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A theory of the instability of full employment

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Abstract

This paper shows how wage and price changes in disequilibrium are likely to lead to instability of a full employment equilibrium independently of whether or not a real balance effect exists. It is shown that resistance to wage cuts can be optimal and, as unemployed workers are employed at lower wages, a wage distribution for homogeneous labour emerges in disequilibrium. The existence of a wage distribution is the source of the instability problem and the evolution of the wage distribution over time provides an explanation for the existence of business cycles which differs considerably from previous analyses.

1. Introduction

In an economy free from structural change or shocks, there is general acceptance of the idea that long-run equilibrium will be at the full or the natural rate level of employment. Even if this is a correct view, there remains a question of robustness – if shocks are few and far between, does an economy at full employment provide a good approximation to what occurs? In general, this will depend upon the stability of equilibrium – with a stable equilibrium, small shocks will have little effect and the economy will move (perhaps slowly) to the new equilibrium.

The purpose of this paper is to examine the stability features of a full employment equilibrium. The main focus of attention is the role that price, and in particular, wage changes have in steering an economy in disequilibrium. To this end, a situation is envisaged where the only dynamic elements are price changes – there is no investment determined in an accelerationist manner and, without price changes, the total effect of a demand shock, say, is what would be predicted by a standard multiplier analysis.

The possible destabilizing effect of price changes is an idea that can be traced back to Keynes and is based upon two propositions:

1. It is in the interests of the unemployed to lower their wage demands to below those being paid by others;

2. With demand deficient unemployment, a reduction in money wages increases the deficiency and exacerbates the unemployment problem.

An implication of the first proposition is that price changes are taking place when there is unemployment—the only candidate for *equilibrium* is full employment. A combination of the two propositions suggests *instability*, the smallest amount of demand deficient unemployment being sufficient to push the economy into an abyss of deeper and deeper recession.

Of course, there are arguments which may be used to temper the instability problem. If wage costs are falling, firms are encouraged to cut prices and compete more aggressively with each other. The existence of even a weak real balance effect will mean that real demand, and employment, will increase as prices and wages tumble. In such a world, stability may be ensured.[1]

All this is well known and much discussed. The purpose here is to look at the structure of price changes in disequilibrium and examine the dynamic evolution of the economy in the light of such price changes. The main point to come from such an analysis is that though a real balance effect may ensure stability when there is a uniform reduction in prices and wages, there is little reason to believe in uniformity and non-uniformity is likely to lead to instability.

To see the reason for non-uniformity and its effects, consider the first proposition given above. Assume that there is a single unemployed worker who offers himself to an employer at a wage which is less than that being paid to others. A rational employer will either renegotiate with his present workforce or terminate the contract with one of his present employees. Assume for the present that workers refuse to renegotiate their wage. In this situation, the labour force composition will be changing whenever there exist contracts made at a wage differing from the prevailing rate. However, as the process is taking place one can expect to observe a wage distribution within the firm, even though labour may be homogeneous.

Assume that there is a recession and new contracts are being made at a low wage. Employers will be replacing their old labour force as

[1] Tobin (1980) provides a useful discussion of this issue.

rapidly as possible, and *with this constraint binding*, the cost of having a unit larger labour force is the wage paid to the *most expensive* worker in the firm. Thus, there will be little opportunity for price-cutting competition amongst firms until all the old labour contracts in the firm have been terminated. The implication is that there will be no substitution effect from wage cuts but there will be an income effect that depresses demand in the economy.

With disequilibrium in the labour market, new contracts are being made and, over time, there is movement towards equilibrium. In disequilibrium, the labour market does not clear and there are unemployed workers or, alternatively, there is full employment and an excess demand for labour; in this latter case one can expect employers to initiate contracts by making premium wage offers.

It has become popular to treat product markets, in terms of a classification of disequilibrium regime, in exactly the same way as labour markets.[2] Thus classical unemployment is distinguished from Keynesian unemployment by examining whether product markets are in excess demand or supply. In this paper, the lead originally offered by Keynes is pursued and it is assumed that product markets always clear—firms set prices and a decision not to sell more or less is based solely on the fact that lower profits will follow from a lower or higher price.

The difficulty arises as to what is the difference between Keynesian and classical unemployment. When markets clear, low demand is equivalent to a low demand price so that a Keynesian regime arises when the general level of factor prices in terms of the product demand price is high. As one associates classical unemployment with a high wage, the difference between the two regimes is determined by the structure of non-labour factor prices. For instance, high interest rates suggest Keynesian unemployment whilst low interest rates suggest classical unemployment.

As the interest of this paper is dynamic adjustment, it is necessary to briefly deal with the status of the (monopolistically) competitive equilibrium where markets clear. Under most dynamic specifications this outcome will be a resting position whenever it is reached. This is not to deny that there may be an instability problem and, to make the model interesting, it will be assumed that there are (infinitesimal) random shocks that have the role of disturbing unstable equilibria. This stochastic feature will not be modelled in detail.

The rest of the paper is divided into two parts. In the first, an

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[2] See in particular Malinvaud (1977).

analysis of the dynamic evolution of an economy is examined. Rather than working with a general model, a specific example is investigated. This example can be easily generalized. In the example, it is taken for granted that employed workers refuse to take wage cuts when unemployed workers offer themselves for work. With a technological restriction on the rate at which new labour can be absorbed, a wage distribution arises in disequilibrium. By making the simplifying assumption that wages on new contracts change at the same rate as new labour can be absorbed, the wage distribution that results at any instant takes a simple form and the path of the economy can be explicitly calculated.

