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The Great Depression in the United States From A Neoclassical Perspective

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Abstract

Can neoclassical theory account for the Great Depression in the United States—both the downturn in output between 1929 and 1933 and the recovery between 1934 and 1939? Yes and no. Given the large real and monetary shocks to the U.S. economy during 1929–33, neoclassical theory does predict a long, deep downturn. However, theory predicts a much different recovery from this downturn than actually occurred. Given the period's sharp increases in total factor productivity and the money supply and the elimination of deflation and bank failures, theory predicts an extremely rapid recovery that returns output to trend around 1936. In sharp contrast, real output remained between 25 and 30 percent below trend through the late 1930s. We conclude that a new shock is needed to account for the Depression's weak recovery. A likely culprit is New Deal policies toward monopoly and the distribution of income.

Between 1929 and 1933, employment fell about 25 percent and output fell about 30 percent in the United States. By 1939, employment and output remained well below their 1929 levels. Why did employment and output fall so much in the early 1930s? Why did they remain so low a decade later?

In this article, we address these two questions by evaluating macroeconomic performance in the United States from 1929 to 1939. This period consists of a *decline* in economic activity (1929–33) followed by a *recovery* (1934–39). Our definition of the *Great Depression* as a 10-year event differs from the standard definition of the Great Depression, which is the 1929–33 decline. We define the Depression this way because employment and output remained well below their 1929 levels in 1939.

We examine the Depression from the perspective of neoclassical growth theory. By *neoclassical growth theory,* we mean the optimal growth model in Cass 1965 and Koopmans 1965 augmented with various shocks that cause employment and output to deviate from their deterministic steady-state paths as in Kydland and Prescott 1982.[1]

We use neoclassical growth theory to study macroeconomic performance during the 1930s the way other economists have used the theory to study postwar business cycles. We first identify a set of shocks considered important in postwar economic declines: technology shocks, fiscal policy shocks, trade shocks, and monetary shocks. We then ask whether those shocks, within the neoclassical framework, can account for the decline and the recovery in the 1930s. This method allows us to understand which data from the 1930s are consistent with neoclassical theory and, especially, which observations are puzzling from the neoclassical perspective.

In our analysis, we treat the 1929–33 decline as a long and severe recession.[2] But the neoclassical approach to analyzing business cycles is not just to assess declines in economic activity, but to assess recoveries as well. When we compare the decline and recovery during the Depression to a typical postwar business cycle, we see striking differences in duration and scale. The decline, as well as the recovery, during the Depression lasted about four times as long as the postwar business cycle average. Moreover, the size of the decline in output in the 1930s was about 10 times the size of the average decline. (See Table 1.)

What factors were responsible for these large differences in the duration and scale of the Depression? One possibility is that the *shocks*—the unexpected changes in technology, preferences, endowments, or government policies that lead output to deviate from its existing steady-state growth path—were different in the 1930s. One view is that the shocks responsible for the 1929–33 decline were much larger and more persistent versions of the same shocks that are important in shorter and milder declines. Another view is that the types of shocks responsible for the 1929–33 decline were fundamentally different from those considered to be the driving factors behind typical cyclical declines.

To evaluate these two distinct views, we analyze data from the 1930s using the neoclassical growth model. Our main finding differs from the standard view that the most puzzling aspect of the Depression is the large decline between 1929 and 1933. We find that while it may be possible to account for the 1929–33 decline on the basis of the shocks we consider, none of those shocks can account for the 1934–39 recovery. Theory predicts large increases in employment and output beginning in 1934 that return real economic activity rapidly to trend. This prediction stands in sharp contrast to the data, suggesting to us that we need a new shock to account for the weak recovery.

We begin our study by examining deviations in output and inputs from the trend growth that theory predicts in the absence of any shocks to the economy. This examination not only highlights the severity of the economic decline between 1929 and 1933, but also raises questions about the recovery that began in 1934. In 1939, real per capita output remained 11 percent below its 1929 level: output increases an average of 21 percent during a typical 10-year period. This contrast identifies two challenges for theory: accounting for the large decline in economic activity that occurred between 1929 and 1933 and accounting for the weak recovery between 1934 and 1939.

We first evaluate the importance of *real shocks*—technology shocks, fiscal policy shocks, and trade shocks—for this decade-long period. We find that technology shocks may have contributed to the 1929–33 decline. However, we find that the real shocks predict a very robust recovery beginning in 1934. Theory suggests that real shocks should have led employment and output to return to trend by 1939.

We next analyze whether *monetary shocks* can account for the decline and recovery. Some economists, such as Friedman and Schwartz (1963), argue that monetary shocks were a key factor in the 1929–33 decline. To analyze the monetary shock view, we use the well-known model of Lucas and Rapping (1969), which connects changes in the money supply to changes in output through intertemporal substitution of leisure and unexpected changes in wages. The Lucas-Rapping model predicts that monetary shocks reduced output in the early 1930s, but the model also predicts that employment and output should have been back near trend by the mid-1930s.

Both real shocks and monetary shocks predict that employment and output should have quickly returned to trend levels. These predictions are difficult to reconcile with the weak 1934–39 recovery. If the factors considered important in postwar fluctuations can't fully account for macroeconomic performance in the 1930s, are there other factors that can? We go on to analyze two other factors that some economists consider important in understanding the Depression: *financial intermediation shocks* and *inflexible nominal wages*. One type of financial intermediation shock is the bank failures that occurred during the early 1930s. Some researchers argue that these failures reduced output by disrupting financial intermediation. While bank failures perhaps deepened the decline, we argue that their impact would have been short-lived and, consequently, that bank failures were not responsible for the weak recovery. Another type of financial intermediation shock is the increases in reserve requirements that occurred in late 1936 and early 1937. While this change may have led to a small decline in output in 1937, it cannot account for the weak recovery prior to 1937 and cannot account for the significant drop in activity in 1939 relative to 1929.

The other alternative factor is inflexible nominal wages. The view of this factor holds that nominal wages were not as flexible as prices and that the fall in the price level raised real wages and reduced employment. We present data showing that manufacturing real wages rose consistently during the 1930s, but that nonmanufacturing wages fell. The 10-year increase in manufacturing wages is difficult to reconcile with nominal wage inflexibility, which typically assumes that inflexibility is due to either money illusion or explicit nominal contracts. The long duration of the Depression casts doubt on both of these determinants of inflexible nominal wages.

The weak recovery is a puzzle from the perspective of neoclassical growth theory. Our inability to account for the recovery with these shocks suggests to us that an alternative shock is important for understanding macroeconomic performance after 1933. We conclude our study by conjecturing that government policies toward monopoly and the distribution of income are a good candidate for this shock. The National Industrial Recovery Act (NIRA) of 1933 allowed much of the economy to cartelize. This policy change would have depressed employment and output in those sectors covered by the act and, consequently, have led to a weak recovery. Whether the NIRA can quantitatively account for the weak recovery is an open question for future research.

The Data Through the Lens of the Theory

Neoclassical growth theory has two cornerstones: the aggregate production technology, which describes how labor and capital services are combined to create output, and the willingness and ability of households to substitute commodities over time, which govern how households allocate their time between market and nonmarket activities and how households allocate their income between consumption and savings. Viewed through the lens of this theory, the following variables are keys to understanding macroeconomic performance: the allocation of output between consumption and investment, the allocation of time (labor input) between market and nonmarket activities, and productivity.[3]

Output

In Table 2, we compare levels of output during the Depression to peak levels in 1929. To do this, we present data on consumption and investment and the other components of real gross national product (GNP) for the 1929–39 period.[4] Data are from the national income and product accounts published by the Bureau of Economic Analysis of the U.S. Department of Commerce. All data are divided by the *working-age* (16 years and older) population. Since neoclassical growth theory indicates that these variables can be expected to grow, on average, at the trend rate of technology, they are also *detrended,* that is, adjusted for trend growth.[5] With these adjustments, the data can be directly compared to their peak values in 1929.

As we can see in Table 2, all the components of *real output* (GNP in base-year prices), except government purchases of goods and services, fell considerably during the 1930s. The general pattern for the declining series is a very large drop between 1929 and 1933 followed by only a moderate rise from the 1933 trough. Output fell more than 38 percent between 1929 and 1933. By 1939, output remained nearly 27 percent below its 1929 detrended level. This detrended decline of 27 percent consists of a raw 11 percent drop in per capita output and a further 16 percent drop representing trend growth that would have normally occurred over the 1929–39 period.[6]

The largest decline in economic activity occurred in business investment, which fell nearly 80 percent between 1929 and 1933. Consumer durables, which represent household, as opposed to business, investment, followed a similar pattern, declining more than 55 percent between 1929 and 1933. Consumption of nondurables and services declined almost 29 percent between 1929 and 1933. Foreign trade (exports and imports) also fell considerably between 1929 and 1933. The impact of the decline between 1929 and 1933 on government purchases was relatively mild, and government spending even rose above its trend level in 1930 and 1931.

Table 2 also makes clear that the economy did not recover much from the 1929–33 decline. Although investment improved relative to its 1933 trough level, investment remained 51 percent below its 1929 (detrended) level in 1939. Consumer durables remained 36 percent below their 1929 level in 1939. Relative to trend, consumption of nondurables and services increased very little during the recovery. In 1933, consumption was about 28 percent below its 1929 detrended level. By 1939, consumption remained about 25 percent below this level.

