Bankruptcies, Firm Size and Unemployment: A Big Bang Theory of Economic Cycles

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ABSTRACT. This paper analyses the impact of bankruptcies on unemployment in an economy characterised by no substitutability of labour. A computer simulation model is used to analyse its properties. Spectral analysis reveals the existence of cycles in unemployment. It is found that average unemployment tends to be lower the more flexible are wages and interest rates, provided both move anticyclically, and the more rapid is the speed with which existing firms expand. An economy characterised by small firms is found to be more stable with a tendency to a longer cycle than one characterised by large firms. However, given the assumptions we have made, it is also likely to be characterised by higher average unemployment.

1. Introduction

There has been considerable work done on analysing the causes of company bankruptcies; Altman (1983), Hudson (1989), Audretsch (1991) and Mata and Portugal (1994) and slightly less work analysing the determinants of company births; Acs and Audretsch (1989) and Hudson (1989). There has, however, been relatively little which has sought to analyse the impact these variables have on the macroeconomy. Goudie and Meeks (1988, 1991) have argued that failures may well produce large discontinuous drops in macroeconomic aggregates such as employment, output and net exports. Several studies have analysed the impact of adverse demand and supply shocks on capital stock and its further consequences on the economy as a whole (Bruno and Sachs, 1985; Van der Ploeg, 1987). Whilst Blanchard (1988) has explored the possibility that a sustained period of unemployment may lead to capital reduction and therefore to an increase in the equilibrium levels of unemployment. Van de Klundert and Van Schaik (1990) analyse the impact of demand shocks on the capital stock and thence output within a Keynesian framework with price inertia. To an extent this paper is concerned with the impact of bankruptcies and company births on macro aggregates such as unemployment and GDP, but more specifically the focus of the paper lies with the question of whether economic cycles can have purely supply side causes.

A number of attempts have been made to explain the existence of the business cycle. These include the real business cycle theory (the seminal paper being by Kydland and Prescott, 1982) where the fundamental source of unemployment is a productivity shock which, for a number of reasons has a long-term impact upon the economy. A second approach revolves around the idea that there are imperfections in the labour market which prevent it from performing its market clearing role in equating labour demand and supply. Possible reasons for this include nominal inertia in wage setting, the existence of implicit contracts, efficiency wages, the existence of trade unions and insider outsiders. An excellent summary of these approaches can be found in Nickell (1990) whilst an earlier survey by Zarnowitz (1985) looks more generally at the existence of business cycles. Both of these surveys concluded that there was still much that we do not know, understand and cannot explain. Nickell laid particular emphasis on the problems from the supply side and the need to explain hysteresis more convincingly.

The primary task of this paper is to show that cycles and prolonged periods of high unemployment can be generated by a model characterised by fixed coefficient production functions and random bankruptcies where the capital stock of the bankrupt firm is lost to the economy. Intuitively it is clear why such a model should lead to cycles.

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The occurrence of a bankruptcy which destroys the capital stock of a large firm will leave a substantial gap in the supply side of the economy which will lead to a drop in output. If substitution between labour and capital is not possible then this drop in output will be paralleled by an increase in unemployment. Both unemployment and output will only return to their previous level when the capital stock which was previously lost has been replaced either by the growth of existing firms or the establishment and subsequent growth of new firms. Hence the essence of the argument is that bankruptcies can generate output cycles and, with fixed coefficient production functions (or sticky prices), also unemployment. The possibility that capital constraints can lead to unemployment has received considerable attention in the literature (see e.g., Van de Klundert and Van Schaik, 1990). It has, however, been criticised on the grounds that there is considerable ex-post substitutability between labour and capital. Both Blanchard and Summers (1986) and Nickell (1990) quote the case of the rapid return to full employment in the 1930s following re-armament as evidence against the view that unemployment can be caused by a lack of physical capital. This is an important objection. However, it should be remembered that the example relates to over fifty years ago. In the intervening period the nature of capital stock has changed considerably as well as the amount of capital per worker. Thus it is not implausible to argue that during this period the degree of substitutability between labour and capital might also have fallen significantly. In addition the case of re-armament in the 1930s is not a prime example of the market economy at work. Thus, the example cannot be accepted as firm evidence that output in Europe since the 1980s has not been constrained by a lack of capital. It should also be noted that even if substitutability between labour and capital is technically possible, and this is an empirical rather than a theoretical question, sticky wages may make it economically impractical. In this case we shall have de-facto ex-post, and possibly ex ante too, fixed coefficient production functions.

