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Equilibrium Job Mobility

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EQUILIBRIUM JOB MOBILITY*

by

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I. INTRODUCTION AND SUMMARY

This paper explores the implications of a simple job-worker matching model for life-cycle job mobility.

The basics of the model are very straightforward and are modifications of material in MacDonald (1980, 1982). There are two kinds of workers, A and B, and two kinds of firms, α and β. If full information were available, A (B) workers would be employed by α (β) firms. But information is imperfect; indeed no one knows for sure whether a given individual is an A or a B. More information can only be accumulated by working, and even then the ensuing information is imperfect. As individuals accumulate information over time, switching firms is optimal under certain circumstances; that is, job mobility occurs. The contribution of this paper consists of the characterization of this equilibrium job mobility.

The experiments explored below follow from treating information on individual productive traits much in the way human capital is utilized—as part of an unobservable process which generates predictions on observables. Specifically, information on productive traits is available to the agents in the model, but predictions are confined to the relationship between mobility and other observables: wage rates, age, tenure on present job, and past mobility behavior. Further, these predictions are in terms of properties of the distributions of the endogenous entities in the model. These distributions are induced by distributions of the underlying unobservables. Proceeding in this fashion, it is possible to consistently enquire into the impact of tenure on job mobility, for example, taking proper account of the
endogenous nature of both mobility and tenure.

In what follows, mobility is measured two ways. For any set of characteristics (e.g. some particular tenure level), how many individuals will be mobile at the end of the period? This generates the "aggregate" mobility measure $\overline{M}$. $\overline{M}$, as a proportion of those individuals, is denoted $\overline{J}$, the "proportional" mobility measure (also the probability that a randomly drawn member of the group will change jobs).

The main predictions are as follows. Under both mobility measures, individuals having higher wages are less mobile irrespective of whether age, tenure, or past mobility are held constant. Older individuals, or those having greater tenure, are predicted to be less mobile (except perhaps at very short tenure levels) unless wages are held constant and mobility is measured by $\overline{J}$, in which case mobility does not depend on age or tenure.

Predictions on the influence of past mobility are more diverse. Wages, tenure, and age constant, past mobility is related to present mobility nonmonotonically in terms of $\overline{M}$, and not at all in terms of $\overline{J}(\cdot)$. Removing the conditioning on wages, age and tenure, past mobility reduces aggregate mobility but raises it on a proportional basis.

The model presented below makes little claim to generality (though what claims are made are apparently genuine). Indeed, at the individual level the economic behavior and environment are quite trivial. The payoff is that the market-level behavior can be given a very thorough characterization, and the predictions are extremely coarse.

The analysis proceeds as follows. Section II presents the structure of individual skills and the behavior of firms. In Section III, the workers' side of the model is specified. Section IV describes the process whereby
information is accumulated. Market equilibrium is then displayed in Section V.

The main results on equilibrium job mobility are offered in Section VI, which comprises the body of the paper. Section VII, in a very simple fashion, confronts a couple of predictions with data from a study by Mincer and Jovanovic (1981). Though it was not possible to confront the most interesting predictions, Section VII is of interest because it does at least partially test the theory. As this section has summarized the results, Section VII is the final section.

Once the structure of the model is set out, proofs of all the propositions are straightforward but extremely tedious calculations and are therefore omitted; truly voracious masochists will find pleasure in constructing their own.

II. INDIVIDUAL SKILLS AND THE BEHAVIOR OF FIRMS

The structure of skills and behavior of firms given below can be derived from the setup presented in MacDonald (1980). The features relevant to the present analysis are as follows.

There are two types of individuals (A and B) and two types of firms (α and β). Output prices are assumed fixed; there are no factors except labor, and constant returns to scale prevails. (That is, intra-industry detail is suppressed.) It is therefore appropriate to refer to the value of the one-period output of a particular job-worker match. The various possible values of output are assumed to be as in Table 1.
Table 1

<table>
<thead>
<tr>
<th>Worker Type</th>
<th>Firm Type</th>
<th>( \alpha )</th>
<th>( \beta )</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1 + ( v )</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>1 + ( v )</td>
<td>( v &gt; 0 )</td>
</tr>
</tbody>
</table>

The essential characteristic of the entries in Table 1 is that an A-\( \alpha \) (B-\( \beta \)) match is more productive than an A-\( \beta \) (B-\( \alpha \)) match; \( v \) is the increment associated with a "correct" match. That \( v \) is the same across matches is not crucial for what is to follow, but allows considerable analytical simplification.

In a world of complete information, the A-\( \alpha \) and B-\( \beta \) matches would follow readily. However, it is assumed that no one (i.e. information is completely symmetric) knows whether any given individual is an A or a B. Moreover, this information cannot be retrieved by observing output. Production is assembly line style. For the present, all that need be said about how the uncertainty is resolved is that there is an information set (\( \Xi \Omega \)) for each individual, and everyone is aware of \( \Omega \).