These unique and large changes in economic activity during the Depression also changed the *composition* of output—the shares of output devoted to consumption, investment, government purchases, and exports and imports. These data are presented in Table 3. The share of output consumed rose considerably during the early 1930s, while the share of output invested, including consumer durables, declined sharply, falling from 25 percent in 1929 to just 8 percent in 1932. During the 1934–39 recovery, the share of output devoted to investment averaged about 15 percent, compared to its postwar average of 20 percent. This low rate of investment led to a decline in the *capital stock*—the gross stock of fixed reproducible private capital declined more than 6 percent between 1929 and 1939, representing a decline of more than 25 percent relative to trend. Foreign trade comprised a small share of economic activity in the United States during the 1929–39 period. Both exports and imports accounted for about 4 percent of output during the decade. The increase in government purchases, combined with the decrease in output, increased the government's share of output from 13 percent to about 20 percent by 1939.

These data raise the possibility that the recovery was a weak one. To shed some light on this possibility, in Table 4, we show the recovery from a typical postwar recession. The data in Table 4 are average detrended levels relative to peak measured quarterly from the trough. A comparison of Tables 2 and 4 shows that the recovery from a typical postwar recession differs considerably from the 1934–39 recovery during the Depression. First, output rapidly recovers to trend following a typical postwar recession. Second, consumption grows smoothly following a typical postwar recession. This contrasts sharply to the flat time path of consumption during the 1934–39 recovery. Third, investment recovers very rapidly following a typical postwar recession. Despite falling much more than output during a recession, investment recovers to a level comparable to the output recovery level within three quarters after the trough. During the Depression, however, the recovery in investment was much slower, remaining well below the recovery in output.

Tables 2 and 4 indicate that the 1934–39 recovery was much weaker than the recovery from a typical recession. One interpretation of the weak 1934–39 recovery is that the economy was not returning to its pre-1929 steady-state growth path, but was settling on a considerably lower steady-state growth path.

The possibility that the economy was converging to a lower steady-state growth path is consistent with the fact that consumption fell about 25 percent below trend by 1933 and remained near that level for the rest of the decade. (See Chart 1.) Consumption is a good barometer of a possible change in the economy's steady state because household dynamic optimization implies that all future expectations of income should be factored into current consumption decisions.[7]

Labor Input

Data on labor input are presented in Table 5. We use Kendrick's (1961) data on labor input, capital input, productivity, and output.[8] We present five measures of labor input, each divided by the working-age population. We don't detrend these ratios because theory implies that they will be constant along the steady-state growth path.[9] Here, again, data are expressed relative to their 1929 values.

The three aggregate measures of labor input declined sharply from 1929 to 1933. *Total employment,* which consists of private and government workers, declined about 24 percent between 1929 and 1933 and remained 18 percent below its 1929 level in 1939. *Total hours,* which reflect changes in employment and changes in hours per worker, declined more sharply than total employment, and the trough didn't occur until 1934. Total hours remained 21 percent below their 1929 level in 1939. *Private hours,* which don't include the hours of government workers, declined more sharply than total hours, reflecting the fact that government employment did not fall during the 1930s. Private hours fell more than 25 percent between 1929 and 1939.

These large declines in aggregate labor input reflect different changes across sectors of the economy. *Farm hours* and *manufacturing hours* are shown in the last two columns of Table 5. In addition to being divided by the working-age population, the farm hours measure is adjusted for an annual secular decline in farm employment of about 1.8 percent per year. In contrast to the other measures of labor input, farm hours remained near trend during much of the decade. Farm hours were virtually unchanged between 1929 and 1933, a period in which hours worked in other sectors fell sharply. Farm hours did fall about 10 percent in 1934 and were about 7 percent below their 1929 level by 1939. A very different picture emerges for manufacturing hours, which plummeted more than 40 percent between 1929 and 1933 and remained 22 percent below their detrended 1929 level at the end of the decade.

These data indicate important differences between the farm and manufacturing sectors during the Depression. Why didn't farm hours decline more during the Depression? Why did manufacturing hours decline so much?

Finally, note that the changes in nonfarm labor input are similar to changes in consumption during the 1930s. In particular, after falling sharply between 1929 and 1933, measures of labor input remained well below 1929 levels in 1939. Thus, aggregate labor input data also suggest that the economy was settling on a growth path lower than the path the economy was on in 1929.

Productivity

In Table 6, we present two measures of productivity: *labor productivity* (output per hour) and *total factor productivity.* Both measures are detrended and expressed relative to 1929 measures. These two series show similar changes during the 1930s. Labor productivity and total factor productivity both declined sharply in 1932 and 1933, falling about 12 percent and 14 percent, respectively, below their 1929 detrended levels. After 1933, however, both measures rose quickly relative to trend and, in fact, returned to trend by 1936. When we compare 1939 data to 1929 data, we see that the 1930s were a decade of normal productivity growth. Labor productivity grew more than 22 percent between 1929 and 1939, and total factor productivity grew more than 20 percent in the same period. This normal growth in productivity raises an important question about the lack of a recovery in hours worked, consumption, and investment. In the absence of a large negative shift in the long-run path of productivity, why would the economy be on a lower steady-state growth path in 1939?

An International Comparison

Many countries suffered economic declines during the 1930s; however, there are two important distinctions between economic activity in the United States and other countries during the 1930s. The decline in the United States was much more severe, and the recovery from the decline was weaker. To see this, we examine average real per capita output relative to its 1929 level for Belgium, Britain, France, Germany, Italy, Japan, and Sweden. The data are from Maddison 1991 and are normalized for each country so that per capita output is equal to 100 in 1929. Since there is some debate over the long-run growth rate in some of these countries, we have not detrended the data.

Table 7 shows the U.S. data and the mean of the normalized data for other countries. The total drop in output is relatively small in other countries: an 8.7 percent drop compared to a 33.3 percent drop in the United States. The international economies recovered quickly: output in most countries returned to 1929 levels by 1935 and was above those levels by 1938. Employment also generally recovered to its 1929 level by 1938.[10]

While accounting for other countries' economic declines is beyond the scope of this analysis, we can draw two conclusions from this comparison. First, the larger decline in the United States is consistent with the view that the shocks that caused the decline in the United States were larger than the shocks that caused the decline in the other countries. Second, the weak recovery in the United States is consistent with the view that the shocks that impeded the U.S. recovery did not affect most other countries. Instead, the post-1933 shock seems to be largely specific to the United States.

The data we've examined so far suggest that inputs and output in the United States fell considerably during the 1930s and did not recover much relative to the increase in productivity. Moreover, the data show that the decline was much more severe and the recovery weaker in the United States than in other countries. To account for the decade-long Depression in the United States, we conclude that we should focus on domestic, rather than international, factors. We turn to this task in the next section.

Can Real Shocks Account for the Depression?

Neoclassical theory and the data have implications for the plausibility of different sources of real shocks in accounting for the Depression. Since the decline in output was so large and persistent, we will look for large and persistent negative shocks. We analyze three classes of real shocks considered important in typical business cycle fluctuations: technology shocks, fiscal policy shocks, and trade shocks.

Technology Shocks? Perhaps Initially

First we consider *technology shocks*, defined as any exogenous factor that changes the efficiency with which business enterprises transform inputs into output. Under this broad definition of technology shocks, changes in productivity reflect not only true changes in technology, but also such other factors as changes in work rules and practices or government regulations that affect the efficiency of production but are exogenous from the perspective of business enterprises. How do technology shocks affect economic activity? The key element that leads to a decline in economic activity in models with technology shocks is a negative shock that reduces the marginal products of capital and labor. Shocks that reduce the efficiency of transforming inputs into output lead households to substitute out of market activities into nonmarket activities and result in lower output. Recent research has identified these shocks as important factors in postwar business cycle fluctuations. Prescott (1986), for example, shows that a standard one-sector neoclassical model with a plausibly parameterized stochastic process for technology shocks can account for 70 percent of postwar business cycle fluctuations. Can technology shocks account for the Depression?

If these shocks were responsible, we should see a large and persistent drop in *technology*—the efficiency of transforming inputs into output—during the 1930s. To see if such a drop occurred, we first need a measure of technology for this period. Under the neoclassical assumptions of constant returns to scale in production and perfectly competitive markets, theory implies that changes in total factor productivity are measures of changes in technology. The data do show a drop in total factor productivity—a 14 percent (detrended) drop between 1929 and 1933 followed by a rapid recovery. What is the quantitative importance of these changes in accounting for the Depression?