The paper will proceed as follows. Firstly will come a theoretical section setting out the equations of the model. Because the model will be characterised by discontinuities we will not use analytical techniques to examine the properties but simulate it in a computer run. Additional simulations will investigate the reaction of the model to changes in certain equations. Following a brief discussion of the computer program, the results of these simulations will be presented. Finally, there will be a brief concluding section.

2. Assumptions and macro equations

We shall adopt the convention that parameter values will be denoted in Greek letters, whilst Latin characters will be reserved for variables. In general we will omit time subscripts with it being implicit, unless otherwise stated, that all variables relate to period t. We shall assume a clay-clay technology where output for the entire economy (Y) is set by available capital (K) and labour supply (N):

$$Y = \min(\rho_1 N, \rho_2 K), \tag{1}$$

where ρ_1 and ρ_2 are the output-labour and output-capital ratios, respectively. We choose a clay-clay model rather than a putty-clay one for reasons of simplicity in terms of constructing the simulation model. The results will not differ too greatly from those of a putty-clay model as greater ex-ante flexibility in substituting labour for capital will result in a more rapid reduction in unemployment during a period of capital shortage which can be proxied by increasing the growth rates of firms during the period of capital shortage. What we will not be able to capture is the trade-off between short-term output and unemployment gains versus the long-term output costs in choosing more labour intensive technologies.

The employed labour force (L) is then equal to the amount of labour needed to produce this output or total labour supply whichever is the smaller.

$$L = \min(\rho_2 K/\rho_1, N). \tag{2}$$

Unemployment (U) is equal to the difference between labour supply and the desired labour force or equal to zero if the latter exceeds the former, i.e.,

$$U = \max(N - L, 0) \tag{3}$$

The basic process of capital accumulation is given by the following equation:

$$\Delta K = \min(Y - wL, \eta F_0 + \sum[\alpha_1 + \alpha_2 r + \alpha_3 w + (\alpha_4 + \alpha_5 r + \alpha_6 w)K_{it-1}]) - \sum \phi_i K_{it}, \quad (4)$$

where ΔK is the change in capital stock from period to the next and the summation operator is defined over the number of firms, with the subscript i relating to the i'th firm. For the economy as a whole, the upper bound to capital stock formation is the difference between output and the wages bill (wL), as it is assumed that workers do not save. Thus all investment has to be financed from profits within the corporate sector and there is no capital depreciation. The actual amount of capital formation can be less than this and depends upon the growth rate of existing firms, the number of new firms formed and the bankruptcy rate amongst existing firms. K_{it-1} represents the capital stock in the previous period of the i'th firm, F_0 denotes the number of new firms formed in the current period, and η the capital stock required to set up a new firm. This is assumed to be fixed and all firms start with this amount of capital.

The growth of existing firms is defined in the term in square brackets in Equation (4). Investment is in part autonomous of the size of the firm and in part directly related to it. Both parts are functions of interest rates and wage rates – the latter proxying profits. Of course other assumptions are feasible and it is possible that having reached a state of maturity firms eventually start to decline. The key factor in their rate of expansion is the profit rate per unit of output. There is a one to one inverse relationship between this and the wage rate and it is this which determines the speed with which capital stock approaches its long-run level. The greater are profits, and the lower are wages, then the more rapid will firms approach their equilibrium level. This will be a crucial determinant of whether and how quickly the economy returns to full employment from a state of below full employment. We shall be experimenting with imposing a capital ceiling on firms and examining how the cycle varies with the size of this ceiling.

