

# Real Business Cycle Models of the Great Depression

L. Pensieroso

Discussion Paper 2009-34

Institut de Recherches Économiques et Sociales  
de l'Université catholique de Louvain



**UCL**

# Real Business Cycle Models of the Great Depression<sup>\*</sup>

Luca Pensieroso<sup>†</sup>

October 19, 2009

## Abstract

This paper presents and assesses the recent application of models in the Real Business Cycle (RBC) tradition to the analysis of the Great Depression of the 1930s. The main conclusion is that the breaking of the depression taboo has been a desirable completion of the cliometric revolution: no historic event should be exempt from a dispassionate quantitative analysis. On the other hand, the substantive contribution of RBC models is not yet sufficient to establish a new historiography of the Great Depression.

**Keywords:** Great Depression, Real Business Cycle, Dynamic Stochastic General Equilibrium, Cliometrics

**JEL Classification:** N10 E13 N01

## 1 Introduction

To understand the Great Depression is the Holy Grail of macroeconomics (Bernanke (1995), p. 1).

---

<sup>\*</sup>Paper presented at the 4th BETA Workshop in Historical Economics, Strasbourg, 2008. I would like to thank the participants at that meeting as well as those at a seminar at the University of Rome 3 for interesting remarks. David de la Croix and Michel de Vroey made useful comments on an earlier version. Financial support from the Belgian Federal Government (Grant PAI P6/07 “Economic Policy and Finance in the Global Equilibrium Analysis and Social Evaluation”) is gratefully acknowledged.

<sup>†</sup>Chargé de Recherches FRS - FNRS, IRES, Université catholique de Louvain. E-mail: luca.pensieroso@uclouvain.be

So far, for all the bravery of the knights, the quest has proved to be challenging, and the goal has not yet been fully attained. In the span of almost eighty years, several theorists have claimed to have clinched the matter. Inexorably, each time that claim proved to be wrong, or at best partial. Each time new theoretical developments, or new data successfully challenged the dominant story. What is more, each time the change in the perspective from which the economists looked at the Depression signaled a shift in the dominant paradigm in macroeconomics.

This paper deals with a new stage of the quest. A few years after Eichengreen's synthesis between the Keynesian and monetarist explanations was believed to have provided the final word on the Depression history (Eichengreen (1992)), Harold Cole and Lee Ohanian brought it all up for discussion again (Cole and Ohanian (1999), Cole and Ohanian (2001), Cole and Ohanian (2004)). In daring to tackle the Great Depression by means of a fully-fledged neoclassical model in the real business cycle (RBC) tradition, they broke what was perceived by many authors as a taboo (Prescott (2002)). For the first time in the history of macroeconomics, an analytical neoclassical model entered the battlefield of the Great Depression, once considered a theme defying any equilibrium explanation. What is new about the RBC explanation of the Great Depression? Are we witnessing the emergence of a new dominant paradigm in macroeconomics? How did the paradigm need to be amended in the endeavour to tackle the Depression issue?

This paper elucidates the fundamentals of RBC modeling of the Great Depression. It investigates its origin back in the history of the new classical revolution, provides some critical thought on its current situations and assesses the roles of economic history and theory in the light of the Depression.

## 2 RBC models of the Great Depression

### 2.1 Assumptions and methodology

The RBC research programme stems from the assumption that business cycles can be studied in a framework postulating market clearing and agents' optimising behaviour (Lucas (1977)). This "equilibrium hypothesis" is coupled with what I shall describe as the "exogenous shock hypothesis", namely the idea that the origins of economic cycles lie in exogenous shocks to the fundamentals, rather than being somewhat intrinsic to the economic system.

The joint consideration of these two hypotheses is full of consequences. To start with, there is nothing inherently bad in business cycles, and they are not deemed to be sub-optimal. Indeed, in the RBC tradition, the business cycle

is the optimal response of rational economic agents to unexpected changes in the economic environment. Consequently, there is no room - nor need - for stabilization policies implemented by the Government.

A second implication concerns the definition of depressions. RBC researchers think of business cycles in terms of deviation from a defined trend. Typically, in the analysis of the great depression, the trend is the deterministic growth rate of the economy predicted by the Solow model (Solow (1956)). To them, a great depression is a ‘big’ business cycle, namely a period in which the rate of growth of the economy is suddenly and significantly below that which it would have been if the exogenous random shock that hit the economy had never occurred. In particular, Kehoe and Prescott (2002) consider that any negative deviation of output from trend qualifies as a great depression, if it satisfies the following conditions:

1. It should be big enough. Kehoe and Prescott’s first condition is that output per working-age person should fall at least 20% below trend.
2. It should occur rapidly. Output per working-age person should fall at least 15% below trend within a decade.
3. It should be long-lasting. Output per working-age person should not return to trend for a decade.

As is clear from this definition, to Kehoe and Prescott the term ‘great depression’ is a conceptual category rather than a designation of a particular historical episode. As a result, other occurrences than the 1930 crisis fall into the great depression category. These include the Latin American recessions of the 1980s and the 1990s and the enduring stagnations in Switzerland and New Zealand since the 1970s. I shall return to this point later in this article.

A third implication of the RBC assumptions concerns the methodology. If we assume that any economic cycle starts with an exogenous shock, then studying the specific characteristic of this shock is not necessary for the task of elaborating a general theory of the business cycle. It is much more important to understand the regularities that ensue after the shock occurs. Accordingly, RBC theorists build an artificial model economy in the Solow-Ramsey tradition, and study the reaction of the model to stochastic shocks. The objective is to make the model economy reproduce the patterns of a given set of data (Lucas (1980)). If the model reproduces the regularities we observe in the data under examination, it can be considered to represent a plausible theory of the cycle.

In order to run these simulations, the structural parameters of the model must first be calibrated, that is, a numerical value must be assigned to each

of them. This is typically done either on the basis of econometric estimates, or by choosing suitable values to guarantee the internal consistency of the model.

As to the nature of the shock, the typical shock considered in the earlier, standard RBC models is a technological one, represented as an autoregressive stochastic shock to the total factor productivity (TFP) (Kydland and Prescott (1982)). The TFP is a parameter of the production function that embodies a broad concept of efficiency by combining inputs to obtain output.<sup>1</sup>

## 2.2 The national dimension of the Great Depression

A controversial feature of the RBC literature on the Great Depression is its focus on a closed-economy, nation-by-nation analysis. Although the international dimension of the Great Depression has long been recognised by historians as a fundamental trait of the event (Kindleberger (1973) Eichengreen (1992), Eichengreen and Temin (2000), Temin (1989)), RBC macroeconomists have mostly concentrated on idiosyncratic shocks in single countries in a closed-economy perspective. This is true for the analysis of the United States (Bordo, Erceg, and Evans (2000), Christiano, Motto, and Rostagno (2004), Cole and Ohanian (1999), Prescott (1999), Weder (2006)), France (Beaudry and Portier (2002)), the United Kingdom (Cole and Ohanian (2002)), Germany (Fisher and Hornstein (2002)) and Belgium (Pensieroso (2007)).

