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11 An Aspect of the Economic Role of Unemployment

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INTRODUCTION

Economic thought on the role of unemployment has evolved in the past decade from the view that unemployment is a simple waste of resources to the view that at least some unemployment is privately and socially beneficial because it yields a better match between jobs and workers. The papers by Phelps, Holt, and Mortensen in the famous volume, *Microeconomic Foundations of Employment and Inflation Theory* (1970) have been especially influential in bringing about this change in thinking. The literature on the microeconomics of unemployment has not settled the issue of the optimality of the equilibrium level of unemployment present in an unfettered competitive economy. The extreme view that the private and social costs and benefits are precisely equal is not widely held. In his thoughtful review of the subject (Tobin, 1972), James Tobin has observed that the process of job search involves externalities associated with congestion and queuing, but is uncertain 'whether the market is biased toward excessive or inadequate search' (p. 8). My purpose in this paper is to study one specific externality in considerable microeconomic detail. The externality arises from the effect of unemployment in the market on the hiring and firing policies of employers. Earlier empirical work of mine has suggested the following hypothesis, which Arthur Okun has picturesquely called the 'spare tyre theory': firms in chronically tight labour markets try to minimise turnover by holding overhead labour during temporary reductions in demands for their products. The costs of recruiting in tight markets motivates this policy. In chronically slack markets, on the other hand, firms treat the unemployed as a readily available buffer stock from which they can draw whenever labour is needed. They do not hold overhead labour because recruiting labour when it is needed is inexpensive. Within the United States, there is a certain amount of evidence in favour of the hypothesis. There are dramatic chronic differences in unemployment rates among cities. Those with low unemployment rates have strikingly low lay-off rates – the weekly probability of losing a job in Chicago, a city with a tight market, is less than one quarter of the probability in San

Francisco, where the labour market is chronically slack.[1] International comparisons are even more striking – lay-off rates are virtually zero in countries with low unemployment rates.

This paper studies a microeconomic model with a structure that has been simplified in order to examine the particular issue of the external effect of unemployment. The model has no claim whatever to generality or realism. Rather, it serves as an extended example of the externality. In the model, a pathological equilibrium is possible, where output is far below its feasible level because an excessively tight labour market induces firms to hold overhead labour. The model also has an efficient equilibrium in which reserve labour is held only in the market where all firms have access to it. The wage is sufficiently high and recruiting sufficiently cheap that overhead labour within the firm does not pay for itself.

The structure and properties of the model of this paper cut very much against the grain of most recent thinking about unemployment and the function of labour markets. In the model, turnover is beneficial to both workers and employers, whereas most recent thought emphasises the costs of turnover owing to the dissipation of specific human capital and portrays employers as trying to minimise turnover (see Stiglitz, 1974, for example). Here, unemployment has no private benefits associated with the accumulation of topical knowledge of the labour market. It is not a search theory in the spirit of Mortensen (1970) and others. The contrast with other work is clearest in its conclusions about subsidies for the unemployed. Many economists favour unemployment compensation on grounds of equity while conceding the inefficiency it brings about by making the private return to unemployment exceed the social return. Martin Feldstein (1973), for example, has cited the generosity of unemployment compensation as an important obstacle to low unemployment rates in the United States. He favours tight labour markets achieved by making individuals bear more of the cost of unemployment. In the model of this paper, just the opposite is optimal: slack labour markets supported by full unemployment compensation. Driving unemployment out of the labour market only makes it reappear less efficiently in the form of overhead labour within the firm.

I THE MODEL

I will consider the problem of allocating a fixed labour force of size L to a fixed number of firms, N. Each firm produces one unit of output with one worker; however, there is only a probability of one half that it can produce at all. Agricultural firms dependent on stochastic rainfall are an example of the technology the model embodies. I assume that there is a sufficiently large

[1] There is weaker evidence that wages are correspondingly higher in cities with slack markets. This is necessary to attract labour to high-unemployment cities, and is possible because labour is more fully employed within the firm, and hence more productive, in those cities. See Hall (1972) for an extended discussion.

number of firms that the fraction of them who are able to produce is deterministic and equal to one half. It is possible for firms to put labour to work *after* they have determined whether they can produce. In the absence of any constraints on the allocation process, it is clear that all firms should wait until it is known which of them can produce and then to hire the $N/2$ workers they will need. With this scheme, if the labour force is exactly the right size ($L = N/2$), every worker will produce one unit of output and every firm will produce as much as possible. Assigning a worker to a firm before it was known whether or not he could be used would make his expected productivity only half as high. Unconditional assignment would be efficient only if labour was sufficiently redundant to assign a worker to every firm ($L = N$). For the rest of the paper I will assume for simplicity that $L = N/2$, so labour is not redundant.

