A Theory of Employee Job Search and Quit Rates

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The purpose of this study is to develop and analyze a model of job search which allows for the possibility of workers looking for a job while employed. Such a model leads to significant generalizations of results already in the job search literature. Results obtained are then used to specify a theory of job quits and quit rates.

Previous studies on job search, with one recent exception[1] (see Donald Parsons, 1973), assume workers never look for a job while employed. James Tobin has noted that this restriction can only be justified if job search is significantly more efficient when unemployed, and this is patently not the case in many actual labor markets.[2] In support of this argument J. Peter Mattila has estimated that 60 percent of those workers who voluntarily change jobs in the United States suffer no interim unemployment. Since this can only occur if some employed workers obtain new jobs before quitting, allowing workers to search while employed appears to be valid empirically. The consequences of such a change are of some importance as job search models are at the center of much modern work on unemployment and inflation.

The basic structure used in job search models is now well known.[3] Unemployed workers select a strategy to maximize their own discounted lifetime income in a market where job offers are envisaged as random draws from a known distribution of wage offers. It has been shown that the best strategy in such a market is for a worker to select a reservation wage before an offer is received. Any offer then made to that worker will be accepted if and only if the wage offered is at least as great as the reservation wage. If an offer is accepted, the worker is assumed to work at the firm until retirement, presumably because the cost of looking for a better job is too great. In this study it is shown that this is only the best strategy if the cost of looking for a job while employed is high relative to the cost when unemployed. If this is not the case another strategy yields a greater expected payoff. This strategy involves a worker selecting two "reservation" wages, X and Y, where $X < Y$. An unemployed worker will then accept any offer if and only if the wage offered is at least as great as X. However, if the wage offered is acceptable but less than Y, the worker will continue to look for another job when employed. Any offer with a wage at least as great as Y implies the worker will accept and not look for a job when employed. An employed worker who is looking for another job will accept any offer received with a wage greater than his current wage. Details of these results are presented in Section I.

Two facts dominate the empirical literature on quit rates: the probability a worker quits a job declines as the worker's age increases, and as job tenure increases.[4] Two explanations of these results have been proposed. First, it has been argued that workers accumulate firm-specific capital as they work at a firm (see Parsons, 1972). This implies the wage of a worker will increase relative to the next best alternative as tenure increases if workers are paid according to their marginal products. The second explanation stresses the idea that workers do not know all the relevant characteristics of a firm when becoming employed (see Dale

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[1]To generate results on employee job search Parsons assumes that the cost of search function is quadratic. No such restriction will be used in the present study.

[2]Tobin uses the example of the labor market for academic economists as one where the cost of search when employed is not greater than the cost when unemployed.

[3]Steven Lippman and John McCall present an excellent survey of job search studies.

[4]Robert Hall's article is a good example of this literature.

Mortensen, 1975). A worker in this case may decide to quit if the characteristics of the firm learned when working at the firm make the job unacceptable. Using either of these explanations it is possible to derive a negative relationship between quitting and job tenure. The negative relationship between quitting and age follows as a consequence of the positive correlation between age and job tenure.

In this study workers do not accumulate firm-specific capital and know all about a job before starting employment. Workers quit only because a better wage offer is found. Quits of this type may be termed *wage quits*. There are two possible causes of such behavior. First, a worker's wage may decline relative to others. Quits motivated by such a change are termed *dynamic wage quits*. In the present study workers look for another job when employed as part of an optimal search strategy even when relative wages are held constant. Quits of this type may be termed *equilibrium wage quits*. This type of quit can occur as a long-run feature of a market, whereas dynamic wage quits only occur after some shock to the system. With equilibrium wage quits the causal relationship is between quitting and age. The association between quitting and job tenure follows as a consequence of the positive correlation between tenure and age. The job quits theory developed leads to the prediction that the average wage received by workers of a given age increases as the age group considered increases. This is similar to results in the human capital literature. The reasons behind this prediction are different, as workers do not accumulate human capital (by assumption).