Although such a perspective may be questionable, its rationale is twofold. First, the initial studies on the Great Depression from an RBC perspective were strictly concerned with the United States. For the United States at least, the closed-economy approximation is not too bold an assumption. Second, the typical RBC model explains recessions by means of a shift in the labour-demand schedule (Mankiw (1989)). This implies that the international dimension need not be the main focus of the analysis. This is especially true if the gain in terms of data-mimicking from considering an open-economy scenario are not big enough to make it worth complicating the model. Parsimony, after all, is a virtue.

---

<sup>1</sup>See Solow (1957). Hulten (2000) provides a review of TFP. More recently, other shocks such as those on taxes, government expenditure, money supply and preferences have been included in the framework. The inclusion of the monetary dimension in particular has caused a change in the terminology: nowadays, the label of dynamic stochastic general equilibrium models (DSGE) is preferred to the old RBC definition. In this paper I shall make no distinction between DSGE and RBC models.

## 2.3 Main results

So far, the main results of the RBC literature on the Great Depression are a new dating of the event and a new focus on the recovery aspect, with an attempt to subvert the accepted historical wisdom about the New Deal.

The traditional view of the Great Depression in the United States and, by extension, worldwide divides the period into a great contraction and a recovery phase, with different opinions about the speed of the latter (Friedman and Schwartz (1963), Romer (1993), Temin and Wigmore (1990)). The dating results from a simple reading of the data. Considering the data from peak to trough, the US GDP declined by almost 30% between 1929 and 1933. From 1933 to 1937, the US economy grew at an average annual rate of 8%, which became 10% between 1938 and 1941 (Romer (1992)). The division between a contraction and a recovery phase must have looked self-evident to many researchers.

But if you consider the very same evidence ‘through the lens of neo-classical theory’ (Cole and Ohanian (1999)), then the intuitive dating looks different. Detrended output in the United States was far below trend for a decade. This pattern was common for almost all the countries analysed within the RBC framework (see Figure 1). If depressions are defined as sudden and significant deviations from the trend, then the obvious conclusion is that the Great Depression covers the entire 1929-1939 period. No distinction between a contraction and a recovery phase is therefore made.

A consequence of this definitional change is a shift in the focus of analyses. As Prescott (1999) points out, the focus on the entire decade shifts the nature of the question from an explanation of the output and employment drop of the early 1930s to an explanation of the protracted character of the depression. In particular, all the negative shocks that may be considered as causes of the depression were over by 1936. At that date, however, output was still far below the trend. To solve this puzzle, Cole and Ohanian (2004) advanced the hypothesis that the National Industrial Recovery Act (NIRA) and the National Labour Relations Act (NLRA), two pre-eminent New Deal bills by President Roosevelt, are to be blamed for the long duration of the depression. Their argument is that these acts induced cartelization and high wages into the economy, slowing down the recovery. Their model is able to account for 60% of the lack of recovery in the United States. This explanation is endorsed by many other economists for the United States (Bordo, Erceg, and Evans (2000), Christiano, Motto, and Rostagno (2004)), and similar analyses have also been advanced for other countries (Beaudry and Portier (2002)).

According to this view, then, far from dragging the US and the world economy out of the Great Depression, the New Deal worsened it by changing

the institutional setup that ruled the labour market in a way that was unfavourable to business. In a sense, the New Deal may actually have caused the Great Depression: had the Government not intervened in the market, the economy would have been back to trend by 1936, or even earlier, if one thinks that the Great Depression originated from a monetary shock (the Federal Reserve started an expansionary monetary policy after the dollar devaluation of 1933). The Keynesian view is turned upside down: the Great Depression was not a market failure but a State failure. This vision can lead to a big change in the historiography of the period.

### 3 From the great exception to the equilibrium Great Depression

The modelling of the Great Depression from a neoclassical perspective might be a breakthrough for economic history, and it is surely one for economics, and for macroeconomics in particular.

The Great Depression plays a crucial role in the history of economic ideas. The perceived inadequacy of contemporary economic theory to explain the Great Depression motivated John Maynard Keynes to write the *General Theory*. With his work, a new discipline now called macroeconomics saw the light of day. Keynes insisted on the inability of a market system to fully exploit its potential in the short run, leaving resources idle, and in particular leaving labour unemployed. He wanted to exonerate price and wage rigidity from being the obstacle to equilibrium, by stressing the systemic, general equilibrium nature of unemployment in the short run. Workers, in other words, were unemployed through no fault of their own. They were ready to work for lower wages, and still found no job. They were the ‘involuntary’ unemployed (Keynes (1936)).<sup>2</sup> Although in the *General Theory* the discourse is at high level of abstraction, it is certain that Keynes was thinking about the experience of the Great Depression.

The Keynesian approach became mainstream with the interpretative works by John Hicks (Hicks (1937)) and Franco Modigliani (Modigliani (1944)). It was challenged by Milton Friedman at the end of the 1960s (Friedman (1968)), and dethroned by the new classical counterrevolution, led by Robert Lucas (Lucas (1972)) in the 1970s. The new paradigm was a macro-Walrasian model based on equilibrium as a methodological premiss. The focus of macroeconomics gradually shifted away from involuntary unemployment to

---

<sup>2</sup>See De Vroey (2004) for an historical and analytical discussion of the involuntary unemployment concept in macroeconomics.

business cycle fluctuations.

Even when the new classical macroeconomics had become the dominant paradigm, its major authors were still reluctant to apply their method to the case of the Great Depression. Apparently, there was some perplexity about tackling a period characterised by mass unemployment such as the Great Depression, using a model that starts from the premiss that the world is in equilibrium. Critics of the new classical macroeconomics, and of its subsequent evolution into the RBC method, used the Depression case to fiercely attack the equilibrium theoretical perspective (Rees (1970), Summers (1986)). Both Lucas and Prescott initially answered by taking an ‘abstentionist’ viewpoint (De Vroey and Pensieroso (2006)): the equilibrium approach to business cycle was fine for periods of plain sailing, but the Great Depression was something different, possibly calling for different explanations (Lucas and Rapping (1972), Prescott (1983), Prescott (1986)).

While Lucas by and large still sticks to this view (Lucas (1994)), although with some ambiguity (Lucas (2006)), Prescott changed his mind at the end of the 1990s and was influential in promoting the “Great Depressions of the 20th century” project.

This about-face of the equilibrium school in their attitudes towards the Great Depression is telling. It shows that the *a-priori* intuition that an equilibrium model of the Great Depression is impossible is not so obvious. As Cole and Ohanian and the other equilibrium macroeconomists participating in this project have shown, it is possible to build a model based on the equilibrium premise, and yet to apply it at the interpretation of the Great Depression with interesting, if controversial, results. But above all, this about-face teaches us that the equilibrium theory itself has evolved. The new classical macroeconomics has progressively broken away from its original purely Walrasian framework. Nowadays it encompasses imperfect competition, price rigidities and incomplete markets, all elements traditionally taken into account by the Keynesian strand of the macroeconomic literature. This evolution towards what has been defined a ‘new neoclassical synthesis’ (Goodfriend and King (1997)) has made the theory more suitable for analysing a period like the Great Depression.