However, many firms will not reach this state of maturity but go bankrupt, or otherwise fail, in the intervening period. We shall assume that all of the firm's capital stock is lost following a closure. This is an extreme assumption, some of the capital may be transferred to other uses, and in some cases all of it may be. But in many instances machines simply become scrap metal and buildings become derelict and are eventually destroyed. This is more likely to happen during a recession when most other firms are growing slowly if at all. In this model we are only allowing for failures and not for capital scrapping by firms which remain in business. Thus if a firm does not fail it will either carry on expanding or if it has reached full size, stay there. ϕ_i is a one- zero indicator variable taking a value of one if the firm fails. Previous research by Hudson (1987) and Altman (1983) has shown that most bankruptcies tend to involve young firms less than seven years old, and that after this they can be regarded as being established. It also appears that it takes time for firms to get into trouble and that few firms fail in their first year. The failure rate also appears to depend upon profitability and the level of ability of entrepreneurs. There is some evidence that firms started by the unemplyed are less viable than others (Hudson, 1989; Hudson and Cuthbertson, 1993). To a considerable extent the unemployed have been forced into entrepreneurship rather than have chosen it. They may have less ability, be more risk averse and set up in an industry/location with less chance of success than other entrepreneurs. Thus we shall assume the probability of failure to be a function of the wage rate (w) which is inversely related to profits, the age of the firm (Age_i) and whether it was started by an unemployed person (SU_i):

$$\Pr(\phi_i = 1) = f(w, \text{Age}_i, SU_i) \quad (5)$$

More specifically, we will allow for new firms to have a higher probability of failure and firms formed by the unemployed to have a still higher failure rate in their early years. The nature of the relationship with age and the previous employment status of the founder will differ from simulation to simulation and is outlined in more detail when discussing the simulations. We have refrained from including the rate of interest in this equation as the empirical evidence on the impact of interest rates on bankruptcies is mixed (see Simmons, 1989; and Wadhwani, 1986). Finally, no firm will go bankrupt during their first year. We will also analyse the effects of a supply side multiplier as defined by Hudson (1988) and Cork Committee (1982). In simple terms this is the

knock-on effects that a bankruptcy can have on other firms through a set of unpaid debts. If this causes additional bankruptcies then these too can have further knock-on effects.

A crucial factor in this discussion has been profits. These will be defined as the difference between the value of output and the wage bill, setting the price level equal to 1 gives us a profit rate per unit of output of $1 - w$. Given the fixed coefficient production in (1) this will also result in a constant rate of profit per units of labour and capital. Amongst other things, profits will determine the number of new firms setting up and the probability of their failing. There is plenty of evidence for both of these propositions (see Altman, 1983; and Hudson, 1989). In addition, it has been found (Hudson, 1989), that the number of new firms starting is related to the number of unemployed. This had been suggested by Schumpeter as long ago as 1939. Hence we may write:

$$F_0 = \delta + \varepsilon w + \tau U, \tag{6}$$

Finally to close the system we need an equation for wages. We shall use a simple linear Keynesian type relationship linking the wage rate to unemployment. We are also assuming a common wage rate for all firms.

$$w = \lambda_1 + \lambda_2 U. \tag{7}$$

2.1. *A regime constrained by capital*

In a regime where output is to an extent constrained by capital, unemployment is equal to the first of the two arguments in Equation (3). That is

$$U = N - \rho_2 K/\rho_1, \tag{8}$$

We should note at this stage that this is more correctly referred to as "supply deficient" unemployment. This must be added to the natural rate and to any deviations from the natural rate caused by variations in the demand side of the economy. Equation (8) implies that, provided the regime remains one constrained by capital, the change in unemployment equals

$$\begin{aligned}\Delta U = -\rho_2 \Delta K/\rho_1 = -(\rho_2/\rho_1)\ \{&\min(Y - wL \\ &- \delta K,\ \varepsilon F_0 + \textstyle\sum[\alpha_1 + \alpha_2 r + \alpha_3 w \\ &+ (\alpha_4 + \alpha_5 r + \alpha_6 w)K_{it-1}]) - \textstyle\sum \phi_i K_{it}\}.\end{aligned} \tag{9}$$

In the case where desired investment is not constrained by output constraints then ΔU will equal

$$\begin{aligned}\Delta U = -(\rho_2/\rho_1)\ \{&\varepsilon F_0 + \textstyle\sum[\alpha_1 + \alpha_2 r + \alpha_3 w \\ &+ (\alpha_4 + \alpha_5 r + \alpha_6 w)K_{it-1}]) - \textstyle\sum \phi_i K_{it}\}.\end{aligned} \tag{10}$$

