Modeling Great Depressions

Timothy J. Kehoe

University of Minnesota
and Federal Reserve Bank of Minneapolis

www.econ.umn.edu/~tkehoe

Modeling Great Depressions

not

Explaining Great Depressions

To explain something, I need to understand it.

To understand it, I try to model it.

Modeling Great Depressions

not

Explaining Great Depressions

To explain something, I need to understand it.
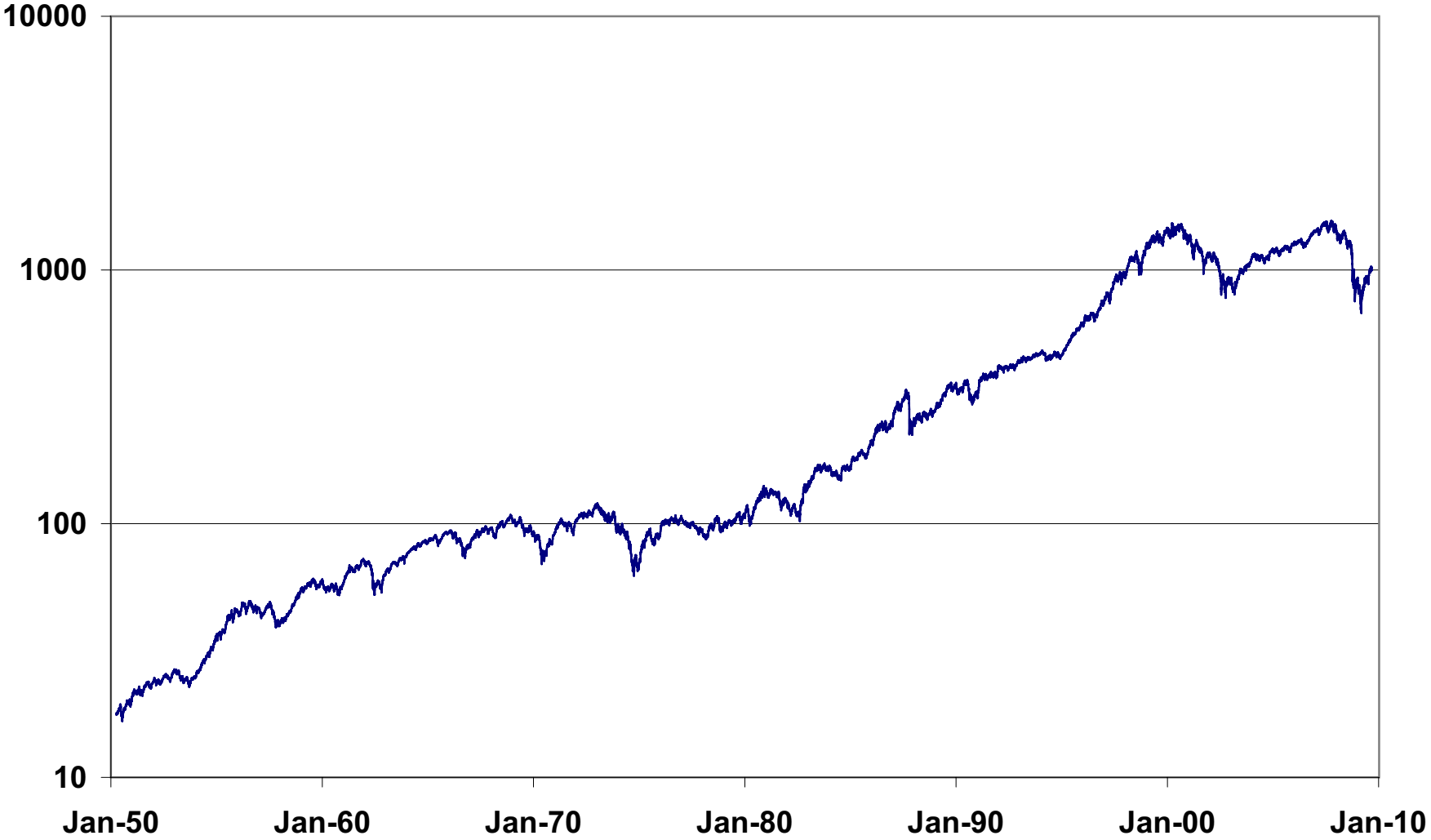
To understand it, I try to model it.

My colleagues and I am making progress on modeling Great Depressions.

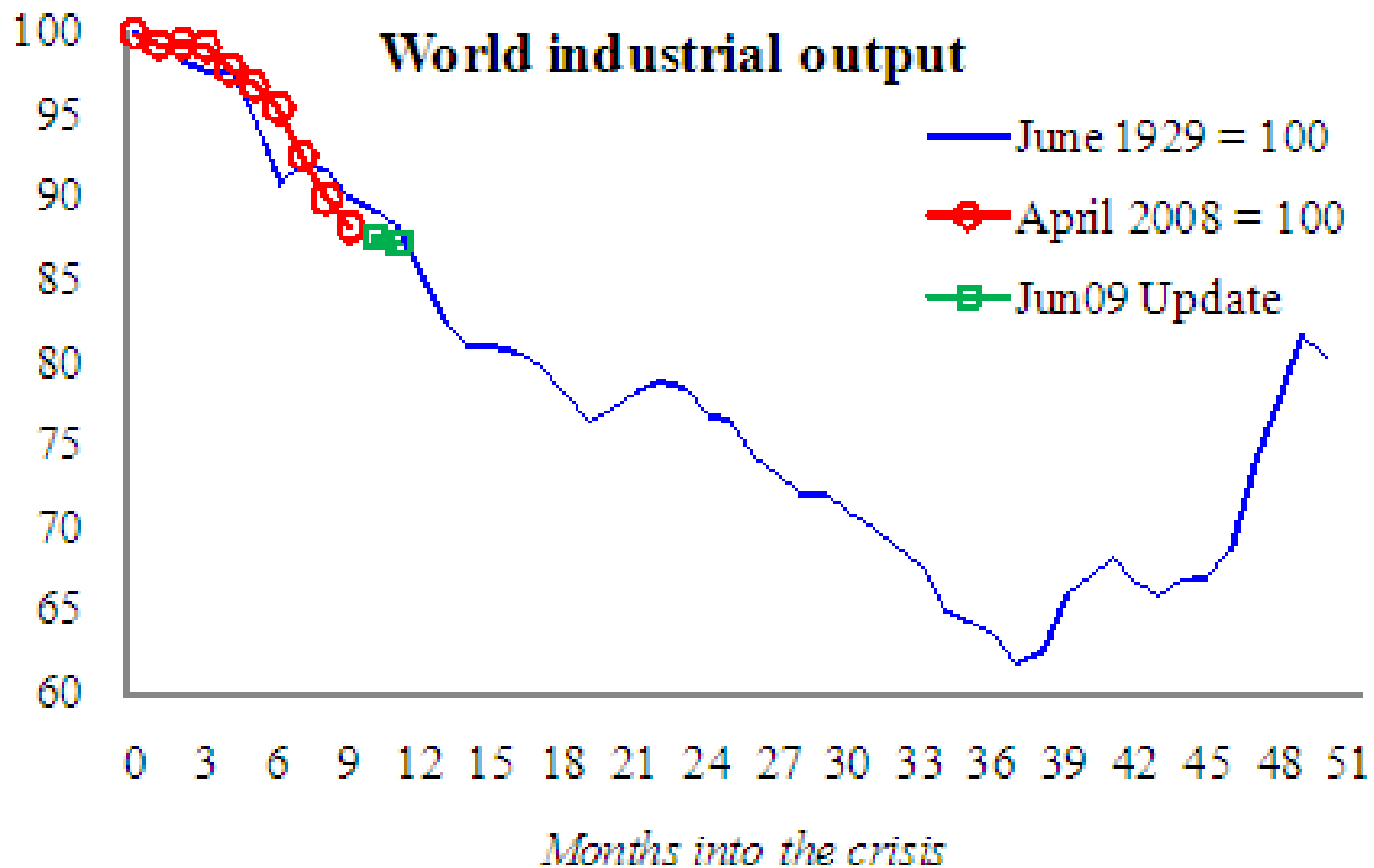**We have not yet arrived at understanding, much less explaining.**

Data show that the current financial crisis in the United States is not unprecedented in the postwar period.