I. Formal Model of Job Search

The labor market structure outlined in this section is similar to that utilized in most previous job search studies. Its most noticeable feature is that all firms do not offer the same wage rate in any given period. Rather it is assumed that the wage offers made by all firms in the market can be described by a nondegenerate distribution function $F(w)$. Associated with this function is a density function $f(w)$.

Suppose a worker's working life can be divided into N periods. In any period a worker can pay a fixed amount (the search cost) and receive one job offer. As workers are assumed not to know which firms are offering which wage, an offer can be envisaged as a random draw from the known distribution of wage offers. This implies $(1 - F(w''))$ denotes the probability a worker who attempts to obtain a job in a period receives an offer with a wage at least as great as w''. A worker who accepts an offer works at the wage rate offered per period until he retires or quits. If an offer is rejected, the worker is assumed capable of returning to accept it in a later period. An unemployed worker who attempts to obtain a job in a period is eligible for unemployment insurance payment u in that period. Unemployed workers who do not look for a job are ineligible for such a payment.

Suppose workers attempt to maximize their own expected discounted lifetime income net of search costs. In previous job search studies it has been assumed a worker selects one of two options in any period: *option* 1, look for a job (search) but not work; or *option* 2, work but not search. In this study a worker will be allowed to choose a further option: *option* 3, work and search. The cost of looking for a job while employed may be different from the cost while unemployed. For example, the cost of search when employed may include loss of earnings while searching. To allow for such possibilities, let c_1 and c_2 denote the cost of search when unemployed and employed, respectively.

Although only three options will be considered in the present study, there is another option open to workers in many labor markets. With this option a worker selects to neither work nor search. This has been termed the discouraged worker option in the literature. To simplify the exposition the discouraged worker option will be ruled out by assumption. A simple way of achieving this goal is to assume $u - c >$ 0. It is straightforward to check a worker will always prefer option 1 to the discouraged worker option if this restriction holds. Ruling out this option does not imply it is not relevant in many market situations but reflects my desire to concentrate on other issues.

A worker about to begin period t of working life will be said to be of (working) age t. Suppose a worker of age t has received a maximum wage offer w'. Let $\mu_{1t}(w', u, c_1)$ denote the maximum expected discounted lifetime income to this worker given that option 1 is selected in the next period and then an unrestricted choice of options is allowed in all future periods. Similarly, let $\mu_{2t}(w')$ indicate the maximum expected payoff if option 2 is chosen in period t and $\mu_{3t}(w', c_2)$ if option 3 is selected when an unrestricted choice is allowed in all future periods. The worker will choose the option in a period that yields the greatest expected discounted lifetime income net of search costs. Let

$$\text{(1)} \quad \psi(w', t) = \max\{\mu_{1t}(w', u, c_1), \mu_{2t}(w'), \mu_{3t}(w', c_2)\}$$

denote the maximum expected payoff to a worker of age t who has received a maximum wage offer w' to date. The expected payoffs to choosing each of these three options in period t of working life when w' is the best wage offer received can be written as

$$\text{(2)} \quad \mu_{1t}(w', u, c_1) = u - c_1 + \beta(1 - F(w'))E\{\psi(w, t+1) \mid w \geq w'\} + \beta F(w')\psi(w', t+1)$$

$$\text{(3)} \quad \mu_{2t}(w') = w' + \beta\psi(w', t+1)$$

$$\text{(4)} \quad \mu_{3t}(w', c_2) = w' - c_2 + \beta(1 - F(w'))E\{\psi(w, t+1) \mid w \geq w'\} + \beta F(w')\psi(w', t+1)$$

for any $t < N$, where $\beta = 1/(1 + r)$ is the discount rate and r the discount factor. What option will a worker choose in the last period before he retires? Without any real loss of generality assume $u - c_1 < w'$ for any possible wage w' in the market. This ensures that a worker will always select option 2 (work and not search) in period N in the market, that is,

$$\text{(5)} \quad \psi(w', N) = \mu_{2N}(w') = w' \quad \text{for any possible wage offer } w'$$

This claim is simple to check if it is noted $\psi(w', N + 1) = 0$ for any w'.