Hence, whether unemployment is falling or rising will in this special case depend upon (i) the number of new firms being formed, (ii) the rate of expansion of existing firms, and (iii) the failure rate amongst existing firms. In a recession, capital scrapping via firm failures is likely to exceed new capital creation via new firm starts and the expansion of existing firms. In the expansionary phase as the economy attempts to move out of the recession, new firm starts together with the expansion of existing firms should see capital stock expanding and unemployment falling, although it is possible that at this stage the picture may be complicated by output constraints limiting the rate at which capital stock can expand. The term recession generally denotes a period of low output/high unemployment caused by a lack of demand. In our analysis a recession is caused entirely by supply side failures. Nonetheless, it will still be characterised by low output/high unemployment. There is a qualification to add to this, as the greater tendency for firms started by the unemployed to fail may lead to a situation whereby an increase in unemployment which sparks of a rise in new firm formation subsequently leads to many of these new firms failing. Indeed because there are knock-on effects when the failure involves bankruptcy with the firm having debts to other firms, it is possible that the net effect of increased unemployment may, ceteris paribus, be to reduce the number of successful firms rather than to increase them. However, what little empirical evidence there is tends to suggest that this has in fact not been the case in the past. These are points we shall return to in the future.

The key variable in this analysis is arguably the wage rate, or, what amounts to the same thing, the profit rate. An increase in the wage rate will reduce the number of new firms starting up, reduce the speed with which existing ones expand and increase the number of firms going out of business. All of these effects will tend to reduce capital stock, productive capacity and in a regime not constrained by demand increase unemployment. Thus in this model it appears that an

increase in the wage rate will, in the short-run, increase unemployment.

We shall not be using analystical techniques to analyse the above model due to their limited ability to analyse complex systems. Firstly they are limited by human ingenuity in the number of equations they can adequately deal with, a facet of which is the need to examine most phenomenon at the aggregate level rather than aggregating the total of microeconomic behaviour. Secondly, they are also limited in their ability to analyse discontinuities. Typically the assumption has to be made of continuity for individual functions and frequently their first and second derivatives as well. Bankruptcies are one important discontinuity, whilst the way the model shifts between being constrained by capital and not being constrained is another, and the placing of an upper bound on a firm's capital stock is a third. Thirdly they are limited in their ability to handle stochastic events within a nonlinear system. In such a system the expected impact of a stochastic event, such as a bankruptcy or other random shock, cannot be found by inserting the expected value of that event into the system. This is why, e.g., the average of a large number of stochastic simulations of a macro economic model will not give the same result as a forecast based on zero error terms. Because of this we shall not analyse the above model using these techniques. Instead we shall simulate a computer program aimed at capturing the essential features of the model.

Computers have been used to simulate macroeconomic systems by, e.g., Gapinski (1981, 1982) and Van Duijn (1983). A disadvantage with this approach is that in order to simulate the model one needs to provide specific values for the parameters of the model. Thus the results derived are less general than those derived using analytical techniques. However, it must be remembered that in the current paper simulations are being used to analyse a system which cannot be analysed using standard mathematical techniques and thus this criticism loses much of its force. The program itself is written in BASIC, about 200 lines and is available from the author upon request. A short description of the program is given in the next section following which the results of the initial simulation together with those of additional simulations are reported.

3. The basic program and simulations

The program links investment to the wage rate, but also introduces potential output constraints to ensure that the investment is feasible. The probability of a firm becoming bankrupt is linked to the real wage. In the standard run this probability is constant across all firms apart from those less than five periods old. The simulation program is run for 100 periods before a record is kept of the value of the variables. The simulation begins with no firms and the early periods are characterised by an economy with virtually no capital stock and a number of small firms which are growing and gradually absorbing the workforce. We are mainly interested in how our economy simulates in normal periods, not those characterised by this start up period and its immediate aftermath, hence these periods are omitted from the results. A further 300 periods are then simulated. This large number of simulations is undertaken to remove, as far as possible, any arbitrariness from the results. We will be mainly interested in the means, variances and spectrums of the simulated series and by using such a large number of periods it is hoped that this will reduce the impact of any large shock in a single period.