Given \( \Omega \), the probability that the worker is an A, \( P(\Omega) \), can be computed. The expected value of marginal product of an individual on whom there is information \( \Omega \) is

\[
q_{\alpha}(\Omega) = 1 + P(\Omega) \cdot v
\]  

(1)

in a firm of type \( \alpha \), and

\[
q_{\beta}(\Omega) = 1 + [1 - P(\Omega)] \cdot v
\]  

(2)

in a type \( \beta \) firm. The simplification introduced by assuming the value of a
correct match to not vary across match types is just that
\[ q_{\alpha} \lesssim q_{\beta} \text{ as } P(\Omega) \gtrless \frac{1}{2}. \] (3)

Under competition, assuming risk neutral and perfectly competitive
entrepreneurs seeking to maximize expected capitalized profit, individuals
for whom \( P(\Omega) > \frac{1}{2} \) (\(< \frac{1}{2} \)) will be hired by firms of type \( \alpha \) (\( \beta \)). (When
\( P(\Omega) = \frac{1}{2} \), it is assumed that the worker is assigned a firm type on the
basis of a coin toss. This is far less innocuous than it seems, but there
is a good reason for such an assumption, and more attention will be
devoted to it below.)

As the quality of the learning mechanism specified below does not vary
across firms, and there are no costs of hiring and firing workers, decisions
based on current expected marginal product constitute dynamically optimal
behavior for firms. Accordingly, all the useful behavior about firms is
contained in (1)-(3).

III. WORKERS

Workers are risk neutral maximizers of expected life wealth over a
five period horizon. Age is indexed by \( m \) (\( m = 0, \ldots, 4 \)). The labor force
is normalized so that there is one aggregate unit of labor of each age.

At each point in time, every worker has a person-specific information
set \( \Omega \). On the basis of \( \Omega \) the market offers a wage \( w(\Omega) \) for one period of
work (which everyone agrees to supply). Again, the learning process specified
below does not depend on which firm the individual works for, and there are
no costs of moving across firms. Accordingly, dynamically optimal behavior
is simply to go to work and receive \( w(\Omega) \) at whatever firms are hiring workers.
having information set $\Omega$. Note that expectations concerning future $\Omega$ do not matter.

IV. INFORMATION

Information comes in two varieties. One is information about the population in general. In the present instance this is merely the fraction of A's in the population. This fraction is assumed to equal 1/2, which is analytically convenient and allows attention to be focussed on the accumulation of the other kind of information, that which is person-specific.

At the end of each period of work (except the last), each worker receives two independent realizations of a random variable $X$. (This process need not be exogenous, but mobility ends when it does. Accordingly in the interest of simplicity, and to focus on mobility, it makes sense to force the information generating process to remain operative over time.) $X$ can take on just two values, $a$ or $b$, and has conditional distribution

$$P(X = a | A) = \theta = P(X = b | B)$$

$$\theta \in \left( \frac{1}{2}, 1 \right)$$

(4)

where $P(x|i)$ denotes the probability that $X = x$ ($x = a, b$) given the individual is a member of group $i$ ($i = A, B$). $X = a \ (b)$ is then a useful but imperfect indication that the worker is of type $A \ (B)$. Any particular unordered pair of realizations of $X$ will be denoted $\{x, x\}$.

The general population information and person-specific information comprise $\Omega$ for each worker. Given $\Omega$, it is straightforward to compute $P(\Omega)$. An easy extension of Proposition 2 in MacDonald (1982) shows that $P(\Omega)$ will take on only nine values in the present framework. That is, $P(\Omega)$ is largest for workers who have been in the market through four periods.
0-3 (referred to as "age 4") and received \( X = a \) eight times; next largest
for workers of age 4 who have received \( X = a \) seven times and \( X = b \) once,
and so on. Note that workers of age 3 who have received \( X = a \) every (i.e. 6)
time also have the same \( P(\Omega) \) value as do the latter group of age 4 workers. This
occurs because the additional \( X = a \) and \( X = b \) possessed by the age 4 workers
are offsetting owing to the probability of correct labelling \((\theta)\) not differing
across worker types (recall (4)).

Given this observation it is immediate that workers of age 4 are
represented in all nine "information classes", where an information class
is the set of all workers sharing a value of \( P(\Omega) \). Consequently the possible
values of \( P(\Omega) \) are given by

\[
P(A|Z=z) = \left[ 1 + \left( \frac{\theta}{1-\theta} \right)^{8-2z} \right]^{-1} \quad z=0,\ldots,8 \tag{5}
\]

where \( Z \) is the number of times the worker has received \( X = a \).

