The Key Empirical Features of Economic Recessions under Capitalism

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Abstract

In this paper, I present empirical findings on economic recessions in a wide range of capitalist economies from the late 19th century to the present day. There are key stylised facts which any scientific model of the business cycle ought to be able to replicate.

I consider evidence such as:

- *The distribution of the size of recessions*
- *The distribution of the duration of recessions*
- *The distribution of 'wait times' between recessions*
- *The international cross-correlation of recessions: the number of countries in recession in any given year*
- *Was the Great Depression of the 1930s an entirely different type of event to other recessions?*

I set out some ideas on the prospect for developing theoretical models of the business cycle, and the methodological approach which I believe has the best chance of success. I suggest that most recessions are not primarily due to financial crises, but can be modelled in the context of Keynesian sentiment percolating across network of agents.

1. Introduction

Simon Kuznets carried out exceptionally outstanding work in both theoretical and empirical economics. But it is his emphasis on empirical work which distinguishes him from many modern economists, and which shows him to have been a true scientist of distinction. Empirical work is both valuable for its own sake and as a motivator of theory.

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2. Data

I take a long perspective, and consider the experiences of a broad range of Western economies since the late 19th century, the period by which they could all reasonably be regarded as industrial rather than agricultural economies. The main data source is the annual real GDP data for 17 Western economies available from 1870 to 1994 in Maddison, (1995)[1] . Data over the 1995-2010 period is from the IMF database. (Strictly speaking, the two sources are not exactly comparable since the Maddison data is in real Geary-Khamis dollars and the IMF in real domestic currency, but given that the definition of a recession involves the growth rate of GDP, this is of little consequence). The data is available in an Excel file on application to the author.

The conventional definition of a recession, using annual data, is a year in which the rate of growth of real GDP is less than zero. A more sophisticated approach to defining a recession is that of the National Bureau of Economic Research[2], where a team of distinguished economists apply judgement to a wider series of economic indicators in order to define a period of recession, which can be summarised as a 'period of significant decline in economic activity'. The main indicator they use is in fact GDP, but they take into account other variables such as employment. The conventional approach and that of the NBER usually give the same result. But NBER-type indicators are not

[1] The countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, New Zealand, Norway, Sweden, Switzerland, UK and US

[2] http://www.nber.org/cycles/recessions.html

generally available for some of the countries in the data set, and even when they are, relate only to the decades at the end of the 20th century.

So the analysis is carried out using the standard definition. The duration of a recession is the number of consecutive years in which real GDP growth is less than zero. The size of a recession is the cumulative percentage fall in GDP during these years.

As a check on robustness, in Ormerod (2010) I examined the data 1871-2008 using an alternative definition, in which a recession is defined as being the entire period over which real GDP remains below its previous peak level. In other words, even when positive growth is resumed, the level of GDP can still be below the previous peak, and on this definition, such years are counted as recession years. The size of the recession on this definition is the cumulative percentage fall in GDP below its previous peak value. The qualitative nature of the results is very robust with respect to the definition. This alternative definition is not used here, because in most countries on this definition at the time of writing the recent recession is not yet over (the United States is a notable exception), and so no further data points are available.

3. The resilience of capitalism

The striking feature of the data is how quickly the economies recover after a recession. This certainly does not mean that they are in any way in equilibrium, but they have very strong properties of resilience.

Prior to the 2008 financial crisis, around two-thirds of all recessions had lasted for just a single year, and nearly 90 per cent lasted just one or two years. (More nuanced estimates of duration can be obtained when quarterly GDP data is available. But such data is not available for any country prior to World War Two. For the UK and the US it is available since then, but in other countries these estimates were not made until considerably later).

This experience was borne out by the recent crisis. One country in the sample, Australia, did not experience a recession at all. In 11 of the 17 countries, output fell only in 2009 and positive growth was resumed in 2010. And in 5 of the countries, output fell in both 2008 and 2009, but in each of these, growth in 2010 was also positive.

Table 1 summarises the evidence.

Table 1 Duration of recession, years, i.e. number of consecutive years in which real GDP growth is less than zero

	Years						
Number	1	2	3	4	5	6	7
	175	63	20	6	5	1	1

The sample period, both in terms of time and country, embraces a very wide variety of different approaches to economic policy by individual governments and international bodies. So it is unlikely

that rapid and successful policy responses are the reason why the typical recession is of such short duration. It is more reasonable to postulate that this is an inherent feature of how the economies operate.

The distribution of the duration of recessions appears to be robust with respect to the size of the initial shock, in other words the fall in output in the first year of the recession. So, for example, if we divide the sample into recessions where the initial fall was very mild, less than 1 per cent, and those where it was more than one per cent, the distribution of duration of the recessions in the two sub-samples is almost identical. This continues to be the case up to an including initial drops of 6 per cent in output, a very serious fall indeed (beyond this point there are small sample issues, few recessions start with a fall in output of more than 6 per cent).

Further, the recovery tends to be rapid. Figures 1a and 1b plot the experience of all recessions since the Second World War up to 2008 of one and more than one year's duration respectively. In each of the charts, the level of GDP in the year prior to the recession is indexed and set equal to 100.

