170</td>
</tr>
<tr>
<td>1939†</td>
<td>920</td>
</tr>
<tr>
<td>1949</td>
<td>949</td>
</tr>
<tr>
<td>1959</td>
<td>970</td>
</tr>
<tr>
<td>1969</td>
<td>1,034</td>
</tr>
<tr>
<td>1979</td>
<td>1,030</td>
</tr>
</tbody>
</table>

*Adult = 16 years and older.
†For 1929 and 1939, hours are Kendrick’s (1961) estimates multiplied by 0.897. With this adjustment, Kendrick’s series equals the value of the modern series used in 1948. The year 1948 is the earliest nonrecession year for which both series are available.
Sources: See the Appendix.