EUI WORKING PAPERS IN ECONOMICS

EUI Working Paper ECO No. 92/90

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EUROPEAN UNIVERSITY INSTITUTE, FLORENCE

ECONOMICS DEPARTMENT

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BADIA FIESOLANA, SAN DOMENICO (FI)

Printed in Italy in July 1992
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Badia Fiesolana
I – 50016 San Domenico (FI)
Italy

I QUIT

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(May 1992)

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Abstract

Is the privately optimal quit rate too high or too low? Since quits impose negative externalities on employers due to hiring costs and delays and training costs one might expect the privately optimal quit rate to be higher than socially optimal. In particular one might expect this to be true if laws or social norms rule out contracts in which such externalities are internalized - that is contracts in which workers pay firms damages when they quit or equivalently post bonds when hired. Interestingly, this need not be true since firms' optimal response to this problem is to pay higher than market clearing wages. This causes involuntary unemployment, which in turn means that quits create positive externalities for the unemployed. In particular, if there are match specific non-pecuniary amenities, workers who dislike their jobs and are indifferent between keeping them and quitting may increase average utility if they quit. This paper presents examples in which the privately optimal quit rate is lower than the socially optimal quit rate. Counter-intuitively, if workers are allowed to commit to paying damages to firms when they quit, the privately optimal quit rate increases until it equals the socially optimal quit rate. The possibility that privately optimal quit rates are lower than socially optimal, suggests an additional rationale for unemployment insurance not based on risk sharing or redistribution.

Keywords: Unemployment, quits, matching, externalities.

I Introduction

When labour markets are perfectly flexible, theory asserts that the matching of workers to jobs is Pareto efficient. It is not possible to make two workers better off by giving each the other's job without reducing the profits of one of the employers. Wages reflect the skills of workers and the non-pecuniary aspects of jobs. Equally qualified marginal workers are indifferent between different jobs. Infra marginal workers strictly prefer the jobs they have to any other which might be available to them. However, if search is costly or training is firm-specific this need not be so ex post. Workers may regret their initial choice of jobs and choose to sacrifice their firm-specific human capital in order to see if a new job suits them more. This imposes a cost on their current employer, which workers may ignore. This tends to suggest that if labour markets are perfectly flexible but there is firm-specific training, quit rates will be inefficiently high, a subsidy for quits will have first order costs and a penalty for quits may reduce dead weight losses (Jovanovich [1979], Mortensen [1978]). Indeed considerations of this sort led to the introduction of such a penalty in the former Soviet Union (see Marnie, [1992]).

In contrast Akerloff, Rose and Yellen ([1988] denoted ARY from now on) note that if the labour market does not clear, workers may keep jobs which they do not like in order to avoid the risk of involuntary unemployment. Dissatisfied workers may quit only if they know that there will be vacant jobs. If there is involuntary unemployment, quits create positive as well as negative externalities. By quitting, a worker makes a job available to an unemployed or dissatisfied worker. ARY argue that if there is involuntary unemployment, workers will not be efficiently matched to jobs and a Pareto improvement may be achieved if workers switch jobs. ARY suggest that quit rates might be inefficiently low and that a subsidy to quits could be socially beneficial in the sense that it could cause first order increases in money metric social welfare.

Their analysis is analogous to earlier work on vacancy rate externalities (Diamond [1981]). Diamond assumes full employment and an exogenous job separation rate, and considers frictional unemployment and vacancy rate externalities caused by match-specific moving or training costs. He concludes that (neglecting risk aversion and therefore the costs of inequality) the optimal unemployment insurance rate may be positive. Since he does not consider voluntary quits, he does not consider whether unemployment insurance should be available to voluntary quitters. His results are driven by the assumed match-specific start-up costs, which are less clearly documented than match-specific non-pecuniary amenities.

In another related article, Diamond and Maskin [1979] describe a model of breach of contract clearly related to quits. They assume costly search, making their model different from that discussed below. They find that the equilibrium search intensities and breach (quit) rates may be lower than the socially optimal intensity and breach (quit) rate. It is important to note that this result occurs when the matching technology is quadratic, but not when it is linear. In other words, it is a result of aggregate increasing returns to scale in matching. In the model described below, matching is costless and the number of matches is the lesser of the number of vacant jobs, and the number of involuntarily unemployed workers. This implies that our results are not a special case of Diamond and Maskin's results.

There are certainly search costs and a quadratic matching function is at least arguably reasonable. However one may still ask whether the result that, if the matching function exhibits constant returns to scale (is CRS), the breach (quit) rate is at least as high as the social optimum, is robust to modifications of Diamond and Maskin's assumptions. It is particularly striking that we find counter-examples to this rule without assuming that the firm can demand to be paid for the damage caused by breach of contract (quits), since Diamond and Maskin find that, without damages, the breach (quit) rate is unambiguously too high if the matching function is CRS.

ARY do not rationalise the assumption of involuntary unemployment in their model. While fairly few economists doubt that there is involuntary unemployment, the reasons for its existence are still a matter for serious concern. It is possible that the mechanism which causes involuntary unemployment itself implies that there are social costs of reducing unemployment or of increasing turnover which could cancel the benefits which ARY note. It is possible that involuntary unemployment cannot therefore be eliminated. Hence it is worth constructing a formal model which allows for involuntary unemployment to assess possible remedies for the problem noted by ARY.