Both a rational planner and a competitive market would arrive at the same conditional process of allocation if workers could be shifted costlessly among firms. The problem becomes interesting only when a more realistic view of the labour market is adopted. In practice, each firm has access to only a small fraction of the labour force, typically just those who enquire about work around the time when it is available. The danger of the conditional hiring policy to the firm is that there is a probability, v, that no workers will be available when needed. If v is high enough, it may be more profitable to hold workers permanently rather than to hire them only when work is available. A reasonable, general characterisation of the probability of failing to find a worker is that it depends on the total number of workers available in the market, say S (which may be less than $N/2$), and the total number of firms actually hiring, say D (which may also be less than $N/2$):

$$v = \phi(S, D) \tag{1}$$

I will make use of a particularly simple version of this general model. Suppose that each of the S workers visits one employer chosen at random and takes a job if it is available; if more than one worker appears, one is chosen at random for employment. The probability that a given worker will visit a particular employer is $1/D$. The probability that an employer will not be visited by *any* worker is

$$\begin{aligned}\phi(S, D) &= \left(1 - \frac{1}{D}\right)^S \\ &= \left[\left(1 - \frac{1}{D}\right)^{-D}\right]^{-S/D} \\ &\doteq e^{-S/D}\end{aligned} \tag{2}$$

Since I take D to be large it is reasonable to take $\phi(S, D)$ to be exactly $e^{-S/D}$. When supply and demand are equal, the unemployment rate is $e^{-1} = 0.37$. Later in the paper I will discuss more effective matching processes that achieve much lower unemployment rates when supply and demand are equal.

The probability v can be viewed as the vacancy rate.[1] It is linked to the unemployment rate, u, by the identity that the number of filled jobs is equal to the number of employed workers:

$$(1 - v)D = (1 - u)S \tag{3}$$

Firms may adopt a conditional employment strategy, hiring only if they are able to produce, or an unconditional strategy. Suppose that a fraction x of them operate conditionally and the remaining $1 - x$ operate unconditionally. Employment in unconditional firms will be $(1 - x)N$ and output will be $(1 - x)N/2$. Labour supply in the conditional market will be $S = N/2 - (1 - x)N = (x - \frac{1}{2})N$ and demand will be $D = xN/2$. The vacancy rate will be

$$\begin{aligned}v &= \phi((x - \tfrac{1}{2})N, xN/2) \\ &= e^{-(2x-1)/x}\end{aligned} \tag{4}$$

Total output will be the output of unconditional firms who are able to produce plus the output of conditional firms who are able to produce *and* who are successful in hiring labour:

$$\begin{aligned}Q(x) &= ((1 - v)x + 1 - x)N/2 \\ &= (1 - vx)N/2\end{aligned} \tag{5}$$

If the vacancy rate did not depend on x, Q would be a decreasing function of x, and the optimum would occur at $x = 1/2$, where all labour is employed unconditionally. Under the assumption that labour is not superfluous, however, the vacancy rate is low for x close to one and rises rapidly as x declines. Every firm switching from conditional to unconditional hiring reduces the supply of labour by one but reduces the demand for labour by only a half. The lower is x, the tighter is the labour market and the lower is the productivity of the conditional firms. The derivative of output with respect to x is

$$\begin{aligned}Q'(x) &= -\left(v + x\frac{dv}{dx}\right)N/2 \\ &= (1 - x)\frac{v}{2x}N\end{aligned} \tag{6}$$

Output *increases* with x over the whole range of x, so the optimum occurs at $x = 1$, where all firms hire conditionally. It is inefficient to hold any labour in reserve within any firm; even though the method of placing workers in jobs is severely limited, it is less costly than placing workers in firms with only a 50 per cent probability of being productive.

[1] This vacancy rate is the number of firms idled by lack of labour. It should be distinguished from the vacancy rate for jobs as collected by the government. Firms with vacant jobs may still operate at capacity if the firms are looking for workers in anticipation of future needs.

