18 Unemployment

Why do we have involuntary unemployment? Why are wages higher than in the competitive market clearing level? Why is it so hard do adjust (nominal) wages down? Three answers:

Efficiency wages: the quality of labor may be related to wage. Higher wages may attract more efficient workers, *higher wages may increase worker's effort when effort is imperfectly observed*.

Implicit contracts: firms are able to supply workers with insurance against income uncertainty, thereby producing a relatively stable wage.

Unions or insider-outsider models: unions, or more generally, employed workers, have some bargaining power that leads to a different pattern of wages and employment than would be observed under competition.

Simple efficiency-wage model

There is a large number of competitive firms, N. The representative firm's profits are given by

$$\pi = Y - wL \tag{1}$$

where Y is the firm's output, w is the wage and L is the amount of labor. For simplicity we assume that only labor enters the production function

$$Y = F(eL) \tag{2}$$

where $F' > 0$, $F'' < 0$, and e denotes the worker's effort. Effort depends positively on the wage the firm pays

$$e = e(w), \quad e' > 0 \tag{3}$$

This is the crucial assumption of the efficiency-wage model. Finally, there are $\bar{L}$ identical workers that supply one unit of labor inelastically.

The representative firm seeks to maximize its profits

$$\max_{L,w} F\left(e\left(w\right)L\right) - wL \tag{4}$$

The first-order conditions for L and w are

$$\begin{aligned} F'\left(e\left(w\right)L\right)e\left(w\right) - w &= 0 && (5) \\ F'\left(e\left(w\right)L\right)Le'\left(w\right) - L &= 0 && (6) \end{aligned}$$

that can be rewritten to give

$$F'\left(e\left(w\right)L\right) = \frac{w}{e\left(w\right)} \tag{7}$$

i.e. the marginal product of labor equals the marginal cost of labor.

Substituting (7) into (6) and dividing by L yields

$$\frac{we'(w)}{e(w)} = 1 \tag{8}$$

In optimum, the elasticity of effort with respect to wage is 1. When the firm hires a worker, it obtains $e(w)$ units of effective labor at cost w; thus the cost per effective unit labor is $w/e(w)$. When the elasticity of e with respect to w is 1, a marginal change in w has no effect on this ratio. The wage satisfying (8) is known as the *efficiency wage*.

Generalized efficiency wage model

Effort may not only depend on wage alone, but also on the possibility of being fired if caught shirking, on how easy it is to obtain a new job if fired, and on the wages those other jobs pay.

Thus a natural generalization of the effort function (3) is

$$e = e\left(w, w_a, u\right)$$

where w_a is the wage paid by other firms, u is the unemployment rate, and $e'_1 > 0, e'_2 < 0, e'_3 > 0$. Each firm is small relative to the economy and takes w_a and u as given.

The representative firm's problem is the same as before, but with the new effort function. The first-order condtitions can therefore be rearranged to obtain

$$\begin{aligned} F'\left(e\left(w, w_a, u\right) L\right) &= \frac{w}{e\left(w, w_a, u\right)} \\ \frac{w e_1\left(w, w_a, u\right)}{e\left(w, w_a, u\right)} &= 1 \end{aligned}$$

These conditions are analogous to the simpler version. Equilibrium requires $w = w_a$, else each firms wants to pay a wage different from the prevailing wage. Let w^* and L^* be the values that satisfy the conditions above, with $w = w_a$. If NL^* is less that $\bar{L}$, the equilibrium wage is w^* and $\bar{L} - NL^*$ are unemployed. If NL^* exceeds $\bar{L}$, the wage is bid up and the market clears.