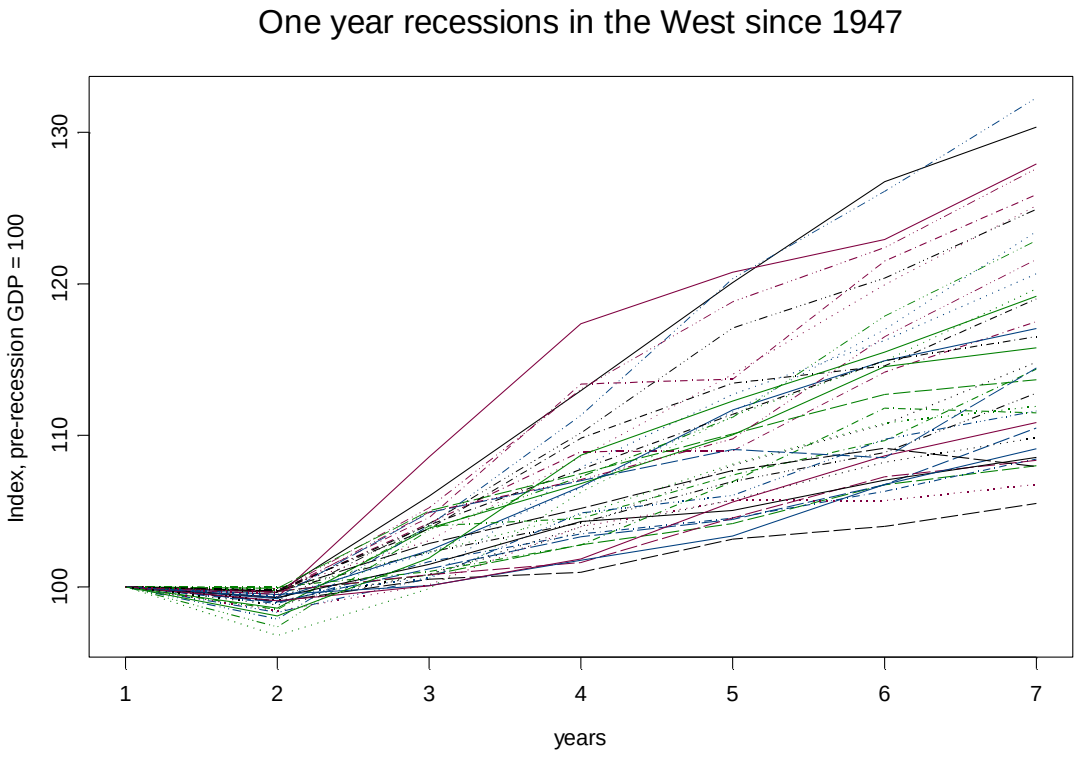

Figure 1a *Recovery profile of GDP in the 37 post-war recessions in 17 Western economies since 1947 which have lasted one year. Year 1 is indexed at 100 for each country at the peak level prior to the recession. Year 2 is the recession year, and years 3 and onwards are the recovery years*

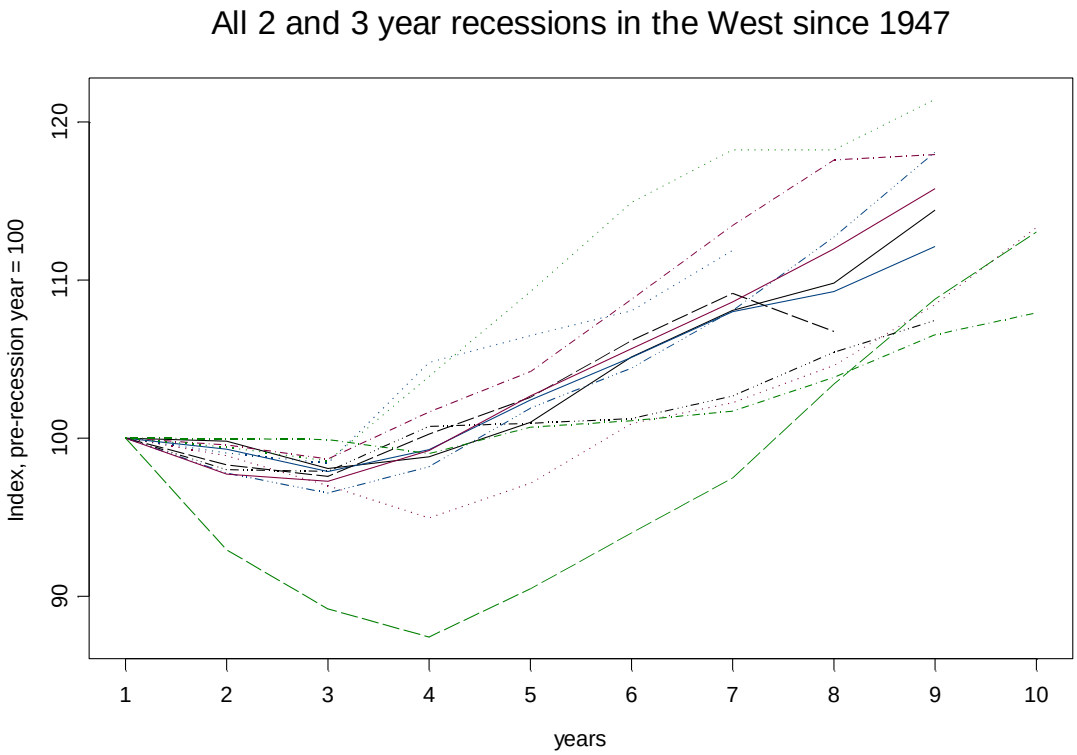

Figure 1b *Recovery profile of GDP in the 12 post-war recessions in 17 Western economies since 1947 which have lasted 2 or 3 years. Year 1 is indexed at 100 for each country at the peak level prior to the recession. Years 2 and 3 are recession years in all countries in the sample, and year 4 is also a recession year for some examples. The extreme drop plotted by the dashed green line is Finland in the early 1990s*