The expected payoff to selecting any option in a period depends on the maximum wage offer received at the start of the period. Taking the partials of (2), (3), and (4) with respect to w' and using (5) implies

$$\text{(6)} \quad \frac{\partial \mu_{2t}(w')}{\partial w'} > \frac{\partial \mu_{3t}(w', c_2)}{\partial w'} > \frac{\partial \mu_{1t}(w', u, c_1)}{\partial w'} > 0$$

when evaluated at any given w' and for any $t < N$. Hence an increase in w' to $w' + \delta$ ($\delta > 0$) will increase the expected payoff to selecting option 2 in the next period more than the payoff to option 3, which in turn increases more than option 1.

When will option 1 be preferred to option 3 in any given period? From (2) and (4) it follows that if the maximum wage offer received to date equals z, where

$$\text{(7)} \quad z = u - c_1 + c_2$$

then the expected payoffs to options 1 or 3 in the next period are the same, i.e., $\mu_{1t}(z, u, c_1) = \mu_{3t}(z, c_2)$ for any t. Further, (6) implies

$$\text{(8)} \quad \mu_{1t}(w', u, c_1) \gtreqless \mu_{3t}(w', c_2) \quad \text{as } w' \lesseqgtr z$$

Thus a worker will select option 3 in preference to option 1 in any period if and only if the maximum wage offer received to date is at least z. The situation is not so simple when other pairs of options are compared. Consider options 1 and 2. For any fixed $t < N$ let x_t denote the maximum wage offer received to date that equates the payoffs to selecting either of these options in period t of working life. Equating (2) with (3) yields

$$\text{(9)} \quad x_t = u - c_1 + \beta \int_{x_t}^{\infty} \{\psi(w, t+1) - \psi(x_t, t+1)\} f(w)\, dw$$

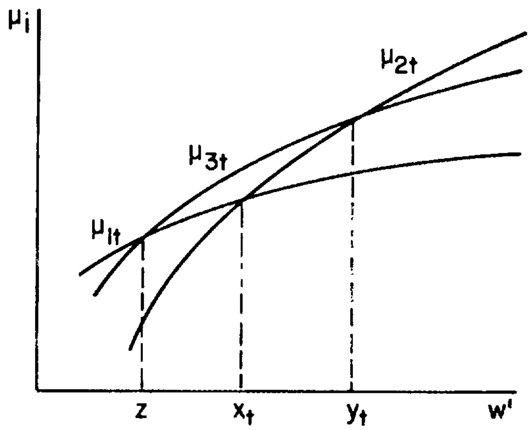

FIGURE 1a

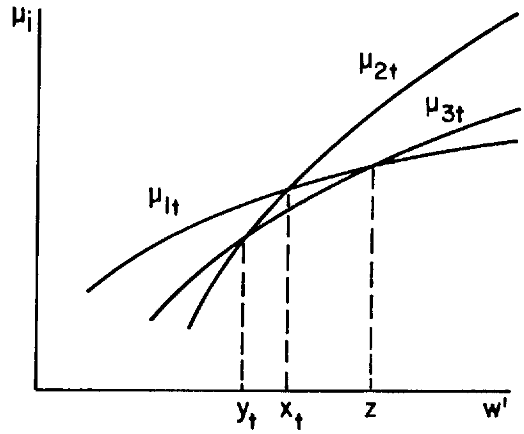

FIGURE 1b

Similarly, let y_t indicate the maximum wage offer received to date that equates the payoffs to choosing options 2 or 3 in any period t of working life. This implies

$$(10)\quad c_2 = \beta \int_{y_t}^{\infty} \{\psi(w, t+1) - \psi(y_t, t+1)\} f(w)\,dw$$

Using (6) it can be seen both x_t and y_t are unique for any fixed $t < N$ and

$$(11a)\quad \mu_{1t}(w', u, c_1) \gtrless \mu_{2t}(w') \quad \text{as } w' \lesseqgtr x_t$$

$$(11b)\quad \mu_{3t}(w', c_2) \gtrless \mu_{2t}(w') \quad \text{as } w' \lesseqgtr y_t$$

An important consequence of the above analysis is presented in the following claim.

PROPOSITION 1: *$z \gtrless x_t$ if and only if $y_t \lesseqgtr x_t$.*
The proof is shown in the Appendix.