Several economists have noted that firm-specific training or other costs of turnover can cause involuntary unemployment (Salop [1979], Schlicht [1978], Stiglitz [1974]). Firms will wish to reduce turnover in order to reduce training costs. One way to do so is to pay higher than market clearing wages. Another way is to delay payment of wages, to force workers, in effect, to post a bond which is forfeited if they quit (Hashimoto [1981], Mortensen [1986]). An example of a similar idea is the obligation in certain countries to repay scholarships if a job in the public sector is not taken. In some cases (for example the one described below) delaying wage payments cannot eliminate the incentive to pay higher than market clearing wages. Hence involuntary unemployment will result unless negative payments are allowed. This means that there will be positive externalities from quits, and that workers and jobs may be mismatched. Firm-specific training is both the clearest reason for quits being inefficient and a potential explanation as to why quit rates are too low. Is it then possible for quit rates to be inefficiently low in a model which differs from the textbook efficient labour market because of firm-specific training? Can allowing firms to charge workers a fine when they quit cause increased quit rates? The remainder of this paper is devoted to a highly stylised example in which the answers to both questions are yes.

The paper has eight sections. Section II presents a simple model of turnover efficiency wages in which involuntary unemployment is caused by the costs imposed on firms by quits, and in which a higher quit rate increases average utility. In section III the multiplicity of Nash equilibria of the model is demonstrated. In section IV the counter-intuitive effects of allowing workers to contract to pay fines if they quit are demonstrated. A slight generalisation is discussed in section V. A different model of the cost of turnover is presented in section VI. Generalisations are discussed in section VII. Conclusions are sketched in section VIII.

II A Simple Model

The model described below has two basic assumptions. First, the non-pecuniary amenities of jobs are match-specific and workers must work for at least one period to find out how much they like the job. Second, jobs require specific training which is not useful for other jobs. The basic characteristics of this world are as follows:

Time is discrete and there is an infinite horizon.

Firms. There are many identical firms, each of which employs at most one worker. Each firm j produces the same good, the price of which is normalised to be one. Firms maximise the expected present value of profits.

Workers. Workers are risk neutral and maximise discounted expected utility given by equation 1:

1) $$U_t = \sum_{s=t}^{\infty} (1+r)^{t-s} (u_t)$$

where u_t is equal to c_t if the worker is unemployed, and $c_t + \eta_{ij}$ if the worker is employed for η_{ij}, a match-specific non pecuniary utility for worker i in job j which is time invariant. The assumed utility function implies that the interest rate is always r. It does not matter to workers when they consume.

The benefits of improved matching depends on the upper tail of the distribution for η. We will assume that η has a very fat upper tail. Results similar to those presented can occur in more complicated models in which more standard distributions for η are assumed, as we discuss below. We assume that η is distributed with probability density given by

2) $$f(\eta) = ((1+r)/(r\beta))(\eta + 1 + \alpha)^{-(1+(1+r)/r\beta)} \quad if\ \eta > -\alpha$$
$$0 \quad if\ \eta < -\alpha$$

and that for each worker i, the distribution of η_{ij} is independent for different firms j, and that for each firm j, the distribution of η_{ij} is independent for different workers i.

Workers produce nothing for one training period. Training is firm-specific, so even if a worker has been employed by a previous firm he produces nothing in his first period with a new firm. Each firm with a trained employee produces $\beta + \alpha$ units of the good. Firms with no employees or an employee in training produce nothing. Firms are not allowed to pay a wage less than zero, in other words the only way in which they can make workers pay for a job is by tilting the wage profile.

There are more workers than firms, so some workers are not employed. The first question is whether the unemployed are involuntarily unemployed, that is do firms have an incentive to offer wages higher than the unemployed workers' reservation wage?

Assume that in period zero, workers are randomly assigned to firms. Firms must decide what wage to pay. Given the assumed distribution of η, firms find it optimal to pay a wage equal to 0 in the first period and α thereafter. The cost to the firm of offering a wage slightly below α is the chance that a worker quits times the cost of training a new worker. It is assumed that the firm will hire the first new worker who asks for the job and that, given the wage the firm offers, that worker will not reject the job. If there is a chance that new hires will quit immediately when they find that the job is not to their taste, the costs to the firm will be greater (and somewhat more complicated to calculate).

Consider a candidate equilibrium with no quits. There are no vacancies in equilibrium and there is a pool of unemployed who take any vacant job created by a quit terminating the vacancy chain created by deviations from the no quit equilibrium. Hence any workers who quit have zero chance of re-employment, and so the value of unemployment is 0. This means that workers who know η will quit if and only if $w + \eta$ is negative. Given the strategy of firms, workers will gladly accept a period without pay in order to learn η.

Given the assumption about the distribution of η, the firm is indifferent between offering α and a slightly lower wage. For $w < \alpha$, the derivative of the expected discounted value of profits with respect to the wage is positive. It would be zero if the firm could be certain that a replacement worker would accept w. The assumed distribution of η was chosen so that the risk of a quit is proportional to the profit at the current wage. Thus the ratio of profits lost per period of zero output to the risk of a quit is constant. If the firm were sure that a quit would imply only one period of lost output, the derivative of profits with respect to the wage would be zero. Since this is not certain, the cost of a quit is greater than the benefit of reducing wages below α. If a firm paying a wage less than α cuts it further and its employee quits, the firm must offer new hires α or face the risk that they quit as well. It is this additional cost which implies that firms paying less than α will definitely not cut their wages further, and that paying wage α gives the global maximum of profits.

As noted above, workers are glad of a chance to try a job. In other words, the unemployed are involuntarily unemployed. This follows from asymmetric information about η, turnover costs and the restriction that w must be positive each period. Tilting the wage profile is only feasible for the first period of employment before the worker learns η. After the worker learns η, workers with η close to $-\alpha$ will quit if the wage is cut. Before workers learn η they will accept lower wages (for one period) for two reasons - the expected value of η is greater than $-\alpha$ and the option to quit after learning η (which is not exercised in this equilibrium) has a non-negative value.

