REAL BUSINESS CYCLE MODELS OF THE GREAT DEPRESSION: A CRITICAL SURVEY

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Abstract. Recent years have witnessed a revival of interest in the Great Depression of the 1930s. Among the differing new interpretations, the real business cycle (RBC) approach is particularly significant. It represents an outstanding methodological innovation in trying to cast the Great Depression within an 'equilibrium' framework. This paper critically reviews the RBC interpretation of the Great Depression, clarifying its theoretical and methodological foundations, and paving the way for future assessments of its validity.

Keywords. Great Depression; Real Business Cycle Theory

1. Introduction

The Great Depression of the 1930s was undoubtedly the most important economic crisis ever witnessed in the twentieth century. Its extension and duration convinced several contemporary observers that it might well signal the approaching collapse of the capitalist production system.

The Great Depression plays an outstanding role in the history of ideas. Keynes's General Theory, in effect, dates to 1936, and the Great Depression unquestionably paved the way for Keynes's work. The Keynesian approach to economic theory concentrates on the concept of market failure, as opposed to the classical *laissez faire* theory. Consequently, in the eyes of most contemporary observers, the experience of the Great Depression seemed to confirm the correctness of Keynes's intuition, that, in the short run at least, a capitalist economy does not gravitate towards full employment.

The Keynesian approach to economics remained the mainstream theory until the end of the 1960s, when it was first challenged by Friedman and the monetarists, and subsequently replaced by new classical macroeconomics. The new theory is an 'equilibrium' business cycle theory, meaning that the analysis is cast in a Walrasian framework, and grounded on individual rational choices. The main message of this new trend in economic literature, with respect to the history of economic thought, is that there is no need to resort to any market failure idea in order to provide a thorough explanation of the business cycle. A properly defined neoclassical model can provide a plausible explanation of the phenomenon.

0950-0804/07/01 0110–33 © 2007 The Author JOURNAL OF ECONOMIC SURVEYS Vol. 21, No. 1

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Nevertheless, even after the Keynesian model had lost its predominance and been replaced by new classical macroeconomics, the Great Depression still appeared to be an example of market failure, whose causes were mainly attributed to the complex social and institutional situation after World War I (Kindleberger, 1973; Eichengreen, 1992), and whose end could be ascribed to the intervention of public authorities (Romer, 1992; Vernon, 1994). New classical macroeconomists themselves considered the Great Depression a phenomenon somehow beyond the reach of equilibrium theory. In particular, Lucas, whose distinctive contribution to economic theory consists of having stated that all cycles were alike and could be studied as equilibrium phenomena (Lucas, 1977), wrote:

The Great Depression . . . remains a formidable barrier to a completely unbending application of the view that business cycles are all alike. (Lucas, 1980, p. 273) If the Depression continues, in some respects, to defy explanation by existing economic analysis (as I believe it does), perhaps it is gradually succumbing under the Law of Large Numbers. (Lucas, 1980, p. 284)

However, at the end of the 1990s, attempts to overcome this limitation saw the light of day: a new interpretation of the Great Depression, which tried to explain it within a real business cycle $(RBC)^1$ framework, began to gain ground. Instead of viewing the Great Depression as a phenomenon lying beyond the grasp of the equilibrium discipline, authors working in this direction believe that the new classical methodology and theory might be able to tackle it.

The aim of this paper is to present a critical review of this RBC interpretation of the Great Depression, by singling out its theoretical and methodological foundations. The paper will be organized as follows. In Section 2, I will explain some methodological premises for the application of RBC theory to the Great Depression. In Sections 3 and 4, a review of existing RBC papers about the US and international Great Depressions will be presented. Section 5 provides some critical remarks, and indicates guidelines for future research, while Section 6 summarizes the argument.

2. RBC Theory and the Great Depression: Assumptions and Methodology

2.1 Assumptions

The distinctive feature of RBC theory is its attempt to explain cyclical fluctuations of income and employment by two fundamental hypotheses: the 'equilibrium hypothesis' and the 'exogenous shock hypothesis'.

The 'equilibrium hypothesis' is the postulate that an economic cycle can be studied as an equilibrium phenomenon, or, in other words, that it can be studied in a framework postulating market clearing and agents' optimizing behaviour (Lucas, 1977). Under this assumption, business cycles are the aggregate result of the optimum response of individuals to changes in the economic environment (Hartley *et al.*, 1997).

I will label as 'exogenous shock hypothesis' the assumption that the source of any economic cycle is exogenous to the growth process. In an RBC perspective, the economic cycle is conceived as a stochastic oscillation around a trend. Such a trend is determined by savings, demography and technology, as in Solow's (1956) model.² This hypothesis characterizes the conception of economic cycles within the RBC framework as being due to exogenous shocks to the fundamentals of an economic system, as opposed to theories in which fluctuations are endogenous or to 'animal-spirit' driven theories, in which fluctuations result from the indeterminacy of the long-run growth path.

This conception of economic cycles has important implications for the definition of depressions. Researchers in the RBC tradition define a depression as 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. As to the notion of a Great Depression, Kehoe and Prescott (2002) consider, as a 'working definition', that a recession is a Great Depression if output falls cumulatively by more than 20% with respect to its trend level, dropping by more than 15% in the first decade of the depression. These numbers serve to give a quantitative definition of the borderline between a business cycle, and a business cycle that has become a Great Depression. Of course they contain a good dose of arbitrariness, and although they may be reasonable, no theoretical meaning should be attributed to them.³

2.2 Dating the Depression

It might be thought that the dating of the Depression would be an issue on which consensus existed, but this is not the case. As a matter of fact RBC theorists have changed the general way of thinking on this issue. Traditionally, economists tended to consider the Great Depression as starting with the stock market crash of 1929, and ending with the election of Roosevelt in 1933 (Robbins, 1934; Friedman and Schwartz, 1963; Temin, 1989; Eichengreen, 1992).⁴ However in an RBC interpretation, the Great Depression is defined as covering the entire decade of the 1930s. This results from the definition of a Great Depression given above: US de-trended output dropped more than 35% in 4 years, while in 1939 it was nearly 27% below its 1929 de-trended level (Cole and Ohanian, 1999). As Prescott (1999) points out, this change in the timing of the event shifts the nature of the central question to be addressed from 'Why was there such a big decline in output and employment between 1929 and 1933?' to 'Why did the economy remain so depressed for the entire decade?' In other words, according to RBC theoreticians, a new issue should be added to the 'traditional' question of what caused the Great Depression, namely, 'What explains the slowness of the recovery phase?'

2.3 Methodology

As to methodology, RBC theorists tread in Lucas's footsteps by arguing that the central purpose of a theory of the economic cycle is to make the artificial, modelled

economy reproduce the actual behaviour of a real-world economy (Lucas, 1980). Elucidating the origin of a particular cycle is perceived as secondary. The logic of this methodological premise must be traced back to the fundamental hypotheses we have singled out. If any economic cycle starts with an exogenous shock, studying the specific characteristic of this shock serves little purpose for the task of elaborating a general theory of the business cycle. It is much more important to understand the regularities that will ensue after the shock occurs.

RBC theoreticians build models in the Solow–Ramsey tradition, modified to allow for stochastic shocks that hit the economy at random. Any stochastic shock of this nature is called an 'impulse mechanism' of the business cycle. The typical impulse mechanism considered in standard RBC models is a technological shock, represented as an autoregressive stochastic shock on the total factor productivity (TFP). TFP is a parameter of the production function, which embodies a broad concept of efficiency in combining inputs to obtain output.⁵

Having defined the impulse mechanism of the business cycle, RBC theoreticians compute the equilibrium reaction to the impulse mechanism. That is, they study the qualitative and quantitative response of the model economy to the random shock, on the basis of the set of relationships postulated by the model that allows them to identify a 'propagation mechanism' for the shock. Such a propagation mechanism is standard in all the models reviewed here, and is typically based on both the intertemporal substitution in leisure and consumption, and the intratemporal substitution between labour and leisure.

This simulation technique requires the model to be calibrated, that is, a numerical value must be assigned to each parameter on the basis of econometric estimates, or, if reliable econometric data are absent, on the basis of economic plausibility. If the perturbed model economy 'reproduces' aggregate fluctuations reasonably well, it can be considered as a plausible theory of the cycle. That is, the ability of an artificial model to reproduce a set of stylized facts after being hit by an exogenous random shock is the methodological litmus test by which the robustness of the theory is judged.

2.4 The 'Normality View': History and Economics

RBC's methodological premises have important implications for the analysis of historical events such as the Great Depression. In the RBC approach, economic theory and economic history are perceived as pertaining to different, though possibly complementary, realms. Economic theory, as stated above, is concerned with regular co-movements in the behaviour of economic variables. Economic history, on the contrary, is a different branch of social science, naturally inclined towards considering singularities. In this way, a specific event is amenable to economic theory if, during that event, economic variables co-moved as predicted by the theory. If, however, the event is peculiar, it should simply be left to historians, and considered beyond the grasp of economic theory.

Once this consequence of their methodological assumptions is spelt out, the breaking of the earlier limit to equilibrium theory assumes new connotations. To all

intents and purposes, it amounts to considering the Great Depression as a business cycle, possibly of greater than usual magnitude; the alternative view is that the Great Depression was a singularity. That is, in assuming that the Great Depression is amenable to RBC theory and method, these authors implicitly assume that during the Great Depression economic aggregates behaved as in any other business cycle, although with greater variance in their oscillation. In this paper, I will refer to this implicit assumption as the 'normality view'.