For one year recessions, the mean growth rate in the subsequent year was 3.5 per cent and in the next year 3.8 per cent. For the longer recessions, the numbers are lower but still reasonably strong, at 2.8 and 2.7 per cent respectively.

The experience following the 2008/09 crisis, the most serious financial crisis since the Great Depression of the 1930s, is similar. In 2010, in the countries which experienced a one year recession, growth averaged 2.2 per cent, whilst in the two-year recession countries is was even higher a 3.2 per cent. Noting that this was without any doubt a major financial crisis, the recovery is a remarkable illustration of the resilience of these economies.

A plausible reason for this is that most recessions are essentially inventory cycles. During the upswing, businesses tend to become too optimistic about future prospects. As a result, production begins to run ahead of sales and inventory levels rise. Firms then cut back on production in order to restore inventories to more reasonable levels. As part of this process, fixed investment projects may be postponed. Temporary reductions in capital expenditure plus actions to reduce inventory levels are of themselves inherently of short duration. The adjustment takes place quickly. Of course, this does not answer the deeper question as to *why* it is that firms' expectations recover so quickly.

Keynes, for example, described but did not formalise such an approach. He distinguished very clearly between short-run (chapter 5 of the *General Theory*) and long-run expectations (chapter 12 'The

State of Long Term Expectation'). The former relate to the decision about how much to produce in the immediate future with a given level of capital stock. The second relate to decisions on whether or not to change the amount of capital stock, in other words investment.

In terms of short-run expectations, Keynes postulated that these were formed by an individual agents using a very simple rule of thumb: 'it is sensible for producers to base their expectations on the assumption that the most recently realised results will continue, except in so far as there are definite reasons for expecting a change'. In other words, Keynes' firms are not assumed to perform complicated optimising decisions when setting their level of output. Instead, they operate with limited knowledge of the environment, and use a simple rule of thumb.

For Keynes, the long-run expectations of firms were the most important determinant of the business cycle through their impact on investment. The long-run expectation of a firm at any point in time is not the result of a rational calculation of the amount of profit which an investment is expected to yield. Rather it is a sentiment, the degree of optimism or pessimism which the agent holds about the future.

He regarded such expectations as being subject to great uncertainty, and unanticipated swings. For example, in chapter 12, he writes that 'the outstanding fact is the extreme precariousness of the basis of knowledge on which our estimates of prospective yield [of a new investment] have to be made … If we speak frankly, we have to admit that our basis of knowledge for estimating the yield ten years hence of a railway, a copper mine, a textile factory, the goodwill of a patent medicine, an Atlantic liner, a building in the City of London amounts to little and sometimes to nothing; or even five years hence'.

In other words it is as if - a favourite phrase of economists - firms have very low or zero cognition when taking decisions on whether or not to vary the size of the capital stock. He re-emphasises this view in chapter 22 ('Notes on the Trade Cycle'), where he writes that 'the basis for such expectations is very precarious. Being based on shifting and unreliable evidence, they are subject to sudden and violent changes', and refers to the 'uncontrollable and disobedient psychology of the business world'.

Keynes did not specify a formal model of how such expectations are generated, but there appear to be two components. Most importantly, sentiment is altered across the network of firms as a whole by 'waves of irrational psychology'. Keynes also writes of changes in sentiment being generated as the 'outcome of mass psychology of a large number of ignorant individuals'. This is the key feature of long run expectations. In addition, an agent seems to have the ability to change its optimism/pessimism spontaneously without regard to external factors, including the sentiments of other agents. Keynes writes of 'spontaneous optimism' and a 'spontaneous urge to action rather than inaction'. This is the context in which his famous phrase 'animal spirits' appears.

4. Size of recessions

A prior question in this analysis is the extent to which the data from the 17 individual countries can be regarded as being drawn from the same population. There are 136 pair-wise comparisons of countries in this sample, and the null hypothesis that the size distribution of recessions is identical was tested for each of these pairs. Given the right-skew nature of the distributions, the Anderson-

Darling (1952) test is more appropriate than the more widely used Kolmogorov-Smirnov, and this was the test used. The null hypothesis is rejected at the conventional level of p = 0.05 in only 11 out of the 136 cases, suggesting that it is valid to pool the data from the individual countries into a single sample. There is a very mild suggestion of heterogeneity, since at p = 0.05, strictly speaking, we would expect the null hypothesis to be rejected in only 7 cases, but it is very mild indeed.