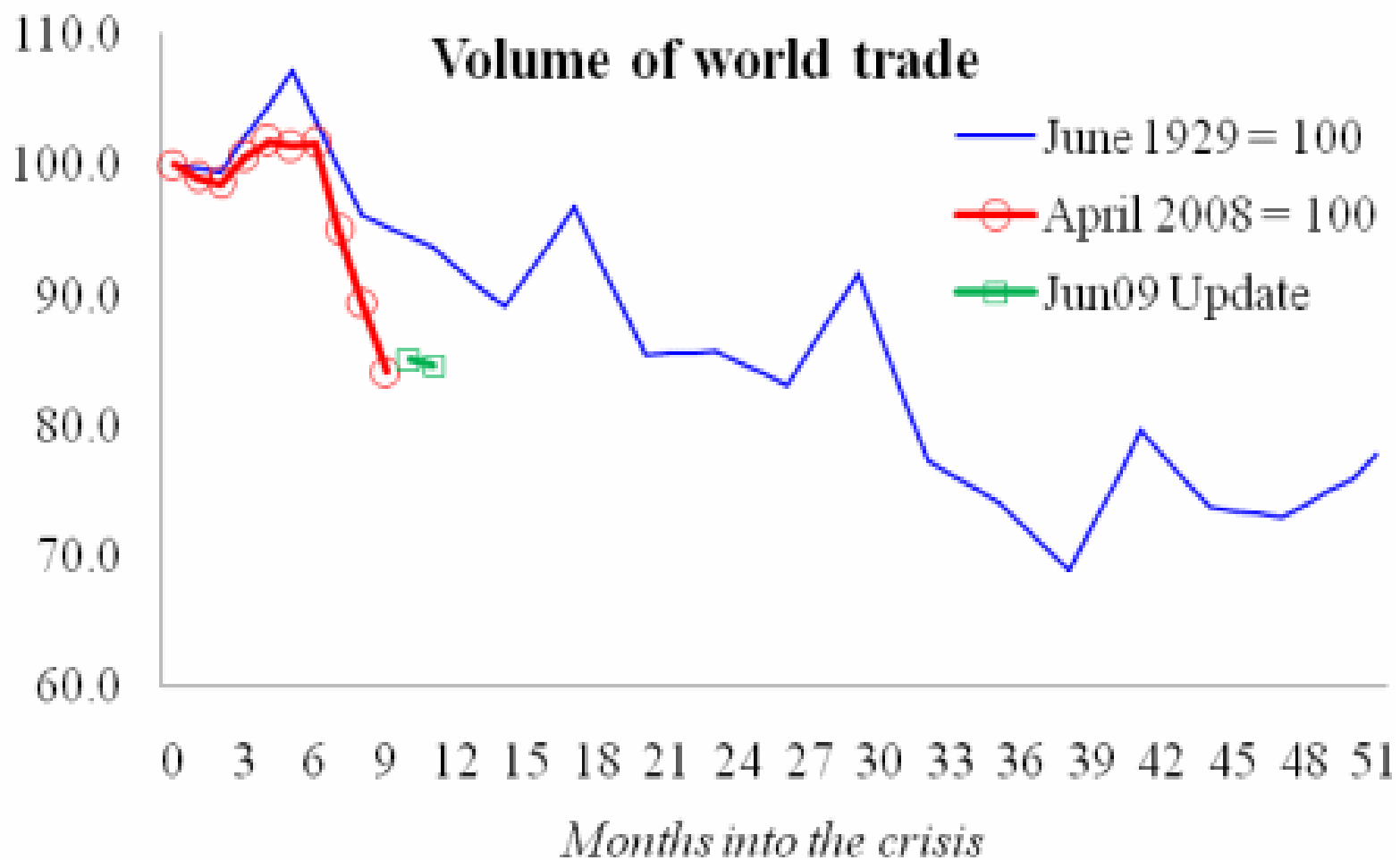Furthermore, there are signs that a recovery may be in sight.

S&P 500 (log scale)

International data show a darker picture.

World industrial output

Legend:
- June 1929 = 100
- April 2008 = 100
- Jun09 Update

Y-axis: 60, 65, 70, 75, 80, 85, 90, 95, 100

X-axis (Months into the crisis): 0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51

Source: Eichengreen and O'Rourke

Volume of world trade

- June 1929 = 100
- April 2008 = 100
- Jun09 Update

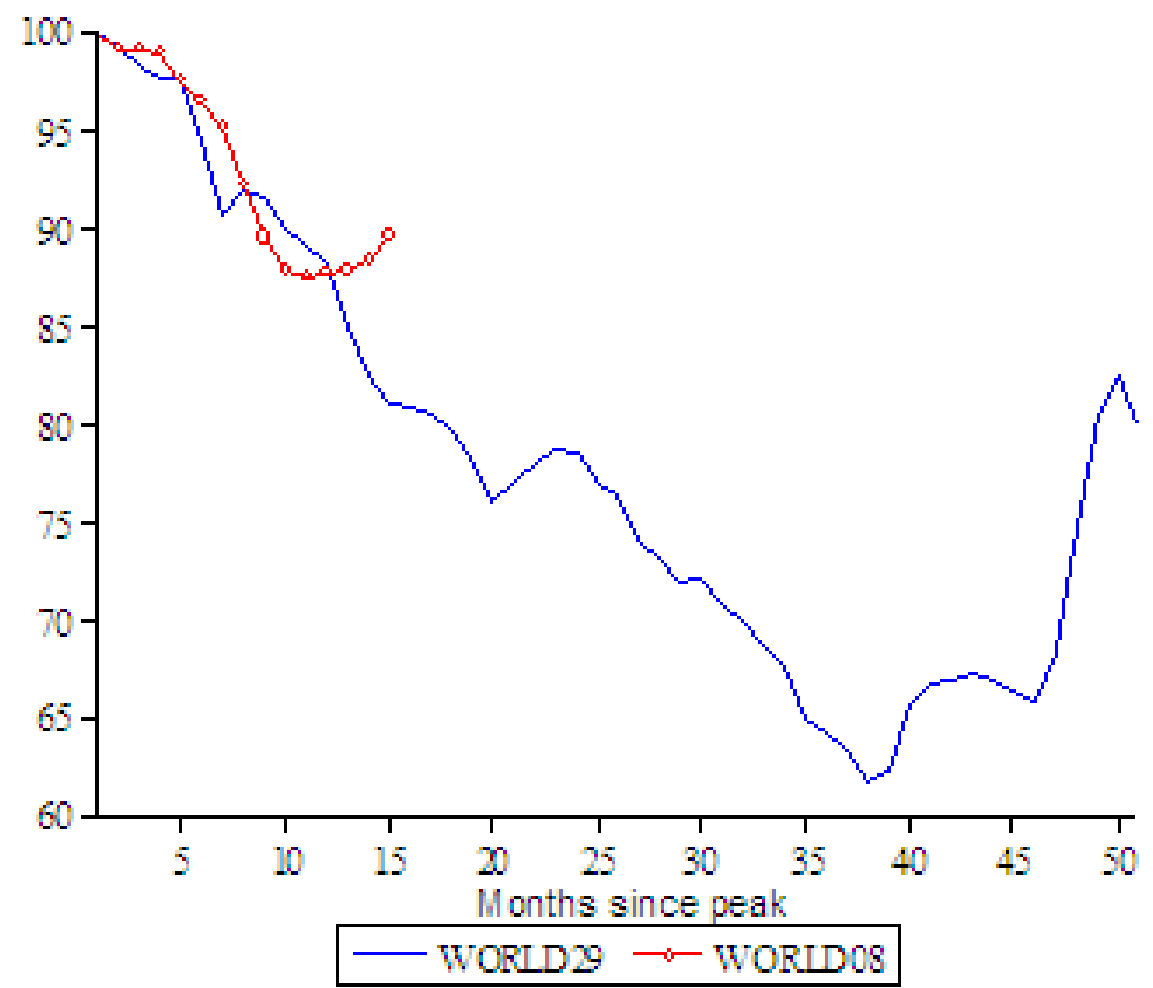Months into the crisis

Source: Eichengreen and O'Rourke

To sum up, globally we are tracking or doing even worse than the Great Depression, whether the metric is industrial production, exports or equity valuations. Focusing on the U.S. causes one to minimize this alarming fact. The "Great Recession" label may turn out to be too optimistic. This is a Depression-sized event.