2.5 The National Dimension of the Phenomenon

The RBC interpretation of the Great Depression differs from previous interpretations in the role assigned to the international political and economic environment during the 1930s. While earlier leading authors (Kindleberger, 1973; Eichengreen, 1992; Bernanke, 1995) stressed the international dimension of the Great Depression, and went so far as to say that a full understanding of that phenomenon could not be reached without considering the international dimension, RBC researchers reversed this position by concentrating their analysis on isolated country studies. Several reasons for this change of perspective may be given:

- The first work on the Great Depression from an RBC perspective is the paper by Cole and Ohanian (1999), which is strictly concerned with the Great Depression in the USA. Data prove that the Great Depression hit harder in the USA than in other industrialized countries; output fell relatively more, and the state of depression of the economy lasted longer than in any other country. This evidence persuaded the authors to assume that the shock that affected the US economy must have been far bigger than the shocks that affected other economies and, in addition, that the slowness of the US recovery was probably due to some idiosyncratic shock, since other countries recovered earlier. Moreover, the USA is notoriously an almost closed economy as far as international trade is concerned. Consequently, a national dimension appeared to them sufficient to analyse the US Great Depression.⁶
- From a methodological point of view, the mathematical formalization that is typical of RBC research forces the economist to leave out many aspects of reality in order to concentrate on the aspects that are considered essential. Given that RBC models explain recessions by means of a shift in the labour-demand schedule (Mankiw, 1989), exogenous shocks to TFP (i.e. exogenous variations in the Solow residual) are an easy way to reproduce such a shift, while keeping the model sufficiently compact. This implies that the international dimension need not be the main focus of the analysis.

3. The RBC Interpretation of the US Great Depression

RBC models of the US Great Depression can be split into two classes. The first includes Cole and Ohanian (1999, 2000, 2001, 2004) and Prescott (1999). In this interpretation, the explanation of the plunge of the early thirties (that is, the historical identification of the shock that caused the Great Depression) is considered

methodologically less interesting than the explanation of its long duration (that is, why the Great Depression did not behave in the same way as business cycles observed in the post-war period). The causes of the productive collapse of the USA economy in the 1930s are mostly traced back to some exogenous supply shock, embodied for simplicity in a parameter of the production function (TFP). As for the protracted character of the depression, these models charge New Deal policies with having been responsible for it. These policies produced substantial distortions in the economy, thus impeding the otherwise inevitable recovery.

The second class of models includes all the other RBC papers on the Great Depression. These models are more interested in the traditional question of what caused the Great Depression. To this end, they resort to a variety of variables (monetary shocks and sticky wages in Bordo *et al.* (2000); preference for liquidity in Christiano *et al.* (2004); exogenous demand shocks in Weder (2006)). As to the long duration of the Great Depression, all these authors accept the implications of the 'normality view': either the Great Depression would have been a normal business cycle of greater magnitude had distorting State interventions been absent (Bordo *et al.*, 2000; Christiano *et al.*, 2004); or the Great Depression was a normal business cycle of great magnitude that lasted a long time because the shock producing the cycle was extremely long lasting (Weder, 2006).

Other papers exist, the classification of which under the RBC label is more uncertain. Sunspots models are a case at hand.⁷ In sunspots models, there is multiplicity of equilibria. Business cycles are defined as the economy's swinging from one equilibrium to the next. Such swinging movements are determined by self-fulfilling (rational) expectations. The Great Depression appears as a demanddriven phenomenon arising from people's unexplained, though plausible, pessimistic behaviour. I will review one paper in this tradition, that by Harrison and Weder (2002), in a separate subsection.

3.1 Cole, Ohanian and Prescott on the Great Depression

The RBC interpretation of the US Great Depression stems from the work of two leading authors, Harold Cole and Lee Ohanian. Initially, they focused on the standard issue of explaining the origins of the Great Depression. This inquiry led to a rather frustrating result. Neither the standard RBC story of technological shocks, nor other standard real and monetary factors, could properly account for both the observed magnitude and the long duration of the Great Depression. Cole and Ohanian soon turned their attention to the protracted character of the Great Depression, a theme that eventually proved more congenial to RBC methodology and theory. The distorting elements of some New Deal policies helped to explain why the economy remained depressed for so long. This position has been authoritatively espoused by Prescott, who, in a short comment article in 1999, gave a clear picture of the basic elements of the RBC interpretation of the Great Depression. As it is representative of the whole of this stream of literature, I will start by discussing Prescott's paper, and turn my attention to Cole and Ohanian's article in a second step.

3.1.1 Prescott's Assessment

According to Prescott (1999), the RBC interpretation of the US Great Depression consists of two building blocks. First, some of the exogenous factors usually described in terms of shocks to TFP caused a strong recession at the end of 1929. Second, misconceived economic policies, attempting to improve the disastrous economic performance of that time, impeded the normal adjustment of market forces. These policies introduced strong distorting elements into the US economy: by increasing *de jure* the real wage rate, they lowered the normal employment level and the growth path. In Prescott's words:

In the Great Depression, employment was not low because investment was low. Employment and investment were low because labour market institutions and industrial policies changed in a way that lowered normal employment. (Prescott, 1999, p. 27)

The interest of Prescott's comment is that it highlights the basic elements of the RBC methodology, which I have spelt out in Section 2. A dividing line is drawn between the realm of history, which includes the historical identification of shocks, and the realm of economics, which studies the propagation mechanism of the business cycle. In Prescott's methodological approach, the origin of a shock (i.e. the concrete historical determination of the impulse mechanism of the business cycle) is outside the scope of economics. What is more puzzling for an economist is the explanation of the slowness of the recovery. By sticking to this view, Prescott reduces the explanation of the Great Depression to the explanation of the 1934–1939 episode. The following quotation illustrates this point.

The fundamental difference between the Great Depression and business cycles is that market hours did not return to normal during the Great Depression. Rather, market hours fell and stayed low. In the 1930s, labor market institutions and industrial policy actions changed normal market hours. I think these institutions and actions are what caused the Great Depression. (Prescott, 1999, p. 27)

The point is that this method of analysis might make sense, from a theoretical point of view, when the development of a general theory of the business cycle is considered. In that case, the theory can conceivably be more concerned with the regularities of the business cycle (that is, in how a business cycle arises from an exogenous shock) than in studying the peculiarities of each particular shock. However, things should be different when a specific event, such as the Great Depression, is analysed. In that case, explaining the Great Depression must be tantamount to explaining both its onset and its long duration. By sticking to the 'normality view', and trying to cast the Great Depression within the RBC framework, Prescott is led instead to overlook *a priori* any explanation of the plunge of the early 1930s, a standpoint which is not acceptable from an historic point of view. All the more so in that, as shown by Ohanian (2002), in the specific case of the Great Depression, the exogenous shock required to reproduce the data is abnormally large

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(Section 3.1.2 illustrates this point). It is important to make the point that at least this abnormal dimension deserves more detailed historical analysis.

3.1.2 Cole and Ohanian on the Onset of the Great Depression

Cole and Ohanian's early work was mainly negative, consisting of showing that, when closely scrutinized, earlier explanations of the Great Depression are unsatisfactory. In their 1999 paper, they started by describing the behaviour of the main detrended macroeconomic aggregates during the decade 1929–1939; subsequently, they tried to identify, from among the many different explanations in the literature purporting to explain business cycles, the models that best fit these data. Cole and Ohanian (1999) found that stochastic shocks to the growth rate of the TFP could explain roughly 40% of the 1929–1932 drop in output. They obtained this result by taking a suitable specification of the model, and feeding in the observed level of TFP as a measure of technological shock.

An interesting point, highlighted by Ohanian (2002), is that the drop in measured TFP during the Great Depression, although not sufficient to reproduce in the model the magnitude of the decline in output, was still relatively high when compared with the drops in measured TFP that have normally accompanied recessions in the post-World War II period. This feature means that the behaviour of the TFP during the 1930s was peculiar, for reasons still to be elucidated (see Ohanian (2002) for further discussion).

Alternative 'real' explanations, such as shocks to international trade, public expenditure and distorting taxes, are presumed to have had a lesser impact, if any, on the crisis. For international trade, Cole and Ohanian (1999) note that the United States was at that time a relatively closed economy. Moreover, the presence of tariffs suggests that US imports might have had a high elasticity of substitution with domestic intermediate goods. Consequently, international trade disruptions had no appreciable or enduring negative effects on the US Great Depression. As to public expenditure, Cole and Ohanian (1999) report data showing that detrended public expenditure in the USA remained above the trend level during almost the entire decade. So a negative crowding-out effect of public expenditure has to be dismissed. As far as taxes are concerned, Cole and Ohanian (1999) ran two further simulations using data on the average marginal tax rates on factors' income: the first with the 1929 average tax level, and the second with the 1939 average tax level. In the second simulation the steady-state level of labour input was 4% lower than in the first. The authors therefore concluded that negative fiscal policy shocks did not have appreciable effects on the 1929–1933 crisis, but that they can explain some 20% of the weak 1934–1939 recovery.