The example exhibits some interesting features. Firstly, full employment is shown to be a 'cliff edge'. A shock to equilibrium that creates unemployment leads to instability and this is independent of whether or not a real balance effect exists. If there is a real balance effect then unemployment eventually diminishes and full employment is again attained. However, at this full employment situation there is an excess demand for labour and as firms find it profitable to instigate premium wage offers, wages and prices rise until full equilibrium is attained. If the equilibrium receives a shock which creates an excess demand for labour then the economy moves directly to this final stage of the process and, with regard to such changes, the equilibrium is stable. This asymmetry as a response to shocks explains why unemployment is more often observable than excess demand for labour and gives the reason for calling the equilibrium a cliff edge.

Two other features of the process are implicit in what has been said but are worth making explicit. First, in stability terms, the status of the full employment equilibrium is intriguing: for in local terms the equilibrium is unstable, the smallest shock being sufficient to set off a movement away from equilibrium; however, in global terms, the economy always returns to full employment in the long run (given that there are not repeated shocks to the system). Second, it should be clear that with repeated small shocks, business cycles will emerge. Thus, what seems to be a new theory of business cycles emerges from the analysis. The example is considered in detail in §2.

As mentioned above, the example could easily be set up in a more general framework. However, as the example can be considered as a linearization of a more general model, local instability would still follow in other models. But one assumption is crucial to the results and that is the assumption that employed workers refuse to take wage cuts. (If this is not the case then a real balance effect gives stability of the system.)

The second part of the paper deals with this issue. In particular, it is shown in §3 that, if all other workers refuse to take a wage cut, then, close to full employment, any worker finds it optimal to also refuse to take a wage cut. This optimality of downward rigidity follows from the fact that though a wage cut improves the probability of not being fired, the consequences of being fired are mild. For close to full employment, an unemployed worker will quickly obtain employment and so lose little. Although this analysis applies only in a local sense, it is sufficient to give the implication of local instability of full employment—full employment may be the only equilibrium of a system but it does not necessarily provide a good approximation to what one could expect to observe.

2. The example

2.1 The model

2.1.1 The economy is modelled as a simple general equilibrium system. Homogeneous labour is used by firms to produce similar but differentiated products. Firms pay wages and profits to consumer-workers and these consumers allocate their income between consumption goods offered for sale by firms and savings. Savings, or wealth, are held in the form of money balances—the sole role of money is as a store of value. Money is treated as the *numeraire*.

Differentiated products lead to the market for consumption goods being treated like a Chamberlinian monopolistically competitive industry. Thus, prices are set by individual firms. The labour market is more complicated. When there is unemployment, firms act as price takers. Unemployed workers set wage demands and, at any instant, there is a wage rate at which new contracts are being settled. During periods of unemployment, this wage rate is assumed to fall exogenously (but see §3). The situation is different when there is an excess demand for labour. Firms attempt to bid workers away from other firms by making premium wage offers. As the workers with the lowest wages take up these offers, the lowest wage in the economy rises and so it is necessary to raise the wage offer—during periods of excess demand for labour, the wage at which new contracts are being settled is rising.

If the final resting position of the economy is the full employment equilibrium then, in any model of disequilibrium, there must be an assumption about some rate of change over time which is determined exogenously. In the present model, this comes from a technological condition which limits the rate at which new labour can be absorbed by firms. As will become clear, it is very convenient for purposes of the example to assume that the wage on new contracts changes at the same rate in absolute terms as this, and time can be normalized so that

$$|\dot{\omega}_t| = 1 \tag{1}$$

where ω_t is the wage at which labour contracts are made at t. The rate at which new labour can be absorbed is given by some constant e.

The agents in the economy can now be considered in greater detail.

2.1.2 *Consumers* must determine an optimal consumption/saving plan over time. A consumer who is in work and receiving a wage of w and profits from firms of π faces a budget constraint

$$\dot{m} = w + \pi - pc \tag{2}$$

where m is the level of money balances, p is the price-level and c is real consumption. Given that the consumer may be made unemployed, and the length of unemployment is stochastic, the optimization problem involves uncertainty. Further complications arise because w and π also provide information about future income.

An unemployed person is assumed to receive no income and faces a budget constraint

$$\dot{m} = \pi - pc \tag{3}$$

and over time can be expected to draw down money balances.

It is clear that even with an economy of identical preference individuals' aggregate consumption will depend upon the wage/profit/money balance distribution in the population. Here, the situation is grossly simplified and it is assumed that aggregate money consumption pC is a linear function of aggregate wages W and aggregate profits Π. Thus

$$pC = \alpha + \beta_w W + \beta_\pi \Pi. \tag{4}$$

Here, $\alpha \geq 0$ and a strictly positive α designates the existence of a real balance effect—when prices, profits, and wage rates are scaled down, constant money balances imply higher real balances and this stimulates consumption. α is directly proportional to the supply of money and monetary policy takes the form of changing α.