Next I will investigate market equilibrium in this model. I define equilibrium as the absence of opportunity for any individual economic agent to improve his situation. (Supply and demand for labour need not be equal in the model, so the usual definition of competitive equilibrium does not apply.) Two conditions are required for equilibrium defined in this way. First, if both employment strategies co-exist in the market, they must be equally profitable – were one strategy more profitable than another, the second would not be used. Second, employment must be equally attractive in the two kinds of firms. I will assume the absence of risk aversion among workers and employers. The only unattractive feature of the open labour to workers is the reduction in expected income associated with unemployment, not the uncertainty it causes. Then if the wage for stable employment among unconditional firms is w, the suitably higher wage in the open labour market with unemployment rate u is $\frac{w}{1-u}$. With these wage levels, the equal-profit condition for firms can be derived as follows: the expected profit for unconditional operation is $1/2 - w$ – a product selling at price one can be produced with probability 1/2 but a wage w must be paid with certainty. The expected profit for conditional operation is $\frac{1}{2}(1-v)\left(1-\frac{w}{1-u}\right)$ – with probability 1/2, neither production nor attempted hiring takes place, otherwise the firm has probability $1-v$ of hiring a worker at wage $\frac{w}{1-u}$ and selling the product at price 1. The equilibrium condition for co-existence (i.e., $x < 1$) is

$$1/2 - w = \tfrac{1}{2}(1-v)\left(1-\frac{w}{1-u}\right) \tag{7}$$

Given v and u, the only wage consistent with equilibrium is

$$w = \frac{v}{2 - \frac{1-v}{1-u}} \tag{8}$$

In terms of the relation between x and u and v hypothesised in equations 2 and 3, the equilibrium condition is

$$w = xv \tag{9}$$

At the minimum value of x, 1/2, the vacancy rate is 1 and the wage is 1/2, while at the maximum value, $x = 1$, the vacancy rate is $e^{-1} = 0.37$ and the wage is 0.37 as well. The equilibrium wage declines as x increases because the labour market is slackening and conditional hiring is becoming more attractive. With values of x close to one, only a low wage can make unconditional hiring as profitable as conditional hiring. At the point where there are literally no unconditional firms ($x = 1$), equal profitability no longer applies and the wage is free to take on a range of values, bounded below by the point where unconditional operation would be more profitable ($w = e^{-1}$) and above by the point where the profit of conditional operation is zero ($w = 1 - e^{-1} = 0.63$).

The equilibrium possibilities thus consist of mixed conditional and unconditional hiring in a tight labour market with the low wage prescribed by equation (9) together with totally conditional hiring in a slack labour market with a range of higher wages. I have already argued that the high-wage, slack market allocation is the only efficient one for this model. Although the efficient allocation is an equilibrium in the model, it is not the only equilibrium, but the others are inefficient. Under the constraints imposed on the labour market by the model, competitive pressures do not necessarily bring the economy to an optimal allocation of labour. In the inefficient, tight-market equilibrium, there is a genuine externality associated with unemployment. The movement of one worker from the unconditional to the conditional sector would raise output even though it would raise unemployment as well, yet wages are effectively equal in the two sectors and workers face no incentive to move.

II FURTHER STUDY OF THE TIGHT-MARKET, LOW-WAGE EQUILIBRIUM

The inefficient equilibrium of the previous section depends fundamentally on the hypothesis that firms can locate workers only in the way assumed. Many kinds of arbitrage within the market are ruled out by assumption. For example, a group of firms could raise their joint profit by forming a private labour pool. Even two firms can benefit by forming a pool containing a single worker. They could offer sure employment to the worker and thus pay the wage for unconditional employment, w. Their joint expected revenue would be the probability of producing, which is 3/4, less the wage bill, w. The expected profit per firm would be half this, or $3/8 - w/2$. By contrast, the expected profit of an independent firm, either conditional or unconditional, is $1/2 - w$, which is smaller than $3/8 - w/2$ for any w permitted by the model. In the model, firms are assumed not to have access to the workers of other firms in the way illustrated by this example. Firms either pay the cost of holding overhead labour or expose themselves to the chance of a vacancy together with the added cost of compensating workers hired conditionally for their exposure to the risk of unemployment.

The larger the scope of pooling workers among firms, the closer is the equilibrium to the unconstrained competitive equilibrium where all firms have free access to all workers, vacancy and unemployment rates are zero, and expected profits are $1/2 - w/2$. Belief in a labour market with unused resources attributable to stochastic matching of jobs and workers requires a belief that opportunities for arbitrage through pooling are limited. The model of this paper is a first attempt to characterise this limitation.