A helpful convention is to number the information class for which
\( P(\Omega) = 1/2 \) as class 0, and to denote classes having successively larger (smaller)
values of \( P(\Omega) \) as \( 1,\ldots,4 \) (-1,\ldots,-4). Adopting this notation, the information
generating process distributes workers across information classes indexed
by \( \lambda \) (\( \lambda = -4,\ldots,4 \)). Letting \( N_{m,\lambda} \) be the number of workers of age \( m \) in class \( \lambda \),
the total number of workers in class \( \lambda \) is

\[
N_{\lambda} = \sum_{m=0}^{4} N_{m,\lambda} \tag{6}
\]

where

\[
N_{0,\lambda} = \begin{cases} 
1 & \lambda = 0 \\
0 & \text{otherwise}
\end{cases}
\]

\[
N_{1,\lambda} = \begin{cases} 
\frac{1}{2} [\theta^2 + (1-\theta)^2] & \lambda = \pm 1 \\
2\theta(1-\theta) & \lambda = 0 \\
0 & \text{otherwise}
\end{cases}
\tag{7}
\]
\[ N_2, \lambda = \begin{cases} \frac{1}{2}[\theta^4 + (1-\theta)^4] & \lambda = \pm 2 \\ 2\theta(1-\theta)[\theta^2 + (1-\theta)^2] & \lambda = \pm 1 \\ 6\theta^2(1-\theta)^2 & \lambda = 0 \\ 0 & \text{otherwise} \end{cases} \]

\[ N_3, \lambda = \begin{cases} \frac{1}{2}[\theta^6 + (1-\theta)^6] & \lambda = \pm 3 \\ 3\theta(1-\theta)[\theta^4 + (1-\theta)^4] & \lambda = \pm 2 \\ \frac{15}{2}\theta^2(1-\theta)^2[\theta^2 + (1-\theta)^2] & \lambda = \pm 1 \\ 20\theta^3(1-\theta)^3 & \lambda = 0 \\ 0 & \text{otherwise} \end{cases} \]

\[ N_4, \lambda = \begin{cases} \frac{1}{2}[\theta^8 + (1-\theta)^8] & \lambda = \pm 4 \\ 4\theta(1-\theta)[\theta^6 + (1-\theta)^6] & \lambda = \pm 3 \\ 14\theta^2(1-\theta)^2[\theta^4 + (1-\theta)^4] & \lambda = \pm 2 \\ 28\theta^3(1-\theta)^3[\theta^2 + (1-\theta)^2] & \lambda = \pm 1 \\ 70\theta^4(1-\theta)^4 & \lambda = 0 \end{cases} \]

Recall that firms view workers as different only to the extent that \( P(\Omega) \) differs; effectively, they treat workers from distinct information classes as separate factors of production. Adopting this viewpoint the \( N_\lambda \) represent "factor supplies".

V. EQUILIBRIUM

In Sections II and III firms' and workers' problems were examined. Consider \( w(\Omega) = \max[q_\alpha(\Omega), q_\beta(\Omega)] \) as a set of equilibrium wages. Individuals in classes 1, \ldots, 4 (-4, \ldots, -1) supply effort where they can earn \( q_\alpha(\Omega) \) (\( q_\beta(\Omega) \)). Under the assumptions made above, at wage rates \( w(\Omega) \), type \( \alpha \) (\( \beta \))
firms will only wish to hire from classes $0, \ldots, 4 (-4, \ldots, 0)$. It follows that all workers in classes $1, \ldots, 4 (-4, \ldots, -1)$ work for $\alpha$ ($\beta$) firms. Individuals in class 0 are indifferent about where they work, and as mentioned above, it is assumed that $1/2$ of that class is employed by each type of firm.

$$w(\Omega) = \max[q_\alpha(\Omega), q_\beta(\Omega)]$$

and the allocation of classes $1, \ldots, 4 (-4, \ldots, -1)$ plus half of class 0 to firms of type $\alpha$ ($\beta$) thus constitutes an equilibrium of the model. Note that if the economy is assumed to evolve over time, in the sense that each period the oldest workers die and a new age group 0 enters, the equilibrium wages and allocations of information classes to firm types do not change. However, the particular workers occupying the various information classes will in general change, as might the firm type to which a given individual will offer his services. This is what is meant by job mobility herein.

VI. EQUILIBRIUM JOB MOBILITY

As information is accumulated over time, individual workers typically occupy various information classes. Reallocation across firm types is both efficient and individually rational when the worker's expected marginal product is higher in another firm type.

In the model presented above, there will be some mobility which neither raises nor lowers expected marginal product. Half of all individuals remaining in class 0 are assumed to move each period. (Since class 0 is allocated by a coin toss, half of those who remain in class 0 will be reallocated.) On the face of it, this seems an unattractive assumption. Introduction of the slightest mobility cost would wipe out all such mobility. However, the impact of the assumption is as follows.
What is necessary for the results to follow is that there be more than one information class, hired by a given firm type, from which individuals might optimally leave when new information is revealed. Since individuals receive but two observations on $X$ at the end of each period, they can traverse only one information class per period. For example, individuals in class 1 stay there if they receive $\{a, b\}$ but move to class 0 if they receive $\{b, b\}$. Without the assumption that some of class 0 is reallocated, only individuals in class 0 could be mobile at the end of the period, and the above necessary condition fails. But, given the assumption on class 0, individuals presently in class 1 (for example) may move if they enter class 0; the necessary condition is satisfied.