For firms, there is no withholding of profit, and revenue minus wages gives profits. Thus

$$pC = W + \Pi \tag{5}$$

which, in (4), gives

$$pC = \tilde{\alpha} + \tilde{\beta}W, \qquad (6)$$
$$\tilde{\alpha} = \frac{\alpha}{1-\beta_\pi}, \quad \tilde{\beta} = \frac{\beta_w - \beta_\pi}{1-\beta_\pi}.$$

Thus monetary policy affects $\tilde{\alpha}$. It will be assumed that $\tilde{\beta} > 0$, i.e. $\beta_w > \beta_\pi$ and that $\tilde{\beta} < 1$ which is assured if $0 \leq \beta_w,\ \beta_\pi < 1$. This implies that lower wages go with lower aggregate money demand. This is an empirical proposition but is postulated to capture the second proposition of the introduction.[3]

Although (6) gives aggregate consumption it is necessary to investigate the demand for the product of each firm. As all firms produce similar but differentiated products, the demand for the product of firm i, d_i, can, by symmetry, be expected to be C/N when there are N firms and all charge the same price. It is assumed, in general, that demand is given by

$$d_i = Cf^i(p_1, \ldots, p_N) \qquad (7)$$

where $f^i(p, p, \ldots, p) = 1/N$ for all p and for all i and f^i is homogeneous of degree zero.

Finally, the labour force will be measured in units so that full employment corresponds to a labour force of unity.

2.1.3 *Firms*: All N firms are identical but act in a Nash–Bertrand manner in isolation. Consider firm i. The firm will be investigated under two regimes. In the first, there is unemployment and the unemployed are settling for wages below that being paid to some of the firms' workers. In the second, there is full employment and the wage at which new contracts are being settled is below the marginal product of workers.

Consider the unemployment regime. With wage contracts being settled at below the wage paid to some workers, the firm attempts to take on new workers as fast as possible. It will be assumed that the firm is constrained by a rate of new employment e. If a labour force of size $L(Q)$ is needed to produce an output Q, then with demand contracting, the marginal cost of production MC is given by

$$MC = w_u L'(Q) \qquad (8)$$

where w_u is the *highest* wage paid to an employee. For, with contracting demand, the cost of having a unit larger labour force is the cost of not firing the most expensive workers in the firm.

[3] The assumption is essentially a Kaldorian savings assumption.

Taking the prices charged by other firms as fixed and assuming that its decisions are too insignificant to affect C, firm i chooses p_i to maximize profits, i.e. revenue minus costs. Using (7) and (8), marginal revenue equated to marginal cost gives

$$f^i + (p_i - L'w_u)f^i_{p_i} = 0. \tag{9}$$

It is reasonable to look at a symmetric equilibrium where all firms choose the same price—assuming second-order conditions of profit maximization are satisfied, the symmetric equilibrium will be unique if the left-hand side of (9) increases with other firms' prices. When all firms charge the same price, this can be equated with the price level. Furthermore, $f^i = 1/N$ and $f^i_{p_i} = 1/p\ f_{p_i}\ (1, 1, \ldots, 1)$ as f is homogeneous of degree zero. Thus,

$$f^i_{p_i}(p, p, \ldots, p) = \frac{-\tilde{f}}{p} \tag{10}$$

for some $\tilde{f} > 0$. (9) becomes

$$p = \frac{w_u L'\left(\frac{C}{N}\right)}{\left(1 - \frac{1}{N\tilde{f}}\right)}. \tag{11}$$

Notice that with aggregate real demand C fixed, the price charged in equilibrium is proportional to the wage paid to the most expensive employee of the firm. This is where the relevant margin for the firm lies. Notice also that such an argument would be unaffected if the outputs of other firms were used as inputs into the production process.

The regime of excess demand for labour is similar. Firms make premium wage offers to attract new workers and time is again normalized so that $\dot{\omega} = 1$. Anybody employed at a wage less than ω will immediately accept a firm's offer so that, at any point in time, ω will also be the *lowest* wage received by any worker. At the macro level, full employment implies that any new labour force is drawn from other firms. Other firms also draw labour away from the firm under discussion and the net effect is that each firm continues to employ the same number of workers, the only change being in the wage distribution. The process continues until no more labour is required, and this occurs when, given that prices clear the product market, the value of an extra employee is ω, the wage rate prevailing on new contracts (and being paid to all workers).

2.2 The monopolistically competitive equilibrium

We start by considering the full equilibrium of the economy where markets clear and there is no incentive for new contracts to be negotiated. This means that all workers receive the same wage, which is equal to the wage rate for new contracts and which, as there is full employment, is also equal to the wage bill:

$$w^* = \omega^* = W^* \tag{12}$$

(starred values denote equilibrium values). Prices are determined by (11):

$$p^* = \frac{w^* L'\left(\frac{C^*}{N}\right)}{\left(1 - \frac{1}{N\widetilde{f}}\right)} \tag{13}$$

and aggregate real demand C^*, is given by (6)

$$p^* C^* = \widetilde{\alpha} + \widetilde{\beta} W^*. \tag{14}$$

Finally, it is necessary to ensure that the labour market clears. The supply of labour is unity, the demand by each firm is $L(C^*/N)$ so that

$$1 = NL\left(\frac{C^*}{N}\right). \tag{15}$$

Invoking Walras' Law, the market for money balances clears because the labour and product markets clear.

Only a few remarks concerning this equilibrium will be mentioned. First, if firms believe that they are in a perfectly competitive industry then $\widetilde{f} = \infty$ and the equilibrium becomes a Walrasian equilibrium. Second, notice that, from (13), the real wage is a function only of aggregate real demand. By (15), this is independent of the consumption demand by consumers. In fact, consumer demand determines only the price/wage level. If the supply of money is doubled by the government giving hand-outs to workers, then $\widetilde{\alpha}$ doubles and equilibrium wages and prices double. Of course, there is no guarantee that the new equilibrium will be attained as a result of such an action but that is a different issue.