Suppose $z \leq x_t$. This situation is depicted in Figure 1a. As a worker will select the option in period t that maximizes expected payoff, it can be seen by inspection of Figure 1a that the following strategy is optimal in period t of working life.

Strategy A:
(a) Select option 1 (search not work) in period t only if $w' < z$
(b) Select option 2 (work not search) in period t only if $w' \geq y_t$
(c) Select option 3 (work and search) in period t only if $z \leq w' < y_t$

where z and y_t are defined in (7) and (10) and w' is the maximum wage offer received at the start of period t of the worker's working life.

Suppose $z > x_t$. This situation is depicted in Figure 1b. In this case the optimal strategy for a worker of working age t is as follows.

Strategy B:
(a) Select option 1 (search not work) in period t only if $w' < x_t$
(b) Select option 2 (work not search) in period t only if $w' \geq x_t$

where x_t is defined in (9) and w' is the maximum wage offer received.

Note that x_t is irrelevant for decision purposes if Strategy A dominates, whereas z and y_t are irrelevant if Strategy B is preferred. The next claim is a direct consequence of the above analysis and therefore no proof is presented.

PROPOSITION 2: *For a worker about to begin period t of working life, Strategy A maximizes expected discounted lifetime income only if $z \leq x_t (z \leq y_t)$; otherwise Strategy B is preferred.*

In previous job search models only options 1 or 2 were allowed to be selected by a worker in any period. This restriction implies Strategy B must be chosen by a worker in each period. The more general model considered in this study has reached a more general conclusion. Specifically, it has been shown that Strategy B is preferred by a worker of age t only if $z > x_t$.

So far the optimal strategy of a worker in any given period has been analyzed. In the remaining part of this section it is shown how the switchpoint wages x_t and y_t change as a worker becomes older. Of course, the wage z is independent of the age of a worker. Given (1)–(6) it is possible to solve z, x_t, and y_t for all $t \leq N$. Proposition 3 summarizes the results that can be obtained from such a task.

PROPOSITION 3:
(a) $y_{t-1} > y_t$ *if Strategy A is preferred in period t of working life*
(b) $x_{t-1} > x_t$ *if Strategy B is preferred in period t of working life*
(c) *If Strategy B is preferred by a worker in period t^* then strategy B will be preferred by that worker in any period $t > t^*$*

The proof is shown in the Appendix.

Claims (a) and (b) establish that the relevant switchpoint wages x_t or y_t decrease as the worker becomes older.[5] An important implication of this result is that workers will only quit a job to become employed at a firm that has offered a better wage. Workers will not quit a job for unemployment in the environment specified.

Several alternative formulations of the model can be considered without disturbing the basic results. For example, it can be assumed that the cost c_2 is a positive function of the worker's current wage, or that a worker cannot return to a previously rejected offer, without radically altering the results obtained. Similar results are also achieved if workers are assumed to have infinite working lives, although in this case the switchpoint wages y_t and x_t remain constant as t changes. If the distribution of wage offers changes through time, however, significantly different results accrue. For example, in this case a worker may choose to quit a job to become unemployed.

II. Quit Rates

In this section simple job quit functions are investigated. It is first shown that the results of the previous section imply a functional relationship between quitting and (working) age. This implication is then used to show that the probability of quitting decreases as job tenure increases. It should be noted that only equilibrium wage quits as defined earlier are considered. There are many other reasons a worker may quit a job, but these will be ignored to highlight the major argument.

Within the context of the model developed in this study, a worker will quit a job if and only if a better wage offer is received in that period. This event can only occur if option 3 (work and search) is chosen in that period. Workers who utilize Strategy B, however, never select option 3 and thus never quit. Indeed, as previous job search studies assumed workers do not look for another job when employed, an implication of these studies is that workers never quit. To simplify the exposition in this section it will be assumed that $y_t \geq z (y_t \geq x_t)$ for all $t \leq N$. This assumption and Proposition 3 guarantee all workers use Strategy A in each period. Another consequence of this restriction is that only those in their first period in the labor force will be unemployed. To establish this last claim, note from (5) that $F(y_N) = 0$. This result and the restriction $y_t \geq z$ imply $F(z) = 0$, which leads directly to the stated claim from the definition of Strategy A. Although it is somewhat unrealistic to make assumptions that guarantee all workers who have been in the market more than one period are employed, it will not affect the results on job quits and much simplifies the analysis.