At the cost of a surprisingly large increment in the mental gymnastics required to understand the analysis, this assumption can be dropped and replaced by either the assumption that more observations are obtained each period, or that the range of $X$ is larger. Consequently, the assumption that half of information class 0 is reallocated each period is simply a cost-reducing (for the analyst) method of obtaining results which would follow from a richer information structure.

VI.1 Mobility Probabilities

How likely is it that individuals currently occupying the various information classes will leave their current employment at the end of the period? Denote the probability of mobility (at the end of the period) from class $\ell$ to an unspecified class in another firm type by $\phi_\ell (\ell = -4, \ldots, 4)$. By assumption,

$$\phi_0 = \frac{1}{2}. \quad (8)$$
Now consider workers in class 1. Half of the workers who enter class 0 will be mobile. Proceeding from class 1 to class 0 requires new information \([b,b]\). Since type A workers comprise \(P(1)\) of class 1, \(^3\)

\[
\phi_1 = \frac{1}{2} [P(1)(1-\theta)^2 + ((1 - P(1))\theta^2)] \\
= \frac{\theta^2(1-\theta)^2}{\theta^2 + (1-\theta)^2} \text{ from (5).} \tag{9}
\]

which can be written

\[
\phi_1 = [\theta^{-2} + (1-\theta)^{-2}]^{-1}
\]

Since both \(\theta < 1\) and \((1-\theta) < 1\), \(\phi_1 < \frac{1}{2} = \phi_0\). Mobility is less likely from class 1.

Given that \(X\) is observed only twice per period, it is only possible to change information classes at the rate of one per period. Accordingly,

\[
\phi_\ell = 0 \quad \forall \ell \neq 0, \pm 1 \tag{10}
\]

**VI.2 Transition Probabilities---Intrafirm**

For the analysis to follow, it is necessary to know the probability that a worker will, without leaving the firm at which he is presently employed, proceed from class \(i\) to class \(j\) in \(k\) periods (for \(i,j=0,\ldots,3\); and \(k=1,\ldots,3\); \(i=-1,0\) and \(j=-3,\ldots,0\) are entirely symmetric). \(^4\)

Denote the \(4\times4\) array of these probabilities by \(\pi(k)\), with typical element \(\pi_{ij}(k)\). To construct \(\pi(k)\), consider \(\pi(k|A)\), the matrix of transition probabilities given the worker is of type A. The transition from class 0 to class 0 for example, requires \([a,b]\), the probability of which is \(2\theta(1-\theta)\), in conjunction with not being reassigned, which occurs with probability \(1/2\).
Together then, \( \pi_{00}(1|A) = \theta(1-\theta) \). Proceeding in this fashion yields \( \pi(1|A) \).

Next, note that
\[
\pi(k|A) = \pi(1|A)\pi(k - 1|A),
\]
which gives \( \pi(k|A) \) for \( k = 2,3 \). \( \pi(k|B) \) is constructed similarly. Finally, \( \pi(k) \) is obtained using (5) and
\[
\pi_{ij}^{(k)} = P(i)\pi_{ij}^{(k|A)} + [1 - P(i)]\pi_{ij}^{(k|B)}.
\]

In what follows, only the transition probabilities for paths beginning at class 0 and 1 are required (the top two rows of \( \pi(k) \)). These expressions are supplied in Table 2.

V.3 Transition Probabilities - Interfirm

In addition to the intrafirm transition probabilities obtained in the previous subsection, information on the cross-firm transitions is required.

Denote the probability that a worker proceeds from class \( i \) to class \( j \) in one period by \( \Psi_{ij} \). Since individuals can move at most one information class per period, only \( \Psi_{00}, \Psi_{01} \) and \( \Psi_{10} \) (again \( \Psi_{0-1} \) and \( \Psi_{-10} \) are analogous) are positive.

As \( \Psi_{10} \) is the probability of moving from class 1 in a type \( \alpha \) firm to class 0 in a type \( \beta \) firm,
\[
\Psi_{10} = \phi_{1},
\]
the probability of mobility from class 1.