To address this question, we present the prediction for output for 1930–39 from a real business cycle model. (See Hansen 1985, Prescott 1986, or King, Plosser, and Rebelo 1988 for a discussion of this model.) Our model consists of equations (A1)–(A5) and (A9) in the Appendix, along with the following preference specification:

$$(1) \qquad u(c_t,l_t) = \log(c_t) + A\log(l_t).$$

We use the following Cobb-Douglas production function specification:

$$(2) \qquad z_t f(k_t,n_t) = z_t k_t^{\theta}(x_t n_t)^{1-\theta}.$$

The household has one unit of time available each period:

$$(3) \qquad 1 = l_t + n_t.$$

And we use the following specification of the stochastic process for the technology shock:

$$(4) \qquad z_t = (1-\rho) + \rho z_{t-1} + \varepsilon_t,\ \varepsilon_t \sim N(0,\sigma^2).$$

With values for the parameters of the model, we can use numerical methods to compute an approximate solution to the equilibrium of this economy.[11] We set $\theta = 0.33$ to conform to the observation that capital income is about one-third of output. We set $\sigma = 1.7$ percent and $\rho = 0.9$ to conform to the observed standard deviation and serial correlation of total factor productivity. We choose the value for the parameter A so that households spend about one-third of their discretionary time working in the deterministic steady state. Labor-augmenting technological change (x_t) grows at a rate of 1.9 percent per year. The population (n_t) grows at a rate of 1 percent per year. We set the depreciation rate at 10 percent per year.

We conduct the analysis by assuming that the capital stock in 1929 is equal to its steady-state value, and then we feed in the sequence of observed levels of total factor productivity as measures of the technology shock. Given the initial condition and the time path of technology, the model predicts labor input, output, consumption, and investment for each year during the 1930s. We summarize the results of the analysis in Chart 2, where we plot the detrended predicted level of output from the model between 1929 and 1939. For comparison, we also plot the actual detrended level of output. Note that the model predicts a significant decline in output between 1929 and 1933, although the decline is not as large as the observed decline in the data: a 15 percent predicted decline compared to a 38 percent actual decline. Further, note that as a consequence of rapid growth in total factor productivity after 1934, the model predicts a rapid recovery: output should have returned to trend by 1936. In contrast, actual output remained about 25 percent below trend during the recovery.

One factor that may be contributing to the rapid recovery in the model is the fact that the capital stock in the model falls less than in the data. Consequently, output predicted by the model may be relatively high because the capital stock is high. To correct for this difference, we conduct another analysis in which we also feed in the sequence of total factor productivity measures between 1934 and 1939, but we use the actual capital stock in 1934 (20 percent below trend) as the initial condition for 1934. Chart 3 shows that this change reduces output predicted by the model by about 3 percent at the beginning of the recovery. But because the initial capital stock in this analysis is lower, the marginal product of capital is higher, and the predicted rate of output growth in the recovery is faster than in the first analysis. This recovery brings output back to its trend level by 1937. The predicted output level is about 27 percent above the actual data level in 1939.[12] Thus, the predicted recovery is stronger than the actual recovery because predicted labor input is much higher than actual labor input.

Based on measured total factor productivity during the Depression, our analysis suggests a mixed assessment of the technology shock view. On the negative side, the actual slow recovery after 1933 is at variance with the rapid recovery predicted by the theory. Thus, it appears that some shock other than to the efficiency of production is important for understanding the weak recovery between 1934 and 1939. On the positive side, however, the theory predicts that the measured drop in total factor productivity can account for about 40 percent of the decline in output between 1929 and 1933.

Note, however, one caveat in using total factor productivity as a measure of technology shocks during periods of sharp changes in output, such as the 1929–33 decline: An imperfect measurement of capital input can affect measured aggregate total factor productivity. Because total factor productivity *change* is defined as the percentage change in output minus the percentage change in inputs, overstating the inputs will understate productivity, while understating the inputs will overstate productivity. During the 1929–33 decline, some capital was left idle. The standard measure of capital input is the capital stock. Because this standard measure includes idle capital, it is possible that capital input was overstated during the decline and, consequently, that productivity growth was understated.[13] Although there are no widely accepted measures of capital input adjusted for changes in utilization, this caveat raises the possibility that the decline in aggregate total factor productivity in the early 1930s partially reflects mismeasurement of capital input.[14] Without better data on capital input or an explicit theoretical framework we can use to adjust observed measured total factor productivity fluctuations for capital utilization, we can't easily measure how large technology shocks were in the early 1930s and, consequently, how much of a drop in output technology shocks can account for.

It is important to note here that these results give us an important gauge not only for the technology shock view, but also for any other shock which ceased to be operative after 1933. The predicted rapid recovery in the second experiment implies that any shock which ceased to be operative after 1933 can't easily account for the weak recovery.

Fiscal Policy Shocks? A Little

Next we consider *fiscal policy shocks*—changes in government purchases or tax rates. Christiano and Eichenbaum (1992) argue that government purchase shocks are important in understanding postwar business cycle fluctuations, and Braun (1994) and McGrattan (1994) argue that shocks to distorting taxes have had significant effects on postwar cyclical activity.

To understand how government purchases affect economic activity, consider an unexpected decrease in government purchases. This decrease will tend to increase private consumption and, consequently, lower the marginal rate of substitution between consumption and leisure. Theory predicts that this will lead households to work less and take more leisure. Conversely, consider an increase in government purchases. This increase will tend to decrease private consumption and reduce the marginal rate of substitution between consumption and leisure. In this case, theory predicts that this will lead households to work more and take less leisure.

Historically, changes in government purchases have had large effects on economic activity. Ohanian (1997) shows that the increase in government purchases during World War II can account for much of the 60 percent increase in output during the 1940s. Can changes in government purchases also account for the decrease in output in the 1930s?

If government purchase shocks were a key factor in the decline in employment and output in the 1930s, government purchases should have declined considerably during the period. This did not occur. Government purchases declined modestly between 1929 and 1933 and then rose sharply during the rest of the decade, rising about 12 percent above trend by 1939. These data are inconsistent with the view that government purchase shocks were responsible for the downturn.[15]

Although changes in government purchases are not important in accounting for the Depression, the way they were financed may be. Government purchases are largely financed by *distorting taxes*—taxes that affect the marginal conditions of households or firms. Most government revenue is raised by taxing factor incomes. Changes in factor income taxes change the net rental price of the factor. Increases in labor and capital income taxes reduce the returns to these factors and, thus, can lead households to substitute out of taxed activities by working and saving less.

If changes in factor income taxes were a key factor in the 1930s economy, these rates should have increased considerably in the 1930s. Tax rates on both labor and capital changed very little during the 1929–33 decline, but rose during the rest of the decade. Joines (1981) calculates that between 1929 and 1939, the average marginal tax rate on labor income increased from 3.5 percent to 8.3 percent and the average marginal tax rate on capital income increased from 29.5 percent to 42.5 percent. How much should these increases have depressed economic activity? To answer this question, we consider a deterministic version of the model we used earlier to analyze the importance of technology shocks. We augment this model to allow for distortionary taxes on labor and capital income. The values of the other parameters are the same. We then compare the deterministic steady state of the model with 1939 tax rates to the deterministic steady state of the model with 1929 tax rates. With these differences in tax rates, we find that steady-state labor input falls by 4 percent. This suggests that fiscal policy shocks account for only about 20 percent of the weak 1934–39 recovery.

Trade Shocks? No

Finally, we consider *trade shocks.* In the late 1920s and early 1930s, *tariffs*—domestic taxes on foreign goods—rose in the United States and in other countries. Tariffs raise the domestic price of foreign goods and, consequently, benefit domestic producers of goods that are substitutes with the taxed foreign goods. Theory predicts that increases in tariffs lead to a decline in world trade. International trade did, indeed, fall considerably during the 1930s: the League of Nations (1933) reports that world trade fell about 65 percent between 1929 and 1932. Were these tariff increases responsible for the 1929–33 decline?

To address this question, we first study how a contraction of international trade can lead to a decline in output. In the United States, trade is a small fraction of output and is roughly balanced between exports and imports. Lucas (1994) argues that a country with a small trade share will not be affected much by changes in trade. Based on the small share of trade at the time, Lucas (1994, p. 13) argues that the quantitative effects of the world trade contraction during the 1930s are likely to have been "trivial."[16]

Can trade have an important effect even if the trade share is small? Crucini and Kahn (1996) argue that a significant fraction of imports during the 1930s were intermediate inputs. If imported intermediate inputs are imperfect substitutes with domestic intermediate inputs, production can fall as a result of a reduction in imported inputs. Quantitatively, the magnitude of the fall is determined by the elasticity of substitution between the inputs. If the goods are poor substitutes, then a reduction in trade can have sizable effects. Little information is available regarding the substitution elasticity between these goods during the Depression. The preferred estimates of this elasticity in the postwar United States are between one and two. (See Stern, Francis, and Schumacher 1976.) Crucini and Kahn (1996) assume an elasticity of two-thirds and report that output would have dropped about 2 percent during the early 1930s as a result of higher tariffs.

This small decline implies that extremely low substitution elasticities are required if the trade disruption is to account for more than a small fraction of the decline in output. How plausible are very low elasticities? The fact that tariffs were widely used points to high, rather than low, elasticities between inputs. To see this, note that with high elasticities, domestic and foreign goods are very good substitutes, and, consequently, tariffs should benefit domestic producers who compete with foreign producers. With very low elasticities, however, domestic goods and foreign goods are poor substitutes. In this case, tariffs provide little benefit to domestic producers and, in fact, can even hurt domestic producers if there are sufficient complementarities between inputs. This suggests that tariffs would not be used much if substitution elasticities were very low.