A second fundamental implicit assumption of the model is that firms are price-takers in the labour market. They make decisions on the assumption that

they must offer the prevailing wage to get a worker at all, but that they have no higher probability of getting one by offering a wage above the prevailing level. The second part of the assumption is defensible within the model of job search, where workers get at best a single job offer and have no alternative to accepting it apart from unemployment. The first part has no satisfactory rationale. Under the assumptions of the model, the maximising firm should offer a wage only infinitesimally greater than zero when it actually comes to recruit, thereby taking full advantage of its power as a monopsonist. With this behaviour, no equilibrium is possible, because conditional employers as a group would have to offer a wage suitably higher than the unconditional wage to induce workers to enter the open labour market at all, yet each firm would have a large incentive to offer a much smaller wage if a worker actually appeared. This contradiction only demonstrates the inadmissability of the assumption that employers take the vacancy rate as given. The model counterbalances this unrealistic assumption with the equally unrealistic one that firms are also wage-takers. The result is a simple, workable model.

The next full step in this research is the creation of a model where firms take full advantage of their monopsony power but the power is limited because each worker visits more than one employer. A model extended in this direction is complex. Recent work of Gerald Butters (1975) and Daniel McFadden on a related problem in product markets suggests that under certain assumptions the only equilibrium will involve a distribution of wages, not a single prevailing wage. If all other employers offered the same wage, one employer could achieve a substantial increase in the probability of locating a worker by offering a wage only infinitesimally higher than the prevailing level. I will not pursue the development of a fully specified model with monopsony power here. Rather, I will assume that monopsony can be characterised in a certain way and then show that the pathological equilibrium with tight labour markets can arise even when firms recognise monopsony power and take advantage of it. The example I will give requires a slightly different specification of the matching process in the labour market slightly different from the earlier example. In the new example each worker meets with more than a single employer, so it is plausible that firms have a degree of monopsony power, but not the infinite power they had in the earlier example.

The new matching process assumes that the labour market has a second round where unsatisfied employers meet again with workers who did not find jobs in the first round. If S workers and D employers participate in the first round, $u_1 S$ workers and $v_1 D$ employers will remain to participate in the second. The first-round unemployment and vacancy rates u_1 and v_1 are determined as discussed earlier:

$$v_1 = e^{-S/D} \tag{10}$$

$$u_1 = 1 - (1 - e^{-S/D})D/S \tag{11}$$

The same process occurs in the second round, so the vacancy rate among participants in the second round is

$$v_2 = e^{-u_1 S/v_1 D} \tag{12}$$

The total vacancy rate is the probability of not finding a worker in either round and is the product of the two vacancy rates:

$$v = v_1 v_2 = e^{-(1 + u_1/v_1)S/D} \tag{13}$$

As before the unemployment rate is

$$u = 1 - (1 - v)D/S \tag{14}$$

It is apparent from these formulae that both the vacancy and unemployment rates are lower when there is a second round in the labour market. In the model of the previous section where firms are wage- and vacancy-takers, the character of the possible equilibria remains the same with the new specification of $\phi(S, D)$. At the efficient, slack-market equilibrium, $S = D$ and $u = v = e^{-2} = 0{\cdot}14$. Since a larger fraction of the conditional labour force is employed, but the productivity of unconditional firms remains the same, the social cost of a tight-market equilibrium is higher. Further, the tight-market equilibrium occurs at lower wages – equation (9), $w = xv$, still holds, but v is lower for a given x.

Now suppose that workers choose among alternative employers in a way that makes the supply of labour to an individual firm upward-sloping in the following way:

Probability of locating a worker $= 1 - \tilde{v}$

$$= \min\left(\left(\frac{\tilde{w}}{w}\right)^{\frac{1}{2}}(1 - v),\ 1\right) \tag{15}$$

Here $\frac{\tilde{w}}{1-u}$ is the firm's wage, $\frac{w}{1-u}$ is the prevailing wage offered by other firms and v is the vacancy rate for firms paying the prevailing wage. The expected profit for conditional hiring is then

$$\tfrac{1}{2}(1 - \tilde{v})\quad 1 - \frac{\tilde{w}}{1-u} \tag{16}$$

Profit is maximised when

$$w = (1 - u)/3 \tag{17}$$

Since this calculation is performed by all firms, the prevailing wage, w, will in fact be $(1 - u)/3$. The possible equilibria in an economy with this process of wage-setting and the two-round matching scheme are shown in Figure 11:1.