## 4 An example: Belgium

To illustrate the application of the RBC modelling strategy to the Great Depression, I shall present some results from my analysis of the Belgian case (Pensieroso (2007)).

The model is a closed economy populated by an infinitely long-living



representative household, which solves the maximization problem:

$$\max_{\{c_t, l_t, k_{t+1}\}_{t=0}^{\infty}} E_t \sum_{t=0}^{\infty} \beta^t [\ln(c_t) + \phi \ln(1 - l_t)], \quad (1)$$

under the constraints:

$$\begin{aligned} c_t + k_{t+1} &\leq (1 - \delta)k_t + y_t, \\ y_t &= e^{s_t} k_t^\alpha (x_t l_t)^{1-\alpha}, \\ s_t &= \rho s_{t-1} + v_t, \\ x_t &= \gamma^t x_0 \\ k_0 &= \text{given}, \\ s_0 &= \text{given}. \end{aligned}$$

In this model, I have assumed perfect competition, rational expectations and complete markets. I have used a log-log, time separable utility function, with consumption ( $c$ ) and leisure ( $1 - l$ ) as arguments. The production function is assumed to be Cobb-Douglas, with  $e^s x^{1-\alpha}$  being the TFP. I have detrended the data by taking the labour augmenting technological progress  $x$  out of the data. The parameter  $\beta$  is the household's discount rate.  $\phi$  is the preference for leisure in the utility function and  $\delta$  is the capital depreciation rate due to technical obsolescence and physical disruption. I have assumed that the detrended TFP,  $s_t$ , follows an AR(1) process with  $\rho$  being its autoregressive coefficient, and  $v_t$  being a zero-mean i.i.d. innovation.

Solving the maximization gives first order conditions

$$\gamma \frac{1}{\tilde{c}_t} = E_t \left[ \beta \frac{1}{\tilde{c}_{t+1}} \left( 1 - \delta + \alpha e^{s_{t+1}} \left( \frac{\tilde{k}_{t+1}}{l_{t+1}} \right)^{\alpha-1} \right) \right], \quad (2)$$

$$\gamma \tilde{k}_{t+1} = (1 - \delta) \tilde{k}_t + e^{s_t} \tilde{k}_t^\alpha l_t^{1-\alpha} - \tilde{c}_t, \quad (3)$$

and

$$\frac{\phi}{1 - l_t} = \frac{1}{\tilde{c}_t} e^{s_t} (1 - \alpha) \left( \frac{\tilde{k}_t}{l_t} \right)^\alpha, \quad (4)$$

plus a transversality condition, where  $\tilde{x}$  indicates the detrended  $x$ .

Equation (2) is the Euler equation governing savings, or the intertemporal allocation of wealth. Equation (3) is the standard production-equals-demand condition, while Equation (4) is the equilibrium between labour supply and

labour demand. In such an economy there exist a stationary state for all the detrended variables.

In this model, the transmission mechanism of the shock works as follows. The productivity shock influences production directly. When productivity decreases, the labour demand decreases as well. If prices and wages are flexible, the real wage will decrease, pushing up the real interest rate (remember it takes time to build, investment today will become productive capital only tomorrow). This will lower investments. On the other hand, the increase in the interest rate will make working - and saving - today more attractive than working tomorrow, thereby increasing the labour supply, and thus reinforcing the downward pressure on the real wage. Higher interest rates and lower wages make consumption decrease. The decrease in consumption does not match that in output, because the income effect lowers saving as well as consumption.

The application of the theory to the Great Depression in Belgium consists of comparing the reaction of this model to a measured TFP shock with the historical statistics for Belgium in the 1930s. In order to run a numerical simulation, I need to first calibrate the structural parameters of the model. Table 1 illustrates my choices.

$\beta$	0.96
$\gamma$	1.03
$\delta$	0.1
$\alpha$	0.33
$\phi$	1.78
$\rho$	0.99

Table 1: Initial calibration of the parameters

It may be instructive to explain how the calibration was done. The parameters  $\beta$ ,  $\delta$  and  $\alpha$  are fixed as in Cole and Ohanian (1999). The deterministic growth rate of the economy  $\gamma$  is the measured growth rate of the GDP per capita in Belgium between 1900 and 1994, excluding the two World Wars and the Great Depression. The parameter  $\phi$  is calibrated so that the hours worked ( $l$ ) are 1/3 in the steady state. The autocorrelation parameter  $\rho$  is calibrated by regressing the logarithm of the detrended TFP (i.e.  $s_t$  in the model) as an AR(1).

As is customary in this field, I assumed that the model economy was in a steady state in 1929. Then, I fed in the residuals from regressing the logarithm of detrended TFP as AR(1) to represent the unexpected shock  $v_t$ .

This means that the shock is measured from the data, making the model deterministic rather than stochastic.

Figure 2 presents the dynamic response of the model to the shock, and compares it with the pattern of detrended data. It shows that a standard RBC model with TFP shock is not a good candidate for explaining the onset of the Great Depression in Belgium. The Belgian economy entered the Great Depression in 1930. TFP, on the contrary, stayed at trend - and even slightly above trend - until 1931. It dropped 10% below trend between 1932-1934, to stay basically constant thereafter. In the model economy output, consumption and investments increased until 1931, to decrease only later on, a pattern at variance with the data.

Quantitatively, the model is able to reproduce about 35% of the 1929-1934 output drop. It also shows no signs of recovery after 1934, a feature in accordance with the data. Nonetheless, its overall quantitative performance is poor, especially as concerns investments and hours worked.

Although the results are mostly negative, the exercise is telling. First, it shows that it is possible to speak about the Great Depression within a very stylized equilibrium model. Second, the very failures of the model suggest what modification are likely to induce a better reproduction of the data. In the present case, a wedge in the labour market is the most likely candidate.