Assumptions made above ensure that all workers who have been in the market more

[5]Another consequence of this claim is that the switchpoint wages y_t and x_t can be written as

$$c_2 = P(t+1)\beta \int_{y_t}^{\infty} (w - y_t) f(w)\, dw$$

$$x_t = P(t+1)\beta \int_{x_t}^{\infty} (w - x_t) f(w)\, dw$$

where $P(t+1) = \sum_{i=1}^{N-t} \beta^i$

than one period select either option 2 or 3 in any period. From the definition of Strategy A it follows that a worker of age t employed at wage w'' will choose option 3 in the next period only if $w'' < y_t$. Note that as $y_{t-1} > y_t$ (from Proposition 3), a worker who once selects option 2 will choose this option until retirement. A worker in his first period in the market is forced to select option 1 (search not work) as a job offer will not have been received. Define $t(w'')$ as the maximum t such that $y_t \geq w''$ for any fixed w''. This implies that of all workers who work at wage w'' only those with no greater than $t(w'')$ will work and search in the next period. If a worker of age t employed at w'' selects option 3 in a period, there is a probability $(1 - F(w''))$ a better offer is received and hence the worker quits. Let $q(w'', t)$ denote the probability a worker of age t employed at wage w'' quits during the next period. It follows that

$$(12)\quad q(w'', t) = \begin{cases} 1 - F(w'') & \text{if } t \leq t(w'') \\ 0 & \text{if } t > t(w'') \end{cases}$$

A worker employed at a wage less than another worker of the same age is more likely to quit (or at least not less likely) for two reasons. First, if both select option 3 in a period, the lower paid worker is more likely to obtain a greater wage offer than current wage, i.e., $1 - F(w'') > 1 - F(\hat{w}'')$ if $w'' < \hat{w}''$. Second, the lower paid worker will choose option 3 at least as long as the other worker, i.e., $t(w'') \geq t(\hat{w}'')$ if $w'' < \hat{w}''$. These predicted relationships between age, current wage, and the probability of quitting appear not to be refuted in the empirical studies on the subject (see Hall).

Above it was argued that the wage rate and age of a worker determine the probability of quitting. The worker's job tenure did not influence the quitting decision. Nevertheless, it will be shown the above results imply a relationship between quitting and job tenure. This goal is achieved in three stages. First, the expected number of each age group who search a firm in a period is specified. Second, the expected number of each age group who accept a firm's offer is calculated. Finally, it is shown how many quit or retire from a firm in a period after s periods of employment at the firm. The last result leads directly to the claimed negative relationship between quitting and job tenure.

Suppose K new workers enter the market each period. Due to the assumptions made all these workers will accept the first offer they receive. Some of the workers will obtain an offer with a wage at least as great as y_2. These workers will choose option 2 in each of their future periods in the market. Those that received a wage offer less than y_2 in their first period in the market will select option 3 in the next period. Hence the expected number of workers in period 2 of their working lives who choose option 3 is denoted by $KF(y_2)$. Let k_t indicate the expected number of age t workers who select option 3 in a given period. It follows that

$$k_t = K[F(y_t)]^{t-1} \quad \text{if } 1 \leq t \leq N-1 \quad \text{and} \quad k_N = 0$$

Assume γ percent of each working age group who are looking for a job in a period visit a particular firm. This is a harmless restriction in the model considered, as it has previously been assumed that workers randomly choose the firm to search in a period from the set of all firms. This implies γk_t denotes the expected number of workers of working age t who search a particular firm in a period. Note that the expected number who search a firm in a period is independent of the wage offered by that firm. This is not the case when considering how many workers accept a firm's offer.