A graph of unemployment in the standard run is shown in Figure 1. It can be seen that there is no indication that the variable is approaching an equilibrium position or that the fluctuations are getting smaller. The variation in unemployment is considerable and there are periods when high

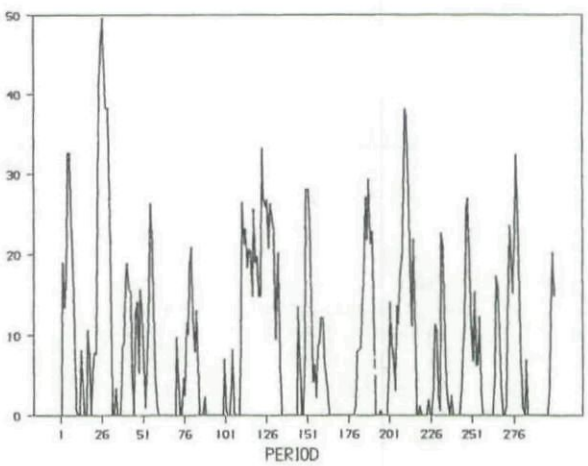

Fig. 1. Simulated unemployment.

levels of unemployment are maintained for several periods, most noticeably between periods 109–135. It can be seen that "unemployment" frequently equals zero. This is, as we have already emphasised, more correctly interpreted as "supply deficient" unemployment being zero. Unemployment will still exist at the natural rate as an outcome of the job search process. Indeed it may even deviate from the natural rate as demand conditions vary. The plot is much more volatile than any actual series of unemployment. But the model is a simple one without a demand side, and the main task has been to demonstrate that cycles can be generated by such a model. Table I shows us that the average level of unemployment throughout the period is 8.80% and the variance is 112.04.

Sargent (1979) gives two methods for determining the existence of a cycle. In the first, a variable possesses a cycle of a given frequency if its covariogram displays damped oscillations at that frequency. Figure 2 shows the correlogram (which is based on the ratio of the covariance to the variance and hence follows the same pattern as the covariogram, but is bounded by ± 1). It can be seen that such oscillations, although not obviously damped, are strongly in evidence with the troughs (peaks) separated by approximately 33 periods. A second definition of a cycle is the occurrence of a peak in a spectral density of a series. The spectral density for the data shown in Figure 1 is illustrated in Figure 3. It was calculated using a fast Fourier transform using a flat window with a taper. The result is what Granger (1966) has called the "typical spectral shape" of an economic variable, i.e., it decreases dramatically as frequency increases, with most of the power in the low frequency high periodicity region. There is a single pronounced peak in the series at a cycle length of 22.3 periods. Thus both of Sargent's conditions for the existence of a cycle are met and we can can conclude that the simulated unemployment data in Figure 1 is cyclical rather than a random series of peaks and troughs.

A second simulation is carried out with interest rates flexible and moving inversely with the level of unemployment. The formula achieving this would result in an interest rate of 6%, which is the fixed interest rate in simulation one, if unemployment was held at the average level it reached in this first simulation. Hence any differences between these two simulations can be attributed to flexibility in interest rates rather than more favourable interest rates. The mean level of unemployment (at 8.91%) is marginally higher and the variance (at 92.90) substantially lower than before. The increase in the mean level of unemployment may appear unexpected as anticyclical interest rates should boost capital spending and firm growth in a recession. This effect, however, is countered by the downward impact of high interest rates during a boom. This will reduce the

TABLE I
The results of the simulations

Simulation	Mean unemployment	Variance of unemployment	Spectrum	
			1st Peak	2nd Peak
1. Standard run – $a(1) = 5$; $m = 100$	8.80	112.04	22.3	none
2. Standard run with flexible interest rate	8.91	92.90	19.7	8.7
3. Standard run with fixed wage rate	11.27	162.93	28.5 (small)	none
4. Standard run with supply side multiplier	22.99	239.28	28.5	6.7
5. Standard run with firms set up by unemployed more likely to go bankrupt in first five years	15.84	127.81	17.7	none
6. Standard run with $m = 200$	5.43	101.90	25.6	11.1
7. Standard run with $m = 50$	17.27	72.50	21.3 (small)	none
8. Standard run with $m = 500$	5.84	144.67	19.7	9.9
9. Standard run with $a(1) = 3$; $m = 100$	10.64	122.75	24.4	none
10. Standard run with $a(1) = 3$; $m = 500$	8.03	183.68	9.3	none

m = the upper bound on an individual firm's capital stock.
$a(1)$ = the autonomous increase in each firm's capital stock as used in Equation (4).