'Monetary' shocks, financial disruptions and nominal rigidities are also considered to have had little impact on the Great Depression. Cole and Ohanian (2000) reviewed the main mechanisms identified by economists to explain possible real effects of monetary policy during the 1930s, namely the Lucas and Rapping (1969) unexpected deflation model, the debt deflation model of Irving Fisher (1933), the sticky-wage hypothesis and theories centred on the role of banking disruptions induced by

deflation (Bernanke, 1983). By comparing deflation in 1929–1933 to that in 1920–1921, the authors first excluded Lucas and Rapping's (1969) and then Fisher's (1933) hypotheses.⁸

To test the sticky-wage hypothesis, Cole and Ohanian (2000) built a two macrosector general equilibrium model, in which a final good is produced by means of two different types of intermediate goods. Each intermediate good is produced by means of capital and labour. There are two sectors producing intermediate goods: one, n, is a competitive sector, with wages set at the market-clearing level; the other, m, is a noncompetitive sector, where wages are fixed above the market-clearing level. Both sectors use the same constant returns to scale Cobb–Douglas technology. The final goods sector uses a constant elasticity of substitution (CES) technology. Both capital and labour are assumed to be immobile. The preferences of the representative household are specified through a logarithmic utility function. The household can allocate its working time between the two sectors, and it is assumed that wage fixity in the noncompetitive sector is perceived as a nonrecurring phenomenon (i.e. the model assumes that each wage shock occurring in any of the Depression years is completely unexpected).⁹ The model was calibrated using, as far as possible, standard values from the RBC literature for the parameters. A calibration for the model-specific parameters is also provided. The values of these parameters were chosen by considering the manufacturing sector as the empirical counterpart of the noncompetitive sector in the model. Running two simulations, one with a benchmark model without nominal wage rigidities, and the other with the model as described above, and comparing their results with the data, Cole and Ohanian conclude:

These results suggest that the high wage was not the primary cause of the Great Depression...This wage accounts for about a 3 per cent decline in output at the trough of the Great Depression, compared to an actual 38 per cent decline. Increasing the size of the distorted sector to 50 per cent, or reducing the substitution elasticity to 0,1 did not significantly change the result. (Cole and Ohanian, 2000, p. 20)¹⁰

Cole and Ohanian (2000) also exclude the possibility that wages might be significantly underestimated, and argue that in fact the contrary is likely to be true. Referring to Margo (1993), they assert that wages were probably also well below the trend line in the manufacturing sector, because of the compositional bias in favour of high-skilled workers that affected the US economy in the 1930s.¹¹

As to the analysis of banking shocks, Cole and Ohanian (2000) first defined banking shocks as bank closures affecting the information capital. Then they built a model in which information capital was used by banks as input, together with deposits, to obtain a 'banking output'. This banking output appears, in the end, as an input to the production of the final good. Both these productive processes are assumed to be constant returns to scale. This model is built so that, in each sector, the ratio of inputs to outputs is equal for all inputs. Consequently, the loss of information capital relative to output due to bank closures is equal to the fraction of deposits on output loss due to bank closures. As the US data reported by Cole and Ohanian (1999) show this to have been pretty low during the Great Depression, the authors conclude that, because the loss of information capital was also low during the Great Depression, it only affected the economy slightly.

3.1.3 Cole and Ohanian on the Long Duration of the Great Depression

According to standard RBC theory, the Great Depression should have ended much earlier than it actually did. Once the effects of the TFP negative shock were exhausted, the economy should have returned to its steady-state growth path. In Cole and Ohanian's (1999) simulations, output would have recovered to its trend level by 1936, if the measured shocks to TFP in the 1930s had been the sole impulse mechanism for the economic cycle. The TFP returned to its trend level that year. However, detrended data show that in 1939 output was still a good 25% below its trend level. This observation led Cole and Ohanian (1999) to argue that the Great Depression was not only the result of a temporary shock that caused a fluctuation around the trend-growth path, but was also rather the outcome of a mixture of a temporary shock and some permanent shocks that caused the growth path itself to shift downwards. At the end of their paper, Cole and Ohanian (1999) suggest that a likely culprit could be the New Deal policies introduced after 1933.

While this line of research is only alluded to in Cole and Ohanian's 1999 paper, the link between New Deal policies and the Great Depression is the central object of their subsequent research (see Cole and Ohanian (2004) and an earlier and more detailed working paper version, Cole and Ohanian (2001)). Their basic claim is that New Deal competition and labour market policies are to blame for the duration of the Great Depression. In particular, they consider two important reforms: the National Industrial Recovery Act (NIRA),¹² and the National Labour Relations Act (NLRA).¹³ These measures had a relatively high coverage in the economy: about 52% of total employment was in sectors covered by the NIRA, while this figure reached 77% in the private nonfarm sector (Cole and Ohanian, 2001, p. 67, Table 2). Cole and Ohanian (2004) present a model to show that the rise in prices and wages actually curbed the recovery in production, rather than boosting it (as Roosevelt's economic advisers thought it would).¹⁴ The model is explicitly oversimplified insofar as it assumes NIRA and NLRA to be the same thing, and does not consider the effects of other New Deal policies. This is done in order to predict output for the whole 1934–1939 period more easily.

The benchmark specification of the model is a multisector version of a standard real business cycle model, in which a final good in period t is produced using a variety of intermediate goods. These intermediate goods are produced by different industries, each belonging to a sector. All the production technologies exhibit constant returns to scale. Labour is assumed to be perfectly mobile across industries and sectors, whereas capital is considered sector-specific. Households are supposed to maximize a logarithmic utility function in which labour is assumed to be indivisible.

To model New Deal policies in this setup, Cole and Ohanian (2004) modified the model in three ways. First, they assumed that, in the economy, a fraction χ of the sectors producing intermediate goods forms a cartel. In these sectors

there is, therefore, a rent to be shared between workers and firms arising from the monopolistic extra profits. Second, they assumed that, as a consequence, wages in these cartelized sectors are the result of bargaining between workers and firms; the relative bargaining power of the two parties is embodied in a parameter ω that gives the probability of a firm gaining monopolistic extra profits without accepting workers' wage demands. The cartelized sector behaves in the same way in an 'insider–outsider' model, where all insider workers are paid the same wage. Third, Cole and Ohanian assumed that there are frictions in the labour market, which allow for flows of workers between the competitive and the cartelized sectors. Considering that jobs in the cartelized sectors are better paid, workers prefer to move to these sectors rather than to similar jobs in the competitive sectors. A search process for these jobs therefore ensues.

These three modifications were intended to emphasize the characteristic of the New Deal policies that Cole and Ohanian consider essential: a connection between collective bargaining (allowing *de facto* for the greater bargaining power of unions and workers) and price control by cartelized firms. They also reproduce the 'equal pay for equal work' principle, a cornerstone of union policy in the 1930s. Calibrating and simulating their model, Cole and Ohanian fed in the sequence of observed TFPs as measures of technological shocks, and compared the results of the cartel modification with the competitive benchmark, both relatively and in terms of reproducing the actual data.

Their main result was that cartelization caused a greater drop in output the greater the bargaining power of workers, i.e. the lower the calibrated value for the parameter ω , and, *ceteris paribus*, the higher χ (the share of the economy involved in such a policy). However, the effects of varying χ were much larger than those induced by variation in ω ; as Cole and Ohanian observe:

The key depressing element of the policy is not monopoly *per se*, but rather the link between wage bargaining and monopoly. (Cole and Ohanian, 2004, p. 805)

As far as a comparison with the actual data is concerned, while the competitive model failed to reproduce the observed trend of economic aggregates during the recovery, the cartel model made predictions that were considerably closer to the facts. On the basis of the figures obtained, Cole and Ohanian (2004) argue that the cartel model is able to explain a good 60% of the slow recovery. The rationale for this result is that the negative effects of higher wages and lower production propagated from the cartelized sectors to the competitive sectors, insofar as the reduced output in the cartelized sectors tended to lower wages and employment in the cartelized sectors. So, they conclude,

... New Deal labor and industrial policies did not lift the economy out of the Great Depression... Instead, the joint policies of increasing labor's bargaining power, and linking collusion with paying high wages, prevented a normal recovery by creating rents and an inefficient insider–outsider friction that raised wages significantly and restricted employment. (Cole and Ohanian, 2004, p. 813)

3.2 Other RBC models of the Great Depression

3.2.1 The Debate about Sticky Wages

Cole and Ohanian's (2000) conclusion that sticky wages were irrelevant in accounting for the onset of the US Great Depression is far from uncontroversial. Empirical evidence on cross-sectional international data (presented by Eichengreen and Sachs (1985)) suggests that currency-devaluating countries experienced relatively lower real wages and higher industrial production, a finding consistent with the stickywage hypothesis.¹⁵ On the other hand, Christiano *et al.* (2004) point out that

... There just does not seem to be a tight negative relationship between the real wage on the one hand, and output and employment on the other. (Christiano *et al.*, 2004, p. 11)

This point is also debated theoretically among RBC authors. Bordo *et al.* (2001) and Gertler (2001) argue that Cole and Ohanian's (2000) result follows from the unjustified assumption of perfect wage flexibility in the nonmanufacturing sector. As Gertler (2001) points out, this model excludes nominal wage rigidity by definition, and thus excludes the decrease in the aggregate demand for labour that is necessary if the sticky-wage hypothesis is to produce real effects. Moreover, Bordo *et al.* (2001) emphasize that there is no justification for this choice, either theoretically or empirically, because it is based on a questionable extension of the wage flexibility observed in the farming sector to the whole nonmanufacturing sector. According to Bordo *et al.* (2001), imposing noncompetitive wages in the nonmanufacturing sector – even lower, perhaps, than the manufacturing sector's wages – completely reverses Cole and Ohanian's (2000) results.