The Shapiro-Stiglitz model

The economy consists of a large number of workers, $\bar{L}$. Each worker is risk neutral with the utility function

$$u(w, e) = w - e \tag{9}$$

At any moment the worker must be in one of three states; employed and exerting effort (E), employed and shirking (S), or unemployed (U). The level of effort can only take two values: $e = 0$ if the worker shirks or $e > 0$ if he does not shirk. In other words, utility in the three states are

$$u(w, e) = \begin{cases} w - e & \text{if employed and exerting effort} \\ w & \text{if employed and shirking} \\ 0 & \text{unemployed} \end{cases}$$

Profits and transitions

There are also a large number of firms in the economy, N. The firms' profits are given by

$$\pi = F(eL) - w(L + S) \tag{10}$$

where L is the number of employees who are exerting effort and S is the number who are shirking.

The firm can only imperfectly monitor workers, though the monitoring technology is not made explicit. It is simply assumed that the probability of being caught, if shirking, is equal to q. All workers who are caught shirking are fired. The hazard rate of job breakup for reasons other than shirking, is equal to b and is the same for all firms. Finally, unemployed workers find employment at rate a per unit time. Each worker takes a as given, but in the whole economy, a is determined endogenously.

Asset pricing equations

Workers are foreward looking, incorporating in their utility not only current wage, but also what follows in the future. Let V_i denote the expected present value of utility in each of the three states, $i = E$, S, and U. Because transitions among states are Poisson processes, the V_i's do not depend on how long a worker has been in a specific state. Also, because we are focusing on steady states, the V_i's are constant over time. Romer derives three asset pricing equations for the firm

$$\rho V_E = w - e - b\left(V_E - V_U\right) \quad (11)$$

$$\rho V_S = w - (b + q)\left(V_S - V_U\right) \quad (12)$$

$$\rho V_U = a\left(V_E - V_U\right) \quad (13)$$

where ρ is the worker's discount rate, w is the wage rate, e is the workers effort, q is the probability a worker is caught shirking, b is the hazard rate for job breakup, and a is the rate at which workers find employment.

The rent from being employed

The wage paid must be such that

$$V_E \geq V_S$$

else the workers exert no effort and produce nothing. The firm chooses w so that $V_E = V_S$. Inserting for V_S in asset equation (12) this implies that

$$w - e - b\left(V_E - V_U\right) = w - (b+q)\left(V_E - V_U\right)$$

or

$$V_E - V_U = \frac{e}{q}$$

This is the rent from being employed and not shirking.

Effort-inducing wage

Solving the first asset equation (11) for V_E, and the second asset equation (12) for V_S, it must be that

$$\frac{1}{b+\rho}\left[w - e + bV_U\right] = \frac{1}{b+\rho+q}\left[w + (b+q)\,V_U\right]$$

Solving for w yields

$$\begin{aligned} w &= \frac{e}{q}(b+\rho+q) + \rho V_U \\ w &= \frac{e}{q}(b+\rho) + e + \rho V_U \end{aligned}$$

To induce effort, a firm must pay a wage that at least covers the return to being unemployed, and that compensates for the effort the worker exerts. In addition the worker earns a return on the rent from being employed and not shirking.

Endogenous unemployment

Next, we want to find the market equilibrium with an endogenous value of being unemployed. Using the condition that $V_E - V_U = e/q$ and inserting this in the third asset equation (13) the resulting wage equation is

$$w = e + \frac{e}{q}(b + \rho + a)$$

as in Romer. The higher the likelihood of finding a new job, a, the lower the disutility from unemployment. Hence, the firm needs to pay a higher wage. Note that $1/a$ gives the expected duration of being unemployed, which is low for high a.