That said, we are only one year into the current crisis, whereas after 1929 the world economy continued to shrink for three successive years.
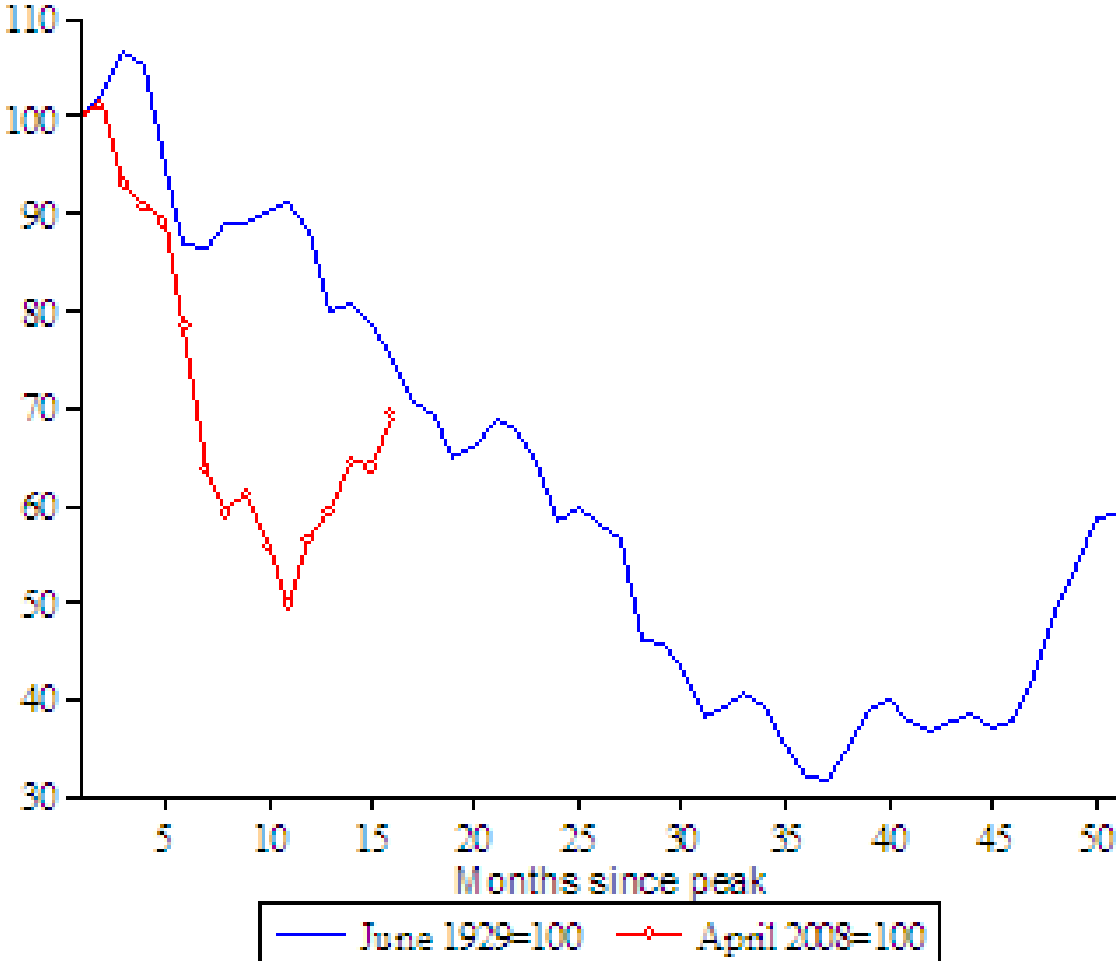
Barry Eichengreen and Kevin H. O'Rourke (June 2009), "A Tale of Two Depressions."
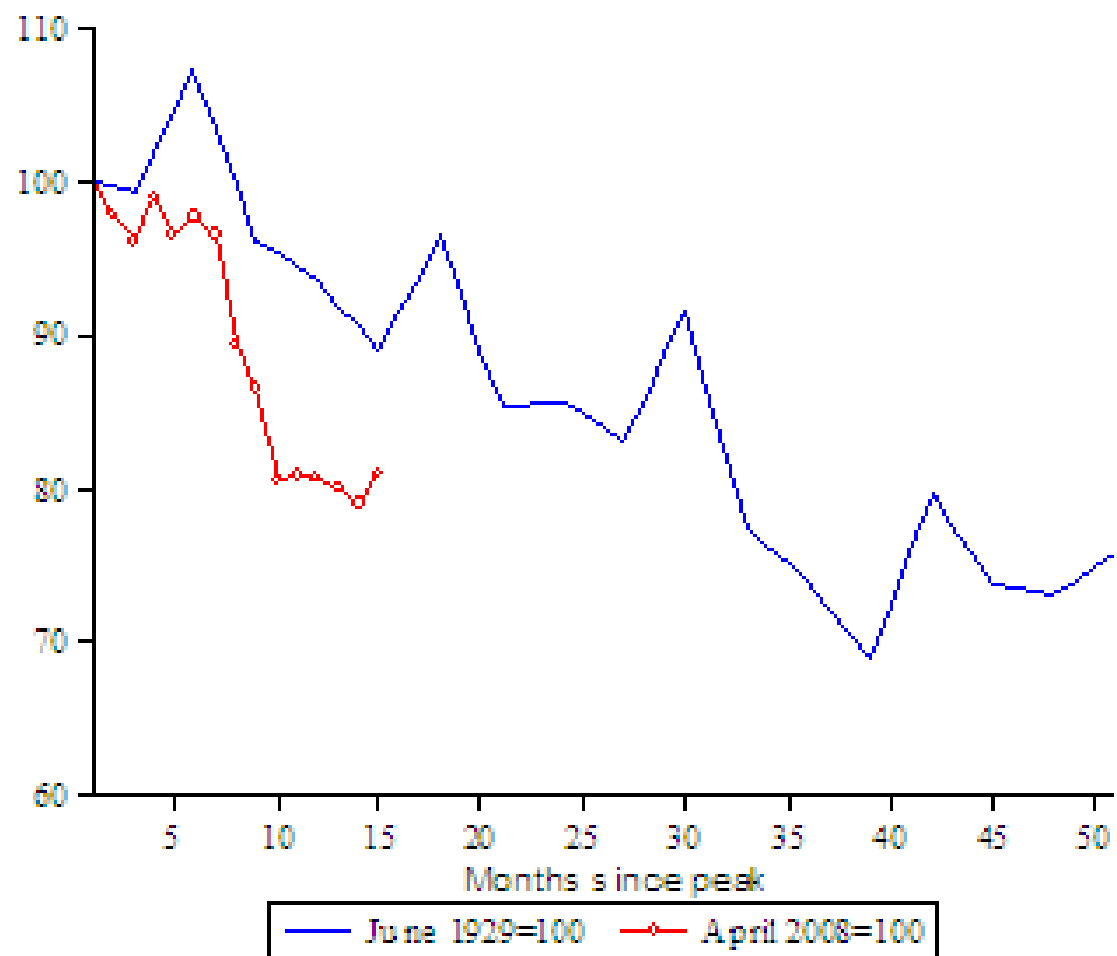
A September 2009 update on Eichengreen-O'Rourke

World industrial production

Months since peak

WORLD29 — WORLD08

World stock markets

Months since peak

June 1929=100 — April 2008=100

World trade

Months since peak

June 1929=100   April 2008=100

What do the new data tell us?

- Global industrial production now shows clear signs of recovering.

This is a sharp divergence from experience in the Great Depression, when the decline in industrial production continued fully for three years. The question now is whether final demand for this increased production will materialise or whether consumer spending, especially in the US, will remain weak, causing the increase in production to go into inventories, leading firms to cut back subsequently, and resulting in a double dip recession.

- Global stock markets have mounted a sharp recovery since the beginning of the year. Nonetheless, the proportionate decline in stock market wealth remains even greater than at the comparable stage of the Great Depression.

- The downward spiral in global trade volumes has abated, and the most recent month for which we have data (June) shows a modest uptick. Nonetheless, the collapse of global trade, even now, remains dramatic by the standards of the Great Depression.
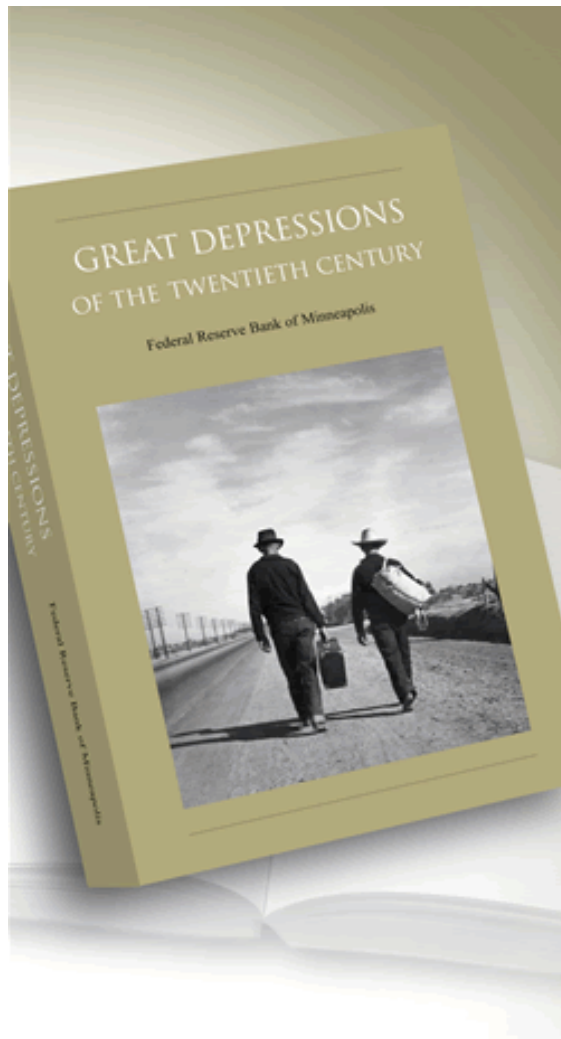
Great Depressions of the Twentieth Century Project

**Timothy J. Kehoe and
Edward C. Prescott**

www.greatdepressionsbook.com

Cole and Ohanian, "The Great Depression in the United States from a Neoclassical Perspective," *Federal Reserve Bank of Minneapolis Quarterly Review*, Winter 1999.