Accordingly, I modified the previous model to introduce sticky nominal wages and monetary shocks. The modified problem of the representative household is

$$\max_{\{c_t, m_t, k_{t+1}\}_{t=0}^{\infty}} E_t \sum_{t=0}^{\infty} \beta^t [\mu \ln(c_t) + (1 - \mu) \ln(m_t)], \quad (5)$$

under the constraints:

$$c_t + k_{t+1} + m_t \leq (1 - \delta)k_t + y_t + \frac{m_{t-1}}{1 + \pi_t} + \tau,$$

$$y_t = e^{s_t} k_t^\alpha (x_t l_t)^{1-\alpha},$$

$$s_t = \rho s_{t-1} + v_t,$$

$$x_t = \gamma^t x_0,$$

$$0 < \rho < 1,$$

$$\zeta_t = \ln(M_t) - \ln(M_{t-1}),$$

$$\zeta_t - \hat{\zeta} = \theta_t$$

$$\theta_t = \eta \theta_{t-1} + \nu_t,$$

$$\begin{aligned}\pi_t &\equiv \frac{P_t - P_{t-1}}{P_{t-1}}, \\ k_0 &= \text{given}, \\ s_0 &= \text{given}, \\ \theta_0 &= \text{given}.\end{aligned}$$

In this model, money is modelled as a choice variable for the agent, who draws utility directly from holding it. The parameters  $v_t$  and  $\nu_t$  are zero-mean i.i.d. innovations,  $\tau_t$  is a lump-sum nominal transfer paid by the government when it issues money, (which in equilibrium must be equal to the seignorage,  $m_t - \frac{m_{t-1}}{(1+\pi_t)}$ , in order to balance the government budget), and  $\zeta_t$  is the growth rate of per-capita money stock, which is assumed to follow an AR(1) process, with  $\hat{\zeta}$  and  $\eta$  as given parameters. I assumed complete markets, perfect competition in the goods market and rational expectations.

I postulated fixed labour supply, and a simple nominal wage rigidity à la Taylor (1980). Workers are divided into two cohorts, each fixing its nominal contract-wage for two years. The contract scheme is such that, say, cohort one fixes its contract in  $t$  for periods  $t$  and  $t+1$ , while cohort two fixes its contract in  $t+1$  for periods  $t+1$  and  $t+2$ . Then cohort one fixes its contract in period  $t+2$  for periods  $t+2$  and  $t+3$ , and so on and so forth. Thus in each period  $t$ , there will be two different contracts, one for the cohort which fixed it in period  $t-1$  and one for the cohort which fixed it in period  $t$ . Calling  $\chi_t$  the contract set in period  $t$ , the average nominal wage in period  $t$  will be

$$W_t = \chi_t^{\frac{1}{2}} \chi_{t-1}^{\frac{1}{2}}. \quad (6)$$

When negotiating contracts, agents set them at the geometric mean of the current average wage and the expected future average wage, as they know they will not be able to modify the contract in the next period. Moreover, contracts are dependent on general labour market conditions: the contract will be positively (or negatively) influenced by the hours worked being higher (or lower) than the steady-state level, when wages are perfectly flexible and the labour supply is endogenous.

The relevant first order conditions for characterizing a solution are

$$\gamma \frac{1}{\tilde{c}_t} = E_t \left[ \beta \frac{1}{\tilde{c}_{t+1}} \left( 1 - \delta + \alpha e^{s_{t+1}} \left( \frac{\tilde{k}_{t+1}}{\tilde{l}_{t+1}} \right)^{\alpha-1} \right) \right]; \quad (7)$$

$$\gamma \tilde{k}_{t+1} = (1 - \delta) \tilde{k}_t + e^{s_t} \tilde{k}_t^\alpha \tilde{l}_t^{1-\alpha} - \tilde{c}_t - \tilde{m}_t + \frac{\tilde{m}_{t-1}}{\gamma(1 + \pi_t)} + \tilde{\tau}; \quad (8)$$

$$\frac{1 - \mu}{\tilde{m}_t} = \frac{\mu}{\tilde{c}_t} \frac{i_t}{1 + i_t}; \quad (9)$$

$$1 - \delta + \alpha e^{s_{t+1}} \tilde{k}_{t+1}^{\alpha-1} l_{t+1}^{1-\alpha} = \frac{1 + i_t}{1 + \pi_{t+1}}; \quad (10)$$

$$\begin{aligned} \ln(\tilde{w}_t) = & \frac{1}{2} \ln(\tilde{w}_{t+1}) + \frac{1}{2} \ln(1 + \pi_{t+1}) + \frac{1}{2} \ln(\tilde{w}_{t-1}) - \frac{1}{2} \ln(1 + \pi_t) + \\ & + \frac{\xi}{2} \left[ 2 \ln \left( \frac{l_t}{\bar{l}} \right) + \ln \left( \frac{l_{t+1}}{\bar{l}} \right) + \ln \left( \frac{l_{t-1}}{\bar{l}} \right) \right]; \quad (11) \end{aligned}$$

$$\tilde{w}_t = (1 - \alpha) e^{s_t} \tilde{k}_t^\alpha l_t^{-\alpha}; \quad (12)$$

plus a transversality condition.

Equation (9) is the money demand, which turns out to be a function of current consumption and the nominal interest rate  $i_t$ . Equation (10) is the no-arbitrage condition between physical capital and money. Equation (11) gives the rule of formation of detrended real wages  $\tilde{w}$ , and comes from the assumed contract formation in the Taylor set-up. Its role is to pick up a wage rate, so that the labour demand (Equation (12)) can give us the corresponding figure for hours worked.

The transmission mechanism of the shock is now different from that in the previous model. A negative monetary shock lowers the price level, via the real-balance, or Pigou effect: as households expect money to gain value in terms of the consumption good, they will change the consumption good for money. Given the sticky-nominal-wage hypothesis, real wages will increase, which in turns will affect production negatively. Consumption, output and labour demand will all decrease.

Table 2 shows the calibration of parameters for the monetary model.

The model economy is assumed to be in a steady state in 1929. The model was simulated after feeding in the series of estimated  $\nu_t$ . Productivity shocks were set to zero.

Figure 3 shows the dynamic response of the model to the unexpected monetary shock, and compares it to the data.

This example shows how detaching the RBC theory from its original purely Walrasian core has made it possible to fruitfully apply the theory to the Great Depression event. The improvement that the inclusion of ‘Keynesian’ elements such as sticky nominal wages into the analysis brings about is huge and self-evident. In particular, the behavior of investments and hours worked is better accounted for. The overall fall in the detrended data between 1929 and 1934 is matched reasonably well.

$\beta$	0.96
$\gamma$	1.03
$\delta$	0.1
$\alpha$	0.33
$\xi$	0.348
$\rho$	0.99
$\eta$	0.14
$\mu$	0.5
$\hat{\zeta}$	0.028

Table 2: Calibration of the parameters to include sticky nominal wages and monetary shocks

## 5 Open issues

As highlighted above, the production of a fully-fledged neoclassical model of the Great Depression is a definite breakthrough. An earlier self-imposed restraint has been removed, a testimony to the resilience and adaptability of the RBC methodology. This new stream of research has tried to provide new answers to old questions. In the process, it has sometimes rephrased the questions themselves in terms more congenial to its theoretical apparatus.

However, the new approach also raises new questions. A first point that deserves to be made concerns the plausibility of the closed-economy analysis. It is undeniable that the closed-economy perspective makes the model easier, often with no or minor losses in terms of data mimicking ability. Nonetheless to overlook the obvious international dimension of the Great Depression sounds like a significant limitation of the scope of the analysis, not least because the model has nothing to say about real and nominal exchange rates, the current account and other trade-related variables. As the new open macroeconomics is currently making considerable progress (Lane (2001)), new research in this area is to be expected. The comparison of the results from this new research with the work of leading scholars of the Great Depression will, I am sure, be most intriguing.