But even if substitution elasticities were low, it is unlikely that this factor was responsible for the Depression, because the rise in the prices of tariffed goods would ultimately have led domestic producers to begin producing the imported inputs. Once these inputs became available domestically, the decline in output created by the tariff would have been reversed. It is hard to see how the disruption of trade could have affected output significantly for more than the presumably short period it would have taken domestic producers to change their production.

Our analysis thus far suggests that none of the real shocks usually considered important in understanding business cycle fluctuations can account for macroeconomic performance during the 1930s. Lacking an understanding of the Depression based on real shocks, we next examine the effects of monetary shocks from the neoclassical perspective.

Can Monetary Shocks Account for the Depression?

Monetary shocks—unexpected changes in the stock of money—are considered an alternative to real shocks for understanding business cycles, and many economists think monetary shocks were a key factor in the 1929–33 decline. Much of the attraction to monetary shocks as a source of business cycles comes from the influential narrative monetary history of the United States by Friedman and Schwartz (1963). They present evidence that declines in the money supply tend to precede declines in output over nearly a century in the United States. They also show that the money supply fell sharply during the 1929–33 decline. Friedman and Schwartz (1963, pp. 300–301) conclude from these data that the decline in the money supply during the 1930s was an important cause of the 1929–33 decline (contraction):

> The contraction is in fact a tragic testimonial to the importance of monetary forces . . . . Prevention or moderation of the decline in the stock of money, let alone the substitution of monetary expansion, would have reduced the contraction's severity and almost as certainly its duration.

Maybe for the Decline . . .

We begin our discussion of the monetary shock view of the decline by presenting data on some nominal and real variables. We present the data Friedman and Schwartz (1963) focus on: money, prices, and output. We also present data on interest rates.

In Table 8, we present the *nominal data:* the monetary base, which is the monetary aggregate controlled by the Federal Reserve; M1, which is currency plus checkable deposits; the GNP deflator, or price level; and two interest rates: the rate on three-month U.S. Treasury bills and the rate on commercial paper. The money supply data are expressed in per capita terms by dividing by the working-age population. The money data are also expressed relative to their 1929 values. The interest rates are the annual average percentage rates. These nominal data do, indeed, show the large decline in M1 in the early 1930s that led Friedman and Schwartz (1963) to conclude that the drop in the money supply was an important cause of the 1929–33 decline.[17]

In Table 9, we present the *real data:* the real money supply, which is the two nominal series divided by the GNP deflator; real output; and the ex post real rate of interest, which is the commercial paper rate minus the realized inflation rate. Note that the real money stock fell considerably less than the nominal stock during the early 1930s and then rose between 1933 and 1939. In fact, the variation in the real money stock during the decline is quite similar to the variation in real output.

To understand the empirical relationship between money and output reported by Friedman and Schwartz (1963), economists have developed theoretical models of monetary business cycles. In these models, money is *nonneutral*—changes in the money supply lead to changes in allocations and relative prices. For money to have important nonneutralities, there must be some mechanism that prevents nominal prices from adjusting fully to a change in the money supply. The challenge of monetary business cycle theory is to generate important nonneutralities not by assumption, but as an equilibrium outcome.

The first monetary business cycle model along these lines was developed by Lucas and Rapping (1969). This model was later extended into a fully articulated general equilibrium model by Lucas (1972). Two elements in the Lucas-Rapping model generate cyclical fluctuations: intertemporal substitution of leisure and unexpected changes in wages. The basic idea in the Lucas-Rapping model is that agents' decisions are based on the realization of the real wage relative to its normal, or expected, level. Suppose that the wage turns out to be temporarily high today relative to its expected level. Since the wage is high, the opportunity cost of not working—*leisure*—is also high. If preferences are such that leisure today is substitutable with leisure in the future, households will respond by intertemporally substituting leisure today for future leisure and, thus, will work more today to take advantage of the temporarily high wage. Similarly, if the wage today is temporarily low relative to the normal wage, households will tend to take more leisure today and less leisure in the future when wages return to normal.

How does the money supply in the 1929–33 decline figure into this model? Lucas and Rapping (1969) model households' expectation of the real wage as a weighted average of the real wage's past values. Based on this construction of the weighted average, the rapid decline in the money supply resulted in the real wage falling below its expected level, beginning in 1930. According to the model, the decline in the real wage relative to the expected wage led households to work less, which reduced output.

. . . But Not for the Recovery

Quantitatively, Lucas and Rapping (1969) find that the decline in the real wage relative to the expected wage was important in the 1929–33 decline. The Lucas-Rapping model predicts a large decline in labor input through 1933. The problem for the Lucas-Rapping model is what happened after 1933. The real wage returned to its expected level in 1934, and for the rest of the decade, the wage was either equal to or above its expected level. According to the model, this should have resulted in a recovery that quickly returned output to its 1929 (detrended) level. This did not happen. (See Lucas and Rapping 1972.) The Lucas-Rapping (1969) model can't account for the weak recovery.

Another model that connects changes in money to changes in output is Fisher's (1933) debt-deflation model. In this model, deflation shifts wealth from debtors to creditors by increasing the real value of nominal liabilities. In addition to making this wealth transfer, the increase in the real value of liabilities reduces net worth and, according to Fisher, leads to lower lending and a higher rate of business failures. Qualitatively, Fisher's view matches up with the 1929–32 period, in which both nominal prices and output were falling. The quantitative importance of the debt-deflation mechanism for this period, however, is an open question. Of course, Fisher's model would tend to predict a rapid recovery in economic activity once nominal prices stopped falling in 1933. Thus, Fisher's model can't account for the weak recovery either.[18]

Alternative Factors

Factors other than those considered important in postwar business cycles have been cited as important contributors to the 1929–33 decline. Do any provide a satisfactory accounting for the Depression from the perspective of neoclassical theory? We examine two widely cited factors: financial intermediation shocks and inflexible nominal wages.

Were Financial Intermediation Shocks Important?

□ *Bank Failures? Maybe, But Only Briefly*

Several economists have argued that the large number of bank failures that occurred in the early 1930s disrupted financial intermediation and that this disruption was a key factor in the decline. Bernanke's (1983) work provides empirical support for this argument. He constructs a statistical model, based on Lucas and Rapping's (1969) model, in which unexpected changes in the money stock lead to changes in output. Bernanke estimates the parameters of his model using least squares, and he shows that adding the dollar value of deposits and liabilities of failing banks as explanatory variables significantly increases the fraction of output variation the model can account for.

What economic mechanism might have led bank failures to deepen the 1929–33 decline? One view is that these failures represented a decline in information capital associated with specific relationships between borrowers and intermediaries. Consequently, when a bank failed, this relationship-specific capital was lost, and the efficiency of intermediation declined.

It is difficult to assess the quantitative importance of bank failures as a factor in deepening the 1929–33 decline because the output of the banking sector, like broader measures of economic activity, is an endogenous, not an exogenous, variable. Although bank failures may have exacerbated the decline, as suggested by Bernanke's (1983) empirical work, some of the decline in the inputs and output of the banking sector may also have been an endogenous response to the overall decline in economic activity.[19] Moreover, bank failures were common in the United States during the 1920s, and most of those bank failures did not seem to have important aggregate consequences. Wicker (1980) and White (1984) argue that at least some of the failures during the early 1930s were similar to those during the 1920s.

However, we can assess the potential contribution of intermediation shocks to the 1929–33 decline with the following growth accounting exercise. We can easily show that under the assumption of perfect competition, at least locally, the percentage change in aggregate output, $\hat{Y}$, can be written as a linear function of the percentage change in the sector i outputs, $\hat{y}_i$, for each sector $i = 1, ..., n$ and the shares γ_i for each sector as follows:

$$(5) \qquad \hat{Y} = \sum_{i=1}^{n} \gamma_i \hat{y}_i .$$

The share of the entire finance, insurance, and real estate (FIRE) sector went from 13 percent in 1929 to 11 percent in 1933. This suggests that the appropriate cost share was 12 percent. The real output of the FIRE sector dropped 39 percent between 1929 and 1933. If we interpret this fall as exogenous, we see that the drop in the entire FIRE sector reduces output by 4.7 percent. Thus, in the absence of large aggregate externalities that would amplify this effect, the contribution of the FIRE sector was small.[20]

To better understand the importance of bank failures, especially for the recovery, we next examine data on financial intermediation during the Depression to determine how the capacity of the banking sector changed as a result of exiting institutions; how the quantity of one productive input into the banking sector, deposits, changed; and how the portfolios of banks changed.

In Table 10, we present data on deposits in operating banks, deposits in suspended banks, the stock of total commercial loans, and federal government securities held by banks. All data are measured relative to nominal output. To measure the flow change in loans, we also present the percentage change in the ratio of loans to output. We note four interesting features of these data.

- The decline in deposits during the 1929–33 decline was small relative to the decline in output. The ratio of deposits of operating banks to output rose from 0.57 in 1929 to 0.77 in 1932.

- Deposits of suspended institutions were less than 2 percent of deposits of operating banks in every year of the decline except 1933, when the president declared a national bank holiday. Moreover, failures disappeared after 1933, reflecting the introduction of federal deposit insurance.
- Loans as a fraction of output did not begin to drop much until 1933, but dropped sharply during the 1934–39 recovery.
- The fraction of federal government securities held by banks as a fraction of output increased steadily during the Depression, rising from 0.05 in 1929 to 0.20 by 1935.