In an earlier article, Bordo et al. (2000) showed that the sticky-wage hypothesis could provide an explanation of the onset of the Great Depression within an RBC framework. They built a simple one-sector real business cycle model with monetary shocks and fixed wages à la Taylor (1980). Running a simulation on this model, they found that it could 'explain' approximately 70% of the 1929–1932 drop in output, a result in sharp contrast to Cole and Ohanian's result. However, Bordo et al. (2000) admitted that their results clearly show that on its own the sticky-wage hypothesis can account neither for the recovery phase of the US Great Depression (characterized by a strong monetary expansion (Romer, 1992)), nor for the final year of the recession, 1932-1933. According to them, some financial disruption of the kind envisaged by Bernanke (1983) might have been responsible for the crisis in the final year. They suggest a more detailed explanation for the recovery phase, built on Cole and Ohanian's (1999) early suggestion about the possible distorting role of New Deal policies. In particular, they focused (as Cole and Ohanian did a year later) on the NIRA. Bordo et al. (2000) then modified the process of wage formation in their model by splitting it into two processes: a Taylor setting, for the period 1929:3–1933:2;¹⁶ and a level of wages fixed to their 1933:2 level later on. This modified model shows that

As long as real wages were legislatively mandated at levels well above the marginal product of labour that would prevail at full employment,

monetary expansion alone could not lead to recovery. (Bordo *et al.*, 2000, p. 1461)

3.2.2 Christiano et al. (2004)

A further development in the application of RBC methodology to the Great Depression is the recent work by Christiano *et al.* (2004). This paper attempts to build a 'realistic' dynamic stochastic general equilibrium model able to tackle contemporary policy questions. The authors consider the US Great Depression as the toughest possible test for such a model. Christiano *et al.*'s main conclusion is that while the Great Depression was certainly the result of many joint shocks, it is mainly attributable to two factors: a 'preference for liquidity shock' (which induced a shift away from demand deposit towards money, thus in large part causing the onset of the depression); and the increased market power of workers during the New Deal (which explains why, during the recovery phase, employment was still so low, thereby shedding some light on why the recovery phase itself was so slow).

These results are obtained by means of a very complex RBC model. Its basic structure is as follows. It is assumed that a final good Y_t is produced by a perfectly competitive representative firm, using a number of intermediate goods $Y_{j,t}$. These intermediate goods are produced by monopolists who set their prices $P_{i,t}$ subject to Calvo (1983) style friction. The intermediate-good firms need labour $l_{i,t}$ and capital $K_{i,t}$ for their productive activity. They buy working hours from households, paying a wage rate W_t . They rent capital from entrepreneurs, paying a rental price of capital Pr_t^k for capital services. Moreover, each intermediate-good firm must finance in advance fractions ψ_k and ψ_l of capital and labour services, respectively. They do this by asking for loans from banks, and paying a net interest rate of R_i . Entrepreneurs buy capital x from capital producers, paying for it at the price $Q_{\bar{k}',t}$. In order to pay these amounts they use their net worth N_t and they borrow $B_t = Q_{\bar{k}',t} - N_t$ from banks, paying a gross interest rate Z_t . At the end of the period, they sell the undepreciated capital back to capital producers, at the same price $Q_{\bar{k}',t}$. Entrepreneurs can be bankrupted during each period with a probability $1 - \gamma_t$, which also represents the fraction of the new entrepreneurs entering the market during each period.

Capital producers produce units of new capital good x' by means of previously installed capital x and investment goods I_t . They buy investment goods from the finalgood sector, paying them P_t . Banks use capital and labour to 'produce' their services and hoard reserves. They buy working time l_b^t from households, and rent capital K_b^t from entrepreneurs, paying W_t and Pr_t^k , respectively. They hold demand deposits D_t^t and D_t^h from firms and households, respectively, paying them an interest rate of R_t^a . They also hold time deposits, T_t , from households, which pay a non-state-contingent expected rate of return R_{t+1}^e . Finally, households consume an amount C_t of the final good, paying P_t per unit; they hold high-powered money M^b ; they pay lump-sum transfers to entrepreneurs, in order to guarantee free entry to entrepreneurship and they receive lump-sum transfers corresponding to the net worth of entrepreneurs leaving the economy. Households are modelled as maximizing a complex utility function encompassing, *inter alia*, habit persistence, shocks to the preference for leisure and shocks to liquidity preference. Households are assumed to be able to exert some monopoly power over labour, so that they set wages within a Calvo contract setting. There is also a nonmodelled Government, which buys G_t unit of the final good, at the price of P_t per unit.

Next, Christiano *et al.* (2004) introduce eight exogenous shocks and study their joint and individual impact on the model, comparing their outcomes with data for the US Great Depression. These shocks affect the monopoly power of intermediate-good firms, the monopoly power of wage earners, households' preference for currency versus demand for deposits, the preference for liquidity, productivity shocks for intermediate goods, the survival probability of the entrepreneur, the relative value of excess reserves in the banking sector and the willingness of entrepreneurs to take risks. These shocks are drawn from stochastic processes, and estimated with a maximum likelihood procedure. Christiano *et al.* assume that the shocks influence the rate of growth of money, because of the monetary authority reaction function.

After having estimated all the parameters and calibrated the model, Christiano et al. ran a simulation, including estimated values for the shocks. They found that their model reproduced key features of the data properly. As anticipated at the beginning of this section, they also found that two shocks are crucial in explaining the Great Depression in the United States: preference for liquidity and workers' market power. While workers' market power resembles the traditional high-wages story, which we have discussed above, the preference for liquidity deserves some further explanation. An exogenous shock to the preference for liquidity leads to a decrease in the ratio between demand deposits and money demand, D_t^h/M_t , in consumption and in time deposits. The aggregate M1 falls, causing the interest rates to increase. The higher interest rates cause an increase in the debt burden and a decrease in the rental price of capital,¹⁷ leading to a higher probability of bankruptcy for entrepreneurs. As a consequence, entrepreneurs drop their demand for capital goods, and so capital-goods producers lower their level of production. Their prices, therefore, go down. The fall in the price of capital worsens the drop in investments, because it causes the net worth of entrepreneurs to diminish.

At the end of the paper, Christiano *et al.* (2004) modelled a counterfactual example in which the monetary authority actively reacts against the shocks, allowing the growth rate in the monetary base to overcompensate for the reduction due to the eight shocks. This led them to argue that, had an appreciably more expansive monetary policy been in place in the 1930s, the size and duration of the Great Depression would have been much less.

3.2.3 *Weder*

The last papers to be considered in this section are both by Weder, who has produced two accounts of the same idea (Weder, 2001; 2006). The two papers share the same model, but differ in the narrative part, which is much more developed in the earlier

one. I will mostly refer to the more recent (2006) paper, while occasionally referring to the earlier (2001) paper. In these papers, a dynamic stochastic general equilibrium model of the RBC type is modified to allow exogenous shocks to the aggregate demand for consumption to be the only impulse mechanism of the business cycle. The aim is to evaluate the impact of the consumption shock on the Great Depression quantitatively, by simulating the model. As for the methodological concern, the model is in the RBC tradition. Nevertheless, it has a clearly Keynesian flavour, all the more so in that Weder (2001) defines his model as an RBC formalization of Temin's (1976) view of the Great Depression as a phenomenon mainly caused by a contraction of the autonomous components of aggregate demand for consumption.

In Weder's model, households are thought of as maximizing a logarithmic utility function with a random variable affecting the subsistence level of consumption. The model also includes variable capital utilization, 'organizational synergies' and increasing returns to scale in the production function. Weder (2006) identifies the preference shifter econometrically.¹⁸ He calibrates his model, largely on the basis of Cole and Ohanian's (1999) analysis, and runs a simulation. It turns out that the model with increasing returns matches the trend in US output, 'explaining' around 59% of the collapse, and almost all of the slow recovery and the 1937-1938 recession.

An interesting point, which is developed in Weder's 2001 paper but abandoned in the drier 2004 one, is the explicit comparison between Weder's model and the competitive and cartel models discussed by Cole and Ohanian (2001). Weder (2001) points out that his model can mimic the onset of the Great Depression as well as the slowness of the recovery (reproducing about 80% of the variance in the data correctly), whereas Cole and Ohanian's (2001) competitive model can explain only about 40% of the onset of the depression, and very little of the recovery phase. Moreover, Cole and Ohanian's (2001) cartel model can only explain 50–60% of the recovery phase. In addition, Weder argues that his model can reproduce the 1937 recession, which other models cannot.

To investigate further which model 'explains' the data in a statistically more appropriate way, Weder (2001) runs a regression of actual US output on the 'predicted' output of three models (his own, Cole and Ohanian's (2001) competitive model and Cole and Ohanian's (2001) cartel model). He finds that the predictions of his model are statistically more significant than those of the other two. When output from his model is added to the regression, the other two lose any explanatory power, meaning that the null hypothesis (that they do not explain US output at all) cannot be rejected. When only the recovery period is considered, the 'explanatory' powers of his model and Cole and Ohanian's cartel model are equally statistically significant. For both models the null hypothesis is rejected at 1% significance level, with regression coefficients of 0.57 and 0.41 for the cartel and the demand-driven model, respectively. Weder (2001) concludes that:

Judging the overall performance, the demand-driven model fares at least as good [sic] as its considered contenders. (Weder, 2001, p. 18)

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3.3 A Sunspots Neoclassical Interpretation of the US Great Depression

All the models reviewed above fit the definition of RBC models developed in Section 2, in that they respect the equilibrium discipline, and business cycles are assumed to arise from exogenous shocks to the fundamentals. A slightly different approach to the Great Depression was proposed by Harrison and Weder (2002). In this paper the authors stuck to the equilibrium hypothesis, but business cycles were assumed to be driven by animal spirits (or sunspots), i.e. self-fulfilling expectations not related to the fundamentals of the economy.