This property of the data has distinct advantages. First, from a purely statistical point of view, calibrating a distribution of the data is much more straightforward if the data can be pooled in this way (Lancaster 1979). Second, a more importantly, it does suggest that a common theory of recessions can be offered, whatever that might be. The countries have differed in their political structures, their institutions and their policies, yet the individual size distributions of their recessions can reasonably be regarded as identical.

This analysis is carried out excluding the war years and their immediate aftermath, 1914-19 and 1938-47. This is because, in particular, the drops in output in the defeated powers were much larger than anything experienced in peace time. Following the widespread conventional firebombing of her major cities and the atomic attacks, for example, output in Japan in 1945 fell by 50 per cent.

The size distribution of recessions is plotted in Figure 2.

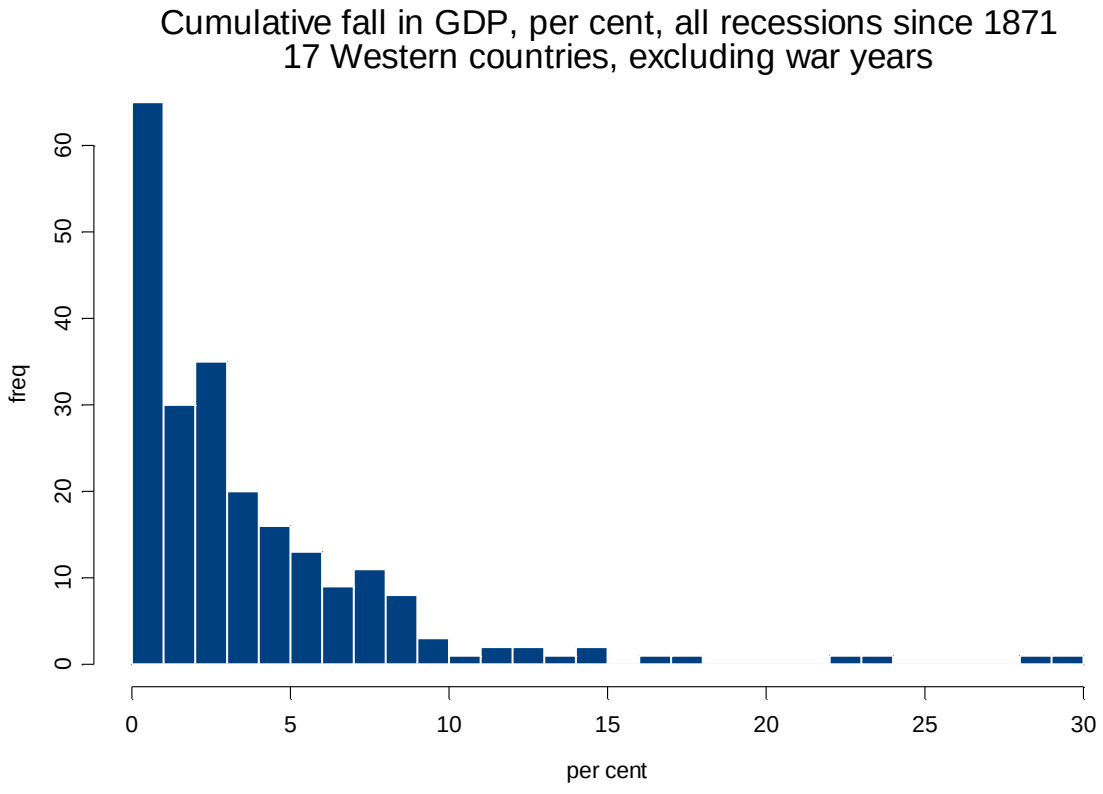

Figure 2 *Cumulative percentage fall in output in recessions in 17 Western countries, 1871-2010 excluding war-related years*

De Guilmi et.al (2003) use a very similar data set in terms of the countries and years and find that the Weibull distribution offers a good approximation to the size of recessions. This is potentially important, because they find that the shape parameter, β, is greater than 1, suggesting that the probability of a recession ending increases with its size. However, they define the size of a recession as the sum of consecutive deviations of actual output below potential output, where potential output is calculated by extracting the trend component from the actual data by means of a Hodrick-Prescott filter. A problem with defining a recession in this way is that years which are characterised as being recessions years may also exhibit features not normally associated with a recession, such as rising levels of employment. Observations where the actual growth rate is only slightly below 'potential' will in general have growth above the growth of productivity and hence will exhibit small but positive employment growth.

As it happens, using the definition of a recession as a year in which real GDP growth is less than zero also indicates that the size distribution of recessions is best characterised by a Weibull distribution. I examined the power law distribution, the exponential (a special case of the Weibull in which $\beta = 1$), and Weibull itself. The power law gives a relatively poor fit.

The best fit is given by a Weibull with shape parameter less than 1. A grid search was carried out testing the null hypothesis that the size distribution follows a Weibull for different combinations of the scale and shape parameters. The p-value is maximised (0.90) for shape = 0.95 and scale = 3.47.

Replicating this distribution of the size of recessions appears to be a major challenge for mainstream economic models of the business cycle.

5 Wait times between recessions

Recessions are in fact rather frequent. Of the 2335[3] data points in the pooled sample of the 17 countries, for example, in 423 of them recessions are experienced, in other words, real GDP growth is negative in these observations. Of course, some recessions last more than 1 year. The number of separate instances of recessions is 271, or 11.6 per cent of the total number of observations.