The second point worth discussing is the effective contribution that the RBC models of the Great Depression have brought about in terms of our knowledge of the period. In other words, if we leave aside the important methodological innovation, have we learned anything new about the Great Depression from the RBC models? Alas, the answer is currently a qualified ‘no’.

Models using exogenous TFP shocks to account for the depression con-

tribute little to our understanding. TFP, once labelled ‘the measure of our ignorance’ (Abramovitz (1956)), is definitely a poor concept for historic analysis. In other words, to rephrase the question of the origin of the Great Depression in terms of TFP variations, and then study its quantitative impact in a fully-fledged neoclassical model is certainly an important methodological contribution. But, as aptly noticed by Temin (2008), it adds little if anything, to the impressive historical literature on the theme.

Even from a methodological viewpoint, the claim that the predictive ability of a theory is the litmus test by which its validity ought to be judged is far from self-evident. Such a claim can find some justification in Friedman’s renowned methodological stance: as complete realism of hypotheses is clearly impossible, the question of whether a theory is realistic enough should be settled by seeing whether it yields predictions that are accurate enough for the case at hand, or at least better than competing assumptions (Friedman (1953)). Although Friedman did not have exogenous TFP shocks in RBC theory in mind, Prescott’s argument that ‘a theory of technological change is not needed to predict response to technological change’ (Prescott (1986)) is an extreme, possibly unintended offspring of Friedman’s methodological position. Be that as it may, Prescott’s standpoint does not withstand closer examination. As Summers pointed out, the history of human thought is full of plainly wrong theories, that still delivered good predictions: Ptolemaic astronomy and Lamarckian biology are good example of this (Summers (1986)).

As to the claim that economic policies like the NIRA and the NLRA slowed the pace of the recovery, the claim is interesting, and its formalization useful. Still, the claim is hardly new. Several authors have already proposed it, starting with Keynes (1933) and Simons (1934) in the 1930s, and moving on to Hawley (1966), Lucas and Rapping (1972), Weinstein (1981) and Eichengreen (1992) in the post-war era.

All this is not to say that the effort has been useless, nor to dismiss the entire research project. The quantitative dimension of the RBC analysis will be crucial for anyone wanting to speak about the Great Depression in the future. The impressive pile of data that has resulted as a by-product of this research project is also valuable per se. There are signs that the new approach may lead to a general shift of focus in the analysis (from the cause of the slump to the cause of its long duration, for instance), and to a new assessment of the New Deal as well. For the time being, however, the equilibrium approach to the Great Depression has still to prove his worth in terms of substance.

Another controversial issue concerns the definition of what Kehoe and Prescott call ‘great depressions of the 20th century’ (Kehoe and Prescott

(2002), Kehoe and Prescott (2008)). Before their intervention, no economist apparently felt that a definition of ‘great depression’ was really needed. To all intents and purposes, the term was used to designate one single episode, the world-wide crisis of the 1930s. The fact that the latter was somewhat different from, and bigger than any other crisis was taken for granted - hence the ‘great’ modifier and the use of capital letters to denote the event (the Great Depression). By contrast, RBC authors think of great depressions as a conceptual category, defined in quantitative terms. What is striking in their definition is that it pays little attention to the obvious differences among different historic events. The following example illustrates this point.

Figure 4, shows the detrended output per working-age person for the United States during the Great Depression of the 1930s and compares this with data for New Zealand and Switzerland during what Kehoe and Prescott call a great depression in the 1970s. For the purpose of comparison, I have also plotted the undetrended real GDP per capita in PPP in Figure 5. Two facts are immediately evident. First, the detrended output drop was far more rapid during the U.S. depression in the 1930s than during those of the 1970s. Second, if we look at the undetrended data only, there is no evidence of Kehoe and Prescott’s so called ‘great depression’ in New Zealand and Switzerland. There was no significant and protracted contraction in real GDP in those countries that is remotely comparable to that observed in the United States in the 1930s. They simply grew more slowly than expected from a simple extrapolation of a 2% linear trend.

The major flaw in Kehoe and Prescott’s definition is that it is too all-encompassing. It mistakes the stagnations of the 1970s for depressions. Apparently, something peculiar happened during the Great Depression, which Kehoe and Prescott’s definition does not catch. Although more research on this theme is desirable, this definitional pitfall also casts some doubts over the capability of the RBC approach to provide a new dating of the Great Depression.

## 6 History and macroeconomics

The Great Depression of the 1930s was once an uncontested realm of economic history. With the appearance of RBC models of the Great Depression, a territorial dispute may arise, with the two approaches clashing over issues of method and substance. I do not think this is either inevitable or desirable. As I shall discuss in this section, the two approaches are complementary rather than alternative.

As well as being an obvious consequence of the circumstances under which



macroeconomics was born as a discipline, the fascination the Great Depression holds for macroeconomists is part of a renewed interest in economic history in general (Goldin (1995)).

The parallel advances in the collection of historical data and in macroeconomic modelling have suggested the use of history as the kind of laboratory experiment long lacking in macroeconomics. Nowadays, growth theory is successfully being applied in a century-long perspective, trying to explain the shift from the low growth rates of the ‘Malthusian’ regime, to the high growth rates of the modern era (Galor and Weil (1999), Hansen and Prescott (2002)). Cole and Ohanian have started the same vogue for business cycle theory, by applying it to the explanation of the Great Depression. Historical macroeconomics is an exciting new field, where models can be tested in a ‘controlled’ environment, in a feverish search for better explanations.

In this respect, the breaking of the Depression taboo is definitely a great feat. For better or worse, the Great Depression will be a powerful test of the theory, and it might still deliver the new insights on the event that so far are missing. Moreover, as Ohanian (2000) put it once, there are many stories of the Great Depression: models help to assess whether a particular story holds water.

The other side of the coin is that models are based on exclusions. It may be that the excluded factors are crucial in the explanation of the single event at hand. This may be true even if the model produces a good *ex-post* ‘prediction’ of the fact. The reason is that to explain a fact is not necessarily the same as to build a model that reproduces a fact.

A good example of this limitation of the modelling strategy is my analysis of the Great Depression in Belgium. As I have shown above, the introduction of negative monetary shocks coupled with nominal wage stickiness helps the model to account for the 1929-1934 evidence. In no way, however, does it explain what caused the slump. The monetary shock, indeed, was the result of the exchange rate regime Belgium stuck to, the Gold Standard, coupled with the devaluation of the British pound in 1931. All this information is in a sense meta-theoretical, as it is outside the model, and stems from the work of historians (Cassiers (1989)). Nonetheless, we need to refer to it, if we want to make sense of the model.

To conclude, for all the novelties they have brought about, the substantive contribution of RBC models is not yet sufficient to amount to a historiography of the Great Depression.