The data in the first two rows of Table 10 suggest that funds available for loans were relatively high during the Depression and that the overall capacity of the banking sector, measured in terms of deposits lost in exiting institutions, did not change much. Why, then, did banks not make more loans during the Depression? Was it because a loss of information capital associated with exiting banks caused a reduction in the efficiency of intermediation? Unfortunately, we can't measure this information capital directly. We can, however, assess this possibility with a very simple model of intermediation, in which loans made at bank i, l_i, and intermediated government debt held by bank i, b_i, are produced from a constant returns to scale technology using deposits, d_i, and exogenous information capital, x_i, such that $l_i + b_i = f(d_i, x_i)$. The total stock of information capital is the sum of information capital across all banks, and the information capital of any bank that exits is destroyed. With competition, the ratio of productive inputs, d_i/x_i, will be identical across banks. This implies that the fraction of information capital in banking lost due to exiting banks is equal to the fraction of deposits lost in exiting banks. Theory thus suggests that, except during 1933, the loss of information capital as a direct result of exiting banks was low during the Depression.[21]

There are other channels, however, through which bank failures could have had important aggregate affects. For example, failures caused by bank runs may have led solvent banks to fear runs and, therefore, shift their portfolios from illiquid loans to liquid government bonds. However, this shift doesn't explain the low level of loans relative to output that persisted during the 1934–39 recovery. Moreover, during the recovery, federal deposit insurance eliminated bank runs. Why would banks still fear runs years later?

This analysis raises some questions about the view that bank runs had very large effects during the 1929–33 decline. It also shows that there is little evidence to support the view that the intermediation shock associated with these bank runs had persistent effects which slowed the recovery after 1933. We next turn to the other intermediation shock that some researchers argue is important for understanding the weak recovery.

□ *Reserve Requirements? Not Much*

In August 1936, the Federal Reserve increased the required fraction of net deposits that member banks must hold as reserves from 10 percent to 15 percent. This fraction rose to 17.5 percent in March 1937 and then rose to 20 percent in May 1937. Many economists, for example, Friedman and Schwartz, attribute some of the weak macroeconomic performance during 1937 and 1938 to these policy changes.

These economists argue that these policy changes increased bank reserves, which reduced lending and, consequently, reduced output. If this were true, we would expect to see output fall shortly after these changes. This did not happen. Between August 1936, when the first increase took place, and August 1937, industrial production rose about 12 percent. It is worth noting that industrial production did fall considerably between late 1937 and 1938, but the downturn did not begin until October 1937, which is 14 months after the first and largest increase in reserve requirements. (Industrial production data are from the October 1943 *Federal Reserve Index of Industrial Production* of the Board of Governors of the Federal Reserve System.)

Another potential shortcoming of the reserve requirement view is that interest rates did not rise after these policy changes. Commercial loan rates fell from 2.74 percent in January 1936 to 2.65 percent in August 1936. These rates then fell to 2.57 percent in March 1937 and rose slightly to 2.64 percent in May 1937, the date of the last increase in reserve requirements. Lending rates then ranged between 2.48 percent and 2.60 percent over the rest of 1937 and through 1938. Interest rates on other securities showed similar patterns: rates on Aaa-, Aa-, and A-rated corporate debt were roughly unchanged between 1936 and 1938.[22] (Interest rate data are from *Banking and Monetary Statistics, 1914–1941* of the Board of Governors of the Federal Reserve System.) These data raise questions about the view that higher reserve requirements had important macroeconomic effects in the late 1930s and instead suggest that some other factor was responsible for the weak 1934–39 recovery.

Were Inflexible Nominal Wages Important? Hard to Know

The other alternative factor cited as contributing to the Depression is inflexible nominal wages. This view dates back to Keynes 1935 and more recently to Bernanke and Carey 1996 and Bordo, Erceg, and Evans 1996. The basic idea behind this view is that nominal wages are inflexible—a decline in the money supply lowers the price level but does not lower the nominal wage. This inflexibility suggests that a decline in the price level raises the real wage and, consequently, reduces labor input. Were inflexible nominal wages a key factor in the Depression?

To address this question, in Table 11, we present data on real wages in manufacturing, nonmanufacturing, and the total economy. The data for the manufacturing sector, from Hanes 1996, are divided by the GNP deflator, adjusted for long-run real wage growth of 1.9 percent per year, and measured relative to 1929. The wage rate for the total economy is constructed as real total compensation of employees divided by total hours worked. The total economy rate is also adjusted for long-run real wage growth and measured relative to 1929.

We use the data for the manufacturing wage, the constructed total economy wage, and the employment shares for manufacturing and nonmanufacturing to construct the wage rate for the nonmanufacturing sector. The percentage change in the total wage ($\%\Delta w^{tot}$) between dates t and $t-1$ is equal to the sum of the percentage change in the manufacturing wage ($\%\Delta w^{mfg}$) weighted by its share of employment (shm) at date $t-1$ and the percentage change in the nonmanufacturing sector weighted by its share of employment at date $t-1$. Thus, the percentage change in the nonmanufacturing wage ($\%\Delta w^{nonmfg}$) is given by

$$(6) \qquad \%\Delta w^{nonmfg} = [\%\Delta w^{tot} - shm_{t-1}(\%\Delta w^{mfg})]/(1 - shm_{t-1})$$

The economywide real wage was roughly unchanged during 1930 and 1931, and fell 9 percent by 1933. This aggregate measure, however, masks striking differences between the manufacturing and nonmanufacturing sectors. The nonmanufacturing wage fell almost 15 percent between 1929 and 1933 and remained almost 10 percent below trend in 1939. This decline was not unusual: postwar data indicate that real wages are moderately procyclical, which suggests that the large drop in output during the 1929–33 decline would likely have been accompanied by a considerable drop in the real wage.[23]

In contrast, real wages in manufacturing rose above trend during the 1929–33 decline and continued to rise during the rest of the decade. By 1939, manufacturing wages were 16 percent above trend. These data raise questions about the manufacturing sector during the Depression. Why did real wages in manufacturing rise so much during a decade of poor economic performance? Why was the increase only in manufacturing? It seems unlikely that the standard reasons for nominal wage inflexibility—money illusion and explicit nominal contracts—were responsible for the decade-long increase in the manufacturing real wage.[24]

We conclude that neither alternative factor, intermediation shocks or inflexible nominal wages, sheds much light on the weak 1934–39 recovery.[25]

A Possible Solution

Neoclassical theory indicates that the Depression—particularly the recovery between 1934 and 1939—is a puzzle. The conventional shocks considered important in postwar business cycles do not account for the decade-long drop in employment and output. The conventional shocks are too small. Moreover, the effects of monetary shocks are too transient. Nor does expanding our analysis to consider alternative factors account for the Depression. The effects of alternative factors either are too transient or lack a sufficient theoretical framework.

Where do we go from here? To make progress in understanding the Depression, we identify the observations that are puzzling from the neoclassical perspective and then determine which direction these puzzles point us in. Our analysis identifies three puzzles in particular: Why did labor input, consumption, and investment remain so low during a period of rapid productivity growth? Why did agricultural employment and output remain near trend levels during the early 1930s, while nonagricultural employment and output plummeted? Why did the manufacturing real wage increase so much during the 1930s? With competitive markets, theory suggests that the real wage should have decreased, rather than increased.

These puzzles suggest that some other shocks were preventing a normal recovery. We uncover three clues that may aid in future hunts for the shocks that account for the weak 1934–39 recovery. First, it seems that we can rule out shocks that hit all sectors of the economy proportionately. During the 1929–33 decline, for example, agricultural employment and output fell very little, while manufacturing output and employment fell substantially. Second, our view that the economy was settling on a new, much lower growth path during the 1930s indicates that the shocks responsible for the decline were perceived by households and businesses to be permanent, rather than temporary. Third, some of the puzzles may be related—the fact that investment remained so low may reflect the fact that the capital stock was adjusting to a new, lower steady-state growth path.

To account for the weak recovery, these clues suggest that we look for shocks with specific characteristics, for example, a large shock which hits just some sectors of the economy, in particular, manufacturing, and which causes wages to rise and employment and investment to fall in those sectors. We conjecture that government policies toward monopoly and the distribution of income are a good candidate for this type of shock.

Government policies toward monopoly changed considerably in the 1930s. In particular, the NIRA of 1933 allowed much of the U.S. economy to cartelize. For over 500 sectors, including manufacturing, antitrust law was suspended and incumbent business leaders, in conjunction with government and labor representatives in each sector, drew up codes of fair competition. Many of these codes provided for minimum prices, output quotas, and open price systems in which all firms had to report current prices to the code authority and any price cut had to be filed in advance with the authority, who then notified other producers. Firms that attempted to cut prices were pressured by other industry members and publicly berated by the head of the NIRA as "cut-throat chiselers." In return for government-sanctioned collusion, firms gave incumbent workers large pay increases.