2.3 Dynamic disequilibrium

2.3.1 At the monopolistically competitive equilibrium, markets clear and there is no incentive for change. However, if the equilibrium is unstable, then, with random shocks, the resting position feature of the equilibrium is lost.

2.3.2 Disequilibrium regime I

Assume that there are random vertical shifts in the function L and that these shifts are small and of rare occurrence. A downward shift implies technical progress and the initial impact of the change is a redistribution towards profits which causes unemployment. If the initial drop in the labour force is Δ then this effect is immediately multiplied to give a drop of

$$\delta L = \frac{\Delta}{1 - \widetilde{\beta}\Big(\frac{w^* L'}{p(1 + \frac{L''C}{L'N})}\Big)} = \frac{\Delta}{1 - \beta^*} \tag{16}$$

where $\beta^* = \widetilde{\beta}(w^* L'/p(1 + (L''C/L'N)))$.

As $p \geq w^* L'$ and $L'' \geq 0$, $0 \leq \beta^* < 1$. This is obtained by putting (11) into (6) and noting that the wage bill changes by $w^* \delta L$, i.e. those still employed are employed at the wage rate w^*. (16) is an amendment of a standard multiplier; if prices did not fall as a result of a drop in demand, i.e. $L'' = 0$, and if firms were perfectly competitive, i.e. $L' = p/w^*$, then (16) would reduce to $\Delta/(1 - \tilde{\beta})$.

(16) describes an *atemporal* instability of equilibrium. If, for some structural reason, it is necessary to fire some workers, the impact will be that a greater number will be forced out of employment. Of greater interest here is a dynamic instability created by wage cutting in the presence of unemployment.

Given that unemployment has been created, wage demands fall (see (1)) and the wage bill declines. Until all employees have been fired—or all contracts renegotiated—the highest wage w_u is equal to w^*. As $\dot{\omega} = -1$ and the rate at which new contracts can be made is restricted to e, the distribution of wages is as in Fig. 1 with a mass point at w^*.[4]

If the level of unemployment is U then the wage bill when new contracts are being negotiated at ω is given by

$$\begin{aligned} W &= \int_{\omega}^{w^*} w\, e\, dw + \Big(1 - U - \int_{\omega}^{w^*} e\, dw\Big) w^* \\ &= (1 - U)w^* - \tfrac{1}{2}(w^* - \omega)^2 e. \end{aligned} \tag{17}$$

[4]The simple dynamics on ω and the limit of new intake on e are assumed to ensure that the wage distribution is uniform with the possible addition of a mass point.

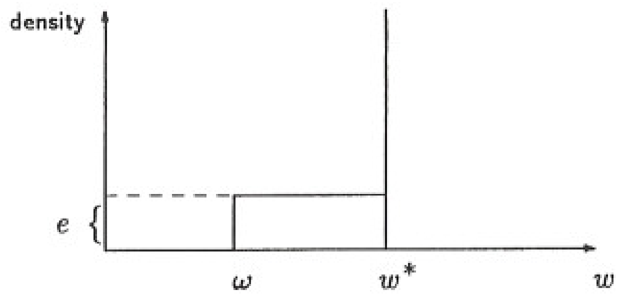

Figure 1

When real demand is C, unemployment is given by

$$U = 1 - NL\left(\frac{C}{N}\right) \tag{18}$$

Differentiating (6), (11), (17) and (18) with respect to time gives

$$\dot{U} = \frac{\left(1 - \frac{\omega}{w^*}\right) e\,\beta^*}{1 - \beta^*}. \tag{19}$$

Thus, with the wage on new contracts falling, unemployment begins to increase beyond the instantaneous effect given by (16). Notice that when $\omega = w^*$, the unemployment increase, to a first order, is zero.

(19) shows that, in a dynamic sense, the monopolistically competitive equilibrium is unstable. The important feature of (19) is its independence from $\tilde{\alpha}$, i.e. *the existence and magnitude of a real balance effect does not affect the stability of equilibrium.* This is because although prices and wages are falling, prices fall only because there is a slackening of demand; if there was no increase in unemployment then prices would not fall and there would be no scope for a real balance effect to operate.

As β^* is endogenous, it is difficult to use (19) to compute the path of unemployment. But if β^* is assumed fixed then the exercise is easy. For instance, when the last worker with a wage of w^* is fired, unemployment is given by

$$U = \frac{\beta^*}{ew^*(1 - \beta^*)}. \tag{20}$$

Notice that the effect of a higher or lower e value in (19) and (20) give very different views as to employment repercussions. If e rises, say, so that firms find it easier to make new contracts, then, by (19) unemployment tends to rise faster but, by (20), unemployment does not become so high before wage reductions start influencing prices.[5]