From class 0 in a type \( \alpha \) firm there are two possible destinations: class 0 and class 1, both in a type \( \beta \) firm. Mobility to class 0 requires new
\[ \pi(1) = \begin{bmatrix} \theta (1-\theta) & \frac{1}{2}[\theta^2+(1-\theta)^2] & 0 & 0 \\ \frac{\theta^2 (1-\theta)^2}{\theta^2+(1-\theta)^2} & 2\theta (1-\theta) & \frac{\theta^4+(1-\theta)^4}{\theta^2+(1-\theta)^2} & 0 \end{bmatrix} \]

\[ \pi(2) = \begin{bmatrix} \frac{3}{2} \theta^2 (1-\theta)^2 & \frac{3}{2} \theta (1-\theta)[\theta^2+(1-\theta)^2] & \frac{1}{2}[\theta^4+(1-\theta)^4] & 0 \\ \frac{3\theta^3 (1-\theta)^3}{\theta^2+(1-\theta)^2} & \frac{11}{2} \theta^2 (1-\theta)^2 & \frac{4\theta (1-\theta)[\theta^4+(1-\theta)^4]}{\theta^2+(1-\theta)^2} & \frac{\theta^6+(1-\theta)^6}{\theta^2+(1-\theta)^2} \end{bmatrix} \]

\[ \pi(3) = \begin{bmatrix} 3\theta^3 (1-\theta)^3 & \frac{17}{4} \theta^2 (1-\theta)^2[\theta^2+(1-\theta)^2] & 5\theta (1-\theta)[\theta^4+(1-\theta)^4] & \frac{1}{2}[\theta^6+(1-\theta)^6] \\ \frac{17}{2} \frac{\theta^4 (1-\theta)^4}{\theta^2+(1-\theta)^2} & \frac{33}{2} \theta^3 (1-\theta)^3 & \frac{29}{2} \frac{\theta^2 (1-\theta)^2[\theta^4+(1-\theta)^4]}{\theta^2+(1-\theta)^2} & \frac{6\theta (1-\theta)[\theta^6+(1-\theta)^6]}{\theta^2+(1-\theta)^2} \end{bmatrix} \]
information \( [a,b] \), with probability \( 2\theta(1-\theta) \), plus random allocation to the \( \beta \) firm, having probability \( 1/2 \). Accordingly
\[
\psi_{00} = \theta(1-\theta).
\]
(14)

Mobility to class 1 requires information \([b,b]\). This has probability \((1-\theta)^2\) for A workers and \(\theta^2\) for B workers. Using (5) yields
\[
\psi_{01} = \frac{1}{2}[\theta^2 + (1-\theta)^2]
\]
(15)

Note that since \( \phi_0 \) does not distinguish between destinations,
\[
\phi_0 = \psi_{00} + \psi_{01}.
\]
(16)

VI.4 MOBILITY MEASURES

In order to make predictions about job mobility, it is necessary to decide on just what measures of mobility will be examined. Herein there are two.

Let \( Y \) denote an arbitrary set of variables. Define:

\( \mathbb{M}(Y) = \) the number of workers having characteristics \( Y \) who change jobs at the end of the period;

\( \mathbb{N}(Y) = \) the number of workers having characteristics \( Y \);

\( \mathbb{S}(Y) = \mathbb{M}(Y)/\mathbb{N}(Y) \).

The mobility measures examined herein are \( \mathbb{M}(Y) \) and \( \mathbb{S}(Y) \). The predictions are in terms of how \( \mathbb{M}(\cdot) \) and \( \mathbb{S}(\cdot) \) change as elements of \( Y \) do.

In the analysis to follow, only one of the elements of \( Y \) is exogenous: age. This occurs because age and the information set are the only exogenous entities in the model which vary across individuals. Since information is treated as an underlying unobservable, a kind of human capital, there is little to be gained by making predictions which could only be confronted by observing it.
But what are endogenous variables doing in $Y$? The answer is that the evolution of the underlying exogenous variables induces a joint distribution of the endogenous quantities, and examining $\mathcal{M}(\cdot)$ and $\mathcal{I}(\cdot)$ is one method of characterizing that distribution.

Examination of the parallel with the classic pure schooling version of human capital theory is useful. Suppose individuals vary only by age and unobservable (to the analyst) learning ability. Given age, variation in ability induces a joint distribution of schooling duration and earnings. If the distribution of ability is available, a specific schooling-earnings distribution is implied and constitutes the predictions of the model.

In the present analysis, the counterpart to ability is the information set. While we are not so fortunate as to have much theory on where ability comes from, the information generating process herein provides the distribution of information sets readily.

This discussion also highlights the motivation behind the experiments to follow. While the status of the experiments should be clear by this point, it is less obvious why these experiments are of interest. The reason is simply that the literature on mobility has generated a few fairly robust empirical "facts" in the course of testing early theories. These facts happen to involve relationships among variables which are endogenous when viewed from a more complete theoretical standpoint. It has been shown that this does not mean the theory cannot address these findings. Rather, it just implies that the experiments may be somewhat atypical.

Finally, to be clear about what is to follow, it is helpful to briefly consider empirical representations of the mobility measures and the predictions made about them. If there are $n$ elements in $Y$, one should think of
\( \mathcal{M}(\cdot) \) as an \( n \)-dimensional cross tabulation, with entries given by the number of individuals who move at the end of the period. \( \mathcal{J}(\cdot) \) is a similar array with entries equal to the probability of mobility (a binomial event with success probability \( \mathcal{J}(\cdot) \)) conditional on characteristics \( Y \). It should be obvious that, for example, probit regressions of mobility on duration of tenure do not yield estimates of structural parameters any more than do regressions of wages on schooling.