Federal Reserve Bank of Minneapolis Conference, October 2000.

Special Issue of *Review of Economic Dynamics*, January 2002.

Great Depressions of the Twentieth Century, July 2007.

15 studies by 26 researchers using the same methodology

Great depressions

1930s
United States, United Kingdom, Canada, France, Germany

Contemporary
Argentina (1970s and 1980s), Chile and Mexico (1980s), Brazil (1980s and 1990s), New Zealand and Switzerland (1970s, 1980s, and 1990s), Argentina (1998-2002)
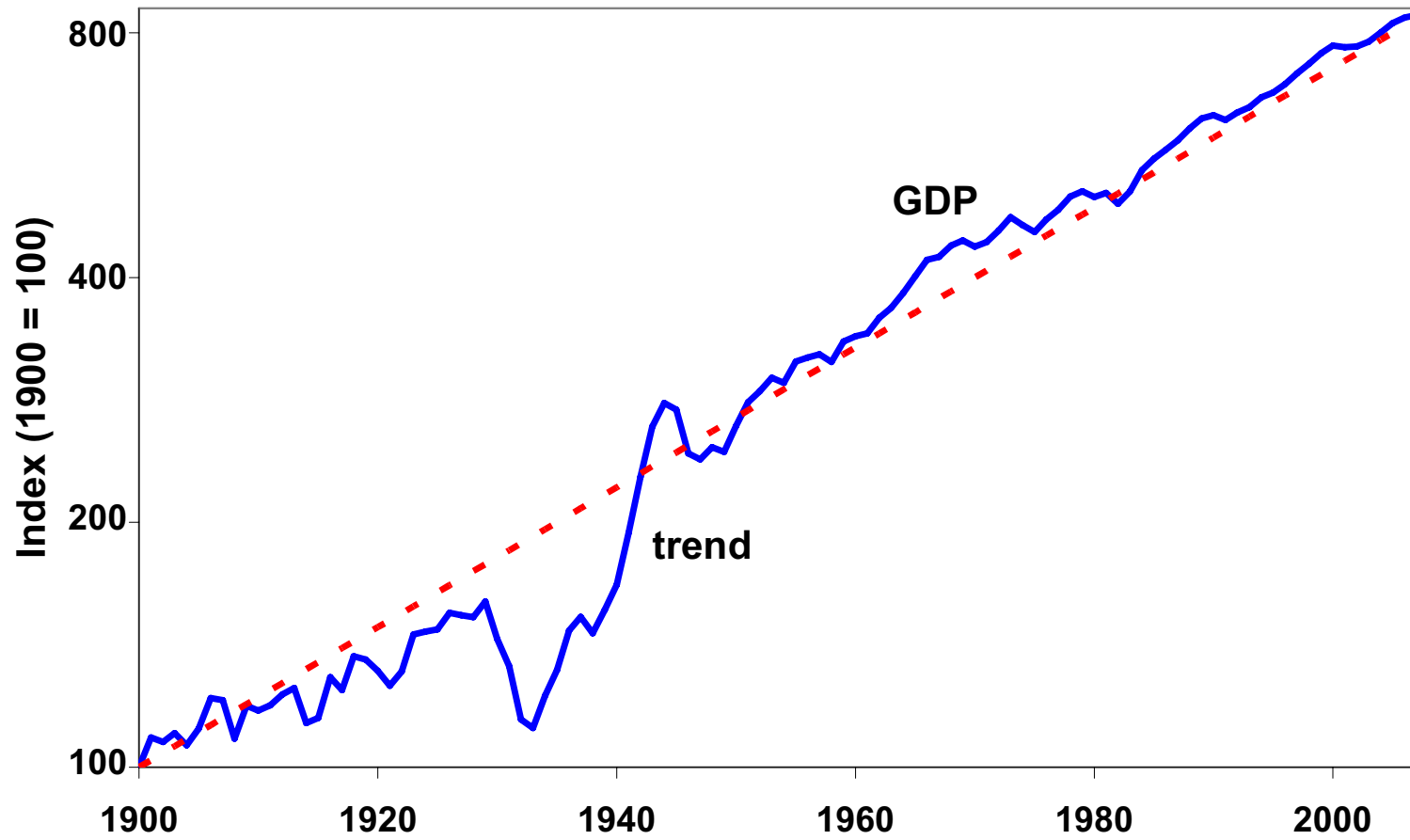
Not-quite-great depressions

Italy (1930s), Finland (1990s), Japan (1990s)

Kehoe and Prescott define a great depression to be a large negative deviation from balanced growth.

They set the growth rate in the balanced growth path to be 2 percent per year, the growth rate of output per working-age person in the United States during the twentieth century.

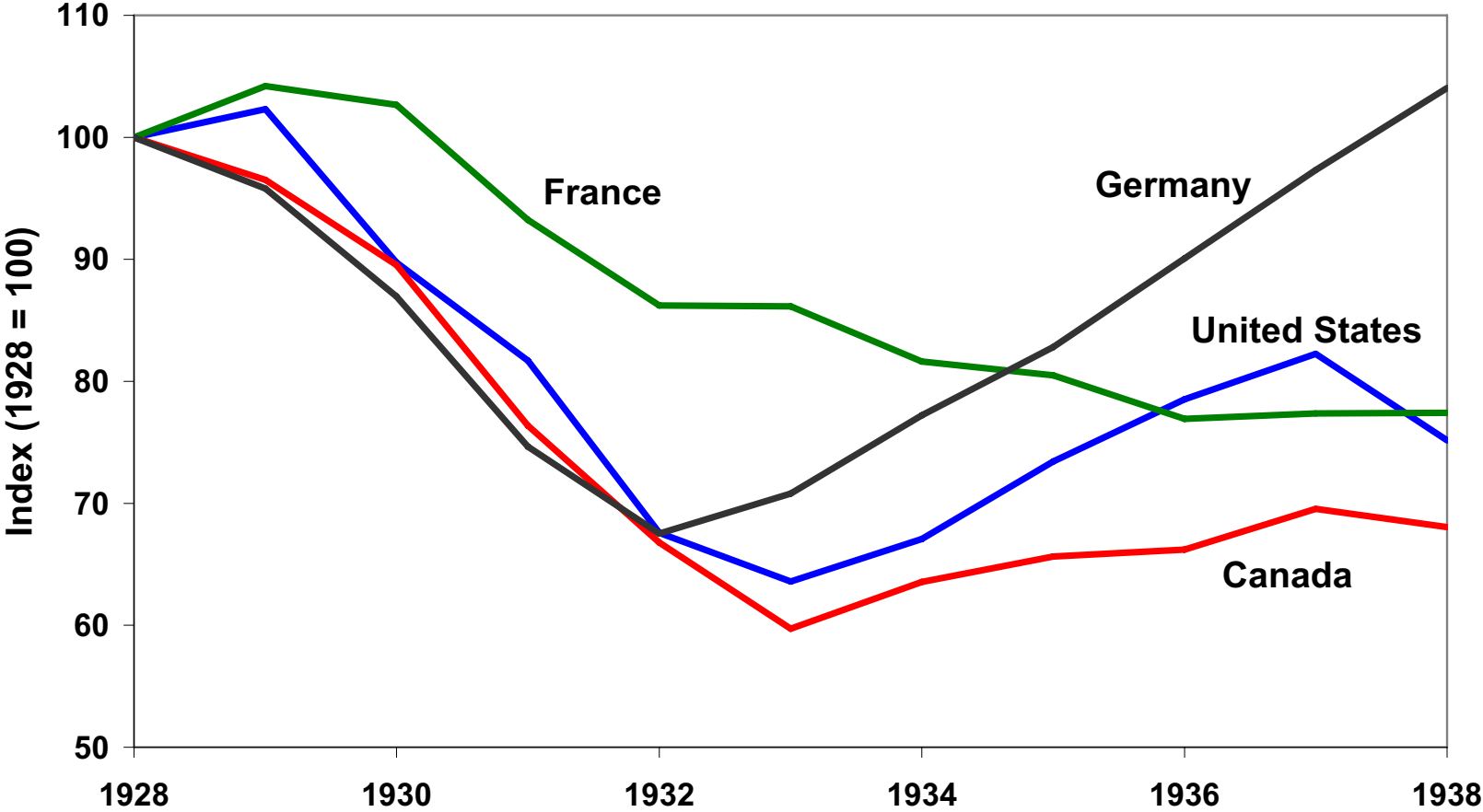# Real GDP per working-age person in the United States