2.3.3 Disequilibrium regime II

We must now investigate what happens when the highest wage being paid drops below w^*. The distribution of wages in firms is now as in Fig. 2 and the wage bill is given by

$$W = \frac{1}{2}e(w_u^2 - \omega^2). \tag{21}$$

Unemployment is related to w_u by

$$U = l - e(w_u - \omega). \tag{22}$$

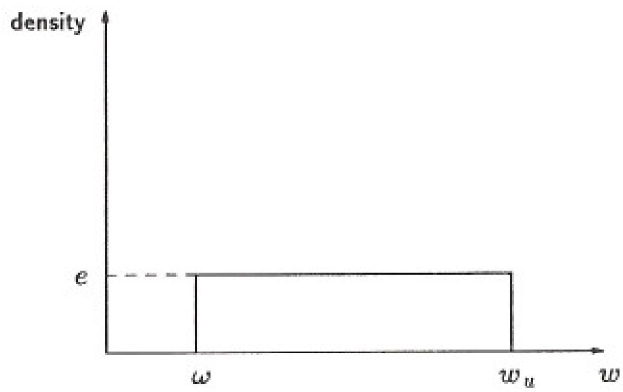

Figure 2

Momentary 'equilibrium' is given by (6), (11), (18), (21) and (22) with w_u, W, p, C and U being unknowns. Initially, an equilibrium exists with $w_u = w^*$ as it is the equilibrium of regime I. To study the dynamic path when the highest wage is falling, it is useful to think of w_u, or alternatively employment, adjusting at each instant to equate consumption demand and supply. Given a particular w_u, (21) and (6) give consumption demand and this is mutually determined together with the price level (equation (11)). Substitution gives an equation for consumption demand C^d:

$$C^d L'\left(\frac{C^d}{N}\right) = \frac{\left(1 - \frac{1}{Nf}\right)}{w_u}\left[\tilde{\alpha} + \frac{\tilde{\beta}e}{2}(w_u^2 - \omega^2)\right]. \tag{23}$$

[5] Union power may act to reduce e, the rate at which 'cheap' labour may be introduced into a firm. Although this slows down the unemployment increase (see (19)), the depth of the recession is made greater (see (20)).

A particular value of w_u also dictates an employment level (by (22)) and this dictates a supply of goods (by (18)), C^s:

$$NL\Big(\frac{C^s}{N}\Big) = e(w_u - \omega). \tag{24}$$

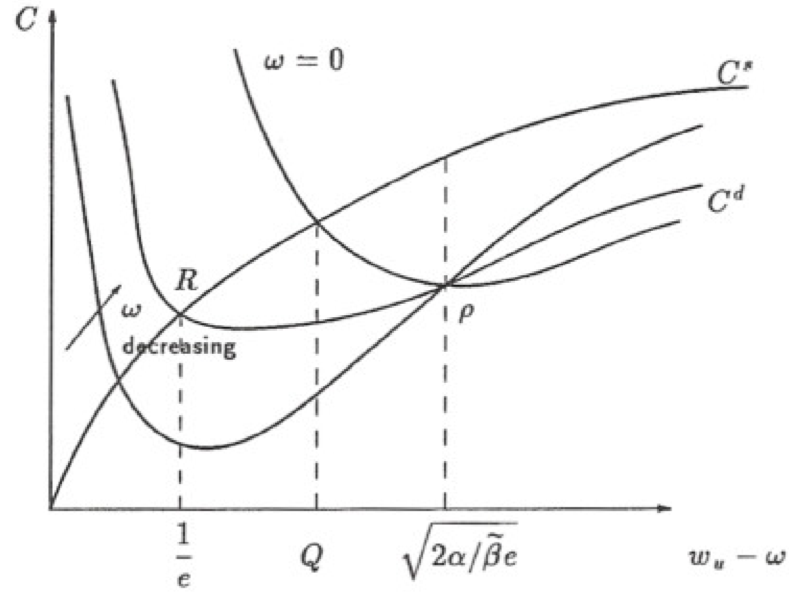

Figure 3

The demand and supply curves are shown in Fig. 3. For convenience, the functions are drawn with $w_u - \omega$ on the axis. The C^s curve is, essentially, a production function whilst C^d is a curve which declines, reaches a unique minimum and then passes through a point P. As ω changes, the C^d curve pivots around P as shown in the figure. Manipulation of (23) and (24) gives the following results:

1) The C^d curve crosses the C^s curve only from above.

2) With $\tilde{\alpha} > 0$, the C^d curve starts above the C^s curve but, at P, is below the C_s curve.

3) At $\omega = 0$, the C^d curve reaches a minimum at P.

(1) and (2) imply the existence of a unique equilibrium. As ω falls, $w_u - \omega$ rises and unemployment diminishes. It is not unreasonable to assume that $\omega = 0$ entails excess demand, i.e. Q in Fig. 3 lies to the right of the full employment point $1/e$. Thus as ω falls, employment rises until full employment is attained at R.

It is necessary to check one point. The equations used to obtain (23) and (24) rely upon the fact that expensive labour is being shed even though overall employment is rising. Combining (23) and (24) gives the change in w_u as ω varies:

$$\frac{dw_u}{d\omega} = \frac{\left[\dfrac{1+\frac{CL''}{NL'}}{1-\frac{1}{N\tilde{f}}}\right] ew_u^2 - w_u\omega\tilde{\beta}e}{\left[\dfrac{1+\frac{CL''}{NL'}}{1-\frac{1}{N\tilde{f}}}\right] ew_u^2 + \tilde{\alpha} - \dfrac{\tilde{\beta}e}{2}(w_u^2+\omega)}. \tag{25}$$

Both numerator and denominator are positive so that, as ω falls, so does w_u, i.e. even when full employment is being reached, expensive workers are still being fired, but at a rate less than that at which new workers are being taken on.