But the distribution of wait times between recessions is very heavily right-skewed. This is indicated clearly by the fact that the median wait time is 5 years but the mean is 8 years. The third quartile is at 10 years, and the maximum is no less than 49 years.

The distribution of the data is not easy to characterise in terms of a known statistical distribution. For example, carrying out a grid search of ranges of relevant parameters to test the null hypothesis that it is either an exponential or a Weibull does not uncover any for which the null is rejected at $p > 0.05$. However, it is plotted in Figure 3 below.

[3] Some early data is not available for Japan and Switzerland

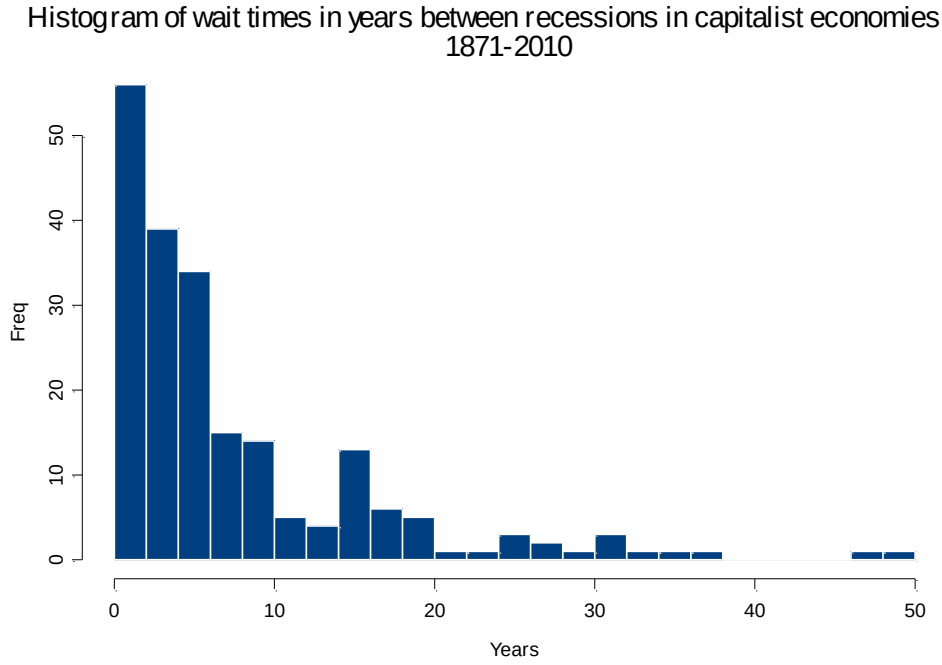

Figure 3 *Wait times between recessions, years, in17 capitalist countries 1871-2010*

6 Number of countries in recession at the same time

In terms of the total output of the 17 countries, the growth rate was less than zero in only 15 out of the total of 140 years in the data sample. For reference these are 1876, 1893, 1908, 1914, 1917, 1919, 1921, 1930-32, 1945-46, 1975, 1982 and 2009.

In no fewer than 40 out of the 140 years, no single country was in recession, and there is no example of a year in which all 17 were simultaneously in recession. The largest single number in any one year is 16 in 2009, closely followed by 15 in 1931, and 14 in 1930. Of the 17 countries, 12 were in recession in 1914 and 1932, and 11 in 1917, 1918 and 1975.

The histogram of the number of countries in recession in any one year is set out below in Figure 4.