The solid line in the Figure is the locus of equal profitability of conditional and unconditional hiring, $w = vx$; the broken line is the profit-

maximising wage $(1-u)/3$. The new model has two distinct equilibria, an inefficient one with tight labour market and an efficient one with a slack market. Relaxation of the unrealistic assumption that firms are wage- and vacancy-takers does not change the fundamental conclusion of the paper that

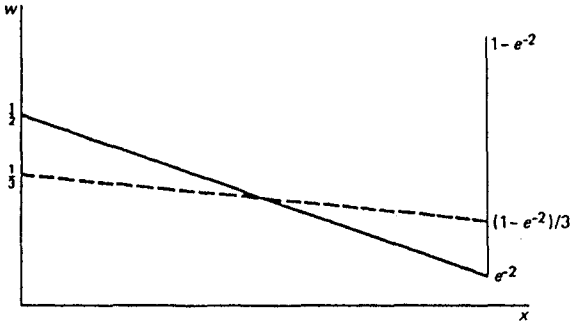

Fig. 11:1

an economy can achieve a pathological equilibrium where labour-hoarding is induced by excessively tight labour markets and where everyone could be made better off by moving some workers from employment in the unconditional sector to unemployment in the conditional sector.

III EFFICIENT SUBSIDY POLICIES

Within the simple model of the first part of this paper, many alternative policies could achieve efficiency. Most directly, the government could simply prohibit the hoarding of labour and require employers to make use of the open labour market. A sufficiently high tax on hoarded labour would have the same effect. However, existing policies rely largely upon subsidising unemployment, so it is of greatest interest to examine the role that such a subsidy could play in achieving efficiency.[1] Suppose that the government compensates unemployed workers at a fraction s_u of the wage they would have received in the open market had they found jobs. Then the gap between the wage for conditional employment and the wage for unconditional employment falls as s_u rises, and the two wages are equal if s_u is one. The conditional wage is $w/(1-(1-s_u)u)$, where, as before, w is the wage for unconditional employment. The condition of equal profit for the two methods of operation becomes

$$1/2 - w = 1/2(1-v)\left(1 - \frac{w}{1-(1-s_u)u}\right) \tag{18}$$

[1] The United States government has no important policies that encourage stable employment by taxing or controlling lay-offs. However, I believe that many other countries do have this kind of policy. Within the model of this paper, anti-lay-off policies are perverse.

Equality remains feasible even if s_u is one and unemployment is fully subsidised. High wages for conditional employment constitute only one of the two forces that make unconditional operation economically attractive, so elimination of the wage gap through an unemployment subsidy does not rule out the possibility of an inefficient equilibrium in which some firms operate unconditionally. The other force is the danger of vacancies in conditional operation. Suppose that the government compensates employers for a fraction s_v of the profit they forgo in case of a vacancy. Then the condition of equal profit is

$$\tfrac{1}{2} - w = \tfrac{1}{2}(1-(1-s_v)v)\left(1 - \frac{w}{1-(1-s_u)u}\right) \tag{19}$$

With high rates of subsidy, equality becomes possible only at very low wages but, in principle, an inefficient, tight-market equilibrium remains possible. When both unemployment and vacancies are fully subsidised ($s_u = s_v = 1$), the condition has the simple form

$$1/2 - w = 1/2(1-w) \tag{20}$$

Equality cannot hold for any positive wage rate, so the only possible equilibrium has all firms operating conditionally and is therefore efficient.

IV CONCLUDING REMARKS

In a very simple model, unemployment has an important externality, in the sense that there is an equilibrium where total output could be increased by reallocating labour in a way that increased the unemployment rate. No claim can be made at this stage that a similar externality exists in a more realistic model where jobs and workers are heterogeneous and unemployment has a private benefit. The optimal unemployment and vacancy subsidies in a more realistic model would clearly be lower, since these subsidies distort private decisions along margins that are not considered in the simple model. The model does support the view, however, that unemployment cannot be conceived of simply as another use of individuals' time for which individual decisions can be relied upon to produce an efficient equilibrium. The presence of unemployed resources, whether labour or other factors, requires a thorough reconstruction of competitive economic theory.

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