Finally, mention may be made of the price level. In regime I, the price level falls as there is a slackening of demand and an increase in the marginal physical product of labour. In regime II, the marginal cost of labour, w_u, is falling but, as the marginal physical product of labour is diminishing, the price level change can either be upward or downwards. Of course, when full employment is reattained, the drop in the price level from equilibrium must be the same in percentage terms as the drop in the highest wages; all other wages drop more than the price level. In general, the larger the unemployment level attained in regime I ((20) being an approximation), the more likely it is that the price level will rise in regime II.

2.3.4 Disequilibrium regime III

When unemployment falls to zero at the end of regime II, employers find that nobody is making wage demands. However, as firms have just been employing workers at a wage which is less than that paid to almost all their workers, it is reasonable for firms to make wage offers which exceed ω. This process will continue until nobody is receiving a wage greater than that being offered (and accepted) *and* there is no excess demand for labour.

As all firms act identically, the effect of an increase in wage offers is that low-wage labour will be attracted from other firms and any firm will lose its low-wage labour. The net effect will be no change in employment but a pushing up of the lowest wage. Fig. 4 shows the form of the wage distribution with an atom at ω.

In this situation, the wage bill is given by

$$W = \omega + \frac{e}{2}(w_u - \omega)^2 \tag{26}$$

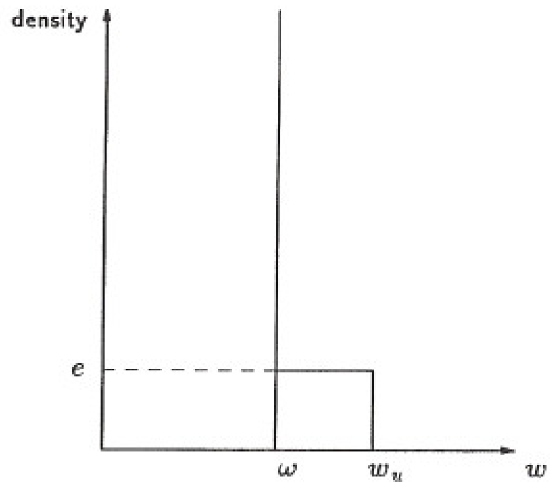

Figure 4

As ω increases, the wage bill rises and the nominal demand for consumption rises. This is given by

$$pC = \widetilde{\alpha} + \widetilde{\beta}\omega + \frac{\widetilde{\beta}e}{2}(w_u - \omega)^2. \tag{27}$$

As there is full employment, firms face labour shortages and the rational response is to raise prices and choke off demand. Thus C in (27) is defined by $NL(C/N) = 1$, i.e. $C = C^*$, and

$$\frac{dp}{d\omega} = \frac{\widetilde{\beta}}{C^*}[1 - e(w_u - \omega)]. \tag{28}$$

As for convenience it is being assumed that $\dot{\omega} = 1$, it is clear from (28) that price increases become more rapid over time. Furthermore, as W is the average wage being paid, the average real wage is given by W/p and, as $W/p = (C^*W/\widetilde{\alpha} + \widetilde{\beta}W)$, the real wage rises as ω and W rise. Thus there are clear characteristics of inflation.

2.3.5 Disequilibrium regime IV

After a period of $1/e$ in regime III, ω reaches w_u and a uniform wage is reestablished. The wage bill is now given by ω and nominal demand is given by

$$pC = \widetilde{\alpha} + \widetilde{\beta}\omega. \tag{29}$$

The uniform wage is below w^* (as regime II existed) so that because of the real balance effect, excess demand still prevails. With C fixed at