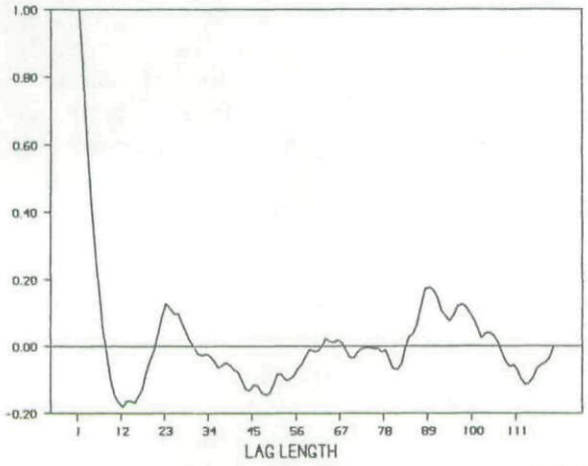

Fig. 2. Unemployment autocorrelation function.

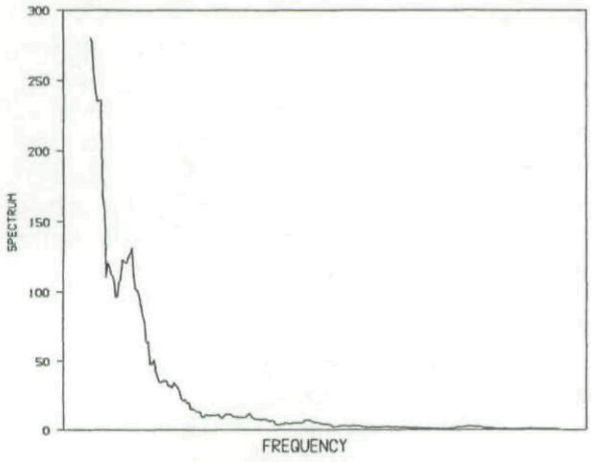

Fig. 3. Unemployment spectrum.

excess of capital over that necessary for full employment which, within the model, takes place during a boom, thus making the economy more susceptible to bankruptcies. This concept of a capital buffer or wedge which helps cushion the impact on the economy of bankruptcies and other shocks is new to the literature and is potentially an important concept. Finally, two cycles are suggested by the spectrum of length 19.7 (slightly shorter than previously) and 8.7 periods.

A still higher level of mean unemployment is found on the third simulation which sees wage rates fixed (at the average level they attained on the standard run through periods 101–400 of the simulation). Unemployment has risen to 11.27%, and the variance has risen to 162.93. The reason for this is that when unemployment is high a fall in wages which produces an increase in profits will lead to an increase in the capital stock, reduce the probability of existing firms going bankrupt and increase the number of new firm starts. It is important to note that lack of flexibility also leads to a much greater variance in unemployment, and not just a high average level. In addition the spectrum shows that the evidence for a cycle is weaker than previously with there being only a small peak at 28.4 periods. The fourth simulation, in which a form of the supply side multiplier operates, sees both the mean and the variance of unemployment very high indeed. Simulation number five also sees the mean of unemployment now very high, at 15.84% and a small increase in the variance (compared to the standard run) to 146.67. In this run firms set up by the unemployed were twice as likely to become bankrupt during their first five years than other firms. It is clear why this should lead to higher unemployment as it tends to reduce the ability of the growth of new firms to lead the economy out of recession.