For some values of α and β, quits increase the sum of profits and workers' money metric welfare. The social cost of a quit by a worker with $\eta = -\alpha$ is equal to the product of an experienced worker for the single training period, which is $\alpha + \beta$. The expected social benefit is equal to the expected value of a job at wage α to an unemployed worker

$$3) \qquad E(V) = (1 + 1/r)E(\eta + \alpha) = (1 + 1/r)\int_{-\alpha}^{\infty} \frac{(\alpha + \eta)((1+r)/(r\beta))}{(1 + \eta + \alpha)^{((1+r+r\beta)/(r\beta))}} d\eta$$

Integrating by parts gives

$$4) \qquad E(V) = (1 + 1/r)\int_{-\alpha}^{\infty} \frac{1}{(1 + \eta + \alpha)^{((1+r)/r\beta)}} d\eta = \frac{\beta(1+r)}{1 - r(\beta - 1)}$$

this means that the total social benefit signs as the value given by the following equation

$$5) \qquad \text{benefit} \overset{\text{s.a.}}{\longrightarrow} 1 + r - (1 + \alpha/\beta)(1 - r(\beta - 1)) = r\beta - \alpha/\beta + r((\beta - 1)\alpha/\beta)$$

which is positive so long as β is greater than one and greater than or equal to the square root of α/r, e.g if $\alpha = \beta = 1/r$. This in turn implies that it is possible for quits of the least satisfied workers to be socially useful. This means that there is an equilibrium to the model in which the quit rate is lower than socially optimal. A formal model of turnover efficiency wages need not imply costs of quits which outweigh the benefits of improved matches.

If each firm has a risk neutral proprietor whose welfare is equal to profits, this means that quits increase average utility. The firm is indifferent between paying α and paying a little less and accepting some quits. This means that a small subsidy to quits will not simply cause an increase in wages. Such a policy would require a transfer from someone to those who quit. These are the agents with the lowest level of utility in the equilibrium of this model, so this transfer would presumably be desirable in a model with risk aversion. It would also increase average utility even in our model without risk aversion.

The subsidy to quits can be considered a short term unemployment insurance programme paying some very small amount μ to the unemployed for at most one period. Unemployment insurance paying $r\mu$ per period available indefinitely would have the same effect on quits, given the negligible chance of re-employment. It would also imply a transfer from the tax-payers to those already unemployed, which does not affect average utility in our model, and is actually desirable in a model with strictly concave utility functions.

The assumed distribution of η was chosen in order to give a fat upper tail consistent with firms finding it rational to offer a wage which allowed no quits. As such it was chosen in order to make the benefits from turnover as high as possible but still consistent with an equilibrium with zero turnover. The conclusions do not necessarily hold for otherwise identical models with different assumptions about the distribution of η (e.g. models in which η takes one of two values). It is possible that in every Nash equilibrium, many workers quit. It may be the case that the profit-maximising wage is less than workers' reservation wage so that the labour market clears and there are no social benefits of quits. Finally it is possible that there is involuntary unemployment, but the social costs of quits outweigh the benefits.

III Additional Equilibria of the Model

We have discussed only one possible equilibrium which is sustained by the trivial circular argument. There are no quits so there are no vacancies so there are no quits. There may, however, be other equilibria of the same model in which there are quits. Hence there are vacancies so those who quit can find and try new jobs and so there are quits. In particular for the model developed above, there is an unemployment rate U_{max} such that if the unemployment rate is below U_{max}, there are equilibria in which workers who prefer their job very slightly to unemployment quit.

To describe these equilibria, we assume that workers who prefer their current job to indefinite unemployment by ε per period quit. For expository convenience, we will assume that firms ignore this when they choose wages and pay α each period, then demonstrate that the effect of such quits on wages strengthens the conclusion that there is a Nash equilibrium in which they occur. In the second period (the first period after workers learn η) this opens up a number of vacancies of order ε. In the third period, due to the improved matches, the number of workers who prefer their job to unemployment by ε or less is of order ε^2. If ε is small this means that even if they quit they would not create enough vacancies to rationalise quitting. We assume that ε is small, so there is at most one wave of quits. This means that quitters have only one chance to get a new job and if they are not hired in the second period are never hired.

For it to be rational to quit if the wage is α and if and only if

$$\eta \leq -\alpha + \varepsilon,$$

it is necessary for the value of unemployment and job search in the second period to be equal to $\varepsilon(1+r)/r$, the value of the foregone job. The value of unemployment in the second period is the probability of finding a job times the value of a new job. Recall the value of finding a new job as described in equation 4.

6) $$E(V) = \frac{\beta(1+r)}{1-r(\beta-1)}$$

The probability of finding a new job is equal to the number of vacancies $F(-\alpha+\varepsilon)n$, where n is the number of jobs, divided by the number of unemployed $F(-\alpha+\varepsilon)n + u$, where u is the number of unemployed in the absence of quits. This means that (for wage = α each period) quitting if $\eta \leq -\alpha + \varepsilon$ is rational if the following inequality holds

7) $$\frac{\beta(1+r)F(-\alpha+\varepsilon)n}{[1-r(\beta-1)](u+F(-\alpha+\varepsilon))} - \frac{\varepsilon(1+r)}{r} \geq 0$$

for small ε, $F(-\alpha+\varepsilon)$ is approximately equal to $\varepsilon(1+r)/(r\beta)$ and is much smaller than u so inequality 7 is approximately equivalent to inequality 8).