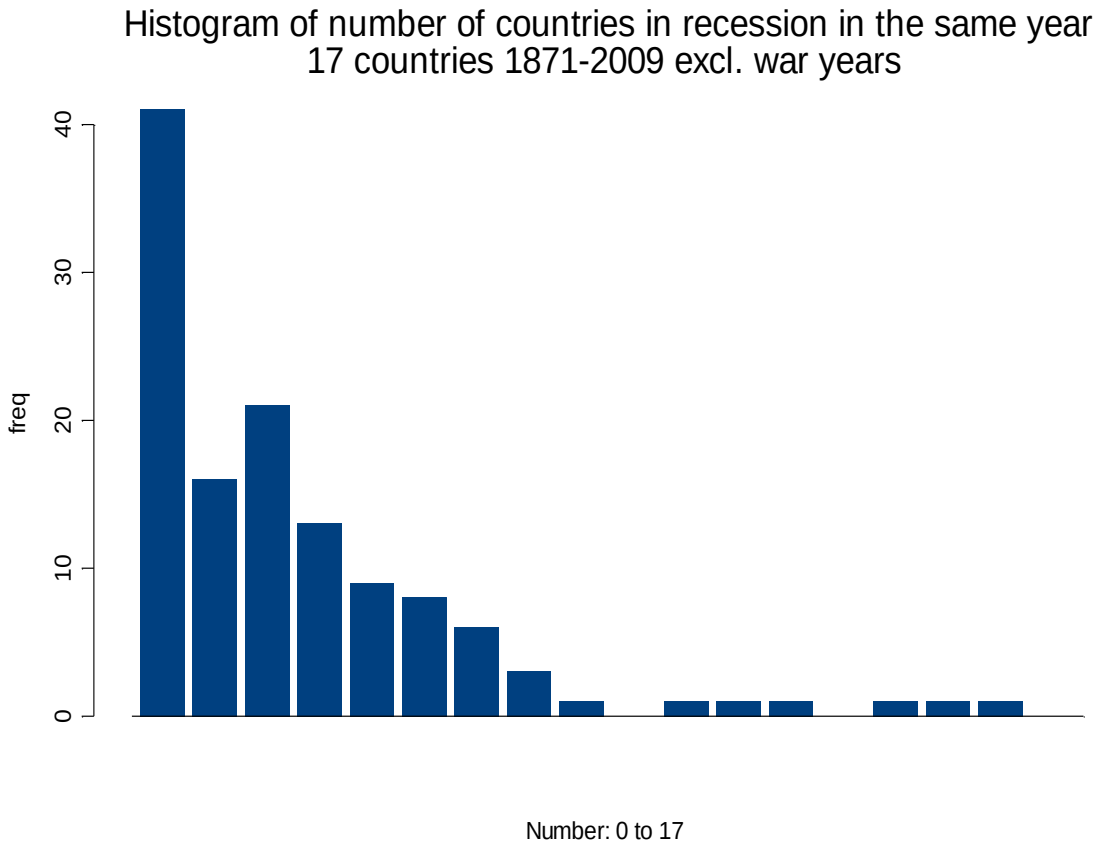

Figure 4 *Number of the 17 countries in recession in the same year. The most frequent observation is 'zero' and the maximum value is 16 in 2009*

If we exclude war years and their immediate aftermath, the only years in which 11 or more (11 being around two-thirds of the total) were in recession in the same year are 1930, 1931, 1932, 1975 and 2009. Four of these five years correspond to serious financial crises. The observation in 1975 was a result of the fourfold increase in oil prices which took place in 1973/74, transferring substantial amounts of real income directly from the oil consuming West to the oil producing Middle East countries. So it, too, was the result of a global event.

This does suggest, albeit tentatively, that recessions brought about by financial crises are different from other types of recession. There are counter examples, with the severe recession of the early 1990s in Finland and Sweden being of a financial nature, but one which did not spread. But certainly, financial crises in the leading capitalist economy, the United States, do appear to have a tendency to either spread across the world or be part of the same global phenomena which brought it about.

In terms of the cumulative size of recessions, the Great Depression of the 1930s exceeds all others by some margin. There are only four examples, excluding war related years, when output fell cumulatively by more than 20 per cent, and these are all in the early 1930s: Austria, Canada, Germany and the United States. And two out of the three examples are also in these years (the exception being very sharp falls in output in the then mainly agricultural economy of Australia in 1892-93).

With respect to the duration of recessions, again excluding war years, there are only 6 examples of recessions lasting for four or more years. Five of these are in the Great Depression of the early 1930s. The sixth, Australia, 1926-31, was in part due to this, a mild but prolonged depression in the late 1920s was exacerbated by the financial crash[4].

These striking characteristics of the Great Depression in the early 1930s do not of course mean that this data, in whatever dimension, are not drawn from the same sample as the rest of the recession-related data. We could merely be observing an extreme event drawn from right-skewed distributions. But its overwhelmingly financial nature in part singles it out. And we might also reflect on the possibility that the spirits of entrepreneurs, after a period, undergo a potential phase transition and, far from being resilient, become depressed and harder to revive as the duration and scale of the recession rise.

7 Tentative thoughts on modelling recessions

Each individual recession undoubtedly has its own proximate causes, its own particular features. The very detailed descriptions of every recession which had taken place in the United States until the middle of the 20th century by Burns and Mitchell (1946), for example, makes this clear.

But we can still aspire to a general model which attempts to capture the key features of the causes of recessions. There is a very large literature within economics on business cycles within individual economies, going back at least as far as the work of Marx in the 19th century.

A key division within this is whether or not the capitalist economies have a natural tendency to either be at or move back towards equilibrium or not. For the equilibrium theorists, recessions essentially arise because of shocks external to the economy as such. This is the mainstream tendency within academic economics, the latest manifestation of which is so called dynamic stochastic general equilibrium models (DSGE). This is not the place to either explain or criticise such models, the interested reader can find a recent description of them in Tovar (2009).

The view that economies are for the most part either in dynamic *dis*equilibrium or far from any theoretical equilibrium which might be purported to exist, is undoubtedly that of the minority. However, this minority contains famous names such as Marx and Schumpeter. In my view, it also contains Keynes and Hayek. (Ormerod, 2009).

We can essentially regard recessions – and economic booms – as being created by cascades of opinion across networks of economic agents, mainly firms but also consumers. We have seen the views of Keynes on this. And in his 1937 article 'Economics and Knowledge', for example, Hayek writes that 'It appears that the concept of equilibrium merely means that the foresight of the different members of the society is in a special sense correct. It must be correct in the sense that every person's plan is based on the expectation of just those actions of other people which those other people intend to perform and that all these plans are based on the expectation of the same set of external facts, so that under certain conditions nobody will have any reason to change his plans'.

[4] Australia eventually made up for it by being the only country out of the 17 to escape a recession in 2009!