This model is a variation on Weder's (2001) theme. Instead of assuming an exogenous shock to preferences, and setting parameters to solve the dynamics for a saddle path, Harrison and Weder (2002) set the parameters so as to allow for bubbles. The possibility of animal-spirit-driven business cycles arose in their model because they assumed sufficiently increasing returns to scale to ensure the existence of multiple equilibria. A high degree of increasing returns to scale actually ensures that optimistic or pessimistic expectations will be self-fulfilling. Consumers will move savings accordingly, labour supply will shift and capital utilization will vary. Variations in capital utilization will mean variations in labour demand up to the new equilibrium, at which point expectations will actually have been fulfilled.

Harrison and Weder (2002) identified nonfundamental shocks to the 'degree of confidence' by means of a vector auto-regression (VAR) model. They assume that the interest rate spread between high-risk and low-risk bonds is a reasonable proxy for the degree of confidence. Running two alternative versions of the VAR, plus a Granger causality test, they claim that residuals from the VAR specification, in which the spread of interest rates is the 'most exogenous' shock to the system, do Granger-cause output.¹⁹ Subsequently, they used the sunspot shock series generated by this procedure to compute the output, consumption, investment and productivity series implied by the model.

The findings fit the data well. Provided the increasing returns to scale are large 'enough', the model reproduces stylized facts better than Cole and Ohanian's competing models. Both the sharpness of the downturn and the slowness of the recovery are accounted for by sunspots shocks. Moreover, Harrison and Weder's model reproduces the 1937–1938 recession, which all the other models fail to do.

These results led them to give the following account of the Great Depression:

The 1929 stock market crash was followed for about a year by what appeared to be the start of a normal recession. Only later, during the summer of 1930, did confidence began to deteriorate dramatically. Hence the recession was transformed into a depression. In 1932, faith in the economy hit bottom; and the continuing sequence of pessimistic animal spirits are a prime candidate in the quest to explain the subsequent stagnation that only ended with the onset of World War II. (Harrison and Weder, 2002, p. 26)

Extending the analysis, Harrison and Weder tested their model over a longer period starting from the end of Great Depression and ending in 2000. Results in this case were poor. They concluded that

demand shocks [that is sunspots] were either less important or smaller in the postwar period or were partially neutralized by active fiscal and monetary policies. (Harrison and Weder, 2002, p. 25)

4. RBC Theory and Great Depressions Worldwide

The RBC interpretation of the Great Depression outside the USA is made up of two elements. The first is a critique of what RBC theorists call the 'consensus view',²⁰ stressing the role of deflation and nominal wage stickiness in the diffusion of the depression from the USA to the rest of the world. The basic idea of the 'consensus view' is that adherence to the gold exchange system induced restrictive monetary and fiscal policies in the presence of serious deficits in the balance of trade, or in order to avoid them. These policies are normally deflationary, and deflation causes unemployment, unless nominal wages decrease. The second element is a case-study analysis of a number of countries, applying an identical methodology and theoretical setup to each country. These studies, it is claimed, demonstrate that idiosyncratic shocks to TFPs and country-specific economic policies provide a fairly good explanation for the Great Depression in each country, without any reference to an international dimension.

4.1 The Critique of the 'Consensus View'

The arguments presented by Cole *et al.* (2005) for rejecting the 'consensus view' are empirical and mainly based on the signs of the correlations between log deviations from the trend-lines of real wages and output, and prices and output. According to these authors, if the 'consensus view' were right, there should be a positive correlation between the rates of growth of prices and real output, and a negative correlation between the rates of growth of real wages and real output. In other words, pinning things down to a traditional labour supply and demand graph, we should observe an upward and leftward movement along the labour demand schedule, with increasing real wages and decreasing employment.

Studying cross-sectional data on 17 OECD countries, Cole *et al.* (2005) noted that when regressions were performed on the cross-sectional averages for 1929–1932, the correlation between the log deviations of prices and real output turned out to be slightly negative, while the correlation between the log deviations of real wages and real output was moderately positive. This observation led them to conclude that the cause of the international Great Depression could not be sought in a movement *along* the labour demand curve, but rather should be found in a movement *of* the labour demand curve. To model this hypothesis, they considered an RBC model with money \hat{a} la Lucas. In this model, the economy can be hit by two shocks: a monetary shock, causing a movement along the labour demand curve. Cole

et al. calibrated the parameters of the model so that the two shocks taken together reproduced the data set as exactly as possible. They then tried to work out, for different orthogonalizations²¹ of the two shocks, how much of the movement of the total quantities during the Great Depression could be explained by each factor. They found that a country-specific TFP shock orthogonal to deflation could explain two-thirds of output variation in each country, while monetary shocks explained the remaining third. Moreover, their artificial series of TFP shocks matched the small amount of data available for economy-wide productivity during the 1930s.²² On the other hand, the same simulation carried out with only the monetary shock (that is without TFP shocks) produced a strong negative correlation between real wages and real output (in log deviation terms), which is at odds with the cross-sectional evidence.

On the basis of this analysis, Cole *et al.* (2005) concluded that an RBC account of the international Great Depression should be based on a shock that works like a productivity shock, that is orthogonal to deflation, and that looks like a productivity shock in the data. They suggest that natural candidates for such a shock are the financial disruptions stressed by Bernanke (1983), the decrease in 'information capital' hypothesized by Ohanian (2002) and policy interventions that obstruct the normal working of the market forces, as in Cole and Ohanian (2004).

The analysis presented by Cole *et al.* (2005) deserves some critical discussion. The 1929–1932 data show that a positive log deviation from the trend of real wages was accompanied by a negative log deviation from the trend of output in 13 of the 17 countries considered. This means that the relationship between real wages and output was negative in the vast majority of countries. True, the interpolation of the plotted data gave an upward-sloping line. But the observations in the plot were highly dispersed, so that the R^2 was very low. Moreover, considering that the countries under consideration differed substantially in this period, the fact that an international increase in the rate of growth of wages was accompanied by a diminishing rate of decrease in output does not necessarily mean that (as long as real wages increase in each country) we should expect a parallel increase in real output. Many other factors that have not been taken into account here could influence the results – for example, internal political factors (such as the role of unions and of socialist parties), international political factors (such as war reparations and war debts) and exchange problems in connection with problems in the balance of trade.

4.2 Case Studies

The case study analyses are all contained in a special issue of the *Review of Economic Dynamics*. Four of them, concerning, respectively, Canada, Germany, France and the United Kingdom in the 1930s, will be considered here.²³

4.2.1 *Canada*

Amaral and MacGee (2002) carried out a comparative analysis of the Great Depression in Canada and the USA, using an RBC model that is formally equivalent to that used by Cole and Ohanian (1999). Their principal result is that an exogenous

shock to TFP could reproduce about 50% of the Canadian depression. This shock also performed well in accounting for the slow recovery. Moreover, building on arguments by Cole and Ohanian (2000), they excluded the possibility that monetary factors could have played a major role in causing the Canadian Great Depression. Finally, they tested the importance of terms-of-trade shocks in explaining the depression. During the 1930s, Canada's economy was small, and trade constituted a high proportion of GDP; trade shocks were certainly appreciable at that time. The test was done by running a simulation on a two-country RBC setup, under the limiting assumption that inputs are nontradable goods. The results show that terms-of-trade shocks are unable to account for the Great Depression in Canada.

The comparison between Canada and the USA is interesting, although puzzling. It shows that, in spite of some similarities in the general economic trend between the two countries, the USA experienced a recovery starting in 1933, while Canada did not. The US recovery was characterized by a strong TFP recovery. TFP, in effect, came back to its trend level by 1937 in the USA, while it remained below the trend level throughout the 1930s in Canada. Interestingly enough, the time of recovery coincided with the implementation of New Deal policies in the US, while Canada had no such policy. On the other hand it is surprising to note that, while all the aggregate variables suggest that from 1933 onwards the USA was on the path to recovery (unlike Canada), the total hours worked increased more rapidly in Canada than in the USA during this time.

Amaral and MacGee (2002) tried to solve these problems by using Cole and Ohanian's (2001) ideas; they argue that New Deal policies in the USA affected labour employment negatively, and therefore measured TFP (which is a residual) tended to be, *ceteris paribus*, higher in the USA.

In my opinion this explanation conceals some logical pitfalls. Amaral and MacGee argue that the economy in the USA recovered earlier than in Canada, because TFP in the USA recovered earlier than in Canada. Such a faster recovery, they suggest, did not create higher employment in the USA than in Canada, because New Deal policies independently affected the labour market in the USA. So, contrary to expectations, Canadian employment recovered earlier than the US employment. So far, the argument works. But then Amaral and MacGee (2002) add that the higher trend of TFP in the USA could depend upon the lower trend in employment! This introduces a circularity in the argument. It might safely be concluded that New Deal policies were the instrument that dragged the USA economy out of the depression because, paradoxically, by allowing for higher unemployment, they allowed for higher TFP, which, in the RBC framework, is the driving force of the economy. This paradox suggests that explanation does not withstand closer examination, leaving the puzzle of why employment recovered earlier in Canada than in the USA unresolved.