8) $$\frac{(1+r)n}{[1-r(\beta-1)]u} - 1 \geq 0$$

If, as in the example discussed above, β is equal to 1/r, equation 8 holds so long as the unemployment rate is less than $(1+r)/(1+2r)$, a rate which, despite considerable efforts in certain countries, has not yet been achieved in practice. If inequality 8 holds, then there is an ε so low that if the wage equals α each period, it is rational to quit if one prefers one's job to unemployment by ε each period. Clearly if one prefers one's job to the average job, it is not rational to quit for a chance of obtaining a different job. The left side of inequality 7 is continuous in ε, so there is an ε such that it is rational to quit if and only if $\eta \leq -\alpha + \varepsilon$. In fact the left side is concave in ε so this value of ε is unique.

So far we have assumed that firms ignore the fact that workers quit in this equilibrium and pay wages equal to α as in the no-quit equilibrium. If firms raise wages when workers are selective, then they may eliminate the quitting equilibrium. In our model, firms actually cut wages if workers are selective about jobs, and this makes it easier for inequality 8 to hold and for a quitting equilibrium to exist.

This is a consequence of the form assumed for $f(\eta)$ but the opposite may hold for other distributions. The reason that quitting reduces wages is that the reverse hazard is declining in η, that is the likelihood that a worker likes his job η, divided by the probability that he likes it more than η, decreases in η. This means that if workers quit when $w+\eta$ is less than ε, this reduces the expected costs of decreasing the wage proportionally more than it reduces the expected benefits. So if workers are more selective, firms will offer wages below α, thus encouraging quits still more. For any positive wage, there are some workers who like their job so much that it is irrational for them to quit no matter how many vacant jobs there are. This means that the continuity argument used above demonstrates an equilibrium in which workers who prefer their job to indefinite unemployment by a very small amount quit.

Another effect which supports quitting equilibria is the following: if some workers quit, those who keep their jobs reveal that they like them. Their employer might exploit this knowledge by reducing their wage. In contrast if a worker quits and finds a new job, the employer does not know how much he likes it and cannot do this. Such behaviour by firms may be ruled out by contracts which are mutually beneficial to firms and workers in our model, but in any case if it occurs it encourages quits. In short, our assumption that wages equal α works against our conclusion that there is an additional equilibrium in which quits occur.

IV The importance of restrictions on allowed contracts and the surprising sign of the effects of such restrictions

In the preceding discussion we casually assumed that wage payments must be non-negative. This assumption rules out contracts which increase profits and are acceptable to unemployed job applicants. As is well known, turnover costs do not imply involuntary unemployment if firms can demand bonds, that is, insist that workers pay for their jobs. With our assumption about workers' preferences, bonding implies no efficiency costs, since workers are indifferent about when they consume. If firms charge workers the expected present value of a job, the labour market clears. This means that a quit provides no beneficial externality for the unemployed and the privately optimal quit probability is at least as high as the consumer surplus maximising quit probability or, with risk neutrality, the utilitarian optimum (from now on called the efficient quit probability).

If firms can charge bonds, they capture all of the gains from trade. Firms can determine the quit rate via their control over wages. If they can demand bonds which are forfeited if workers quit, they can choose the probability of quitting without transfers with positive expected value to workers. This means that if firms cooperate, they will choose the wage that causes an efficient quit probability. In our model, firms can affect other firms only by offering contracts which are more or less attractive to workers. If firms charge workers the expected present value of jobs, all contracts are equally attractive to workers (e.g. not very, but enough). This means that the privately optimal contract is the same as that which firms would choose if they cooperated. This means that the quit probability is efficient if firms choose privately optimal wages and bonds.

The result described above may be counter-intuitive. It has been demonstrated (in section II) that if charging bonds is not allowed, the quit probability is zero. It has also been demonstrated that the efficient quit probability is positive. This means that the quit rate is higher if bonds are allowed than if they are banned. This may seem a bit odd, since bonds are often considered a costless alternative to efficiency wages. In the context of a specific capital/turnover model, bonds are a way in which firms can prevent quits without cost to themselves. It might seem odd that firms which can prevent quits without cost do not do so. It might seem odder still that firms which must sacrifice a positive share of the gains from trade to workers in order to prevent quits entirely. The reason for this apparent paradox is that bonds don't just penalise workers who quit. They also reward firms whose workers quit. If firms can charge workers for jobs, they don't mind so much if their trained worker quits. They must train a new worker, but they can collect a new bond.

While bonding is the standard alternative to non-market clearing wages in the efficiency wages literature, the bilateral matching literature (Mortensen [1978], Diamond and Maskin [1979]) considers another form of possible payments from workers to firms - compensatory damages. If there is a risk that workers quit, the efficient contract requires them to pay firms enough to compensate for the cost to the firm of the quit. This means that workers only quit if it increases the sum of their utility and the firm's present value of profits. This guarantees bilaterally optimal quit rates, and with an appropriate adjustment of the wage this is a bilateral Pareto improvement over simple wage contracts. Like bonds, compensatory damages are ruled out by our assumption that payments from firms to workers must be non-negative.

In our model, workers and firms are risk neutral. This means that bonds and damages paid for quitting are exactly equivalent. Suppose the worker receives w if he doesn't quit and pays D if he does. An identical distribution of profits and utility of the worker arises if the worker posts a bond of D and is paid w + rD when employed and is free to quit and receive 0. If the worker quits, he transfers the present value of rD to the firm, which is still D. If the worker doesn't quit, he gets rD each period in exchange for giving D to the firm when taking the job. Workers with discount rate r are indifferent between the contract with a bond and the contract with damages. Firms which maximise the expected present value of profits are also indifferent. This means that the market outcome with damages is identical to the market outcome with bonds, which in turn means that privately optimal contracts cause the efficient quit probability.

Again, this result is counterintuitive. If contracts which require workers to pay fines when they quit are allowed, workers quit. If such contracts are illegal, workers do not quit. The reason for this apparently puzzling result also explains that the quit probability is increased if firms are allowed to charge bonds.