## 7 Conclusions

The Great Depression of the 1930s is again at the forefront of economic research. Several RBC models of the Great Depression have been advanced since the pioneering work by Cole and Ohanian (1999), who, for the first time dared to frame the Great Depression within the accepted canons of the equilibrium business-cycle theory.

This was a step forward in macroeconomics, in that an earlier self-imposed restraint was overcome. It shows that there are no *a-priori* limits to the scope of the modelling strategy either in economics, or in economic history. This can be seen as a completion of the ‘cliometrics’ revolution.

At the same time, the unimpressive results so far obtained by RBC economists, together with the enduring methodological concerns about the application of RBC theory to the Great Depression call for some caution, especially when deriving historical interpretations and policy implications from the analysis.

Macroeconomic models are a fine test for historians. In particular, their formulation in quantitative terms will force historians to enter the quantitative discourse, probably to the mutual benefit of both macroeconomists and historians. This does not mean that traditional story-telling will cease to be a necessary tool for obtaining the broad picture of history.

## References

- ABRAMOVITZ, M. (1956): “Resource and Output Trends in the United States Since 1870,” *The American Economic Review*, 46(2), 5–23.
- BEAUDRY, P., AND F. PORTIER (2002): “The French Depression in the 1930s,” *Review of Economic Dynamics*, 5, 73–99.
- BERNANKE, B. S. (1995): “The Macroeconomics of the Great Depression: A Comparative Approach,” *Journal of Money, Credit and Banking*, 27, 1–28.
- BORDO, M. D., C. J. ERCEG, AND C. L. EVANS (2000): “Money, Sticky Wages and the Great Depression,” *American Economic Review*, 90, 1447–1463.
- CASSIERS, I. (1989): *Croissance, Crise et Régulation en Economie Ouverte: La Belgique entre les Deux Guerres*. De Boeck Université, Bruxelles.

- CHRISTIANO, L., R. MOTTO, AND M. ROSTAGNO (2004): “The Great Depression and the Friedman-Schwartz Hypothesis,” Working Paper 10255, National Bureau of Economic Research.
- COLE, H. L., AND L. E. OHANIAN (1999): “The Great Depression in the United States from a Neoclassical Perspective,” *Federal Reserve of Minneapolis Quarterly Review*, 23, 2–24.
- COLE, H. L., AND L. E. OHANIAN (2001): “Re-Examining the Contributions of Money and Banking Shocks to the U.S. Great Depression,” in *NBER Macroeconomics Annual 2000*, ed. by B. S. Bernanke, and K. Rogoff, pp. 183–260. MIT Press, Cambridge, USA.
- COLE, H. L., AND L. E. OHANIAN (2002): “The Great UK Depression: A Puzzle and a Possible Resolution,” *Review of Economic Dynamics*, 5, 19–44.
- (2004): “New Deal Policies and the Persistence of the Great Depression: A General Equilibrium Analysis,” *Journal of Political Economy*, 112, 779–816.
- DE VROEY, M. (2004): *Involuntary Unemployment: The Elusive Quest for a Theory*. Routledge, London.
- DE VROEY, M., AND L. PENSIEROSO (2006): “Real Business Cycle Theory and the Great Depression: the Abandonment of the Abstentionist Viewpoint,” *Contributions to Macroeconomics*, 6, issue 1, article 13.
- EICHENGREEN, B. (1992): *Golden Fetters: The Gold Standard and the Great Depression, 1919-1939*. Oxford University Press, Oxford.
- EICHENGREEN, B., AND P. TEMIN (2000): “The Gold Standard and the Great Depression,” *Contemporary European History*, 9, 183–207.
- FISHER, J. D. M., AND A. HORNSTEIN (2002): “The Role of Real Wages, Productivity, and Fiscal Policy in Germany’s Great Depression 1928-37,” *Review of Economic Dynamics*, 5, 100–127.
- FRIEDMAN, M. (1953): “The Methodology of Positive Economics,” in *Essays in Positive Economics*, pp. 3–43. Chicago University Press, Chicago.
- FRIEDMAN, M. (1968): “The Role of Monetary Policy,” *The American Economic Review*, 58(1), 1–17.

- FRIEDMAN, M., AND A. J. SCHWARTZ (1963): *A Monetary History of the United States, 1867-1960*. Princeton University Press (for NBER), Princeton.
- GALOR, O., AND D. N. WEIL (1999): “From Malthusian Stagnation to Modern Growth,” *The American Economic Review*, 89(2), 150–154.
- GOLDIN, C. (1995): “Cliometrics and the Nobel,” *The Journal of Economic Perspectives*, 9(2), 191–208.
- GOODFRIEND, M., AND R. G. KING (1997): “The New Neoclassical Synthesis and the Role of Monetary Policy,” *NBER Macroeconomics Annual*, 12, 231–283.
- HANSEN, G. D., AND E. C. PRESCOTT (2002): “Malthus to Solow,” *The American Economic Review*, 92(4), 1205–1217.
- HAWLEY, E. (1966): *The New Deal and the Problem of Monopoly*. Princeton University Press, Princeton.
- HICKS, J. R. (1937): “Mr. Keynes and the ”Classics”; A Suggested Interpretation,” *Econometrica*, 5(2), 147–159.
- HULTEN, C. R. (2000): “Total Factor Productivity: A Short Biography,” Working Paper 7471, National Bureau of Economic Research.
- KEHOE, T. J., AND E. PRESCOTT (2008): “Using the General Equilibrium Growth Model to Study Great Depressions: a Reply to Temin,” Research Department Staff Report 418, Federal Reserve Bank of Minneapolis.
- KEHOE, T. J., AND E. C. PRESCOTT (2002): “Great Depressions of the 20th Century,” *Review of Economic Dynamics*, 5, 1–18.
- KEYNES, J. M. (1933): “The New Deal,” *The New York Times*, December, 16th, reprinted in *Collected Writings of Keynes*, London 1981-1982, vol. XXI, pp. 289-297, or available online at <http://newdeal.feri.org/misc/keynes2.htm>.
- (1936): *The General Theory of Employment, Interest, and Money*. Macmillan, London.
- KINDLEBERGER, C. P. (1973): *The World in Depression*. University of California Press, Berkeley.