How might this policy change have affected the economy? By permitting monopoly and raising wages, the NIRA would be expected to have depressed employment, output, and investment in the sectors the act covered, including manufacturing. In contrast, economic activity in the sectors not covered by the act, such as agriculture, would probably not have declined as much. Qualitatively, this intuition suggests that this government policy shock has the right characteristics. The key issue, however, is the quantitative impact of the NIRA on the macroeconomy: How much did it change employment, investment, consumption, output, and wages? How did the impact differ across sectors of the economy? Addressing these questions is the focus of our current research.

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[1]For other studies of the Depression and many additional references, see Brunner 1981; Temin 1989, 1993; Eichengreen 1992; Calomiris 1993; Margo 1993; Romer 1993; Bernanke 1995; Bordo, Erceg, and Evans 1996; and Crucini and Kahn 1996.

[2]The National Bureau of Economic Research (NBER) defines a *cyclical decline*, or *recession*, as a period of decline in output across many sectors of the economy which typically lasts at least six months. Since the NBER uses a monthly frequency, we convert to a quarterly frequency for our comparison by considering a peak (trough) quarter to be the quarter with the highest (lowest) level of output within one quarter of the

quarter that contains the month of the NBER peak (trough). We define the *recovery* as the time it takes for output to return to its previous peak.

[3]Note that in the closed economy framework of the neoclassical growth model, savings equals investment.

[4]We end our analysis in 1939 to avoid the effects of World War II.

[5]We make the trend adjustment by dividing each variable by its long-run trend growth rate relative to the reference date. For example, we divide GNP in 1930 by 1.019. This number is 1 plus the average growth rate of 1.9 percent over the 1947–97 period and over the 1919–29 period. For 1931, we divide the variable by 1.019^2, and so forth.

[6]To obtain this measure, we divide per capita output in 1939 by per capita output in 1929 (0.89) and divide the result by 1.019^{10}.

[7]This point is first stressed in Hall 1978.

[8]Kendrick's (1961) data for output are very similar to those in the NIPA.

[9]Hours will be constant along the steady-state growth path if preferences and technology satisfy certain properties. See King, Plosser, and Rebelo 1988.

[10]The average ratio of employment in 1939 to employment in 1929 was one in these countries, indicating that employment had recovered.

[11]Cooley 1995 contains detailed discussions of computing the solution to the stochastic growth model.

[12]Some researchers argue that there are many other forms of capital, such as organizational capital and human capital, and that the compensation of labor also includes the implicit compensation of these other types of capital. These researchers argue, therefore, that the true capital share is much higher, around two-thirds, and note that with this higher capital share, convergence in the neoclassical model is much slower. To see what a higher capital share would imply for the 1934–39 recovery, we conducted our recovery exercise assuming a capital share of two-thirds rather than one-third. While slower, the recovery was still much faster than in the data. This exercise predicted output at 90 percent of trend by 1936 and at 95 percent of trend by 1939.

[13]Bernanke and Parkinson (1991) estimate returns to scale for some manufacturing industries during the Depression and also find evidence that productivity fell during this period. They attribute at least some of the decline to mismeasurement of capital input or increasing returns.

[14]An extreme approach to evaluating the effects of idle capital on total factor productivity measurement is to assume that output is produced from a Leontief technology using capital and labor. Under this Leontief assumption, the percentage decline in capital services is equal to the percentage decline in labor services. Total hours drop 27.4 percent between 1929 and 1933. Under the Leontief assumption, total factor productivity in 1933 is about 7 percent below trend, compared to the 14 percent decline under the opposite extreme view that all capital is utilized. This adjustment from a 14 percent decline to a 7 percent decline is almost surely too large not only because it is based on a Leontief technology, but also because it does not take into account the possibility that the capital left idle during the decline was of lower quality than the capital kept in operation.

[15]One reason that private investment may have fallen in the 1930s is because government investment was substituting for private investment; however, this seems unlikely. Government investment that might be a close substitute for private investment did not rise in the 1930s: government expenditures on durable goods and structures were 3 percent of output in 1929 and fluctuated between 3 percent and 4 percent of output during the 1930s.

[16]To understand why a trade disruption would have such a small effect on output in a country with a small trade share, consider the following example. Assume that final goods are produced with both domestic (Z) and foreign (M) intermediate goods and that the prices of all goods are normalized to one. Assuming an elasticity of substitution between home and foreign goods of one implies that the production for final goods, Y, is Cobb-Douglas, or

$$Y = Z^{\alpha} M^{1-\alpha}$$

where α is the share parameter for intermediate inputs. This assumption implies that with the level of domestic intermediate goods held fixed,

$$\%\Delta Y = (1-\alpha)\%\Delta M.$$

That fact that U.S. imports were 4 percent of total output and U.S. exports 5 percent in 1929 suggests that the highest the cost share of inputs in production could have been is 0.04/0.95 ~ 0.04. Hence, an extreme disruption in trade that led to an 80 percent drop in imports would lead to only a 3.2 percent drop in output. (See Crucini and Kahn 1996 for more on this issue.)

[17]Note that the monetary base, which is the components of M1 controlled by the Federal Reserve, grew between 1929 and 1933.

[18]In addition to Lucas and Rapping's (1969) findings and Fisher's (1933) debt-deflation view, we have other reasons to question the monetary shock view of the Depression. During the mid- and late-1930s, business investment remained more than 50 percent below its 1929 level despite short-term real interest rates (commercial paper) near zero and long-term real interest rates (Baa corporate bonds) at or below long-run averages. These observations suggest that some other factor was impeding the recovery.

[19]Bernanke (1983) acknowledges the possibility of an endogenous response but argues that it was probably not important, since problems in financial intermediation tended to precede the decline in overall activity and because some of the bank failures seem to have been due to contagion or events unrelated to the overall downturn.

Recent work by Calomiris and Mason (1997) raises questions about the view that bank runs reflected contagion and raises the possibility that productive, as well as unproductive, banks could be run. Calomiris and Mason analyze the bank panic in Chicago in June 1932 and find that most of the failures were among insolvent, or near-insolvent, banks.

[20]To see how we derive the linear expression for $\hat{Y}$, note that if $Y = F(y_i, ..., y_n)$, then

$$dY = \sum_{i=1}^{n} F_i d_{yi}.$$

Note also that if goods are produced competitively, then the price of each factor i is given by its marginal product F_i. Hence, $\gamma_i = F_i y_i / Y$, and the result follows.

Note that the fact that the cost shares didn't change very much is inconsistent with the notion that there was extremely low elasticity of substitution for this input and that the fall in this input was an important cause of the fall in output. For example, a Leontief production function in which $F(y_1, ..., y_n) = \min_i y_i$ implies that the cost share of input y_i would go to one if that input was the input in short supply.

[21]Cooper and Corbae (1997) develop an explicit model of a financial collapse with a high output equilibrium associated with high levels of intermediation services and a low output equilibrium associated with low levels of intermediation services and a sharp reduction in the size of the banking sector. Their model also implies that the ratio of total deposits to output is a measure of the available level of intermediation services.

[22]Interest rates on Baa debt, which is considered by investment bankers to have higher default risk than these other debts, did begin to rise in late 1937 and 1938.

[23]While Kendrick's (1961) data on aggregate hours are frequently used in macroeconomic analyses of the pre–World War II economy, we point out that the Bureau of Labor Statistics (BLS) did not estimate broad coverage of hours until the 1940s. Thus, Kendrick's data are most likely of lower quality than the more recent BLS data.

[24]Decade-long money illusion is hard to reconcile with maximizing behavior. Regarding nominal contracts, we are unaware of any evidence that explicit long-term nominal wage contracts were prevalent in the 1930s. This prevalence would seem unlikely, since only about 11 percent of the workforce was unionized in the early 1930s.

[25]Alternative views in the literature combine a variety of shocks. Romer (1990, 1992) suggests that the 1929 stock market crash increased uncertainty, which led to a sharp decline in consumption. She argues that this shock, combined with monetary factors, is a key to understanding the 1930s. To assess Romer's view, which is based in part on the large drop in stock prices, we need a well-established theory of asset pricing. Existing theories of asset pricing, however, do not conform closely to the data. (See Grossman and Shiller 1981 or Mehra and Prescott 1985.) Given existing theory, a neoclassical evaluation of Romer's view is difficult.

Appendix
The Neoclassical Growth Model

Here we describe the neoclassical growth model, which provides the theoretical framework in the preceding paper.

The neoclassical growth model has become the workhorse of macroeconomics, public finance, and international economics. The widespread use of this model in aggregate economics reflects its simplicity and the fact that its long-run predictions for output, consumption, investment, and shares of income paid to capital and labor conform closely to the long-run experience of the United States and other developed countries.