Trend growth:

$$\hat{y}_t^i = \gamma^t \hat{y}_0^i, \ \gamma = 1.02$$
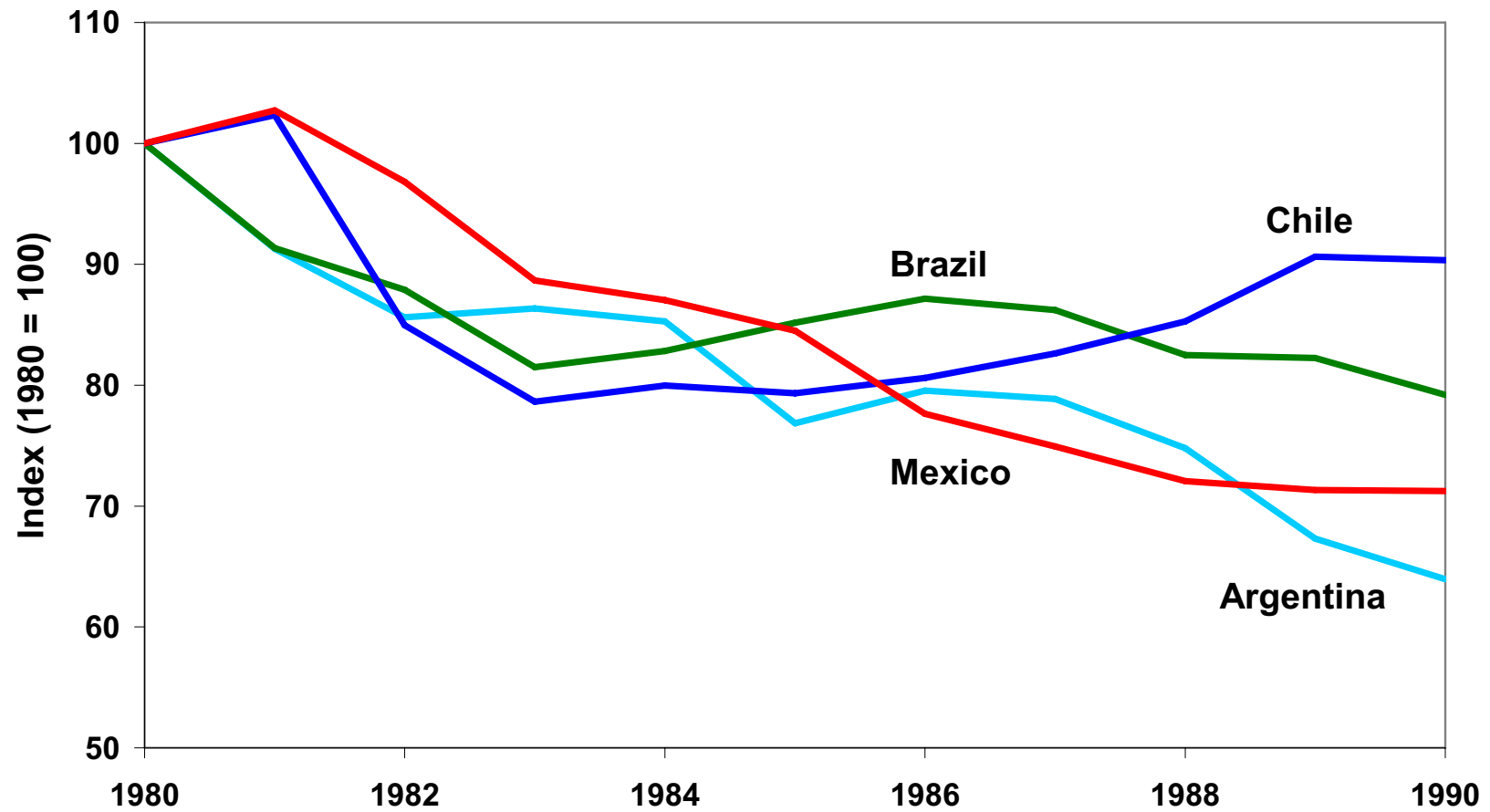
Great depression:

$D = [t_0, t_1]$ such that

1. There is some t in D in such that $\left[y_t^i / \left(\gamma^{t-t_0} \hat{y}_{t_0}^i \right) \right] - 1 \le -0.20$.

2. There is some $t \le t_0 + 10$ such that $\left[y_t^i / \left(\gamma^{t-t_0} y_{t_0}^i \right) \right] - 1 \le -0.15$.

3. There are no t_1, t_2 in D, $t_2 \ge t_1 + 10$, such that
   $\left[y_{t_2}^i / \left(\gamma^{t_2-t_1} y_{t_1}^i \right) \right] - 1 \ge 0$.

Great depressions in the 1930s:
Detrended output per person

Index (1928 = 100)

France

Germany

United States

Canada

110
100
90
80
70
60
50

1928   1930   1932   1934   1936   1938

Great depressions in the 1980s:
Detrended output per working-age person

Great depressions methodology

Crucial elements: Growth accounting and dynamic general equilibrium model

Growth accounting decomposes changes in output per working-age person into three factors:

- a productivity factor

- a capital factor

- an hours-worked factor

Great depressions methodology

Crucial elements: Growth accounting and dynamic general equilibrium model

Growth accounting decomposes changes in output per working-age person into three factors:

- a productivity factor

- a capital factor

- an hours-worked factor

Keynesian analysis stresses declines in inputs of capital and labor as the causes of depressions.

Balanced growth path

In the dynamic general equilibrium model, if the productivity factor grows at a constant rate, then

    the capital factor and the hours-worked factor stay constant and

    growth in output is due to growth in the productivity factor.

Twentieth century U.S. macro data are very close to a balanced growth path, with the exception of the Great Depression and the subsequent World War II build-up.
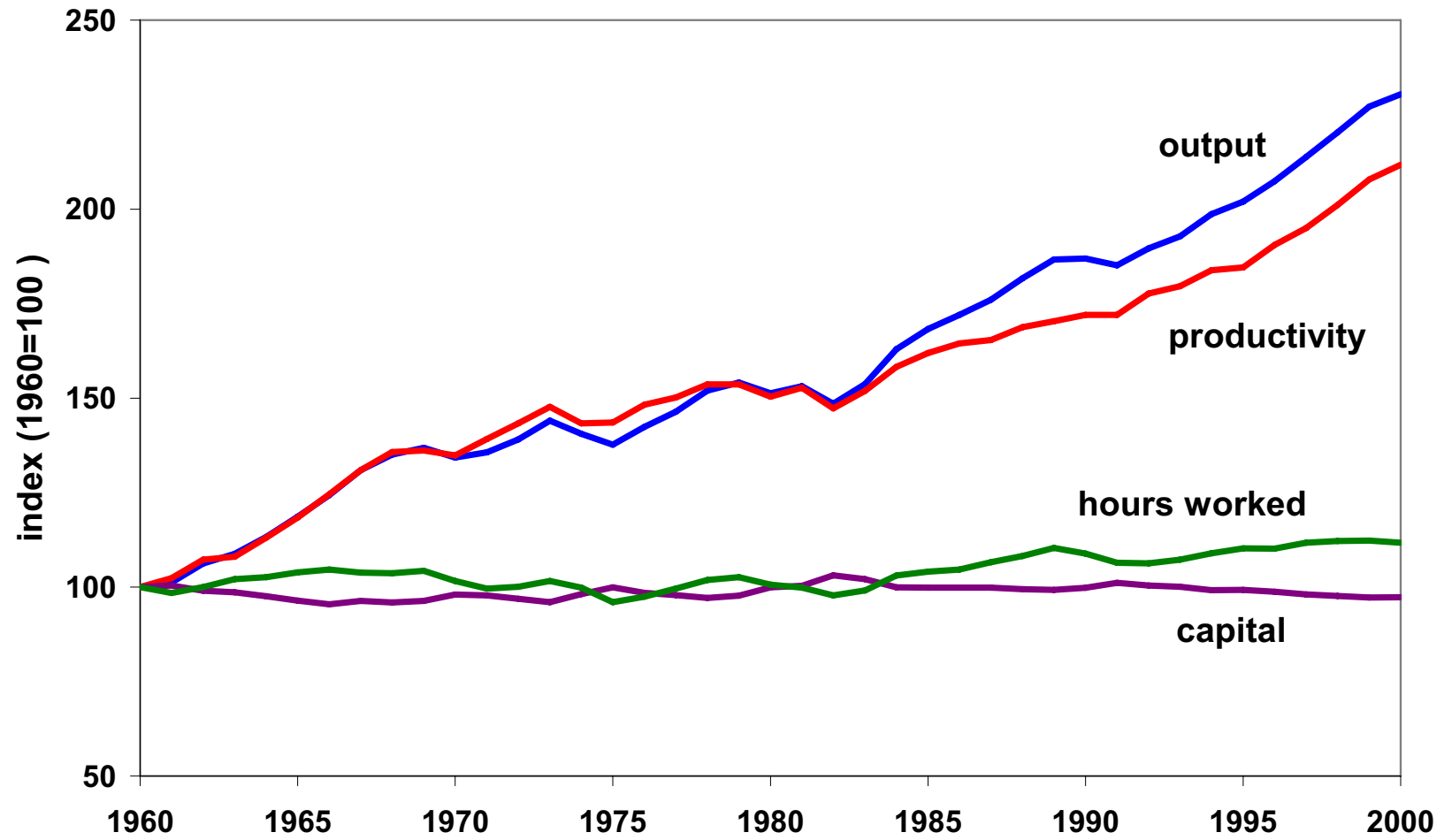
Balanced growth path