- KYDLAND, F., AND E. C. PRESCOTT (1982): “Time to Build and Aggregate Fluctuations,” *Econometrica*, 50, 1345–1370.
- LANE, P. R. (2001): “The New Open Macroeconomics: A Survey,” *Journal of International Economics*, 54, 235–266.
- LUCAS, R. E. (1972): “Expectations and the neutrality of money,” *Journal of Economic Theory*, 4(2), 103 – 124.
- (1977): “Understanding Business Cycles,” in *Studies in Business Cycle Theory*, pp. 215–239. MIT Press, Cambridge, USA, 1981.
- (1980): “Methods and Problems in Business Cycle Theory,” in *Studies in Business Cycle Theory*, pp. 271–296. MIT Press, Cambridge, USA, 1981.
- (1994): “Review of Milton Friedman and Anna Schwartz’s *A Monetary History of the United States*,” *Journal of Monetary Economics*, 34, 5–16.
- (2006): “Remarks on the Influence of Edward Prescott,” *Economic Theory*, 32(1), 7–11.
- LUCAS, R. E., AND L. A. RAPPING (1972): “Unemployment in the Great Depression: Is there a Full Explanation?,” *Journal of Political Economy*, 80, 186–191.
- MANKIW, N. G. (1989): “Real Business Cycles: A New Keynesian Perspective,” *Journal of Economic Perspectives*, 3, 79–90.
- MODIGLIANI, F. (1944): “Liquidity Preference and the Theory of Interest and Money,” *Econometrica*, 12(1), 45–88.
- OHANIAN, L. E. (2000): “Economic Dynamics Interviews Lee Ohanian on the Great Depression,” *Economic Dynamics Newsletter, Review of Economic Dynamics*, 1 (2).
- PENSIEROSO, L. (2007): “The Great Depression in Belgium from a Neoclassical Perspective,” Discussion Paper 2007-25, Université catholique de Louvain.
- PRESCOTT, E. C. (1983): “Can the Cycle Be Reconciled with a Consistent Theory of Expectations? Or, a Progress Report on Business Cycle Theory,” Working Paper 239, Federal Reserve Bank of Minneapolis, in collaboration with A. Guenther, P. Kehoe and R. Manuelli.

- (1986): “Response to a Skeptic,” *Federal Reserve Bank of Minneapolis Quarterly Review*, 10, 28–33.
- (1999): “Some Observations on the Great Depression,” *Federal Reserve Bank of Minneapolis Quarterly Review*, 23, 25–31.
- (2002): “Prosperity and Depression,” *American Economic Review*, 92, 1–15.
- REES, A. (1970): “On Equilibrium in Labor Markets,” *Journal of Political Economy*, 78, 306–310.
- ROMER, C. (1992): “What Ended the Great Depression?,” *Journal of Economic History*, 52, 757–784.
- (1993): “The Nation in Depression,” *Journal of Economic Perspectives*, 7, 19–39.
- SIMONS, H. C. (1934): “A Positive Program for Laissez Faire: Some Proposals for a Liberal Economic Policy,” in *Economic Policy for a Free Society*. Chicago University Press, Chicago, 1948.
- SOLOW, R. M. (1956): “A Contribution to the Theory of Economic Growth,” *Quarterly Journal of Economics*, 70, 65–94.
- (1957): “Technical Change and the Aggregate Production Function,” *Review of Economics and Statistics*, 39, 312–320.
- SUMMERS, L. H. (1986): “Some Skeptical Observations on the Real Business Cycle Theory,” *Federal Reserve Bank of Minneapolis Quarterly Review*, 10, 23–27.
- TAYLOR, J. B. (1980): “Aggregate Dynamics and Staggered Contracts,” *Journal of Political Economy*, 88, 1–23.
- TEMIN, P. (1989): *Lessons from the Great Depression*. MIT Press, Cambridge, USA.
- (2008): “Real Business Cycle Views of the Great Depression and Recent Events: a Review of Timothy J. Kehoe and Edward C. Prescott’s *Great Depressions of the Twentieth Century*,” *Journal of Economic Literature*, 46, 669–684.
- TEMIN, P., AND A. WIGMORE (1990): “The End of One Big Deflation,” *Explorations in Economic History*, 27, 483–502.

- WEDER, M. (2006): “The Role of Preference Shocks and Capital Utilization in the Great Depression,” *International Economic Review*, 47, 1247–1268.
- WEINSTEIN, M. M. (1981): “Some Macroeconomic Impacts of the National Recovery Act, 1933-1935,” in *The Great Depression Revisited*, ed. by K. Brunner. Martinus Nijhoff, Boston.

# Figures

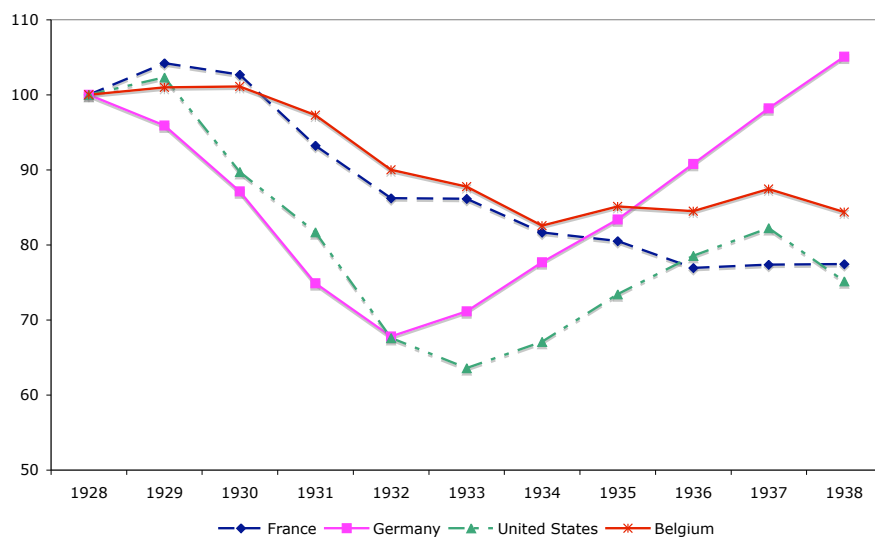


Figure 1: Detrended output during the Great Depression in Belgium, France, Germany and the United States