The arguments above are perhaps too brief to be clear. In the remainder of section IV we will calculate the efficient quit probability for the model of section II. We will derive the contract with damages which maximises firms' expected profits, subject to the labour supply constraint. We will demonstrate that this constraint binds in equilibrium, that is that the labour market clears and that there is no involuntary unemployment. Finally we will demonstrate that, if firms with vacant jobs offer unemployed workers the expected profit maximising contracts, workers will quit if and only if it is efficient for them to do so.

Before doing any formal analysis it is important to note that our assumption of risk neutrality is rather implausible but is essential for this conclusion. If bonds or damages are allowed, workers have zero expected utility and all benefits from the existence of firms go to their owners. If the world were as described by our model, a utilitarian would not care about the distribution of income. A concern for equality could eliminate any relevance of our arguments in favour of bonds or damages for quits. This is in sharp contrast to the arguments in favour of unemployment insurance which are strengthened by egalitarianism.

Proceeding somewhat more formally, first we calculate the allocatively efficient quit rule. That is, we find η^* such that average happiness is maximised if worker i quits if she finds herself working in job j with η_{ij} less than η^*. The contribution to total utility of a quit is clearly decreasing in η_{ij}, so the effect on total utility of a quit by a worker for whom $\eta_{ij} = \eta^*$ is zero. This effect is the value of a vacant job to the firm, plus the value to the unemployed workers, minus the value of the filled job with $\eta_{ij} = \eta^*$, and is described by equation 9 where VV is the social value of a vacant job.

9) $$0 = VV(\eta^*) - (\alpha+\beta+\eta^*)(1+r)/r$$

The value of a vacant job is equal to $E(\eta)$, the expected training cost, plus the expected value of a filled job, times the probability that the new worker decides to keep it, plus the value of a vacant job, times the probability that the new worker quits. This is expressed by equation 10:

10) $$VV(\underline{\eta}) = E(\eta) + E(\alpha + \beta + \eta \mid \eta > \underline{\eta})(1-F(\underline{\eta}))/r \quad + \quad VV(\underline{\eta})(F(\underline{\eta}))/1+r$$

which describes the contribution of a vacant job to total welfare, assuming workers quit if η_{ij} is less than $\underline{\eta}$, which may or may not be equal to the utilitarian optimal η^*, or in other "words" equation 11 describes the social value of a vacant job:

11) $$VV(\underline{\eta}) = \frac{E(\eta) + E(\alpha + \beta + \eta \mid \eta > \underline{\eta})(1-F(\eta))/r}{1 - (F(\underline{\eta}))/1+r}$$

Combining equations 9 and 11 gives the following expression for η^* :

12) $$\frac{E(\eta) + E(\alpha + \beta + \eta \mid \eta > \eta^*)(1-F(\eta^*))/r}{1 - (F(\eta^*))/1+r} = (\alpha+\beta+\eta^*)(1+r)/r$$

Note that we have made no assumptions in this section about the shape of f or F, and so this formula is as general as it is empty of content. Our substantive claim is that if firms are allowed to charge bonds, they will do so and pay wages that cause workers to quit if $\eta_{ij} < \eta^*$, that is if and only if it increases average utility for that worker to quit. This claim is demonstrated in the following paragraph.

Assume now that workers quit if it is privately optimal to do so and that firms choose wage w and sell the job for bond B. First it should be clear that at any wage w, firms will sell the job for the largest bond that unemployed workers are willing to pay. The bond is a simple transfer from newly hired workers to firms and has no effect on workers' subsequent actions. Furthermore, all unemployed are identical, so there is no possible selection effect of a large bond. A firm with a vacancy chooses B and w to maximise its expected discounted profits, that is the value of a vacant job to the firm VF (not to be confused with VV, the social value of a vacant job). VF is described by equation 13, the asset value equation

13) $VF(w,B) = B + (\alpha + \beta - w)(1-F(w))/r + F(w)VF/(1+r)$

and the firm will charge B, equal to the value of trying out a job to the unemployed. This means that the value of unemployment is zero. Even though they are job openings, they have a price equal to their value. This means that the value of trying out a job to a worker VW is given by

14) $B = VW(w) = E(\eta) + E(w+\eta \mid \eta>w)(1-F(w))/r$

which asserts that the bond is equal to the value of trying out a job, which is equal to the expected (dis)utility of unpaid training, plus the expected value of a job the worker keeps, times the probability it is kept. Combining equations 13 and 14 gives an equation for the expected value of the firms' profits as a function of the wage alone, assuming that the optimal bond is charged

15) $VF(w) = E(\eta) + E(\alpha + \beta + \eta \mid \eta>w)(1-F(w)) + F(w)VF/(1+r)$

Equation 15, which describes the value of the firm as a function of w, is identical to equation 10, which describes total utility as a function of η, therefore the firm will choose $w = \eta^*$, which implies that workers will quit if and only if η_{ij} is less than η^*, or in other words if and only if it increases total utility. We have shown that the privately optimal bond and wage chosen by firms cause a utilitarian optimal outcome and in particular an optimum in which firms capture all of the gains from trade. We emphasise that this result does not depend on any assumptions about the distribution of η. It does however depend on the assumption of risk neutrality, that is, that a utilitarian should not care about the distribution of income. This means that it has no relevance to deciding if firms should be allowed to sell jobs. Nonetheless it is striking that if $f(\eta)$ is as assumed in section II, allowing bonds to exist increases the quit rate. One might have thought that bonds were a way of preventing quits which is costless to firms and which would cause a lower quit rate.