The model includes two constructs. One is a production function with constant returns to scale and smooth substitution possibilities between capital and labor inputs. Output is either consumed or saved to augment the capital stock. The other construct is a representative household which chooses a sequence of consumption, savings, and leisure to maximize the present discounted value of utility.[1]

The basic version of the model can be written as maximizing the lifetime utility of a representative household which is endowed initially with k_0 units of capital and one unit of time at each date. Time can be used for work to produce goods (n_t) or for leisure (l_t). The objective function is maximized subject to a sequence of constraints that require sufficient output [$f(k_t,n_t)$] to finance the sum of consumption (c_t) and investment (i_t) at each date. Each unit of date t output that is invested augments the date $t + 1$ capital stock by one unit. The capital stock depreciates geometrically at rate δ, and β is the household's discount factor. Formally, the maximization problem is

(A1) $\max_{\{c_t,l_t\}} \sum_{t=0}^{\infty} \beta^t u(c_t,l_t)$

subject to the following conditions:

(A2) $f(k_t,n_t) \geq c_t + i_t$

(A3) $i_t = k_{t+1} - (1-\delta)k_t$

(A4) $1 = n_t + l_t$

(A5) $c_t \geq 0,\ n_t \geq 0,\ k_{t+1} \geq 0.$

Under standard conditions, an interior optimum exists for this problem. (See Stokey, Lucas, and Prescott 1989.) The optimal quantities satisfy the following two first-order conditions at each date:

(A6) $u_{l_t} = u_{c_t} f_2(k_t,n_t)$

(A7) $u_{c_t} = \beta u_{c_{t+1}}[f_1(k_{t+1},n_{t+1}) + (1-\delta)].$

Equation (A6) characterizes the trade-off between taking leisure and working by equating the marginal utility of leisure, u_{l_t}, to the marginal benefit of working, which is working one additional unit and consuming the proceeds: $u_{c_t} f_2(k_t,n_t)$. Equation (A7) characterizes the trade-off between consuming one additional unit today and investing that unit and consuming the proceeds tomorrow. This trade-off involves equating the marginal utility of consumption today, u_{c_t}, to the discounted marginal utility of consumption tomorrow and multiplying by the marginal product of capital tomorrow. This version of the model has a steady state in which all variables converge to constants. To introduce steady-state growth into this model, the production technology is modified to include labor-augmenting technological change, x_t:

(A8) $x_{t+1} = (1+\gamma)x_t$

where the variable x_t represents the efficiency of labor input, which is assumed to grow at the constant rate γ over time. The production function is modified to be $f(k_t,x_t n_t)$. King, Plosser, and Rebelo (1988) show that relative to trend growth, this version of the model has a steady state and has the same characteristics as the model without growth.

This very simple framework, featuring intertemporal optimization, capital accumulation, and an aggregate production function, is the foundation of many modern business cycle models. For example, models with technology shocks start with this framework and add a stochastic disturbance to the production technology. In this case, the resource constraint becomes

(A9) $z_t f(k_t,n_t) \geq c_t + i_t$

where z_t is a random variable that shifts the production function. Fluctuations in the technology shock affect the marginal products of capital and labor and, consequently, lead to fluctuations in allocations and relative prices. (See Prescott 1986 for details.)

Models with government spending shocks start with the basic framework and add stochastic government purchases. In this case, the resource constraint is modified as follows:

(A10) $f(k_t,n_t) \geq c_t + i_t + g_t$

where g_t is stochastic government purchases. An increase in government purchases reduces output available for private use. This reduction in private resources makes households poorer and leads them to work more. (See Christiano and Eichenbaum 1992 and Baxter and King 1993 for details.)

Because these economies do not have distortions, such as distorting taxes or money, the allocations obtained as the solution to the maximization problem are also competitive equilibrium allocations. (See Stokey, Lucas, and Prescott 1989.) The solution to the optimization problem can be interpreted as the competitive equilibrium of an economy with a large number of identical consumers, all of whom start with k_0 units of capital, and a large number of firms, all of whom have access to the technology $f(k,n)$ for transforming inputs into output. The equilibrium consists of rental prices for capital $r_t = f_1(k_t,n_t)$ and labor $w_t = f_2(k_t,n_t)$ and the quantities of consumption, labor, and investment at each date $t = 0, ..., \infty$. In this economy, the representative consumer's budget constraint is given by

(A11) $r_t k_t + w_t n_t \geq c_t + i_t.$

The consumer's objective is to maximize the value of discounted utility subject to the consumer's budget constraint and the transition rule for capital (A3). The firm's objective is to maximize the value of profits at each date. Profits are given by

(A12) $f(k_t,n_t) - r_t k_t - w_t n_t.$

The effects of monetary disturbances can also be studied in the neoclassical growth framework by introducing money into the model. The introduction of money, however, represents a distortion; consequently, the competitive equilibrium will not generally coincide with the solution to the optimization problem. (See Stokey, Lucas, and Prescott 1989.) In this case, the equations for the competitive equilibrium, rather than the optimization problem, are used in the analysis.

One widely used approach to adding money to the equilibrium model is to introduce a cash-in-advance constraint, which requires that consumption be purchased with cash:

(A13) $m_t \geq p_t c_t$

where m_t is the money supply and p_t is the price (in dollars) of the physical good. In this model, changes in the money stock affect expected inflation, which, in turn, changes households' incentives to work and thus leads to fluctuations in labor input. (See Cooley and Hansen 1989 for details.) More-complex monetary models, including models with imperfectly flexible prices or wages or imperfect information about the stock of money, also use the basic model as a foundation.

[1] Solow's (1956) original version of this model features a representative agent who inelastically supplies one unit of labor and who consumes and saves a fixed fraction of output. Cass (1965) and Koopmans (1965) replace the fixed savings formulation of Solow with an optimizing representative consumer.

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BOX (WITH TABLE ON FOLLOWING PAGE)

The Recession of 1921: The Recovery Puzzle Deepens

Many economists, including Friedman and Schwartz (1963), view the 1921 economic downturn as a classic monetary recession. Under this view, the 1921 recession and subsequent recovery support our view in the accompanying article that the weak 1934–39 recovery is puzzling.

In 1921, the monetary base fell 9 percent, reflecting Federal Reserve policy which was intended to reduce the price level from its World War I peak. This decline is the largest one-year drop in the monetary base in the history of the United States. The price level did fall considerably, declining 18.5 percent in 1921. Real per capita output also fell in 1921, declining 3.4 percent relative to trend.

Since many economists assume that monetary factors were important in both the 1929–33 decline and the 1921 recession, we compare these two downturns and their recov price level normalized to 100 in the year before the downturn and normalized detrended real per capita output.

There are two key differences between these periods. One is that the decrease in output relative to the decrease in the price level during the 1920s is small compared to the decrease in output relative to the decrease in the price level that occurred during the 1930s. The 18.5 percent decrease in the price level in 1921 is more than five times as large as the 3.4 percent decrease in output in 1921. In contrast, the decrease in the price level is only about 62 percent of the average decrease in output between 1929 and 1933. The other difference is that the 1921 recession was followed by a fast recovery. Even before the price level ceased falling, the economy began to recover. Once the price level stabilized, the economy grew rapidly. Real per capita output was about 8 percent above trend by 1923, and private investment was nearly 70 percent above its 1921 level in 1923. This pattern is qualitatively consistent with the predictions of monetary business cycle theory: a drop in output in response to the price level decline, followed immediately by a significant recovery.

In contrast, the end of the deflation after 1933 did not bring about a fast recovery after the 1929–33 decline. This comparison between these two declines and subsequent recoveries supports our view that weak post-1933 macroeconomic performance is difficult to understand. The recovery from the 1921 recession offers evidence that factors other than monetary shocks prevented a normal recovery from the 1929–33 decline.

A Strong vs. a Weak Recovery

Price Levels and Detrended Real Output

In the Early 1920s. . .

Index, 1920=100

Year	Price Level	Real Output
1921	81.5	96.6
1922	75.6	99.0
1923	78.6	108.2

Sources: Kendrick 1961; Romer 1989

. . . And in the 1930s

Index, 1929=100

Year	Price Level	Real Output
1930	97.0	87.3
1931	88.1	78.0
1932	78.4	65.1
1933	76.7	61.7
1934	83.2	64.4
1935	84.8	67.9
1936	85.2	74.7

Source: U.S. Department of Commerce, Bureau of Economic Analysis

Table 1

Duration and Scale of the Depression and Postwar Business Cycles

Measured by the Decline and Recovery of Output

	Length of Decline	Size of Decline	Length of Recovery
Great Depression	4 years	–31.0%	7 years
Postwar Cycle Average	1 year	–2.9%	1.5 years

Sources: National Bureau of Economic Research; U.S. Department of Commerce, Bureau of Economic Analysis

Table 2

Detrended Levels of Output and Its Components in 1929–39*

Index, 1929=100

Year	Real Output	Consumption: Nondurables and Services	Consumption: Consumer Durables	Business Investment	Government Purchases	Foreign Trade: Exports	Foreign Trade: Imports
1930	87.3	90.8	76.2	69.2	105.1	85.2	84.9
1931	78.0	85.2	63.3	46.1	105.3	70.5	72.4
1932	65.1	75.8	46.6	22.2	97.2	54.4	58.0
1933	61.7	71.9	44.4	21.8	91.5	52.7	60.7
1934	64.4	71.9	48.8	27.9	100.8	52.7	58.1
1935	67.9	72.9	58.7	41.7	99.8	53.6	69.1
1936	74.7	76.7	70.5	52.6	113.5	55.0	71.7
1937	75.7	76.9	71.9	59.5	105.8	64.1	78.0
1938	70.2	73.9	56.1	38.6	111.5	62.5	58.3
1939	73.2	74.6	64.0	49.0	112.3	61.4	61.3

*Data are divided by the working-age (16 years and older) population.