Labor supply curve (or NSC)

A final step is to calculate a value for a in steady state. This is done by recognizing that in steady state flows in and out of unemployment have to be equal. (The change in the unemployment rate must be zero)

$$bNL = a\left(\bar{L} - NL\right)$$

where NL is aggregate employment. This gives

$$a = \frac{bNL}{\bar{L} - NL}$$

Inserting for $(a + b)$ in the wage equation gives the *no-shirking condition* (NSC):

$$w = e + \frac{e}{q}\left(\frac{\bar{L}}{\bar{L} - NL}b + \rho\right)$$

Labor demand curve

Firms hire worker up to the point where the marginal product of labor equals the wage. Equation (10) implies that when its workers are exerting effort the profit is given by $F(eL) - wL$. Thus, the first-order condition is

$$eF'(eL) = w$$

The set of points satisfying this condition is simply the demand for labor curve. An assumption of the model is that if each firm hires $1/N$ of the labor force, the marginal cost of labor exeeds the cost of effort

$$eF'\left(e\frac{\bar{L}}{N}\right) > e$$

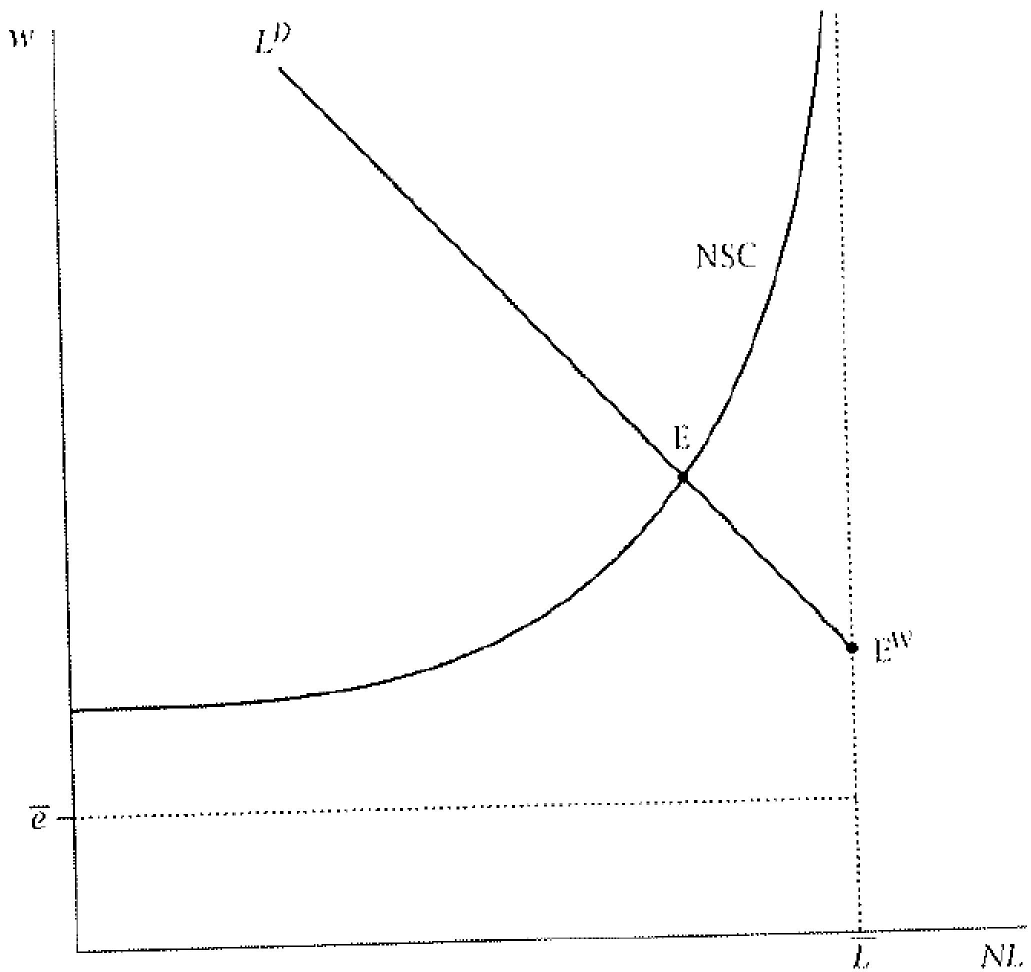

FIGURE 9.2 The Shapiro-Stiglitz model

Implications of the model

The model has two important implications:

- The equilibrium is necessarily associated with unemployment. If there were no unemployment, there would be no cost to a worker of shirking, since he would immediately be hired by another firm.