4.2.2 Germany

While the USA was the epicentre of the Great Depression, Germany was certainly the European country that experienced the worst depression in the early 1930s. In their

paper analysing the Great Depression in Germany from an RBC perspective, Fisher and Hornstein (2002) first observed that detrended US and German data are quite similar in terms of rates of variation, so that, in their opinion, the two phenomena are comparable. Interestingly enough, Germany recovered to its 1928 trend level in 1937, while the USA was still depressed at that date. The paper claims that one or more real shocks could account for the behaviour of the German economy, without any need to refer to monetary shocks or international constraints. Fisher and Hornstein (2002) considered three real shocks that seemed to them to be in accordance with the data: real wages, TFP and fiscal policy. Until 1933 Government policies and union strength caused real wages to increase. In their model, such an increase in real wages could explain the fall in hours worked per working-age person. However, as real wages began to decrease after 1933, the high-wages hypothesis could not account for the slowness of the recovery. The predictive capacity of the model improved when fiscal policies (restrictive up to 1932, and very expansive after Hitler seized power and public expenditure on the military increased massively) and exogenous variations in TFP were added to the model. On the other hand, the model incorporating all three shocks overestimated the magnitude of the fluctuations. In their conclusions the authors suggest that endogenizing TFP by means of the concept of capacity utilization could improve the results of their simulations.

The logic of these results is the usual explanation of a standard RBC model with government expenditure and distorting taxation. An exogenous TFP negative shock, together with a deflationary fiscal policy in the early 1930s, contributes to explaining the onset of deflation. The labour demand curve shifts downwards. Nominal wages rigidities and unions explain the increase in real wages, and therefore the transformation of deflation into a recession. There is a move along the new labour demand curve. With the change in the government, and the accession of Hitler to power, fiscal policy becomes expansive, while prices and nominal wages are controlled, mainly through the abolition of unions. High government expenditure causes a strong crowding-out effect, with public consumption subtracting resources from the private sector. This induces an appreciable 'wealth effect', because people, feeling poorer, are now willing to work more. The labour supply curve shifts rightwards, which explains the recovery in production.

4.2.3 France

If the German Great Depression can be cast in an RBC framework (as argued by Fisher and Hornstein (2002)), the French case (analysed by Beaudry and Portier (2002)) has proved to be a much harder task. According to what Beaudry and Portier (2002) call 'the conventional wisdom', the Great Depression in France was a relatively minor episode, mainly due to monetary factors. France was largely isolated from the Great Depression until roughly 1932, thanks to an undervalued French franc. When the UK and USA left the gold standard and devalued their currencies, in 1931 and 1933, respectively, French production for export started to decrease and precipitated France into a recession that was significant, although less dramatic than in other countries. At the trough of the recession the French unemployment

rate was about 5%. Deflationary policies put into effect by Prime Minister Laval in 1935 worsened things. The recovery was finally due to the devaluation of the franc in 1936, after the leftist Popular Front won the elections.

Against this view, Beaudry and Portier (2002) note that if we look at detrended data, a different picture emerges, which is much more comparable with Cole and Ohanian's (1999) analysis. In terms of detrended data, the depression in France began in 1930, and there was no recovery during the 1930s: assuming 1929 = 100, detrended output in 1939 was 67.5. Moreover, there was no acceleration of the depression after 1933. Finally, international trade only accounted for a small proportion of French output at this time, and for reasonable values of the elasticities of substitution for intermediate goods, an international trade shock can only account for a small part of the fall in output in the model.

Having established the similarity between the French and the US Great Depressions, Beaudry and Portier (2002) checked whether Cole and Ohanian's (1999) main explanation for the US Great Depression (namely an exogenous drop in TFP, followed by distorting economic policies) also works for France. They found that the shock to TFP fails to explain the magnitude of the detrended output drop. Moreover, they found it to be misleading as far as the long duration of the depression is concerned.

Disappointed with the traditional RBC model, Beaudry and Portier (2002) examined whether a business cycle model derived from a vintage capital endogenous growth model performed better. They introduced the embodiment hypothesis (that is, a hypothesis stating that technological improvement only affects new capital goods, i.e. investments, rather than the whole capital stock) into the RBC setup, and supposed that the impulse mechanism of the business cycle was a shock to the input side. Simulations run under these conditions showed a much better fit to the data. The rationale for this result is intuitive. If technological progress is embodied in new investment goods, the drop in the investment to output ratio will have an indirect effect on the rate of technological progress achieved (that is, on the technological progress that is applied to the production of goods and services). In this way, a recession caused by a reduction in the use of inputs will tend to self-replicate.

In order to explain the source of these variations in investments and employment, Beaudry and Portier (2002) argued in favour of some institutional change lowering the steady-state level of total hours worked and the capital to output ratio. In this respect, following Cole and Ohanian (2001), they suggested that a likely culprit for the protraction of the depression after 1936 is the formation of a leftist government in 1936 that reduced by law the number of hours worked for a given wage (i.e. increased the real wage rate). According to Beaudry and Portier (2002), the French depression was merely a normal adjustment process to a lower steady-state growth path induced by institutional modifications.

4.2.4 The United Kingdom

The last case study I want to consider in this section is the analysis of the Great Depression in the United Kingdom from an RBC perspective by Cole and Ohanian (2002). In this paper the authors undertook a growth-accounting exercise, leading them to exclude the view that a TFP shock could adequately account for the 20-year-long depression in the United Kingdom. Detrended data show that both TFP and capital input increased between 1920 and 1938, while labour input decreased markedly, compared to the pre-World War I average. Moreover, they argue that Keynes's (1931) position on the relationship between exchange rate policy, exports and recession was inconsistent with the available data.²⁴ They argue that the restrictive exchange rate policy (i.e. the adoption of the gold standard system with the British pound pegged to its pre-War level) dates to 1925, while, using their definition, the recession began far earlier, in 1919. Moreover, in modern RBC-style models, monetary shocks do not have a propagation mechanism strong enough to account for such a long-lasting depression.

Having excluded the monetary origin of the British depression, Cole and Ohanian proposed an alternative explanation, based on a series of circumstances affecting the labour supply. On the one hand, the diminishing competitiveness of the British economy in producing some traditional export goods led to changes in the structure of production, and to a necessary relocation of the highly concentrated British industrial firms. On the other hand, the contemporaneous adoption of a postwar policy of housing subsidies increased the opportunity cost of moving house, thereby deterring households from following job vacancies around the country. As a third factor, Cole and Ohanian (2002) consider the existence of a 'generous' unemployment benefit scheme. According to this view, the Great Depression in the United Kingdom can be attributed to contingencies and policies causing a leftward shift in the labour supply schedule.

5. A Critical Perspective

The task of tackling the Great Depression from an RBC perspective represents an outstanding methodological innovation, in that an earlier self-imposed limit to equilibrium theory has been breached. In this respect, Cole, Ohanian and Prescott should be credited with initiating this line of research.

For better or worse, the Great Depression is a powerful litmus test for RBC theory and method. At stake is whether specific historical events such as the Great Depression are amenable to RBC theory, or whether there are some theoretical or methodological limits to its scope. A broader perspective is then implied, which goes beyond the case study of the Great Depression, and involves the whole literature on RBC. At this juncture no definitive conclusion can be drawn. Therefore I will limit myself to a few tentative observations.

The general picture that emerges from this survey is that the account of the Great Depression given by RBC authors has two basic characteristics. First, they consider a strictly national phenomenon. Second, they view the Great Depression as a business cycle in the RBC sense, although peculiar in both its magnitude and duration. They explain its onset by means of some exogenous shock, while its protracted character is explained by some additional shock, or by the high persistence of the exogenous shock itself.

This vision stands in sharp contrast to the accepted wisdom of economic historians. Eichengreen and Temin (2000), for example, stress the role of Gold Standard policies in causing the onset of the Great Depression and its widespread diffusion around the world. More generally, all the historians who have studied the period stress the role of both international monetary constraints and some tension-widening socio-political situations (broadly related to the Russian communist revolution and the consequent emergence of strong leftist parties).²⁵ For them, the international dimension is crucial for the correct understanding of any national situation. Historical analysis tends to consider the Great Depression as a specific outcome of a set of historically specific causes; it does not share the 'normality' perspective at all.

Assessing which of these competing views is correct is a hard task, which I am unable to undertake at the present stage. What can be observed here is that, at first sight, the arguments adduced to support the new RBC approach do not seem robust enough to subvert the accepted historical wisdom. While the empirical argument advanced by Cole *et al.* (2005) is lacking definitive evidence, the insights that led. for example, Romer (1993) and Cole and Ohanian (1999) to analyse the US Great Depression in a national perspective (i.e. the observation that the USA was an almost closed economy that experienced a bigger and longer depression than other countries) do not apply to other countries such as France or Germany. On the other hand, it must be admitted that the RBC case studies of the USA and other countries reviewed above are the first attempt to submit the Great Depression in different countries to the same methodological inquiry. Beyond its undeniable heuristic value, such an attempt might prove useful in providing new insights and perspectives, so improving our understanding of the period under examination. Further research comparing the RBC interpretation of the Great Depression worldwide with the work of leading economic historians is highly desirable to clinch the matter.

My main critical observations on the research by Cole, Ohanian and Prescott concern their methodological premises. These authors stuck strictly to the methodology highlighted in Section 2, erecting a borderline between the realms of history and economics. In their view, economics is basically concerned with the elaboration of models, and trying to reproduce a given set of data by the model's response to an unidentified exogenous shock. On the contrary, history has the role of giving both content and meaning to the exogenous shock. The acceptance of the normality view in this methodological context implies that, for the economist, the real question at stake is the long duration of the Great Depression, its onset being, as clearly stated by Prescott (1999), but a minor issue.