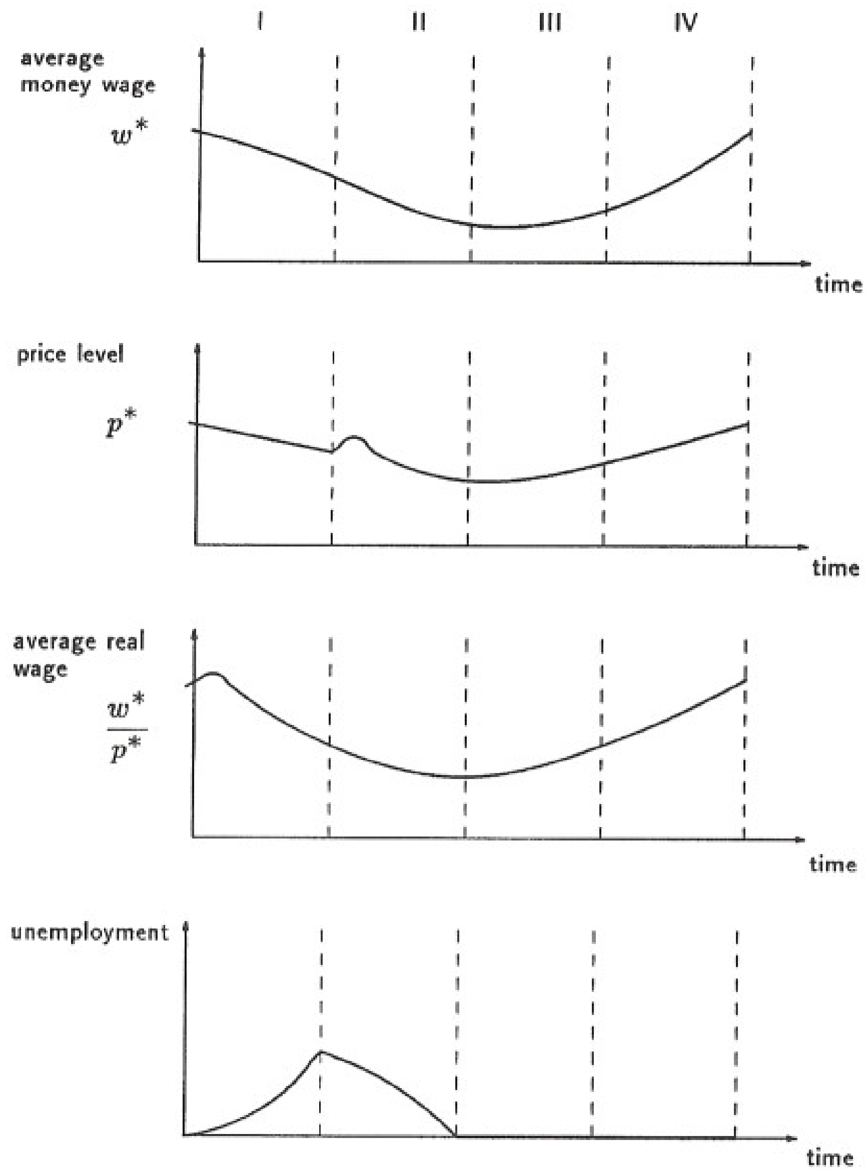

Figure 5

C^*, $\dot{\omega} = 1$, $\dot{p} = \beta/C^*$ and the real wage continues to rise. The process continues until $\omega = w^*$ and the excess demand for labour drops to zero—the equilibrium of the economy is then reattained.

2.4 The macro view of the cycle

To give a 'birds-eye' view of the cycle, Fig. 5 gives an indication of the path of average money wage, the price-level, the average real wage, and unemployment.

The important features are:

1) Prices and wages fall during the cycle and then return to old levels.

2) The real cycle which is indicated by unemployment is over after two regimes whilst prices and wages don't recover until the real cycle is over.

3) Apart from a monopolist mark-up, there is a clear relationship between the cost of labour and marginal productivity (equation (11)). However, the existence of a wage distribution explains why the average real wage can be 'pro-cyclical' and fall in recessions.[6]

4) In the model, inflation is discontinuous between regimes. Fig. 6 gives a rough idea of the relationship between wage inflation and unemployment over the cycle. The existence of a Phillips curve can be imperfectly perceived (in the model, the natural rate of unemployment is zero).

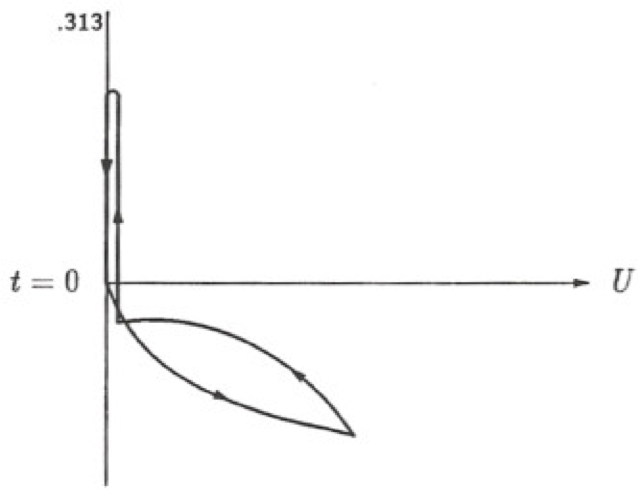

Figure 6

3. The optimality of wage cut resistance

3.1 As is clear, the features exhibited by the example in the last section depend upon the fact that employed workers refuse to take wage cuts when unemployed workers offer themselves at a lower wage. In this section, the optimality of such behaviour is investigated. In particular, attention will be focused on a situation close to full employment just

[6] See, in particular, Keynes' position on this issue (Keynes 1939) and Bodkin (1969).

after an infinitesimal shock has disturbed the system. If wage cut resistance is desirable then instability of full employment follows; however, what is not investigated is whether wage cut resistance is desirable throughout the cycle described in the last section. An analysis of what happens in the example if at some stage wage cuts are accepted is not difficult and does not affect the general conclusions of the analysis.

Consider a worker who is employed at the pre-disturbance wage w^*. If everybody refuses a wage cut then with firings occurring randomly, each worker has a probability of $(e+\dot{U}/1-U)\,\delta t$ of being fired in a small time period δt. Assume that the taking of a wage cut augments the chance of being fired by a factor $g(w)$ if w is the new wage accepted ($g(w^*) = 1$). This can be rationalized by an asymmetric information assumption about worker productivity, e.g. assuming that worker productivity differs across workers but is known only to employers. When a worker takes a wage cut he cannot be certain that he is not still amongst the highest wage per productivity workers.

Let $A(t, w)$ be the expected discounted future utility of a worker at time t given that he is employed at a wage of w and, similarly, let $B(t)$ be the expected future utility of somebody who is unemployed. Assume now for simplicity that individuals consume their wages and obtain instantaneous utility $u(w)$ where $u(0) = 0$. If r is the rate of discount then we will have

$$0 \leq A_w \leq \frac{u'(w)}{r} \tag{30}$$

for some w, $0 \leq w \leq w^*$.