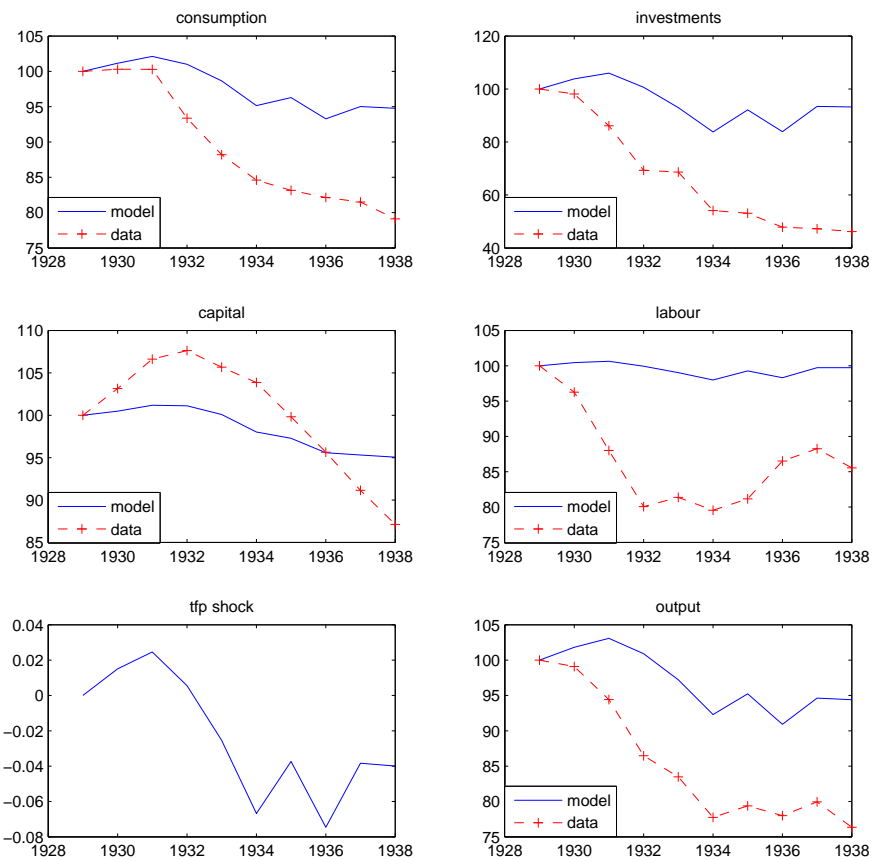


Figure 2: A comparison of the results of the RBC model with TFP shock (blue) and the actual data (red)

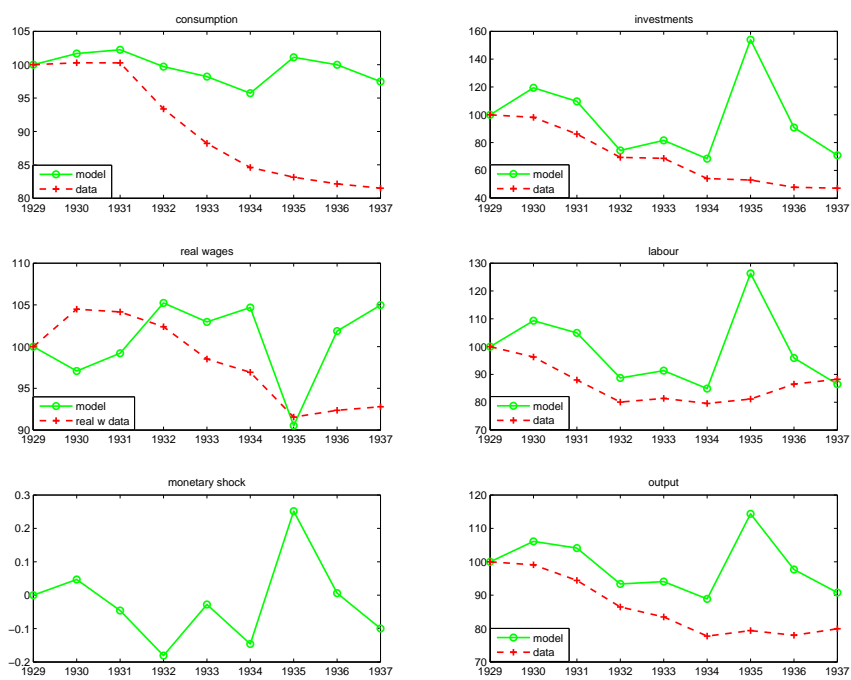


Figure 3: A comparison of the RBC (DSGE) model with monetary shock (green) and the actual data (red)

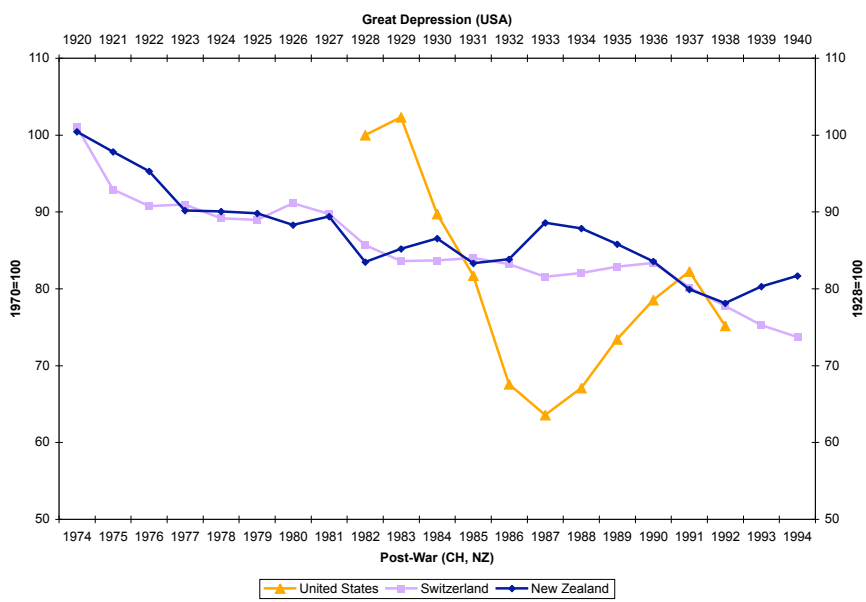


Figure 4: Detrended output data comparing the Great Depression in the 1930s in the USA with the situation since the 1970s in Switzerland and New Zealand. Source: Kehoe and Prescott (2002)

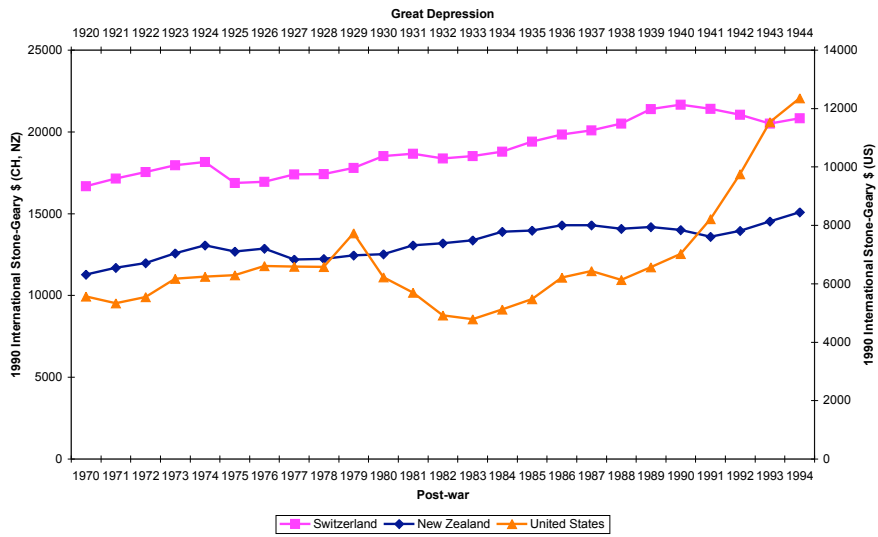


Figure 5: Undetrended output data for the USA during the Great Depression and for Switzerland and New Zealand since the 1970s. Source: De Vroey and Pensieroso (2006)

Institut de Recherches Économiques et Sociales  
Université catholique de Louvain

Place Montesquieu, 3  
1348 Louvain-la-Neuve, Belgique