This methodological stance suffers from drawbacks when applied to the interpretation of the Great Depression. In view of the improvement in our general knowledge of the Great Depression, resorting to an exogenous TFP shock in order to explain its onset is not satisfactory, certainly not as satisfactory as the rich historical accounts already available (for example, Kindleberger (1973) and Eichengreen (1992)). TFP is nothing more than a black box for analytical purposes (Hulten, 2000). Summers's (1986) acute criticisms undermine Prescott's argument that the exact origin of a shock is a secondary issue, provided that the model can mimic a given set of data. Extremely bad theories can predict remarkably well... Many theories can approximately mimic any given set of facts; that one theory can, does not mean that it is even close to right. (Summers, 1986, p. 24)

Summers (1986) emphasizes that the history of scientific thought is full of plainly wrong theories that nevertheless fitted the data well (for example, the cases of Lamarckian biology and Ptolemaic astronomy).

Be that as it may, the TFP story also presents some internal consistency problems. Consider the analysis of the USA. While in Cole and Ohanian's simulation, the drop in TFP explains only 40% of the contraction phase, such a drop is abnormally large when compared with the behaviour of TFPs in the post-war era (Ohanian, 2002). This feature leads Cole and Ohanian up a blind alley. If the abnormal dimension of the drop in TFP is due to some measurement error, then the true TFP drop during the 1930s must have been much less. This implies that a TFP-driven RBC model will explain much less than 40% of the output drop. Moreover, a lower TFP drop would mean that inputs must have decreased more, thus increasing the puzzle of why the level of employment of the labour force and the degree of utilization of capital were so low. If, on the contrary, the value of the TFP drop in the 1930s is reliable, as Ohanian (2002) suggests when referring to an 'organizational capital' concept,²⁶ then the puzzle becomes why output decreased so little. If the post-war ratio between TFP and output drop were maintained, output would have decreased much more. To summarize, if the Great Depression were merely a business cycle, it must show the typical regularities of business cycles, including similarities between the variations of outputs and TFPs.

A further aspect of the application of RBC methodology to the Great Depression worthy of notice is the indeterminateness of results. Small modifications in models sharing the same fundamental transmission mechanisms induce big variations in the results. Such modifications mostly involve unverifiable assumptions, such as the presence of taste shocks, the degree of nominal stickiness and so forth. As an example, consider the sticky-wages story, which, according to Bordo et al. (2000), is the cause of the onset of the US Great Depression, although Cole and Ohanian (2000) consider it totally irrelevant; or the quantitative equivalence between demandshock-driven and supply-shock-driven explanations of the US Great Depression (Weder (2001) vs. Cole and Ohanian (2001)). This last point deserves some attention because the quantitative dimension of RBC theory has always been thought of, by its proponents, as one of its major strengths, allowing as it does for the comparative evaluation of different theories on a quantitative basis. This has been viewed as a big step forward in economic theory, leading towards improved scientific rigour. In theory, the economist analyses each hypothesis by means of the benchmark model, and then chooses the one that best fits the data. However, the ambiguous results reported here for the Great Depression suggest that RBC methodology does not provide suitable criteria for choosing among competing theories. In other words, the researcher has no means to assess which theory is correct, among those with comparable data-mimicking ability. This weakness of the verification technology is a big flaw in RBC theory, and lends credence to Summers's (1986) arguments.

In the context of the analysis of the Great Depression, another technical issue arises. Most RBC models are solved numerically or by means of linearization around the steady state. Numerical solution is a useful tool allowing a computer to approximate, by numerical iteration, a stochastic dynamic system that is otherwise insoluble. The attractiveness of the tool is that it allows the researcher to elaborate more complex models (think of Christiano *et al.* (2004)). Its drawback is that the economic interpretation of the results is far from obvious, relying more on the narrative intuition of the economist than on Lucas's celebrated discipline. As to linearization around the steady state, it is a well-known fact in economic dynamics that the properties of a linearized system are approximately valid only near the steady state. If the suggestions that the US economy was anywhere near a steady state in 1931–1939. In this case, a linear approximation may lead to highly misleading results.

As far as the normative aspect is concerned, the general approach of RBC theory to economic policy is markedly *laissez faire*, as the following quotation from Mankiw (1989) illustrates.

Since real business cycle theory describes economic fluctuations as a changing Walrasian equilibrium, it implies that these fluctuations are efficient. (Mankiw, 1989, p. 83)

This standpoint naturally applies to the Great Depression case. As far as the US Great Depression is concerned, there is widespread agreement among RBC authors on the negative impact of New Deal policies, which are seen as causing the exceedingly long duration of the Great Depression. Weder (2006) and Harrison and Weder (2002) are the exception, insofar as they consider the Great Depression to be a demand-driven phenomenon, which required some policy intervention. Bordo *et al.* (2000) and Christiano *et al.* (2004) take somewhat intermediate positions. On the one hand, these two papers see the NIRA as a concomitant cause of the long duration of the Great Depression. On the other hand, they argue that a more expansive monetary policy would have allowed nominal rigidities to be overcome, thus possibly making the depression much less severe. As to the analysis of the Great Depression worldwide, the pro-*laissez faire* stance is even more marked than it is in the analysis of the United States:

... Government policies that affect TFP and hours per working-age person are the *crucial determinants* of the great depressions of the 20th century. (Kehoe and Prescott, 2002, p. 15, added emphasis)

The traditional Keynesian view that New-Deal-like policies, devaluation and public expenditure on armaments dragged the world economy out of the Great Depression is thus turned upside down by RBC authors. In the RBC view, economic policy is viewed as the principal cause of the event called the Great Depression. This position echoes the old 'liquidationist' view held in the 1930s (in their policy implications, if not in their analyses) by outstanding contemporaries such as Hayek, Robbins and Schumpeter (Bernstein, 1987; De Long, 1990). A comparative analysis

of this stream of literature and RBC theory could clarify whether RBC models of the Great Depression bring new insights to the vexed question concerning the role and effectiveness of economic policy during the 1930s.

6. Conclusions

The Great Depression has been considered for years as the main exception to Lucas's claim that 'all cycles are alike' and therefore call for the same theoretical explanation. In this paper, I have reviewed some recent attempts by RBC authors to bridge this gap between the new classical equilibrium method and the explanation of the Great Depression. While it is too early to draw definitive conclusions, some suggestions for future research have been identified in Section 5.

RBC theory defines business cycles in terms of regularities in the relative behaviour of economic aggregates. Events are amenable to the theory insofar as they show such co-movements in these variables. In this sense, the very fact of trying to tackle the Great Depression with RBC theory is tantamount to assuming that the Great Depression was a business cycle in the RBC sense. I have called this assumption the 'normality view'.

The normality view has important implications, as it is the conceptual basis for the change of the dating of the Great Depression. Before the RBC interpretation, people spoke of a Great Contraction in 1929–1932 and of a recovery in the New Deal era. Explanations were highly differentiated, but the dating was a matter of accepted wisdom. RBC authors, however, interpreted the Great Depression as the whole 1929–1939 period, as output did not recover its trend level during this time, whereas TFP had already recovered by 1936. The normal co-movement between TFP and output implies a recovery that did not actually occur. Therefore, the Great Depression becomes the whole decade, and the 'puzzle' to be solved is why output remained below its trend level for so long. This view is completely new, and the fact of having brought it to the forefront has an intrinsic heuristic value. Cole and Ohanian in particular must be credited for this.

However, the normality view is by no means an uncontroversial assumption. Many historians have taken the opposite view, namely that the Great Depression has deep roots in specific historic circumstances and institutional factors. In other words, it was a single event.

The contrast between these competing viewpoints is intensified by the methodological stance of RBC theory. Business cycles are conceived of as the equilibrium reaction of a modelled economy to some kind of exogenous random shock. The exact identification of the content of the shock is a minor issue with respect to the comprehension of the propagation mechanism. Taking this reasoning to extremes, an inquiry into the cause of any business cycle is seen as outside the domain of economic science, a theme to be left to historians. The application of such a methodology to the Great Depression, however, takes the theory into difficult territory. Because of the method of analysis, the substantive contribution of RBC literature to our general knowledge about the Great Depression is, at most, limited. None of the papers using TFP technology contribute at all. Others, recasting old ideas such as preference for

liquidity, sticky wages and animal spirits in the new classical framework, may be credited with translating old concepts into the new accepted scientific language. This is definitely a feat. But is this enough to talk of a new interpretation of the Great Depression?

RBC methodology puts renewed stress on the quantitative dimension of the analysis and on empirical verification when undertaking the task of analysing historic events such as the Great Depression. This is an important discipline, and subsequent research should take it into account. The theoretical no-compromise approach and the constant reference to empirical evidence should allow researchers to discriminate between good theories and bad theories. Unfortunately, the results of RBC models of the Great Depression are actually quite poor, despite the valuable quantitative effort. As shown in this review, many competing theories of the Great Depression have been advanced, each mimicking the data to a similar extent. The point is that the RBC method does not allow us to discriminate among theories with the same data-mimicking ability. This is a big problem that needs to be addressed in the future.

Acknowledgements

I wish to thank Michel De Vroey for his prodding supervision, and David de la Croix and Franck Portier for criticisms and suggestions. Gabriele Cardullo, Mario Denni, Emanuele Massetti, Giulio Nicoletti and Alessandro Sommacal made useful comments on an early version of this work. Mirella Albano improved the language of this article. The usual disclaimers apply. Financial support from the Belgian French-speaking Community (Grant ARC 03/08-302 'New Macroeconomic Perspectives on Development') and from the Belgian Federal Government (Grant PAI P5/21 'Equilibrium theory and optimization for public policy and industry regulation') is gratefully acknowledged.