VI.5 \( \mathcal{M}(\cdot) \) and \( \mathcal{R}(\cdot) \)

In order to obtain the results below it is necessary to obtain expressions for \( \mathcal{M}(Y) \) and \( \mathcal{R}(Y) \). The variables comprising \( Y \) are as follows:

- \( w \) = current wage rate. \( w_0(w_1) \) denotes the wage received by
  - by workers in class 0 (±1);
- \( m \) = age \( 0 \leq m \leq 3 \);
- \( t \) = tenure at present job;
- \( \mu \) = number of job changes prior to current job.

Note that \( 0 \leq \mu + t \leq m \).

The expressions for \( \mathcal{M}(w,m,t,\mu) \) are contained in Table 3 for those \((w,m,t,\mu)\) configurations for which \( \mathcal{M}(\cdot) \) is positive. (For example, \( m = 3, t = 3, \mu = 1 \) is not possible, so \( \mathcal{M}(w,3,3,1) = 0 \).) The associated expressions for \( \mathcal{R}(w,m,t,\mu) \) are obtained for Table 3 as

\[
\mathcal{M}(w_\lambda,m,t,\mu) = \mathcal{R}(w_\lambda,m,t,\mu) \cdot \rho_\lambda
\]

for \( \lambda = 0, \pm 1 \). Similar expressions may be derived for \( \lambda > 1 \).
Table 3

\[ \Psi_{00} \phi_0 \]

\[ \Psi_{01} \phi_1 \]

\[ \Psi_{00}(1) \Psi_{00} + \Psi_{10}(1) \Psi_{10} \]

\[ \Psi_{01}(1) \Psi_{01} \]

\[ \Psi_{00}(2) \Psi_{00} + \Psi_{10}(2) \Psi_{10} \]

\[ \Psi_{01}(2) \Psi_{01} \]

\[ \Psi_{00}(1) \Psi_{00} + \Psi_{10}(1) \Psi_{10} + \Psi_{01}(1) \Psi_{01} \]

\[ \Psi_{00}(2) \Psi_{00} + \Psi_{10}(1) \Psi_{10} \]

\[ \Psi_{01}(1) \Psi_{01} \phi_1 \]

\[ \Psi_{00}(1) \Psi_{00} + \Psi_{10}(1) \Psi_{10} \]

\[ \Psi_{01}(1) \Psi_{01} \phi_1 \]

\[ \Psi_{00}(1) \phi_0 \]

\[ \Psi_{01}(1) \phi_1 \]

\[ \Psi_{00}(1) \Psi_{00} + \Psi_{10}(1) \Psi_{10} \]

\[ \Psi_{01}(1) \Psi_{01} \]

\[ \Psi_{00}(1) \Psi_{00} + \Psi_{10}(1) \Psi_{10} \]

\[ \Psi_{01}(1) \Psi_{01} \]

\[ \Psi_{00}(2) \Psi_{00} + \Psi_{10}(2) \Psi_{10} \]

\[ \Psi_{01}(2) \Psi_{01} \]

\[ \Psi_{00}(3) \phi_0 \]

\[ \Psi_{01}(3) \phi_1 \]
As an example of the method by which the $\mathcal{M}(\cdot)$ are constructed, consider $\mathcal{M}(w_0, 2, 0, 1)$. $\mathcal{M}(w_0, 2, 0, 1)$ is comprised of individuals who, starting their working life in class 0, find themselves again in class 0 (hence mobile with probability $\phi_0$) having just joined the firm ($t=0$) without a move prior to that which brought them to their present employment. More precisely, each firm type begins with $\pi_{00}/2$ ($\pi_{00}=1$) workers of age 0 in class 0. After one period $\pi_{00}(1)$ remain in class 0 and $\pi_{01}(1)$ have entered class 1 within that firm type. At the end of the next period, $\pi_{00}(t)$ of the $\pi_{00}(\pi_{01}(1))$ in class 0 ($1$) change firms (creating $\mu=1$ and $t=0$), and in particular, enter class 0 in the other firm type. Of this $\pi_{00}(1)\pi_{00}+\pi_{01}(1)\pi_{10}$, the fraction $\phi_0$ will be mobile at the end of the period. Hence the expression for $\mathcal{M}(w_0, 2, 0, 1)$.

VI.6 Conditional Mobility Profiles

Now that the entities required have been constructed some of the theory's predictions on equilibrium job mobility may be examined. There are more predictions than are presented in this and the following subsections, and some attention is given to "another result" in Section VII. However, the results presented here are the ones which are perhaps of most obvious interest.