He argued that such individual plans might indeed have to be revised by external shocks. But, more importantly, the individual plans may not have been, indeed are unlikely to have been, compatible from the outset, so that revisions are inevitable. Heterogeneous agents in this view of the world are operating with limited knowledge of their environment and their foresight is imperfect. Again, it is the interactions between agents, this time in terms of the incompatibility of their individual plans, which brings about the particular macroscopic outcome for the system as a whole.

So, rather unfashionably in the current circumstances, I suggest that the basis of a model of recessions is an account of how waves of optimism or pessimism spread across networks of agents. These agents are taking decisions concerning the real economy, output, consumption, employment.

The financial sector may or may not play a key role in the generation of any individual recession. There is a strong argument that recessions which are primarily due to financial crises have a different nature and are potentially more serious than those which are not. Reinhart and Rogoff (2010) argue this point forcefully. But in most recessions the financial sector appears not to play the decisive role, and so the basic building block should be a more general one of sentiment percolating on networks.

Of course, a more complete model must of necessity include the financial sector and its potential to generate severe and prolonged recessions. But most recessions can in principle be accounted for by in the first instance leaving it out, because they are not by their nature primarily due to financial factors. Haldane and May (2011) show the importance of including networks in models of the financial sector.

Once we consider models from a network perspective, we are requiring that the basis of the model is individual agent behaviour and how the behaviour of any given agent affects the others on the network. So models have a micro-theoretic foundation and the macro properties of the system emerge from the micro-level behavioural rules. The macro properties may in turn influence agent behaviour, as is the case in principle in any complex system.

A valuable concept in this context is one due to Schelling (1973), namely 'binary choice with externalities'. An agent at any point in time can be in one of two states of the world, and the decision rule for switching is based at least in part on the state of the world of the other agents to which it is connected. The model can be generalised to k states of the world, but as a basic approach we might think of agents such as firms being either optimistic or pessimistic.

The model with a fixed network was formalised by Watts (2002). Agents are allocated a threshold drawn at random from a uniform distribution on [0,1]. They are connected by some topology. Initially all agents are in state 0 and a small number is chosen at random to move to state 1. The decision rule for switching is that if the proportion of agents to which any agent is connected exceeds its threshold, the agent switches, and otherwise not. Watts demonstrates that in general such models are robust in the sense that the initial shock – the small number selected at random to move to state 1 – does not spread very far across the network. But occasionally, the shock - which by construction is identical in size each time the model is solved – can percolate on a near global scale.

Figure 5 below sets out the typical distribution of cascade size obtained across 1000 separate solutions of the Watts model.

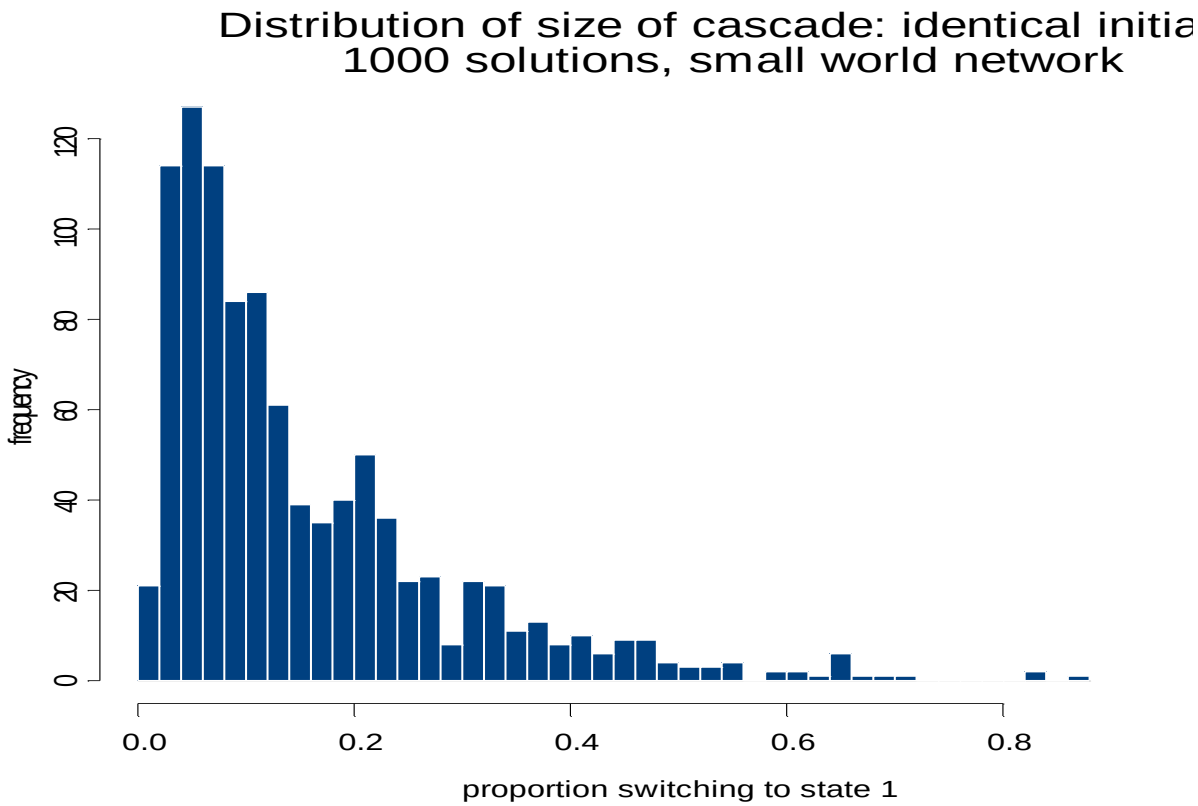

Figure 5 *Typical distribution of proportion of agents switching to state 1 of the world in the Watts (2002) model, when all agents initially are in state 0 and a small number is chosen at random to switch to state 1*