Consider a firm offering wage rate $\tilde{w}$ in each period. Of those workers searching this firm in a period only those who have not previously received a better offer will accept. This implies that the expected number of age t who accept the offer of this firm in a given period N_t can be written as $N_t = \gamma k_t Pr$ (best offer in $t-1$ offers $< \tilde{w} \mid$ best offer in $t-1$ offers $< y_t$) $t = 1, 2, \ldots, N-1$. Using a standard result from probability theory yields

$$(13)\qquad N_t = \begin{cases} \gamma k_t[F(\tilde{w})]^{t-1} & \text{if } t < t(\tilde{w}) \\ \gamma k_t[F(y_t)]^{t-1} & \text{if } t \geq t(\tilde{w}) \end{cases}$$

Let λ_t indicate the proportion of those who begin to work for a firm in a given period who are working age t. Note that workers who accept an offer in period $t-1$ of working life do not start to work at the firm until they are working age t. The next proposition uses this fact and (13) to specify how λ_t changes with t. As the proof follows directly from the analysis above none will be presented.

PROPOSITION 4:

$$\lambda_t = \lambda[F(e_t)]^{t-2} \qquad t = 2, 3, \ldots, N$$

where $\quad e_t = \min\{y_{t-1}, \tilde{w}\}$

and λ *is chosen so that* $\sum_{t=2}^{N} \lambda_t = 1$

Proposition 4 specifies the expected working-age distribution among the group who accept a firm's offer in a given period. This result will now be used to calculate the expected proportion of the group who start to work for a firm in a given period, who quit or retire from the firm s periods later. First, consider the expected number who quit in each period. From (12) it follows that of those who enter this firm in a given period, a proportion $\lambda_2 + \lambda_3 + \ldots + \lambda_{t(\tilde{w})}$ will select to work and search in their first period at the firm. This implies that $(1 - F(\tilde{w}))\{\lambda_2 + \lambda_3 + \ldots + \lambda_{t(\tilde{w})}\}$ denotes the expected proportion who quit after one period at the firm. Workers of working age $t(\tilde{w})$ when entering this firm who fail to obtain a better offer in the first period select not to search in their second period at the firm as $y_{t(\tilde{w})+1} < \tilde{w}$ by definition. Hence, $F(w)\{\lambda_2 + \lambda_3 + \ldots + \lambda_{t(\tilde{w})-1}\}$ indicates the expected proportion who choose option 3 in their second period after entering the firm. Continuing in a similar way it is possible to specify $Q(\tilde{w}, s)$, the expected proportion of those who enter a firm in a given period who quit that firm s periods later. Proposition 4 and (12) imply

(14)

$$Q(\tilde{w}, s) = (1 - F(\tilde{w}))[F(\tilde{w})]^{s-1} \sum_{t=2}^{t(\tilde{w})-s+1} \lambda_t$$

Manipulating (14) yields[6]

$$(15)\quad Q(\tilde{w}, s) = \lambda[F(\tilde{w})]^{s-1}(1 - [F(\tilde{w})]^{t(\tilde{w})-s}) \qquad \text{if } s < t(\tilde{w})$$

and $\quad q(\tilde{w}, s) = 0 \text{ if } s \geq t(\tilde{w})$

After N periods in the market, workers retire. Let $R(\tilde{w}, s)$ indicate the expected proportion of those who enter the firm in a given period who retire while still employed at that firm s periods later. Proposition 4 and (15) imply

$$(16)\quad R(\tilde{w}, s) = \begin{cases} \lambda[F(y_{N-s})]^{N-s-1} & \text{if } s < N - t(\tilde{w}) \\ \lambda[F(\tilde{w})]^{t(\tilde{w})-1} & \text{if } N - 1 \leq s \leq N - t(\tilde{w}) \\ 0 & \text{if } s > N - 1 \end{cases}$$

Finally, let $V(\tilde{w}, s)$ denote the expected proportion of the group who entered the firm in a given period who are still employed at that firm s periods later. As $V(\tilde{w}, 0) = 1$, it follows that

$$(17)\quad V(\tilde{w}, s) = 1 - \sum_{j=1}^{s} \{Q(\tilde{w}, j) + R(\tilde{w}, j)\}$$

After the above tedious but necessary derivation of stocks and flows, the major result of this section can be stated.