- Unemployment is involuntary. Workers who are unemployed would rather work at the prevailing wage.

Other implications

Changes in productivity: In a competitive market with perfect monitoring, a change in productivity would lead to a change in the wage and not in employment. In this model fluctuations in productivity leads to fluctuations in employment, and thus in involuntary unemployment.

Increasing monitoring: An increase in the probability per unit time that the shirker is detected (a rise in q). Wage falls and employment rises. The no-shirking curve approches the competitive market-perfect monitoring supply curve.

Wage subsidies: Such policy shifts will shift the labor demand curve and increase wage and employment along the no-shirking locus.

Other rationalizations for efficiency wages

If workers' reservation wage and abilities are positively correlated, and if ability is not observable, then offering a higher wage will lead to a pool of applicants of better quality and may increase profits. If turnover costs are high, firms may also be able to decrease the quit rate through higher wages.

Could more elaborate pay schemes avoid the market failure that the model implies? Workers could pay a bond, which they would forfeit if they were caught shirking. Or, since it is likely that firms can better assess the ability of a worker after some time, they could ask workers to post performance bonds.

Whether some of the characteristics of actual contracts, such as nonvested pension benefits or rising wage profiles, are in fact proxies for such bonding schemes is an open issue.

Implicit contracts

Firms are able to supply workers with insurance against income uncertainty, thereby producing a relatively stable wage.

There is a long-term relationship between firms and workers; many jobs involve long-term attachments and firm-specific skills. Wages does not have to adjust to clear the labor market in every period. Workers are content as long as their expected income streams are preferrable to their outside options.

The firms

Consider a firm dealing with a group of workers. The firm's profits are

$$\pi = AF(L) - wL$$

where L is the quantity of labor the firm employs, w is the wage, $F' > 0$, and $F'' < 0$. The parameter A is a productivity factor that may shift the production function.

Assume that A is random, and that the distribution of A is discrete. There are K possible values of A, indexed by i; p_i denotes the probability that $A = A_i$. The expected profits are therefore

$$E(\pi) = \sum_{i=1}^{K} p_i \left[A_i F(L_i) - w_i L_i\right]$$

The workers

Each worker is assumed to work the same amount. The representative worker's utility is

$$u = U(C) - V(L)$$

where U gives the utility from consumption (concave; $U' > 0, U'' < 0$) and V the disutility from working (convex; $V' > 0, V'' > 0$). Since $U'' < 0$, workers are risk-averse. Workers' consumption is assumed to be equal to their labor income, $C = wL$. That is, consumers cannot insure themselves against income fluctuations. Expected utility is

$$E(u) = \sum_{i=1}^{K} p_i \left[U(C_i) - V(L_i)\right]$$

There is some reservation level of expected utility, u_0, that workers must attain to be willing to work for the firm. There is no labor mobility once the workers agree to a contract.

The optimization problem

Recall that firms must offer the workers at least some minimum level of expected utility, u_0, but is otherwize unconstrained. In addition, since L_i and w_i determine C_i, we can think of the firm's choice variables as L and C, rather than L and w. The Lagrangian for the firm's problem is

$$\mathcal{L} = \sum_{i=1}^{K} p_i \left[A_i F\left(L_i\right) - C_i \right] + \lambda \left(\left\{ \sum_{i=1}^{K} p_i \left[U\left(C_i\right) - V\left(L_i\right) \right] \right\} - u_0 \right)$$

Implicit contracts as insurance

The first-order condition is

$$-p_i + \lambda p_i U'(C_i) = 0$$

or

$$U'(C_i) = \frac{1}{\lambda}$$

This implies that the marginal utility of consumption is constant across states. Thus the firm fully insures the risk-averse workers.