Notes

- 1. Throughout this article, I will use the epithets RBC and New Classical as synonymous. The focus here is on the methodological aspect of tackling the Great Depression within a neoclassical equilibrium framework. In view of this methodological focus, the distinction between real or monetary shocks is less important than the general method of analysis. This is also the reason why I do not make any *a priori* distinction between RBC and Dynamic Stochastic General Equilibrium (DSGE) models (DSGE being the most recent label adopted in the literature to denote such models). I will, however, refer to a similar distinction when discussing a specific methodological aspect, namely whether the models considered are or are not involved in causal perspectives. Preference is given to the RBC nomenclature.
- 2. For surveys of the RBC literature see, *inter alia*, Hartley *et al.* (1997), Mankiw (1989), Plosser (1989), Ryan (2002) and Stadler (1994).
- 3. Moreover, these definitions produce some odd results. Kehoe and Prescott (2002) argue that Switzerland has been experiencing a Great Depression since 1973, on the grounds that detrended output per person of working age fell by more than 30% between 1973 and 2000, with a decline of more than 18% between 1973 and 1983.

Anyone can witness, however, that life in Switzerland in the last 30 years has had very little in common with life in the USA during the 1930s!

- 4. Here I refer to the dating of the event called the 'Great Depression', not to the dating of its alleged causes. In effect, many of the authors quoted in the text consider the causes of the Great Depression to be rooted in events that occurred well before 1929. Eichengreen (1992) and Friedman and Schwartz (1963) are examples. An exception to this general tendency to date the Great Depression between 1929 and 1933 is Galbraith (1995), who criticises this idea from a post-Keynesian point of view, asserting that the Great Depression never ended, but was swept away by the outbreak of the Second World War.
- 5. Solow (1957). See Hulten (2000) for a review of TFP.
- 6. This is also the position held by Romer (1993). Although working from a different basis, she argues that the Great Depression in the US was due to a mixture of bad monetary policy and aggregate demand shocks, both with idiosyncratic characteristics specific to the American case.
- 7. In the taxonomy adopted here, it is doubtful whether this last class of models should be included in the RBC category. First, expectation shocks are neither exogenous nor endogenous, in the sense that their nature is ambiguous. On the one hand, the very concept of 'animal spirits' suggests that variations in expectations should be considered as an exogenous shock. On the other hand, it defies credulity to assume that people form expectations without looking at reality, or framing it in some causal perspective, i.e. in a model. In this sense, the shock must be at least partially endogenous. Secondly, be that as it may, by definition expectation shocks are not shocks to the fundamentals of the economy, which we have assumed to be a distinctive feature of RBC theory. The counterargument that leads me to include sunspots models in my taxonomy of RBC is that they are 'equilibrium' models à la Lucas, they use the Slutzky intuition of business cycles as summation of random shocks, and they distinguish between the impulse and transmission mechanisms of the business cycle. Being unable to choose whether or not to include sunspots models in the RBC category, I have decided to include at least one of them for the sake of completeness.
- 8. Their objection to the first theory is that deflation was more widely anticipated in the 1930s than in the 1920s because the nominal interest rate was lower during the 1930s. This weakens Lucas and Rapping's (1969) propagation mechanism, which is based on unexpected deflation. As to Fisher's (1933) debt deflation model, they note that, although the level of private debt as a proportion of output was higher in 1929 than in 1920, output dropped more sharply during the 1930s than during the 1920s, despite deflation being less severe. Prices went down by 19.4% in 1920–1922 and by 11.5% in 1929–1931, whereas detrended real income dropped by 3.8% in the 1920–1922 and by 22.4% in the 1929–1931 period. See Cole and Ohanian (2000), p. 6, Table 3.
- 9. This is a technical assumption needed in order to be able to compute the equilibrium in the simulation recursively.
- 10. The economic rationale for this result is as follows. In this two-sector model, wage rigidity has both a direct and an indirect effect on employment. In the distorted sector, firms employ labour up to the point where the marginal product of labour equates to the real wage. Because, by definition, the real wage in this sector is above the market-clearing level, production in the distorted sector will be below its potential level. It follows that part of the labour force potentially employable in the distorted

sector will remain unemployed. Such a direct effect is clearly negative. To understand the indirect effect, it is worth considering that output in the distorted sector is an input in the production of the final good. Cole and Ohanian (2000) assume that technology is such that Y_m and Y_n are imperfect complements in the production of the final good, rather than substitutes. This means that, as Y_m diminishes, its relative scarcity will increase, and so will its relative demand. Firms cannot substitute Y_n for Y_m beyond a certain level. Thus p_m/p_n , the relative price of the distorted sector, must increase. According to the authors, this means that, given a monetary wage w_m^* , the real wage w_m^*/p_m will decrease. In other words, the real wage will decrease in spite of the nominal rigidity, thus producing an upward shift in the value of the marginal product of labour (i.e. the marginal product of labour multiplied by the price of output schedule). Thus the indirect effect would tend to counteract the direct one.

- 11. This point is actually controversial. For instance, Bordo et al. (2000) argue that data at the industrial level suggest that there was no significant skill composition bias.
- 12. The NIRA was enacted in 1933 and declared unconstitutional by the Supreme Court in 1935. The act aimed to ensure that all sectors were covered by 'codes of fair competition', which would put an end to substantial price deflation and increase workers' income, so promoting greater consumption expenditure. The NIRA also suspended anti-trust laws, and encouraged cooperation between firms, and collusion in price setting; it heavily discouraged price competition, requiring administrative approval for price cuts. The codes, though different for each sector, had to be negotiated under the guidance of the National Recovery Administration, and required the approval of the President. Cole and Ohanian (2001) stress that Roosevelt's political inclinations, as well as the deep conviction of his advisers that an increase in prices and nominal wages would be the best way to counteract the Depression, led him to guarantee approval to those codes that included collective bargaining over wages, and minimum wages for low-skilled workers.
- 13. The NLRA was enacted in 1935, and its constitutionality was upheld by the Supreme Court in 1937. It gave workers the right to organize themselves into trade unions independent of their employers; it prohibited discrimination based on union affiliation, as well as coercive enrolment in companies' unions. The Act also established a National Labour Relations Board (NLRB), which had the authority to guarantee the legal enforcement of wage agreements.
- 14. It is very interesting to note that the view that the NIRA policy probably had a negative impact is not the prerogative of RBC theory. J.M. Keynes, in an open letter to Roosevelt published in The New York Times in 1933, expressed his disagreement with this policy as a means of producing a recovery. He argued that the fact that an increase in prices and monetary wages generally characterizes the recovery periods does not mean that it causes the recovery to happen. So, in Keynes's view, the US administration had confused causes with effects. In Keynes's opinion the NIRA was probably an obstacle to recovery, because it increased the costs of production, whereas the appropriate measure for ending the recession was a policy of large government expenditure, financed by long-term public debt, together with a monetary policy that fixed low nominal interest rates. Keynes's diagnosis was that people were not spending money, and that this was causing the cumulative deflation that resulted in depression. To restart a virtuous circle of development, people had to be induced to spend. If this were not possible, a good surrogate for the missing private expenditure would be government expenditure. In the end, the increase in the aggregate demand would generate an increase in the general level of prices.

- 15. Expansionary monetary policy generates price inflation; provided that nominal wages are rigid, real wages will go down. This will produce an increase in labour demand and hence in output.
- 16. Quarterly data are used here.
- 17. Because consumption demand decreases.
- 18. Weder first derives an Euler equation from the first-order conditions for the household's utility maximization problem. He then linearizes the Euler equation, taking a Taylor approximation of it. Finally he uses ordinary least squares to regress the formula he obtained on the data, and takes the residual from the regression as the preference shifter. The dynamic process of this preference shifter is then found econometrically to be second-order autoregressive, of the kind

$$\hat{\Delta} = \xi_1 \hat{\Delta}_{t-1} + \xi_2 \hat{\Delta}_{t-2} + d_t / c$$

Weder (2006) uses this AR(2) to compute a shock series $\{d_t/c\}_{1930}^{1939}$ from the data.

- 19. In the sense that the null hypothesis that the residuals do not Granger-cause output is rejected at a confidence level between 5% and 2%, depending on whether 4 or 8 lags are used (Harrison and Weder, 2002, Table 3, p. 17).
- 20. The term 'consensus view' is used by Cole *et al.* (2005) to refer to papers by Bernanke (1995), Bernanke and Carey (1996) and Eichengreen and Sachs (1985).
- 21. Two random variables x and y are said to be orthogonal if their cross moment E(x y) is zero. In the present case, the favoured procedure is one that orthogonalizes the TFP shock on deflation. This means that the authors regress TFP on deflation, and then subtract the value of TFP obtained by the regression from the actual TFP value. In this way the residual TFP is not correlated with deflation, as the effect of deflation on TFP has already been taken into account by the regression.
- 22. These data refer to the USA, Canada, the UK and Australia.
- 23. For the sake of completeness, the other papers in the issue concern Italy's mild depression of the 1930s, Japan's crisis in the 1990s and analyses of South-American countries' depressions in recent years. I omitted Italy, because the Italian depression was smaller than the others and a bit peculiar (Perri-Quadrini, 2002). Instead I have focused on Canada, to compare it with the United States.
- 24. Keynes's (1931) basic idea was that gold standard constraints forced British policy makers to adopt a strongly deflationary policy, in order to achieve equilibrium in the balance of trade. This was necessary because the high value of the pound caused difficulties in the export sector.
- 25. See, inter alia, Eichengreen (1992) and Hobsbawm (1996).
- 26. Ohanian (2002) suggests that diminished efficiency in combining inputs to produce output might be understood as a general efficiency drop due to widespread failures in the economy. Surviving firms had to look for new suppliers and new customers. Moreover, firms' responses to sudden crashes are sometimes to adopt new technology, which might cause temporary efficiency decreases due to its adoption costs.

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