$$\frac{Y_t}{N_t} = A_t^{\frac{1}{1-\alpha}} \left(\frac{K_t}{Y_t}\right)^{\frac{\alpha}{1-\alpha}} \left(\frac{L_t}{N_t}\right)$$
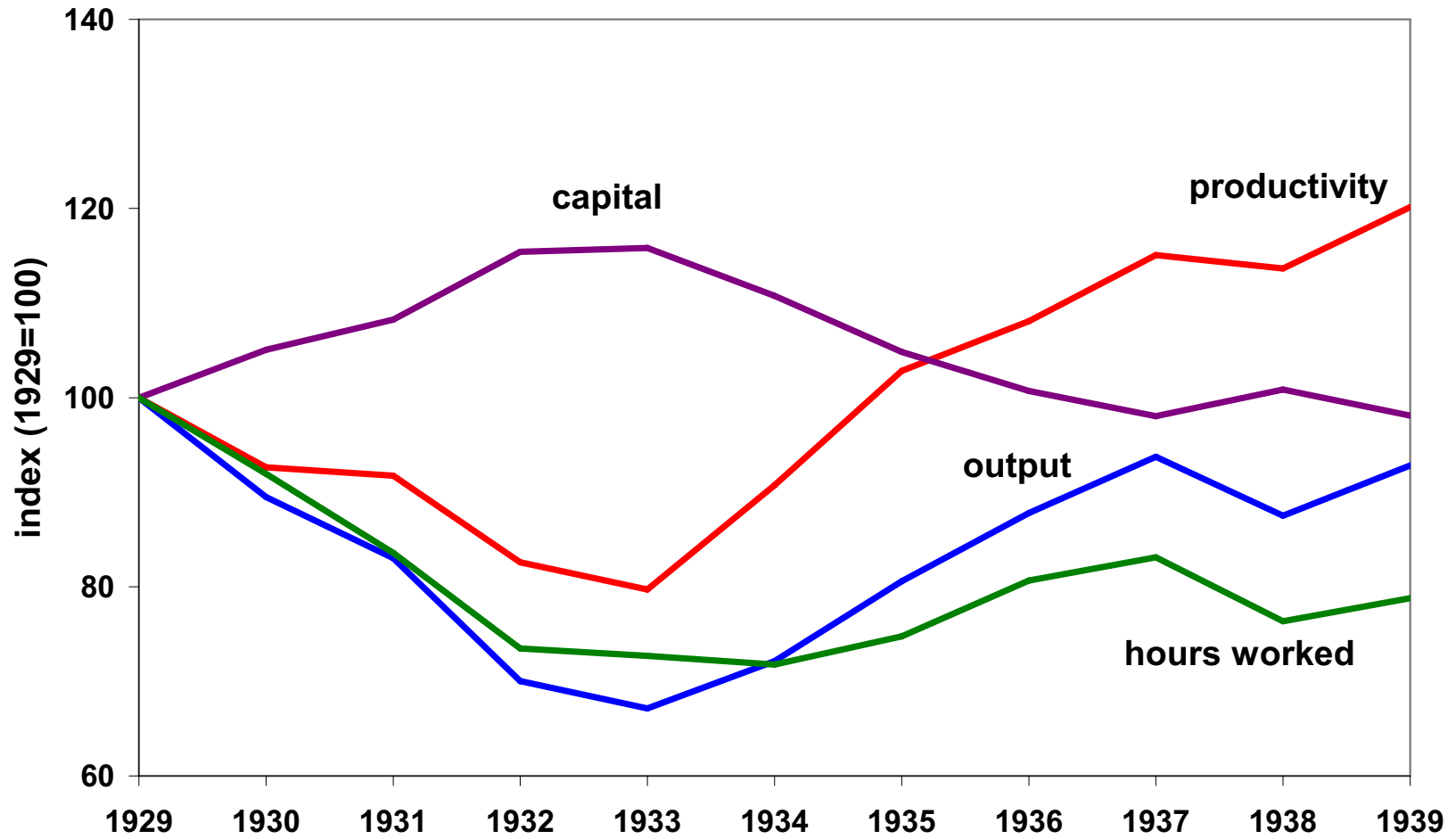
When $A_{t+1} = g^{1-\alpha} A_t$

- $\dfrac{K_t}{Y_t}$ and $\dfrac{L_t}{N_t}$ are constant

- $\dfrac{Y_t}{N_t}$ grows at rate $g - 1$, assume $g - 1 = 0.02$ as in U.S.

Growth accounting for the United States

(chart) index (1960=100)

output

productivity

hours worked

capital

x-axis: 1960, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000

y-axis: 50, 100, 150, 200, 250

Growth accounting for the United States

index (1929=100)

- capital
- productivity
- output
- hours worked

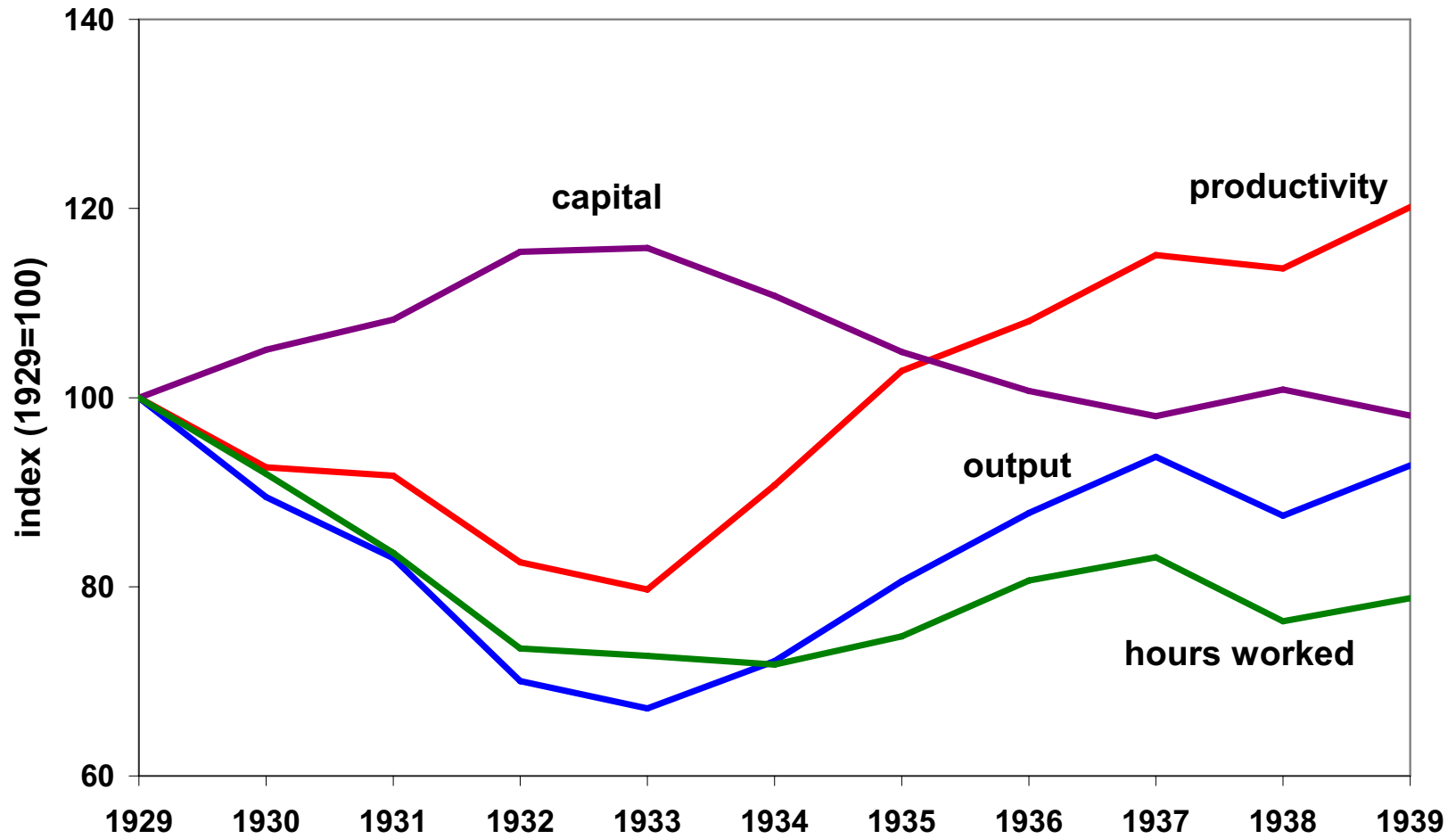| | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 | 1939 |

We use a dynamic general equilibrium model to model the responses of households and firms — in terms of capital accumulation and hours worked — to changes in productivity and changes in government policy.