The analysis of contracts with compensatory damages is identical to the analysis of contracts with bonds. For any wage-bond contract there is an identical wage-damages (fine for quitting) contract and vice versa. Given risk neutrality and perfect capital markets, a contract in which a worker pays B when hired and is paid wage w is identical from the point of view of the worker and the firm to a contract in which the worker need post no bond, is paid w - rB and must pay B in damages when he quits. Therefore the profit maximising wage-damages contract will imply efficient quit rates. As noted by Mortensen [1978], bilaterally efficient wage-damages contracts involve compensatory damages which must therefore imply efficient quit rates.

This result follows trivially from the analysis of wage-bond contracts but is perhaps even more striking. We have given an example in which the quit rate is zero if workers are not allowed to pay fines if they quit, and in which the quit rate is positive if workers can and do agree to pay such fines.

V Stigma Caused by Quitting

A key simplifying assumption of the model described in sections II and III is that workers are identical except for their taste for specific jobs. Since it is assumed that η_{ij} is match-specific, each worker is equally attractive to each firm, and in particular quitting is not stigmatised. In reality workers who quit may give the impression that they are lazy or difficult to please, and may have more difficulty finding new jobs than new entrants have. This is an additional cost of quitting and is particularly interesting to us because it is a private rather than a social cost. This stigma does not change the conditions for a no quit equilibrium in the model described in section II. In this equilibrium, workers quit only if they are indifferent between their current job and permanent unemployment. Stigma is not a factor since the assumption of excess supply of labour and the Nash conjecture of zero quits together imply that chances of re-employment are zero in this equilibrium anyway.

Stigma is, however, very important if the labour market is assumed to clear. If new entrants are assumed to be able to find jobs, some reason must be given as to why quitters can't find them.

If stigma prevents quitters from finding jobs, they may envy the employed without being able to bid down wages. Technically, since the unemployed are distinguishable from the employed (and not just because they have no job), and since the wage offered can be conditioned on their status, their unemployment is not involuntary. In this section we present a model in which the fear of stigma prevents quitting, even though the labour market clears and there is no involuntary unemployment in the no quitting Nash equilibrium.

In the model with stigma, there is a constant flow of young workers and a balancing rate of death of old workers. In addition, some workers become bored or irritable, that is their η drops so they find work less pleasant and unemployment relatively more desirable. Crucially this change affects their taste for all work equally. This means they quit their current job (unless it is very desirable) and are likely to quit any new job when they find out what it is like. This makes them unattractive to firms. It is also important that the decline in their taste for work is not great enough that they would turn down a new job if offered. Instead they would take it, just in case it turns out to be such a perfect match to their tastes that they would want to keep it, in spite of their generally strong distaste for work, which means that quitters will be available for work but unemployable.

To be more precise, assume that the number of workers is N. Assume that δN new workers are born each period, and that δN old workers (or unemployed potential workers) die. Assume also that for a fraction, ϕ, of workers in employment, η falls in their current and any future job. In particular, assume that in steady state a fraction $\gamma < \phi$ of employed workers quit each period for this reason. Finally assume that the decline in η is small enough that they would still like to try new jobs out, knowing that they are very likely to quit when they find out what the job is like. Clearly a decline in η could be assumed and γ calculated for the steady state in which only workers whose inclination to work has dropped, quit. This would be messy and not very useful. Finally assume that there are $1/(1+\gamma)$ firms, each of which wants one worker. This implies that there are exactly the same number of industrious workers as jobs. Needless to say, it would be more satisfactory to describe an elastic labour demand curve and find whether this is true at the profit maximising wage.

The firms' choices can be analysed as before with one change. Instead of discounting the future by $(1/(1+r))^{s-t}$ they discount by

$$((1-\alpha-\gamma)/(1+r))^{s-t}.$$

That is, they discount the advantage of reducing the wage by the chance that the worker whose wage they have cut will be dead or will have quit.

Similarly, the value of a job is the discounted sum of utilities, further discounted by the chance that the worker will die or quit. In addition, the worker must consider the possibility that he will find work less pleasant in the future, but that the job will be a good enough match that he will keep it. This reduces the expected value of an unknown job. It also affects the relative value of good and bad jobs. In particular it reduces the superiority of good jobs over bad ones. A worker in a bad job is more likely to exercise the option to quit if his desire to work drops.

While workers will consider this, we do not, and simply assume that ϕ is small enough that this effect is negligible (since γ is smaller still, the effect of quits on the firm's strategy is negligible as well).

With ail of these assumptions, one possible Nash equilibrium is similar to the no quit Nash equilibrium in the model with an excess supply of workers (except for the change in the discount rate caused by death and quits). Workers accept the first job they are offered and never quit unless they become generally lazy. This choice is enforced by the fact that any worker who quits is stigmatised and, in this equilibrium, is never offered a job again.

Note that if a worker quits because of dissatisfaction with his job rather than a general disinclination to work, there will be one more vacancy than usual. However, all of the lazy quitters will apply for the job not taken by the new entrants. The chance that any one quitter will ever get a job is infinitesimal, and in particular the chance that our hypothetical industrious quitter will get one is as low as that of his lazy but indistinguishable fellow applicants.

Interestingly, the second model has another equilibrium if ϕ is small enough. Assume in particular that the number of workers who have become lazy and quit is much greater than one (as required for the argument above) but much smaller than the number of workers who do not like their job and would like to try a new one (but not enough to choose almost certain permanent unemployment for an infinitesimal chance of trying a new job). Since we have assumed risk neutrality, a worker would like to try a new job if the expected value of a job picked at random is greater than the value of his current job by at least α, the cost of one period's wages foregone while in training. The options to quit again can only increase the value of trying a new job. Therefore we say if, not if and only if.

If almost all of such workers quit, the number of vacancies will be large compared to the number of lazy quitters (which equals the number of workers who will not be offered jobs). In other words, each job searcher will have a high chance of finding a new job in his first period of search (and more chances later if he doesn't succeed the first time). Given this, almost all workers who would like to try a new job will quit.