Source: U.S. Department of Commerce, Bureau of Economic Analysis

Table 3

Changes in the Composition of Output in 1929–39

	Shares of Output				
				Foreign Trade	
Year	Consumption	Government Investment	Purchases	Exports	Imports
1929	.62	.25	.13	.05	.04
1930	.64	.19	.16	.05	.04
1931	.67	.15	.18	.05	.04
1932	.72	.08	.19	.04	.04
1933	.72	.09	.19	.04	.04
1934	.69	.11	.20	.04	.04
1935	.66	.15	.19	.04	.04
1936	.63	.17	.20	.04	.04
1937	.63	.19	.18	.04	.04
1938	.65	.14	.21	.04	.04
1939	.63	.16	.20	.04	.04
Postwar Average	.59	.20	.23	.06	.07

Source: U.S. Department of Commerce, Bureau of Economic Analysis

Table 4

Detrended Levels of Output and Its Components in a Typical Postwar Recovery

Measured Quarterly From Trough, Peak = 100

Quarters From Trough	Output	Consumption	Investment	Government Purchases
0	95.3	96.8	84.5	98.0
1	96.2	98.1	85.2	97.9
2	98.3	99.5	97.3	98.0
3	100.2	100.8	104.5	99.0
4	102.1	102.7	112.1	99.2

Source: U.S. Department of Commerce, Bureau of Economic Analysis

Table 5

Five Measures of Labor Input in 1929–39*

Index, 1929=100

Year	Aggregate Measures: Total Employment	Total Hours	Private Hours	Sectoral Measures: Farm Hours†	Manufacturing Hours
1930	93.2	91.9	91.5	99.0	84.6
1931	85.7	83.5	82.8	101.7	68.7
1932	77.5	73.4	72.4	98.7	54.7
1933	76.2	72.6	70.8	99.0	58.4
1934	79.9	71.7	68.7	89.3	61.2
1935	81.4	74.7	71.4	93.3	68.6
1936	83.9	80.6	75.8	91.1	79.2
1937	86.4	83.0	79.5	99.1	85.3
1938	80.4	76.3	71.7	92.7	67.6
1939	82.1	78.7	74.4	93.6	78.0

*Data are divided by the working-age (16 years and older) population.

†Farm hours are adjusted for a secular decline in farm employment of about 1.8 percent per year.

Source: Kendrick 1961

Table 6

Detrended Measures of Productivity

Index, 1929 = 100

Year	Labor Productivity*	Total Factor Productivity
1930	95.9	94.8
1931	95.4	93.5
1932	90.7	87.8
1933	87.9	85.9
1934	96.7	92.6
1935	98.4	96.6
1936	101.6	99.9
1937	100.7	100.5
1938	102.4	100.3
1939	104.6	103.1

* *Labor productivity* is defined as output per hour.

Sources: Kendrick 1961; U.S. Department of Commerce, Bureau of Economic Analysis

Table 7

U.S. vs. International Decline and Recovery

Annual Real per Capita Output in the 1930s

Index, 1929 = 100

Year	United States	International Average*
1932	69.0	91.3
1933	66.7	94.5
1935	76.3	101.0
1938	83.6	112.4

* International average includes Belgium, Britain, France, Germany, Italy, Japan, and Sweden.

Source: Maddison 1991

Table 8

Nominal Money, Prices, and Interest Rates in 1929–39

Year	Monetary Base*	M1*	Price Level	Annual % Interest Rate: 3-Month U.S. T-Bill	Annual % Interest Rate: Commercial Paper
1929	100.0	100.0	100.0	4.4%	6.1%
1930	95.9	94.4	97.0	2.2	4.3
1931	98.7	85.6	88.1	1.2	2.6
1932	104.3	74.5	78.4	.8	2.7
1933	108.9	69.9	76.7	.3	1.7
1934	119.8	78.0	83.2	.3	2.0
1935	139.2	91.0	84.8	.2	.8
1936	157.2	102.1	85.2	.1	.8
1937	168.5	102.9	89.4	.5	.9
1938	181.5	102.2	87.2	.1	.8
1939	215.5	113.7	86.6	.0	.6

*Money measures are divided by the working-age (16 years and older) population.

Source: Board of Governors of the Federal Reserve System

Table 9

Real Money, Output, and Interest Rates in 1929–39

Year	Monetary Base*	M1*	Output	Interest Rate†
1929	100.0	100.0	100.0	6.0%
1930	98.8	97.3	87.3	7.3
1931	112.0	97.1	78.0	11.8
1932	133.1	95.1	65.1	13.8
1933	142.1	91.2	61.7	3.9
1934	144.0	93.8	64.4	–6.5
1935	164.1	107.3	67.9	–1.1
1936	184.4	119.8	74.7	.3
1937	188.6	115.2	75.7	–3.9
1938	208.1	117.2	70.2	3.2
1939	248.7	131.2	73.2	1.3

* Money measures are divided by the working-age (16 years and older) population.

† This is the interest rate on commercial paper minus the realized inflation rate.

Sources: Board of Governors of the Federal Reserve System; U.S. Department of Commerce, Bureau of Economic Analysis

Table 10

Bank Assets and Liabilities Relative to Nominal Output in 1929–39

Year	Deposits: Operating Banks	Deposits: Suspended Banks	Loans	% Change in Loans	Federal Securities
1929	.57	.00	.41	–6%	.05
1930	.64	.01	.42	3	.06
1931	.62	.02	.48	13	.09
1932	.77	.01	.45	–6	.12
1933	.69	.06	.40	–13	.15
1934	.74	.00	.31	–23	.17
1935	.73	.00	.28	–11	.20
1936	.71	.00	.26	–9	.21
1937	.65	.00	.24	–6	.19
1938	.71	.00	.25	3	.20
1939	.73	.00	.25	–2	.21

Source: Board of Governors of the Federal Reserve System

Table 11

Detrended Real Wage Rates in 1929–39

Index, 1929=100

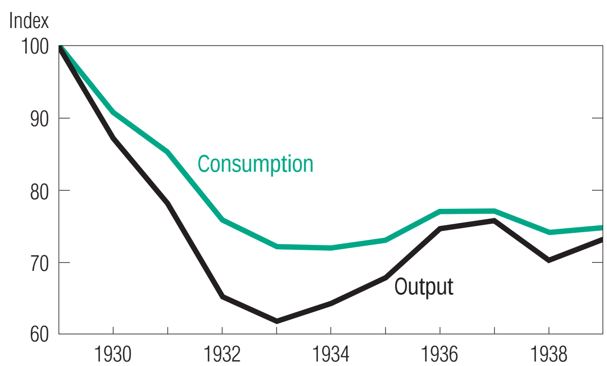
Year	Manufacturing	Total Economy	Nonmanufacturing
1930	101.6	99.1	97.6
1931	105.7	98.6	94.5
1932	105.0	97.0	92.6
1933	102.3	91.0	85.2
1934	108.5	95.5	88.1
1935	108.0	94.8	86.9
1936	106.9	97.3	91.4
1937	112.6	97.6	87.9
1938	117.0	98.9	86.9
1939	116.1	99.9	90.2

Source of basic data: Hanes 1996; U.S. Department of Commerce, Bureau of Economic Analysis

Chart 1

Convergence to a New Growth Path?

Detrended Levels
of Consumption and Output
in 1929–39

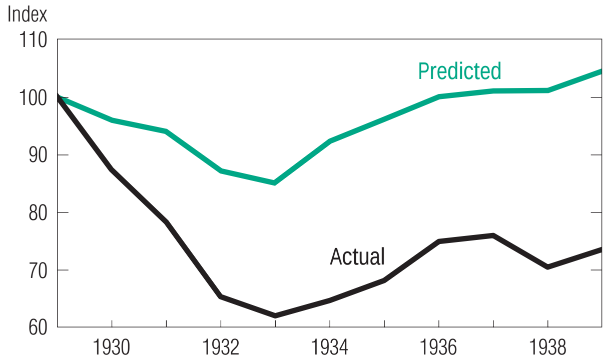


Source: U.S. Department of Commerce, Bureau of Economic Analysis

Chart 2

Predicted and Actual Output in 1929–39

Detrended Levels, With Initial
Capital Stock in the Model
Equal to the Actual Capital Stock
in 1929

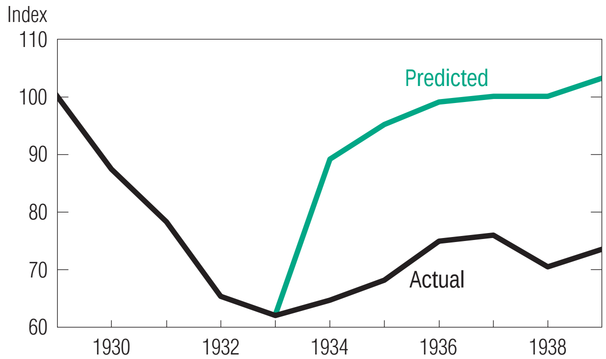


Source of basic data: U.S. Department of Commerce, Bureau of Economic Analysis

Chart 3

Predicted and Actual Recovery of Output in 1934–39

Detrended Levels, With Initial Capital Stock in the Model Equal to the Actual Capital Stock in 1934



Source of basic data: U.S. Department of Commerce, Bureau of Economic Analysis