In this subsection, two propositions on conditional wage profiles are offered. That is, the questions concern the manner in which $\mathcal{M}(Y)$ and $\mathcal{J}(Y)$ change as one component of $Y$ is varied, holding the others fixed. In the next subsection unconditional mobility profiles are examined; the issue is how $\mathcal{M}(\cdot)$ and $\mathcal{J}(\cdot)$ vary when one component of $Y$ changes and the conditioning on the other components is removed.
Proposition 1: 6

(i) \( M(w_0, m, t, \mu) > M(w_1, m, t, \mu); \)

(ii) \( M(w_0, m, t, \mu) > M(w_{\lambda}, m+1, t, \mu), \lambda = 0, 1; \)

(iii) \( M(w_0, m, t, \mu) > M(w, m, t+1, \mu), \)
\( M(w_1, m, t, \mu) < M(w_1, m, t+1, \mu); \)

(iv) \( M(w_{\lambda}, m, t, \mu) \) is unimodal in \( \mu \), first rising, then falling.

As mentioned in the introduction, formal demonstration of this proposition (and those to follow) simply consists of fairly unenlightening manipulation of the expressions in Tables 2 and 3. But given the structure described above, the explanation of the result is relatively straightforward. Parts (iii) and (iv) are explained somewhat more loosely than are (i) and (ii). This is because precise explanation involves a fairly depraved variety of reductionism.

(i) Wage effects--The wage is a sufficient statistic for the information in the model; it identifies the information class of which any worker presently earning that wage is a member. Those earning \( w_0 (w_1) \) occupy class \( 0(1) \). In comparing \( M(w_0, \cdot) \) to \( M(w_1, \cdot) \) noting (17), two forces are at work. One is the relative number of workers: \( M(w_0, \cdot) \) and \( M(w_1, \cdot) \). The other is the relative likelihood of mobility: \( \varphi_0 \) and \( \varphi_1 \). Since \( \varphi_0 > \varphi_1 \), the only issue is whether \( M(w_0) \) can be sufficiently smaller than \( M(w_1, \cdot) \). While \( M(w_0, \cdot) < M(w_1, \cdot) \) can hold, the difference can be shown to be too small to reverse the result. Holding age, tenure, and past mobility constant, higher wages make for less job mobility.
(ii) Age effects—Holding the wage constant implies all individuals under consideration are equally likely to be mobile. Again referring to (17), the question is simply whether there are more or less workers in the given class as age varies. As information separates workers over time, on average they exit from classes 0 and 1 into more disparate ($k>1$) information classes as they get older. Controlling for wages, tenure, and past mobility, less mobility occurs in older age groups.

(iii) Tenure effects—Here there are two influences. Holding age constant, raising tenure forces the given amount of past mobility to occur within a smaller number of periods. This requires a less likely path of information sets and so tends to reduce the number of workers who have received the requisite information sets. Second, once individuals have entered their present employment, they (on average) steadily exit class 0 with rising tenure if that is the class which they entered, necessarily inducing some entry into class 1 along the way. Thus for workers presently earning $w_0$, hence in class 0, the two effects of raising tenure both operate to reduce the number of workers in class 0. But for workers in class 1, earning $w_1$, the effects conflict. For the range of possible tenures considered herein, the effect of increased tenure on entry to class 1 dominates. This is the only instance in which the short duration of the working lives in the model is of any consequence. For longer tenures, increases in tenure will reduce the number of workers in class 1 as well. A more realistic representation of the prediction is therefore that increased tenure reduces mobility except perhaps at low tenures, with the possibility of greater tenure raising mobility being stronger when wages are higher.
(iv) Past mobility effects—Given age and tenure, variations in past mobility purely reflect different experience prior to entering the firm. Loosely speaking, each occurrence of past mobility can be thought of as a binomial event, like flipping coins (ignoring the obvious lack of intertemporal independence). Viewed this way, that the extreme outcomes occur less frequently is intuitively agreeable. Thus holding wages, age and tenure constant, the relationship between mobility and past mobility of the individuals in the group in question is nonmonotone, first rising, then falling.

**Proposition 2:**

(i) \( \mathfrak{F}(w_0,m,t,\mu) > \mathfrak{F}(w_1,m,t,\mu) \);

(ii) \( \mathfrak{F}(w,m,t,\mu) \) does not depend on \( m, t, \) or \( \mu \).

Given the explanation of Proposition 1, Proposition 2 is easily obtained. Wages identify information class. Everyone in a given information class has the same probability of mobility (\( \phi_0, \phi_1, \) or 0). Part (ii) is immediate. Also, those in class 0 are more likely to exit than those in class 1 (\( \phi_0 > \phi_1 \)), yielding part (i).

VI.7 **Unconditional Mobility Profiles**

Unconditional mobility profiles are obtained as follows. Partition \( Y \) into \( Y^0 \) and \( Y^1 \). Then

\[
\mathfrak{M}(Y^0) = \sum_{y \in Y^1} \mathfrak{M}(Y)
\]

and
\[ \mathfrak{Y}(Y^0) = \sum_{y \in Y^1} \left( \frac{\mathfrak{M}(Y^0, Y^1)}{\sum_{y \in Y^1} \mathfrak{M}(Y^0, Y^1)} \right) \mathfrak{Y}(Y^0, Y^0) \]

Thus for example, \( \mathfrak{Y}(m) \) requires the partition \( Y^0 = \{m\} \) \( Y^1 = \{w_k, t, \mu\} \).