Ormerod and Colbaugh (2006) generalise this model, where the network is fixed, and allow the network to evolve endogenously as the result of agents seeking to increase their fitness. Agents are allocated at random a fitness in [0,1] and they are connected on a topology. Negative shocks are applied to the network, which are random both in their size and scope, in other words, how many agents are affected directly by any given shock. Agents can form alliance with other agents, which increases their fitness, but at the same time permits the effects of shocks to be transmitted to them by other agents which receive a shock directly. Agents are deemed extinct if their fitness falls below zero, and a variety of replacement rules can be applied. The results show clearly that a) the more connected is the network the higher is the fitness of the system but b) the more likely it is that any given shock will percolate on a near global scale and cause a mass extinction. These results on connectivity are relevant to the crisis of the late 2000s.

Ormerod (2002, 2004) describes a simple model in which the business cycle is solely due to sentiment – Keynes' animal spirits – of firms connected on a network so that the sentiment of any given agent affects the decisions made by other agents.

The model evolves on a step-by-step basis, and in each step, or period, each firm decides two things:

- its rate of growth of output for that period
- its degree of optimism or pessimism about the economic conditions in which it is operating - 'sentiment' for short

In economic terms, the model is very Keynesian in spirit. Agents do not follow complicated behavioural rules involving multi-period optimisation as they do in many economic mainstream theoretical models of the cycle (for example, [5 - 8]). Agents in this model follow simple rules of thumb.

Each agent sets its rate of growth of output in period t by:

$$x_i(t) = (1 - \alpha)x_i(t - 1) + \alpha[Y(t - 1) + \varepsilon_i(t)] \qquad (1)$$

where $x_i(t)$ is the rate of growth of output of agent i in period t and Y is the overall sentiment of all agents (the weighted sum of the levels of sentiment of the N individual agents). Information about Y can be obtained readily by reading, for example, the *Wall Street Journal* or the *Financial Times*. The views of company chairmen and CEOs are widely publicised, and there is a great deal of commentary on the current state of the economy.

The variable $\varepsilon_i(t)$ plays a crucial role in the model. This is a random variable drawn separately for each agent in each period from a normal distribution with mean zero and standard deviation sd_1. Its role is to reflect both the uncertainty which is inherent in any economic decision making and the fact that the agents in this model, unlike mainstream economic models which are based on the single representative agent, are heterogenous.

The implications of any given level of overall sentiment for the growth rate of output of a firm differs both across the N agents and over time. Firms are uncertain about the precise implications of a given level of sentiment for the exact amount of output which they should produce. Further, the variable Y is based upon an interpretation of a range of information which is in the public domain. Agents again differ at a point in time and over time in how they interpret this information and in consequence the value which they attach to Y.

The sentiment of the i th agent is determined by the following:

$$y_i(t) = (1 - \beta)y_i(t - 1) - \beta[X(t - 1) + \eta_i(t)] \qquad (2)$$

where X is the overall rate of growth of output of the economy (the weighted sum of the x_i), and where η_i is drawn from a normal distribution with mean zero and standard deviation sd_2.

The coefficient on X(t - 1), β, has a negative sign, again reflecting the Keynesian basis of the model. Keynes never articulated a formal theory of the business cycle. In chapter 22 of [14], however, he wrote that: 'By a cyclical movement we mean that as the system progresses in, e.g., the upward direction, the forces propelling it upwards at first gather force and have a cumulative effect on one another but gradually lose their strength until at a certain point they tend to be replaced by forces operating in the opposite direction; which in turn gather force for a time and accentuate one another, until they too, having reached their maximum development, wane and give place to their

opposite'. A mathematical approximation to this description is, of course, that of a simple oscillator, and hence the negative sign on X(t - 1) in (2).

The variable $\eta_i(t)$ again reflects agent heterogeneity and uncertainty. At any point in time, each agent is uncertain about the implications of any given level of X(t - 1) for its own level of sentiment. A further practical point is that, although estimates of X are provided in the national accounts of the economy, they are both estimated with potential error and are subject to future revision.

Even at the risk of over-emphasising the point, it is worth repeating that in each time period firms do *not* share the same ε and η. The variables ε and η are *not* degrees of uncertainty which are common to all firms, but each firm in each period has its own ε and η. In other words, ε and η must *not* be regarded as a common, exogenous shock which all firms experience.

This simple model is able to replicate the right-skew distribution of the size of recessions, the distribution of the duration of recessions and the resilience of the system in recovering and a number of properties of real GDP growth in the time and frequency domains. However, it is not able to generate output falls on quite the same scale as those of the Great Depression, suggesting that a financial sector is required. But the very simple model replicates a number of key empirical features, even without such a sector.

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