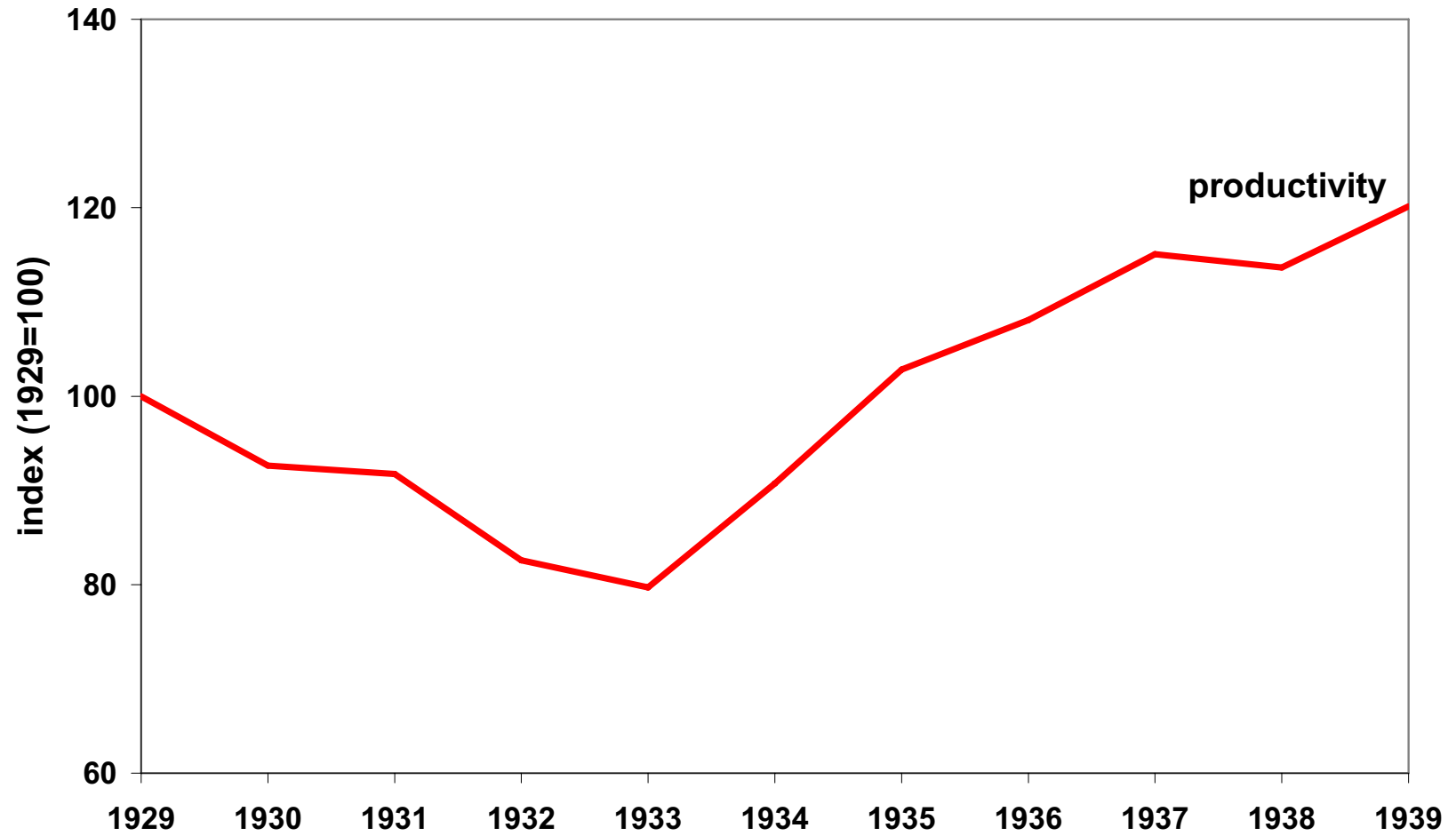We take the path of the productivity factor as exogenous.

Comparing the results of the model with the data, we can identify features of the depression that need further analysis.

Example: The Great Depression in the United States.
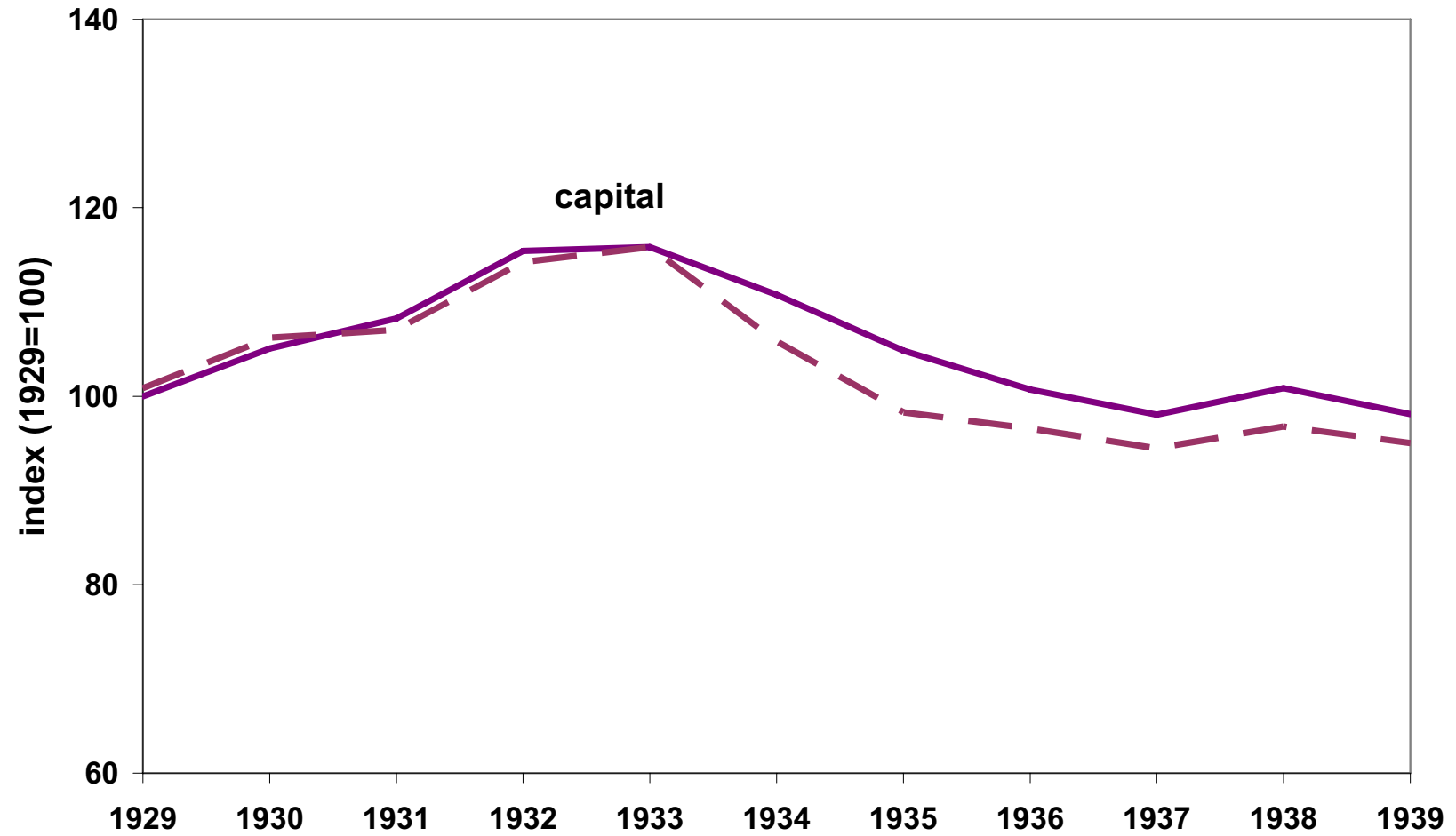
Growth accounting for the United States

