Did sunspot forces cause the Great Depression?

By Sharon G. Harrison and Mark Weder

Introduction

This 2005 paper takes a look at the underlying causes of the Great Depression in the Neoclassical framework. In particular, the authors modify the RBC model to allow for indeterminacy of equilibrium. According to the paper, agents self-fulfilling expectations can serve as a primary impulse behind fluctuations.

The Model

Model

The model used is based on Greenwood et al (1988) and Wen (1998). It is a standard one-sector DGSE model with variable capital utilization and production externalities akin to Burnside and Eichenbaum (1996). The authors assume that the economy of a large number of identical households maximize lifetime utility as:

$$\max_{c_t, f_t, u_t, k_{t+1}} = E_0 \sum_{t=0}^{\infty} \beta^t [(1-\eta) log c_t - \eta l_t]$$

s.t.

$$\begin{aligned} c_t + x_t = y_t &= A_t^{\gamma} (u_t k_t)^{\alpha} l_t^{1-\alpha}, \\ A_t &= (\bar{u}_t \bar{k}_t)^{\alpha} \bar{l}_t^{1-\alpha}, \\ k_{t+1} &= (1-\delta_t) k_t + x_t, \\ \delta_t &= \frac{1}{\theta} u_t^{\theta} \end{aligned} \tag{1}$$

and a given initial stock of capital, $k(0) > 0$. Authors restrict the parameters $0 < \alpha < 1$, $0 < \beta < 1$, $\gamma \geq 0$, $0 < \eta < 1$, and $\theta > 1$.

The symmetric equilibrium, the first order conditions are:

$$\frac{\eta}{1-\eta} l_t = (1-\alpha) \frac{y_t}{c_t}, \tag{2}$$

$$u_t^{\theta} = \alpha \frac{y_t}{c_t} \frac{1}{c_t} = E_t \frac{\beta}{c_{t+1}} (\alpha \frac{y_{t+1}}{k_{t+1}} + 1 - \frac{1}{\theta} u_{t+1}^{\theta}), \tag{3}$$

$$k_{t+1} = (1 - \frac{1}{\theta} u_t^{\theta}) k_t + x_t, \tag{4}$$

$$c_t + x_t = (u_t k_t)^{\alpha(1+\gamma)} l_t^{(1-\alpha)(1+\gamma)} \tag{5}$$

Calibration

α	β	δ	γ
0.36	$1.03^{-1/4}$	0.025	0.25

The capital share is 0.36 and the steatdy state rate of depreciation is 0.025. the discount factor is set at $1.03^{-1/4}$. Finally, increasing returns must be calibrated. Bernanke and Parkinson(1991) and Burns(1936) find evidence of significant increasing returns during depression years. So, they set 0.25.

In order to determine the dynamics of the system, the authors linearize the equilibrium conditions to obtain the following:

$$\begin{bmatrix} \hat{x_{t+1}} \\ \hat{k_{t+1}} \end{bmatrix} = J \begin{bmatrix} \hat{x_t} \\ \hat{k_t} \end{bmatrix} + R \begin{bmatrix} w_{t+1} \\ 0 \end{bmatrix} \tag{6}$$

Propagation mechanism

There is a simple way to understand the process behind the solution to this system. If households are pessimistic about the future and anticipate lower prospective income, they will scale down their present consumption expenditures. Thus, labor supply would shift outwards.
Normally, this would lead to a higher equilibrium labor quantity in the market, at lower wages. However, to understand why this leads to a lower equilibrium quantity, HW take into account an unconventionally sloped demand curve for labor.

$$y_t = const k_t^{\alpha(1+\gamma)(\theta-1)/(\theta-\alpha(1+\gamma))} l_t^{(1-\alpha)(1+\gamma)\theta)/(\theta-\alpha(1+\gamma))} \tag{7}$$

Given calibration parameter, the effective labor output elasticity exceed uilty, implying that the labor demand has a positive slope as well. This leads to lower wages and lower employment in the economy.

Sunspot mechanism

The authors use the spread in yields between AAA and BAA rated bonds as an instrument for animal spirits or confidence in the economy. They justify this choice by asserting that during pessimism about the future of the economy, anticipated risks of default hit lower-rated companies first, widening the interest-spread. Therefore, a rise in spread indicates a fall in confidence.

Model

The authors use the growth rate in GNP, growth in money supply (M2), GNP deflator and absolute change in the nominal returns on commercial paper as variables in the estimating VAR.

$$\begin{bmatrix} m_t \\ cp_t \\ p_t \\ y_t \\ S_t \end{bmatrix} = [P_1(L)] \begin{bmatrix} m_t \\ cp_t \\ p_t \\ y_t \\ S_t \end{bmatrix} + [P_2] \begin{bmatrix} \varepsilon_t^m \\ \varepsilon_t^c \\ \varepsilon_t^p \\ \varepsilon_t^y \\ \varepsilon_t^s \end{bmatrix} \tag{8}$$

where S is the interest rate spread.
Using Cholesky decomposition, HW use the upper triangular matrix to run the VAR since they did not want to exclude the contemporaneous effects of sunspots on the fundamentals of the economy.

Data. The authors use quarterly data from 1920-2002. A spread regression indicates that all variables were significant at the 5 percentage level. Sunspot shocks are significantly smaller post-war period.

It may be noted that the first pessimistic shock was not observed before spring of 1930, after the stock market crash of 1929. The workers and firms apparently perceived the crash as the start of a recession. Only after a year did the recession turn into a depression.
The authors use the data to run the VAR process and simulate the economy between 1929Q1 and 1939Q4, assuming the economy was at stead state in 1929Q1.

Simulation result

Strength

Three important results emerge from comparing the actual data to the simulation

- The model predicts the size and duration of the depression well. Similar to the real economy, output fell significantly only with a lag, following the fall in confidence
- The model predicts a tepid recovery, unlike previous RBC literature, which predicts a much faster recovery. The model economy predicts output to be 13 percentage below trend, as compared to the actual 17 percentage seen for the US data.
- The model also predicts the recession of 1937-1938 very well. In this aspect, as well, it is superior to the previous work.

Weaknesses

- The model predicts the main cycles trough three quarters too soon. This may be because in the model, change in expectations has immediate effects on the economy. In reality, such a shock may take time to propagate.
- Fall in consumption in the model is shallower than that seen in the data. However, the authors manage to replicate the pattern while maintaining the single state assumption, unlike Cole and Ohanian.
- Real wages in the model recover much slower than in the actual data. This could be because of regulations such as NIRA, which were not incorporated by HW.

Conclusion

- The authors use interest rate-spreads as an instrument for confidence to test whether self-justifying pessimism led to the Great Depression.
- Using data from 1920-2000, the authors replicate the decline of 1929-1932, the slow subsequent recovery and the recession of 1937-1938 well.
- According to the paper, the Great Depression can be interpreted as a loss in confidence subsequent to the 1929 stock market crash. During the latter half of 1930, confidence began to deteriorate dramatically after what initially appeared to be a normal recession.
- In 1932, confidence hit bottom and continuing pessimistic animal spirits explain the subsequent stagnation that continued till World War II.