The sixth simulation is the first in which we change one of the parameters of the model, in this case, the ceiling on firm's capital stock was increased from 100 to 200. This has reduced both the mean and the variance, whilst the spectrum suggests two cycles. A priori it was not clear the impact this would have on unemployment. On the one hand there was the possibility that if this led to the growth of a few large firms then the economy would become especially susceptible to the failure of any one of them, as the failure of such a firm would have a significant direct impact on unemployment. However, on the other hand firms which have a capital stock at or near 100 will now be able to carry on growing thus increasing the ability of the economy to respond to structural shocks which lead to supply side shortages. The results of the next simulation provide further evidence that "large is beautiful" in the sense that cutting the maximum capital stock to 50 has substantially increased the mean level of unemployment, although sharply reducing the variance. The eighth simulation which sees the capital stock at an upper bound of 500 has a slightly higher mean than the sixth simulation and a very much higher variance. Figure 4 shows the spectrum for this simulation. There is strong

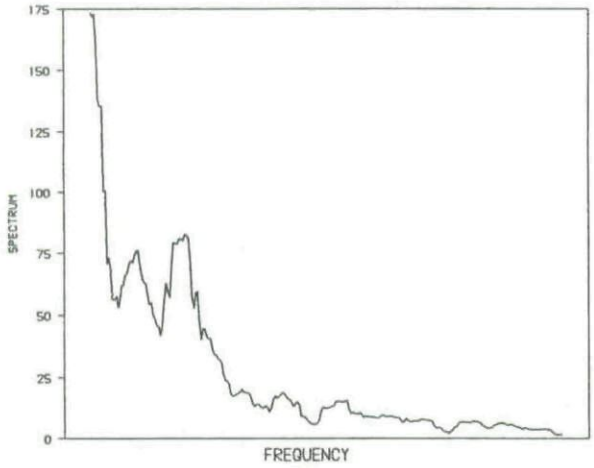

Fig. 4. Unemployment spectrum.

evidence for at least two distinct peaks. The first indicates a cycle length close to that observed in Figure 3, of 19.7 and the second 9.9 periods. This suggests the existence of at least two cycles with a shorter one being superimposed on a bigger one.

Taken together the results of these simulations suggest several conclusions. Firstly, that up to a point large firms do tend to reduce average unemployment. Secondly, that the larger the size of the typical firm the greater will be the degree of volatility of unemployment and the shorter the economic cycle. The reason for this latter result is that if no large firms are allowed then the failure of even the largest firm will have only a small impact upon the economy. These results receive further confirmation by the results shown in the last two simulations which also suggest that slowing down the rate of firm growth tends, not surprisingly, to increase the average level of unemployment. Thirdly, anything which reduces the survival rate of small firms (such as increasing the failure rate of firms started by the unemployed) tends to increase both average unemployment and its variance.

4. Conclusions

We have put forward a simple model of the supply side of the economy which takes little account of the demand side nor the monetary (credit) and foreign trade sectors. We have also ignored the possible impact of economies/diseconomies of scale and whether technical progress is better achieved in the well organised research programs of large firms or in smaller units less burdened by bureaucracy. Within this simplified framework, our results suggest that supply-side cycles in unemployment can be generated in a model with putty-clay or clay-clay technology (or with a flexible production function, but sticky prices) and with bankruptcies occurring in a random manner leading to capital stock being completely lost. There seems to be some evidence that the mean level of unemployment is higher when wages are fixed compared to what might happen when they are allowed to vary in an anticyclical manner. However, even more marked is the increase in the volatility in unemployment when both interest rates and wages are fixed. Again not unsurprisingly, the results suggest that the operation of a supply side multiplier which sees an initial bankruptcy have knock-on effects to other firms also tends to increase the mean level of unemployment.

Less predictable, perhaps, are the results we have gained concerning the impact of the size structure of firms on the time path of unemployment. A lot of very small firms will tend to reduce the degree of variability of unemployment in the economy and the tendency for the economy to vary in a cyclical manner, simply because the bankruptcy of any one of them will leave only a small hole in the supply side of the economy. This greater stability is apparently bought at the cost of higher unemployment, as firms which are already large will tend to find it easier to expand and to fill any such holes. This conclusion is, of course, dependent upon the assumptions one makes concerning the relationship between investment and firm size. We have assumed that, up to a point larger firms add more to the capital stock every period than smaller firms. This is consistent with Gibrat's (1931) law of proportional effect wherebye growth is independent of size. Nonetheless, if we modify the assumption to increase the growth rates for young firms then it is possible that this greater stability would not be bought at the cost of higher unemployment. It also appears that the existence of large firms generates more complex cyclical behaviour with a shorter cycle being superimposed on the cycle we had observed for small firms.