Y-axis: index (1929=100), ranging from 60 to 140

X-axis: 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939
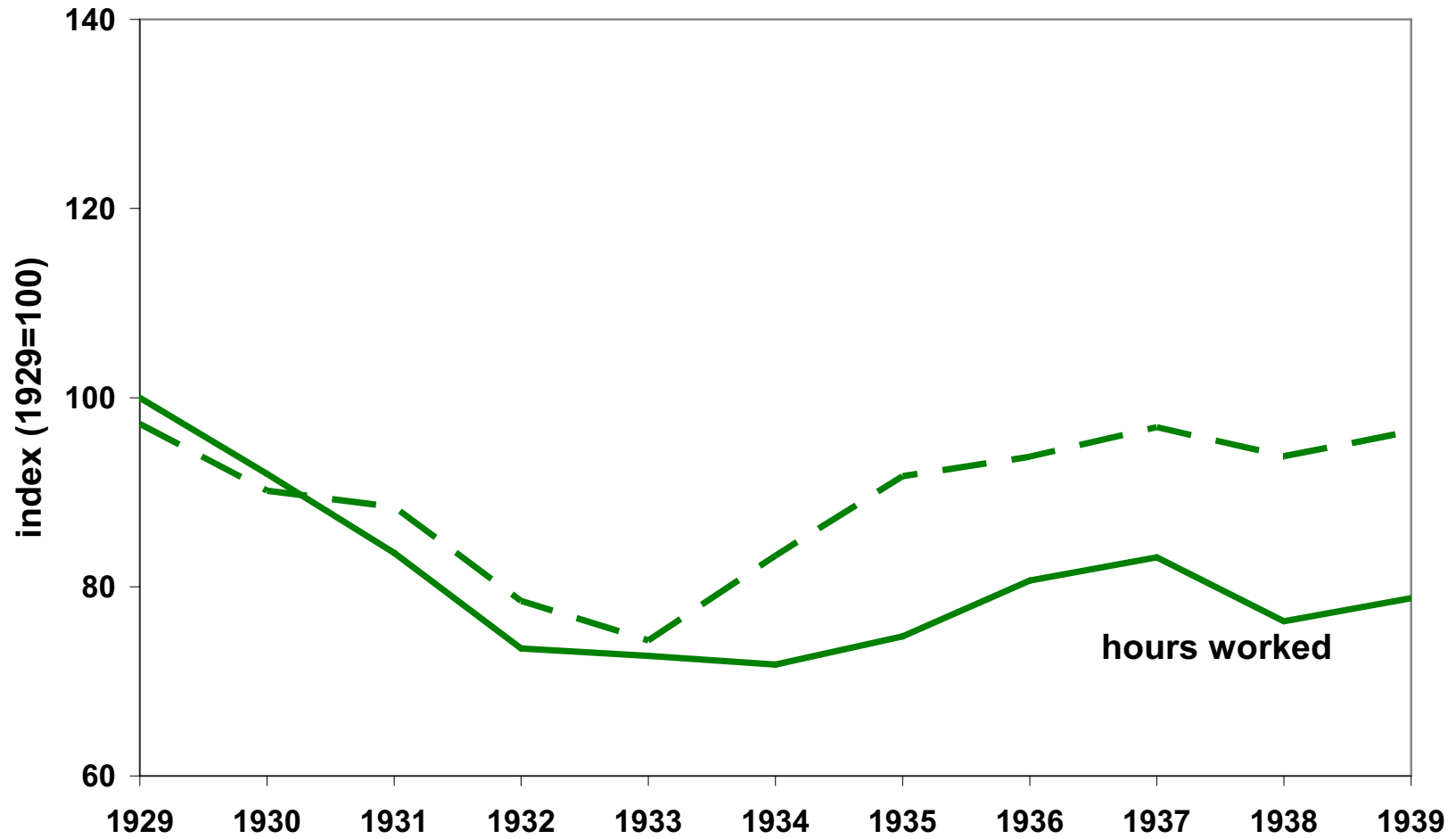
Series labels: capital, productivity, output, hours worked

Growth accounting for the United States

Growth accounting for the United States

Growth accounting for the United States

capital

index (1929=100)

Growth accounting for the United States

hours worked
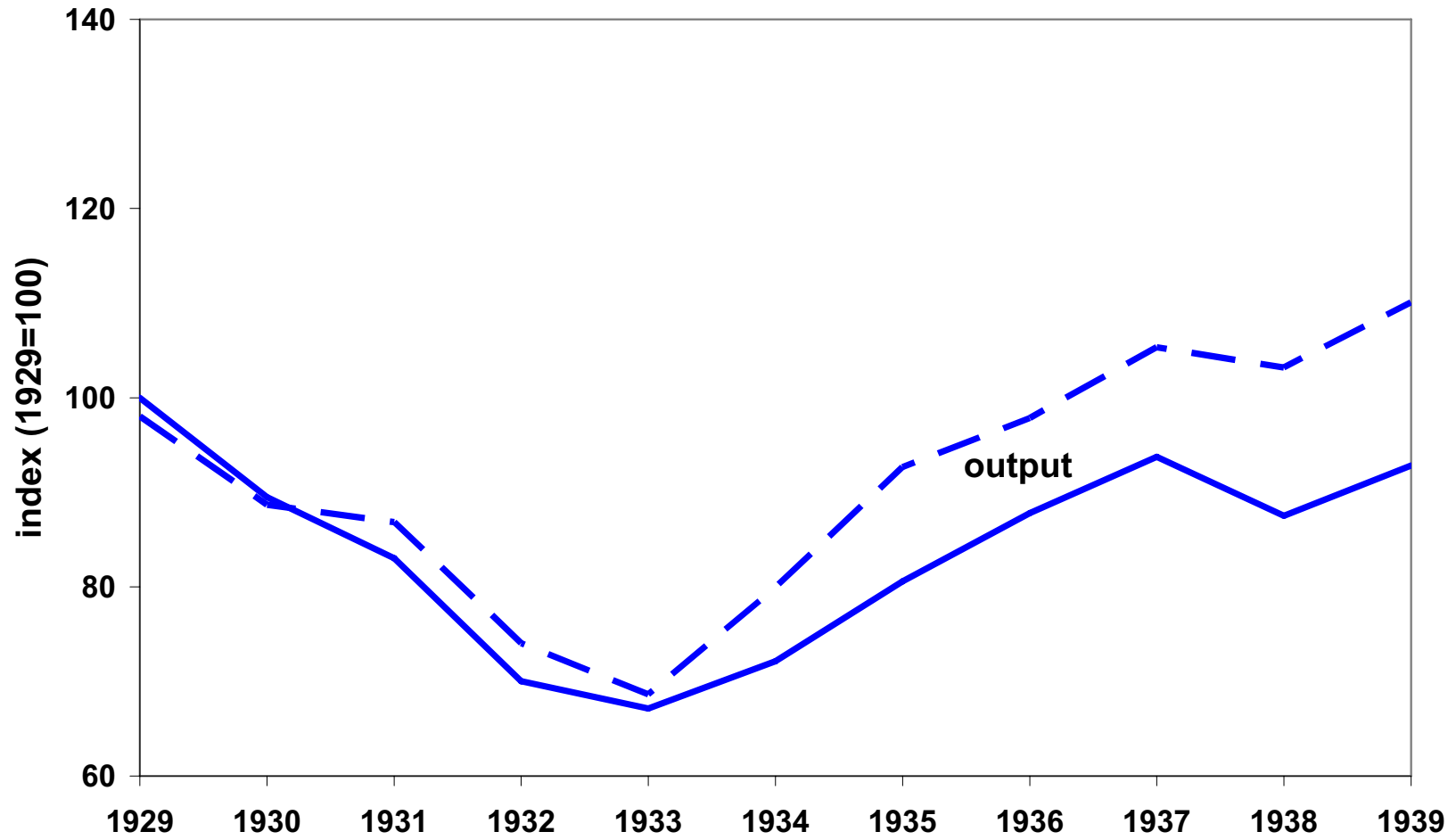
Conclusions

A simple dynamic general equilibrium model that takes movements in the productivity factor as exogenous can explain most of the 1929-1933 downturn in the United States.

The model over predicts the increase in hours worked during the 1933-1939 recovery.

Need for Further Study

The decline in productivity 1929-1933

The failure of hours worked to recover 1933-1939

Lessons from Great Depressions Project

- The main determinants of depressions are not drops in the inputs of capital and labor — stressed in traditional theories of depressions — but rather drops in the efficiency with which these inputs are used, measured as total factor productivity (TFP).

- Exogenous shocks like the deteriorations in the terms of trade and the increases in foreign interest rates that buffeted Chile and Mexico in the early 1980s can cause a decline in economic activity of the usual business cycle magnitude.

- Misguided government policy can turn such a decline into a severe and prolonged drop in economic activity below trend — a great depression.