If a worker who is employed at wage w^* is contemplating accepting a wage reduction to w at time t then his expected future utility is given by

$$\begin{aligned} C(t,w) & \\ &= \lim_{\delta t \to 0}\Big[\Big(1 - \Big(\frac{e+\dot{U}}{1-U}\Big)g(w)\delta t\Big)\Big(u(w)\delta t + (1 - r\delta t)A(t+\delta t, w)\Big) \\ &\qquad + \Big(\frac{e+\dot{U}}{1-U}\Big)g(w)\delta t\, B(t+\delta t)\Big]. \end{aligned} \tag{31}$$

Here, a familiar dynamic programming argument has been used. Now, consider the option of waiting δt and then accepting the wage cut to w. Expected future utility is given by

$D(t,w)$

$$= \lim_{\delta t \to 0} \Big[\Big(1 - \Big(\frac{e + \dot{U}}{1 - U}\Big) g(w^*)\delta t\Big) \Big(u(w^*)\delta t + (1 - r\delta t) A(t + \delta t, w)\Big) + \Big(\Big(\frac{e + \dot{U}}{1 - U}\Big) g(w^*)\delta t\Big) B(t + \delta t)\Big]. \tag{32}$$

Combining (31) and (32), it is optimal to delay if

$$\Big(g(w) - g(w^*)\Big) \Big[\Big(\frac{e + \dot{U}}{1 - U}\Big) \Big(B(t) - A(t,w)\Big)\Big] + \Big(u(w) - u(w^*)\Big) \leq 0. \tag{33}$$

Consider, now, the form of $B(t)$. If everyone who is unemployed is asking for a wage $\omega(t)$ then $\frac{e}{U}\delta t$ is the probability of gaining employment in a period δt. By asking for w, this can be changed by some factor $h(w,t)$ $(h(\omega(t),t) = 1)$. $B(t)$ is given by

$B(t)$

$$= \sup_{w} \lim_{\delta t \to 0} \Big[\frac{e}{U} h(w,t)\delta t \Big[u(w)\delta t + (1 - r\delta t)\Big(A(t + \delta t, w)\Big)\Big] + \Big(1 - \frac{e}{U} h(w,t)\delta t\Big) \Big[(1 - r\delta t)\, B(t + \delta t)\Big]\Big] \tag{34}$$

which, if the optimal w is $\omega(t)$, reduces to

$$B' = rB - \frac{e}{U}\Big(A(t, \omega(t)) - B(t)\Big). \tag{35}$$

With $\dot{U}$ bounded, as $U(0) = 0$ and $B(t) \geq 0$ for all t, (35) shows that for small t,

$$A\Big(t, \omega(t)\Big) = B(t) + O(t). \tag{36}$$

(In fact, in the example of the last section, $\dot{U} = 0$ (see (19)) and $O(t)$ could be replaced by $o(t)$). With $\omega(t) = w^* + O(t)$, (30) and (36) give

$$A(t, w) - B(t) \leq O(t) \tag{37}$$

for all w so that (33) holds for all w if g' is bounded above and u' is bounded below, given only that t is less than some t^*. Thus for small t, it is optimal to resist wage cuts.

Within this framework, it is also possible to see how $\omega(t)$ is determined. First-order conditions for the choice of w in (34) give

$$h_w\Big(\omega(t), t\Big)\Big[A\Big(t, \omega(t)\Big) - B(t)\Big] + A_w(t, \omega(t)) = 0 \qquad (38)$$

if it is optimal to choose $\omega(t)$. Notice that as it may be reasonable to assume that $h(w, t) = 0$ if $w > \omega(t)$, (38) can imply that it is optimal for everybody to set wage demands which are the same as everybody else—the wage demanded is set by custom as, between bounds, any level can be sustained as an equilibrium.

3.2 The attitude of firms

Thus far, firms have been considered to have a passive role. But an obvious way of breaking down an equilibrium of wage cut resistance is to introduce a seniority system. Marginal workers are then certain that they will be fired and will accept wage cuts.[7] If different workers then become marginal they will also take cuts and so on through the workforce.

The question arises as to whether such a practice is desirable. Although it is in the interests of a single firm to force wage cuts, it is true in the example of the last section that, at least in the short term, firms gain from the existence within the economy of wage cut resistance, for as price competition is dictated by the cost of the most expensive worker, the existence of a wage distribution implies that profits are higher than would be the case if everybody received the average wage. Thus firms as a group have an incentive to support legislation outlawing wage cutting.

4. Concluding remarks

This paper has modelled a situation where wage-cut resistance is optimal and has investigated the implications of this for the macro characteristics of an economy. With wage-cut resistance, the onset of a recession will imply that average wages—and so demand—will fall, but the cost of the marginal worker to a firm will hold fast. In this situation, the equilibrium with market clearing will be *unstable* independently of whether or not a real balance effect exists. In fact, this equilibrium has interesting stability properties because it is *locally unstable* but *system stable*. With such a situation, the mildest of shocks is sufficient to generate the existence of business cycles. The model

[7] Unions seem to attempt to prevent this occurring. However, the usual defence of such a practice is employment protection rather than wage protection.

goes at least some way to incorporate price as well as quantity changes in a dynamic macro model.

Nothing has yet been said about the role of government policy. In the model, government policy which stimulates demand, e.g. a lump-sum grant financed by money creation, can ensure that full employment is reattained. However, if the distribution of wages is spread out before the government policy is enacted, then, unless it is possible to interfere with the distribution directly, it is impossible to avoid a situation where low wages rise to the highest wage, that is, wage inflation results. Furthermore, if the government makes no attempt to damp down demand that is created by the wage bill increase, then price inflation will also result. Although a prices and incomes policy may be used to prevent price/wage changes, the fact that there is a disequilibrium distribution of wages implies that inflation can only be put off until the incomes policy is removed: the problem does not disappear.

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