This means that for a small enough ϕ, the model has two equilibria (at least). One in which workers only quit if they find they like work so little that they don't mind permanent unemployment, and another in which almost all workers who value their job one period's wage less than the average job will quit.

This case of multiple equilibria is analogous to the signalling and pooling equilibria of signalling models. In our model and in signalling models, agents are of different types, know their type and attempt to influence the inference of their type by other agents. As in signalling models, externalities occur because different actions of one agent make it more or less difficult to infer the type of other agents from their actions. The low quit equilibrium is a signalling equilibrium in which industrious workers signal that they are not lazy by sticking to jobs which they do not like. The high quit equilibrium is a pooling equilibrium in which lazy and industrious workers do the same thing, so firms cannot learn their type from their actions.

VI Delays in Matching: a third model

In the models described above, it was assumed that vacant jobs are filled instantly. The only reason for firms to fear quits is the cost of training new workers. A delay during which the job is empty imposes an additional cost on the firm. In contrast, a delay in finding job openings obviously does not impose any cost on quitters in the no quit Nash equilibrium, since they have a zero chance of re-employment in this particular equilibrium of the previous model.

In particular, if a job remains vacant for one period and there is no need for training, then the firm's problem remains the same. To maintain comparability we assume that in each period one worker can apply for the job and find out if he likes it with cost. If the worker chooses not to take the job, the firm must wait until the next period to offer it to another worker. The model is equivalent to that given above from the firm's point of view. A vacant job is equivalent to a job filled by an untrained worker who produces nothing and need not be paid.

In contrast, this change makes a job opening more valuable to the unemployed. They do not need to sacrifice one period of leisure for one period of unpaid training. This means that the vacancy value of a job to workers is increased by η and is non-negative no matter how low the wage. In particular, this implies that the result described above remains true. A quit subsidy can increase average utility even though it reduces measured output.

More interestingly, this implies that such a result holds for more plausible distributions of η. For any distribution of η, the unemployed will benefit from a quit. Since they can try jobs without cost, the benefit must be non-negative. It is zero only if the firm offers a wage so low that no applicant takes the job when he finds what it is like. This would imply zero profits, so no firm would do this. Therefore the unemployed benefit when a worker quits.

The conditions for the benefit to the unemployed to exceed the cost to the firm are much less stringent than in the firm-specific training model (model one). In particular it is possible to describe examples of economies in which the privately optimal quit rate is lower than the socially optimal quit rate, even if η only takes negative values, that is, even if no worker actually enjoys his work.

Consider the following model. Assume that workers can learn immediately, at no cost to themselves, how much a job pleases them. Assume further that no firm-specific or general training is required for them to do the work. Assume, however, that it takes one period for a worker and a job to be matched. In other words, assume that one period is used up for each worker who looks at the job (without expending effort or producing output) and decide if he likes it. This means that firms bear all of the turnover costs and that turnover costs are lower by η, the effort required for training in model one. Given these assumptions, it is relatively easy to find an example in which quits are socially desirable.

In particular assume, as in the first model, that there are many firms, each of which hires up to one worker who produces $1+\beta$. Assume the same risk neutral utility function as in model one, but now assume that η is distributed as follows

$\eta = -1$ with probability p_1

$\eta = -1/2$ with probability p_2

$\eta = 0$ with probability $1 - p_1 - p_2$

This is clearly one of the simplest possible distributions for η [1].

Depending on β, p_1 and p_2, firms will pay wage w equal to 1, 1/2 or 0. We consider the case in which firms choose to pay a wage equal to one. The potential benefit of offering a wage of zero is that, with probability $1 - p_1 - p_2$, the firm saves 1 per period. The cost is that, with probability $p_1 + p_2$, the firm's employee quits. If so, given our assumptions, it is optimal for the firm to offer replacement workers a wage of 1. This means that the only effect is that the firm loses one period's profits, β. The firm will not choose to cut the wage to zero if the following inequality holds

16) $$\beta \geq \frac{(1+r)[1 - p_1 - p_2]}{r(p_1 + p_2)}$$

We will assume for convenience that inequality 16 holds with equality, so the firm is indifferent between paying 1 and paying 0. It will be clear below that small violations of this assumption do not affect our conclusions.

Similarly the firm will not pay wages equal to 1/2 if inequality 17 holds.

17) $$\beta \geq \frac{(1+r)[1 - p_1]}{2r(p_1)}$$

Again, for convenience, we assume that this condition holds with equality, yielding the following equation, which is simply a restatement of this assumption.

18) $$p_2 = p_1 \frac{(1 - p_1)}{(1 + p_1)}$$

Our assumptions allow us to calculate β and p_2 as functions of p_1 and r.

It is easy to characterise the values of p_1 and r, which imply that the externalities caused by a quit are, on balance, positive - that the benefit to some unemployed worker who gets a chance to take a

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[1] We considered a distribution in which η takes only two values and concluded that, in this case, quits are socially undesirable.

job is greater than the cost to the firm. In the following paragraph we discuss the effect on the sum of all agents' utilities if one worker who has η = -1 and does not care whether he keeps his job or is unemployed chooses to take that second option by quitting.

The cost to the firm is simply one period's lost profits β. The benefit to the worker who takes his place is given by

19) benefit $= (1 - 2p_1 / (1 + p_1)) / r + p_1(1 - p_1) / (2r(1 + p_1))$

multiplying the net social benefit of a quit by $r / (1 - p_1)$ gives equation 20 where s.a. means signs as

$$\text{20) net benefit} \overset{s.a.}{=} \frac{1 + p_1 / 2}{1 + p_1} - \frac{1 + r}{2p_1}$$

As long as r is less than 1/2, there is a p_1 less than one for which the net social benefit is positive. In particular, for r equal to zero the net social benefit is positive as long as p_1 is greater than $(\sqrt{5}-1)/2$, the golden section. In that case, the benefit of a quit to the unemployed is greater than the cost to the employer.