PROPOSITION 5: *The quit rate,* $Q(\tilde{w}, s)/V(\tilde{w}, s-1)$, *declines as* s *increases if* $Q(\tilde{w}, s)$ *is strictly positive.* $Q(\tilde{w}, s)$ *is strictly positive if* $s < t(\tilde{w})$. *Further,* $Q(\tilde{w}, 1) > Q(\tilde{w}', 1)$ *and* $Q(\tilde{w}', s^*) > 0$ *for any* s^* *implies* $Q(\tilde{w}, s^*) > 0$ *if* $\tilde{w} < \tilde{w}'$.

The proof is shown in the Appendix.

[6]The following result is used in this manipulation. If $0 < x < 1$ and M is any positive integer, then

$$\sum_{t=1}^{M} x^t = (x(1 - x^M))/(1 - x)$$

In the remaining part of this study the relationship between the distribution of wage rates received by each working age group is investigated. Let $H_t(w)$ denote this distribution for workers of age t. Hence $H_t(w'')$ indicates the proportion of workers of working age t who are employed at a wage no greater than w''. A worker in period t of working life will receive a wage at least as great as the wage received in period $t-1$ of working life. Some workers who select option 3 in period $t-1$ of their working lives will obtain a better offer and hence receive a greater wage in period t. This implies $H_{t-1}(w'') > H_t(w'')$ for any w'' for any $t \leq N$ if $0 < F(w'') < 1$. Using this result and Proposition 4 it can be seen that a randomly selected worker of a given age is more likely to quit in the next period than another randomly selected worker of a greater working age. This claim follows if it is noted that (a) a worker receiving wage w'' of working age t is no more likely to quit in the next period than another receiving the same wage of working age $t+1$; and (b) more workers of working age $t+1$ receive a wage at least as great as w'' than workers of age t, for any possible w''.

An implication of the above analysis is that the average wage received by workers of a given age increases as the age group considered increases. Further, it is straightforward to show that this increase in average wage is at a decreasing rate. Formally, we have

$$E\{H_{t-1}(w)\} < E\{H_t(w)\}$$

and

$$|E\{H_{t-1}(w)\} - E\{H_t(w)\}| > |E\{H_t(w)\} - E\{H_{t+1}(w)\}|$$

for any $t < N$. This prediction is similar to that often made from human capital theory, and one that appears to be valid empirically. The reason behind this prediction, however, is quite different. The basic idea behind the human capital explanation is that older workers receive higher wages, on average, because they have accumulated more human capital while working. Hence, if two workers attain the same educational level, the older worker will on average receive a greater wage rate as job experience increases productivity. In the present study it has been assumed workers do not accumulate human capital while working. Older workers in the present study receive higher wage rates, on average, because they have obtained more job offers. And the more job offers a worker receives, the greater the probability a "high" wage rate job will be found.

APPENDIX

PROOF of Proposition 1:

Suppose $z > x_t$. From (8) it follows $\mu_{1t}(x_t, u, c_1) > \mu_{3t}(x_t, c_2)$. Hence $\mu_{1t}(x_t, u, c_1) > \mu_{2t}(x_t)$ from (11a), which implies $x_t > y_t$.

Suppose $x_t > y_t$. From (11b) it follows $\mu_{2t}(x_t) > \mu_{3t}(x_t, c_2)$. Hence $\mu_{1t}(x_t, u, c_1) > \mu_{3t}(x_t, c_2)$ from (11a), which implies $z > x_t$. The rest of the claims of the proposition are established in a similar fashion.