More generally it appears to be the case that the more flexible an economy, the less will be the

problems raised by supply side capital shortages brought about by bankruptcies. This is reflected not just by the results concerning the flexibility of wage rates and interest rates, but also by the results which suggest that the more rapid is the growth of existing firms then the lower will be both the mean and the variance of unemployment. Although based on simulations with an arbitrary set of parameters the qualitative nature of the results are intuitively plausible. What seems less likely to be valid is the order of magnitude suggested by these results. It is quite likely that the operation of the bankruptcy multiplier will operate to increase unemployment but it is most unlikely that it will be close to the values suggested in Table I. Thus the value of the simulations currently lie in their qualitative rather than their quantitative implications.

Moreover it should also be borne in mind that the results only apply to an economy characterised by a fixed coefficient production function and where the capital stock of bankrupt firms is lost. Those who believe that in real economies production functions are characterised by continuous substitutability of the factors of production which is made possible by instantaneous factor market clearing will find the results presented here of limited value in explaining variations in unemployment. However, even in such a world the existence of random bankruptcies with resultant capital loss will still produce output cycles and, for example, the characteristics of these output cycles will still vary with the average size of firms and whether interest rates vary in an anti-cyclical manner or not. But those who believe that in the real world rigidities in production technology are to a degree present will find the work of more relevance in suggesting how unemployment might have supply side as well as demand side causes. For those the policy implications are also of some interest. To date it would appear that flexible wages and interest rates can help reduce unemployment problems, and that any actions to reduce the supply side multiplier would also have beneficial effects. The latter can be achieved by raising the relative priority of unsecured creditors in the distribution of a failed firm's assets. At the moment both preferential creditors and secured creditors have a higher priority in both the U.S.A. and the U.K. This frequently leads to these groups of creditors getting paid in full and the unsecured creditors bearing the bulk of the firm's debts (Hudson, 1995). The practice of secured lending by the banks is, as Cork Committee (1982) has argued, one of the cornerstones of modern banking, and the case to reform this practice needs to be made in greater length than can be done so here. Concentrating, therefore on preferential creditors we note that these include central government and other government agencies. The cost of demoting their priority to that of an unsecured creditor, whilst simultaneously ensuring that the money thus released is distributed amongst unsecured creditors, would therefore be borne by government, and ultimately by the tax payer. However, this cost would be offset by the greater tax revenue and lower social security payments which are likely to follow from the reduction of the supply side multiplier. There may also be a case for doing this on equity grounds (Cork Committee, 1982).

Finally let us examine whether our results shed any light on the problem of why European unemployment has remained stubbornly higher throughout the 1980s and 1990s than it was in 1979, whilst in the U.S. it has not been characterised by this degree of hysteresis. Our analysis would suggest that one of the reasons that this has occurred has been the destruction of capital stock via the large number of bankruptcies which followed the recession. The U.S. also witnessed a considerable number of bankruptcies in the early 1980s. But the U.S. bankruptcy laws put more emphasis upon the rescue of failed firms than is the case in Europe. Chapter 11 of the U.S. Bankruptcy Code deals with firms in difficulties which want to reorganise. Once a Chapter 11 bankruptcy has been filed, secured creditors are prevented from foreclosing and removing their assets except with the Bankruptcy Court's approval. A further advantage is that new loans are more readily available, as well as new trade credit, since post-petition creditors take priority over all pre-petition creditors if the reorganisation plan fails. There are two procedures for adopting this reorganisation plan, one of which requires the consent of all classes of creditors. If this is not forthcoming "cramdown" can be resorted to which with the Courts agreement which forces the plan through. Not surprisingly, Chapter

11 has come under considerable criticism (see White, 1989). However, it does mean that during a recession many large firms survive as an effective supply side entity, thus preserving the ability of the supply side of the economy to respond to an economic recovery. In Europe this does not happen. There is no equivalent to Chapter 11, despite recent attempts at reform, and as a result during a recession the supply side of the economy is affected much more severely than in the U.S. This does not make a full case for the continuance of Chapter 11 or its extension to other countries. This advantage may be bought at the cost of a less dynamic economy where the transfer from old declining and inefficient industries to more efficient ones is less effective. The optimal set of bankruptcy procedures must balance these respective gains and losses.

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