While the example described above is certainly particular, it demonstrates that rather ordinary assumptions about tastes for different jobs are consistent with a socially sub-optimal quit rate. Various simplifying assumptions were made to ease the analysis of an already very simple model. The final result leaves room for flexibility in these assumptions. The conclusion does not rely, for example, on the assumption that employers are just indifferent between the benefits and costs of cutting the wage they offer.

VII Generalisations

The models considered above are stylised even by the standards of economic theory. In this section we attempt to discuss the robustness of our results to generalisations of our assumptions.

First it should be clear that the results (those reported in sections II, III and V in particular) depend on the assumptions about the distribution of η, the non-pecuniary utility of jobs. The distribution considered is unusual and our choice of it was not innocent. While the results reported in sections VI and VII (model three) are more robust, they too are certainly sensitive to assumptions about the distribution of η. Thus our results should be interpreted as examples, and in particular as counter-examples, disproving the claim that quits always impose negative net externalities.

We have assumed risk neutrality, and therefore have nothing to say about the costs or benefits of redistribution of income. This assumption is clearly too strong. Relaxing it would strengthen our conclusion that unemployment insurance can increase average utility. Normally it is argued that unemployment insurance is good, firstly because it is insurance and secondly because it redistributes income from the rich to the poor. We assume that workers face no risks and are not risk averse. We assume that there is no utilitarian rationale for redistribution. The fact that we can still rationalise unemployment insurance is striking, much more so than if we had assumed risk and risk aversion.

Oddly, for an article concerned with quits and quit rates, we present models in which the quit rate is zero or very low in equilibrium. We could, without difficulty, have added a lower tail to the distribution of η, consisting of matches so bad that firms would not find it profitable to pay wages high enough to keep workers who disliked the work they were offered so much. Such a modification would have added to the realism of our models. It would also have strengthened our conclusions. If there are such matches, one quit would lead to a string of quits. Each would provide the same benefits to the unemployed and impose the same costs on the firm. The magnitude of the social costs or benefits of a quit would be increased, but its sign would remain the same. In contrast, the existence of workers who dislike the job they are offered would inhibit the firms' willingness to cut wages and risk a quit by a marginally satisfied worker. The benefit of cutting the wage would not be affected, but the cost would be increased. The firm would face more than the loss of one period's profits, since it would fear having to offer the job to many workers before finding one who would accept it at the original wage. This means that considering extremely bad matches (extremely low ηs) and quits in all equilibria would make it easier to construct examples in which the cost of a quit is great enough to keep firms from cutting wages, but smaller than the benefit of the quit to the unemployed or to dissatisfied workers.

We have considered only two variants of the turnover efficiency wage model. There are many other models of involuntary unemployment, and it is worthwhile considering whether similar results could be obtained for economies described by these models. We chose the turnover model partly because it is especially striking that it can lead to inefficiently low turnover. It should be easier to construct examples of this for other models.

In particular, consider the principal/agent or work/shirk model. If firms do not cut wages because they fear that workers will then only pretend to work, our conclusions may be strengthened. In the principal agent model, shirking is assumed to be more costly to the firm than quitting, as implied by the assumption that firing shirkers is not dynamically inconsistent. In fact it is typically assumed that quits impose no costs directly, since firm-specific training is not generally considered. This means that a subsidy available to quitters but not to workers fired for cause is less costly in the principal agent model than in our models. Of course it is difficult to implement such schemes in practice.

For a morale model, there is no particular reason to assume that a subsidy to quits or an exogenous increase in the quit rate imposes any costs on firms. We suspect that ARY are implicitly considering such a model, and that this is the reason they are unconcerned about the questions we have discussed at length.

VIII Conclusions

The purpose of this paper is to extend and provide firmer microeconomic foundations for the ideas and results presented in Akerloff, Rose and Yellen [1988]. It attempts to answer the economists' question "I know it works in practice but does it work in theory?". In particular, it includes an explanation of the non-market clearing (or potential non-market clearing) required for ARY's argument. It attempts to respond to the concern that ARY find positive externalities due to quits, but only by assuming that involuntary unemployment already exists. Since many models of involuntary unemployment suggest that anything which makes quitting (or being fired) more desirable will increase unemployment, it is possible that a model with involuntary unemployment will imply additional costs of quits. It is at least conceivable that these costs must outweigh the benefits of improved matches and increased job satisfaction.

We assume that firms are willing to pay higher than market clearing wages to reduce turnover costs incurred when workers quit. This would appear to be the model of involuntary unemployment least favourable to ARY's arguments. We find that it is possible for the privately optimal quit rate to be too low. In our models it is possible that a small government subsidy to quits such as unemployment insurance increases money metric utility, which implies that it increases average utility, since we assume risk neutrality.

This result is interesting, since it is generally assumed that unemployment insurance reduces money metric utility and is justified only because agents are risk averse.

We also find inefficiently low quits rates without involuntary unemployment in one equilibrium of a model of heterogeneous workers. This model has multiple equilibria which are in effect screening and pooling equilibria. Such multiplicities have been noted in the economics of information literature. The example we present has clear macroeconomic implications.

Most strikingly, our conclusion that inefficiently low quit rates are possible depends on restrictions imposed on those contracts which are allowed and, in particular, on the fact that we do not allow workers to agree to pay fines if they quit. In our model, workers do not quit if they cannot agree to pay such fines, and do quit and pay fines if they can.

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