PROOF of Proposition 3:

Suppose $x_t \geq z$ and hence from Proposition 1, $y_t > x_t$. Proposition 2 implies that Strategy A dominates and $\mu_{2t}(y_t) = \mu_{3t}(y_t, c_2) = \psi(y_t, t)$. The equations of (11) imply that if $\mu_{3t-1}(y_t, c_2) > \mu_{2t-1}(y_t)$ then $y_{t-1} > y_t$. Hence to establish claim (a) it is sufficient to show $\mu_{3t-1}(y_t, c_2) > \mu_{2t-1}(y_t)$. Using (3) and (4) it follows

$$\mu_{2t-1}(y_t) = y_t + \beta\mu_{2t}(y_t)$$

and

$$\mu_{3t-1}(y_t, c_2) = y_t - c_2 + \beta(1 - F(y_t)) \cdot \{E(\mu_{2t}(w) \mid w \geq y_t) - \mu_{2t}(y_t)\} + \beta\mu_{2t}(y_t)$$

Manipulating and using the definition of $\mu_{2t}(y_t)$ yields

$$\mu_{3t-1}(y_t, c_2) - \mu_{2t-1}(y_t) = -c_2 + \beta \cdot \int_{y_t}^{\infty} (\psi(w, t+1) - \psi(y_t, t+1)) f(w)\, dw + \beta(1 - F(y_t))\{E(w \mid w \geq y_t) - y_t\}$$

Using (9) it follows

$$\mu_{3t-1}(y_t, c_2) - \mu_{2t-1}(y_t) = \beta(1 - F(y_t))\{E(w \mid w \geq y_t) - y_t\} > 0$$

Hence it has been established that $y_{t-1} > y_t$ if Strategy A dominates. Claim (b) can be proved by using arguments essentially the same as the above. Finally, claim (c) follows directly from claim (b).

PROOF of Proposition 5:

Substituting (15) and (16) into (17) and manipulating yields

$$V(\tilde{w}, s) = 1 - \lambda(1 - F(\tilde{w}))^s/(1 - F(\tilde{w})) + d(\tilde{w}, s)$$

where $d(w,s) =$

$$m\lambda[F(\tilde{w})]^{t(\tilde{w})-1} - \lambda \sum_{i=1}^{m} [F(y_{N-i})]^{N-i-1}$$

and $m = \min\{s, N - s - 1\}$. Let $h = V(\tilde{w}, s)Q(\tilde{w}, s) - V(\tilde{w}, s - 1)Q(\tilde{w}, s + 1)$. If $h > 0$ for any $s < t(\tilde{w})$, then the major claim of the proposition is established. But, for $s < t(\tilde{w})$,

$$\begin{aligned} h &= \lambda[F(\tilde{w})]^{s-1} \\ &\quad \cdot \{1 - F(\tilde{w}) - (1 - [F(\tilde{w})]^{t(\tilde{w})-1})\} \\ &\quad + \lambda[F(\tilde{w})]^{s-1}\{d(\tilde{w}, s)(1 - [F(\tilde{w})]^{t(\tilde{w})-s}) \\ &\quad - d(\tilde{w}, s + 1)F(\tilde{w})(1 - [F(\tilde{w})]^{t(\tilde{w})-s+1})\} \end{aligned}$$

The second term on the right-hand side of the above is positive as $d(\tilde{w}, s) \geq d(\tilde{w}, s + 1)$. Hence, if $1 - F(\tilde{w}) - (1 - [F(\tilde{w})]^{t(\tilde{w})-1}) > 0$ then $h > 0$. This implies that if

$$\text{(A1)} \quad \lambda < (1 - F(\tilde{w}))/(1 - [F(\tilde{w})]^{t(\tilde{w})-1})$$

then $h > 0$. From Proposition 4 and equation (12), we have

$$1 = \sum_{i=2}^{N} \lambda_i = \lambda \sum_{j=2}^{t(\tilde{w})-1} [F(\tilde{w})]^{j-2} + \lambda \sum_{k=t(w)}^{N} [F(y_{k-1})]^{k-2}$$

$$= \frac{(1 - [F(\tilde{w})]^{t(\tilde{w})})}{(1 - F(\tilde{w}))} + \lambda \sum_{j=t(\tilde{w})}^{N} [F(y_{j-1})]^{j-2}$$

Hence

$$\lambda = [1 - F(\tilde{w})] \div \left[1 - [F(\tilde{w})]^{t(\tilde{w})} + (1 - F(\tilde{w})) \sum_{j=t(\tilde{w})}^{N} [F(y_{j-1})]^{j-2}\right]$$

and therefore (A1) is satisfied and the major claim is established. The other claims of the proposition follow directly from this result.

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