**Proposition 3:**

(i) \( \mathfrak{M}(w_0) > \mathfrak{M}(w_1) \);

(ii) \( \mathfrak{M}(m) > \mathfrak{M}(m+1) \);

(iii) \( \mathfrak{M}(t) > \mathfrak{M}(t+1) \);

(iv) \( \mathfrak{M}(\mu) > \mathfrak{M}(\mu+1) \).

Again, the explanations based on Proposition 1 are useful. Part (i) follows because not only are workers in class 0 more likely to be mobile, they are also more numerous because large portions of the younger age groups occupy class 0. Part (ii) follows similarly.

Part (iii) is very clearcut in comparison to the corresponding portion of Proposition 1. In contrast to the experiment generating the conditional tenure profile, here short tenure is free to proxy youth and hence predominant membership in class 0.

Similarly, in part (iv) most workers who have experienced little mobility are also young.
Proposition 4:

(i) \( \mathcal{F}(w_o) > \mathcal{F}(w_1) \);

(ii) \( \mathcal{F}(m) > \mathcal{F}(m+1) \);

(iii) \( \mathcal{F}(t) > \mathcal{F}(t+1) \);

(iv) \( \mathcal{F}(\mu) < \mathcal{F}(\mu+1) \).

The explanations of parts (i)-(iii) are similar to those of the corresponding parts of Proposition 3. The main difference involves part (iv). Though significant past mobility implies greater age (hence lower aggregate mobility), it also implies greater concentration in or near class 0. That is, continued job switching prevents the worker from entering information classes far from the marginal class (0). This greater concentration yields greater mobility as a proportion of individuals with given past mobility.

VI.8 Summary of Section VI

This section has presented the predictions of the model in terms of the aggregate mobility measure \( \mathcal{M}(\cdot) \) and the proportional measure \( \mathcal{F}(\cdot) \). The basic results are that greater wages reduce mobility under both measures and irrespective of what else is held constant. Greater age or tenure (subject to the proviso about short tenure) has a similar negative effect except when wages are held constant and the measure \( \mathcal{F}(\cdot) \) examined. In this case age and tenure are predicted to have no effect.

The effects of past mobility behavior are less clearcut. Holding wages, tenure, and age constant, the relationship between past and present mobility is non-monotonic in terms of the aggregate measure, but non-existent when \( \mathcal{F}(\cdot) \) is examined. If wages, age and tenure are not controlled for, greater past mobility reduces mobility as measured by \( \mathcal{M}(\cdot) \) but increases it according to \( \mathcal{F}(\cdot) \).
VII. Empirical Considerations

In the last decade, much effort has been devoted to measurement of the determinants of quits/layoffs/separations. However, in terms of the theory presented above, wherein mobility, tenure, wages and past mobility are endogenous, the available results are very difficult to interpret. Evidently they do not constitute experiments which might conceivably be viewed as convincing evidence that the present theory is wrong. However, there is some published data which may be brought to bear on one of the predictions presented in Section V, and a closely related pair stated below. Though only a small set of implications can be examined, this section briefly explores this data.

The first prediction is the (not particularly novel) claim (Proposition 4(b)) that unconditionally, the fraction of workers who are mobile declines in age (which is identical with experience here). As one would expect, this is essentially what is observed. See Table 4.

<table>
<thead>
<tr>
<th>Table 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Job chances as a percent of employed men</td>
</tr>
<tr>
<td>U.S. 1961†</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>percent</td>
</tr>
<tr>
<td>18-19</td>
</tr>
<tr>
<td>23,5</td>
</tr>
</tbody>
</table>

| (b) Percent moving in a two year period* |
| U.S. 1971 |
| Experience |
| percent |
| 0-4 | 5-9 | 25-29 | 20-24 | 35-39 | 40-44 |
| .47 | .38 | .11 | .11 | .12 | .12 |

†Source: BLS "Job Mobility in 1961," Special Labor Force Report No. 35, 1963. From Mincer and Jovanovic (Table 1.1).

*Source: NLS young and older men. From Mincer and Jobanovic (Table 1.2 panel A).
Similar data can be used to consider the mobility profile $\mathcal{F}(m,t)$, where the conditioning on wages and past mobility has been removed. The predictions are as follows:

**Proposition 5:**

1. (a) $m = t \Rightarrow \mathcal{F}(m,t) > \mathcal{F}(m+1,t)$;
   
   (b) $m > t \Rightarrow \mathcal{F}(m,t) < \mathcal{F}(m+1,t)$;

2. $\mathcal{F}(m,t) \geq \mathcal{F}(m,t+1)$.

To understand part (i), recall that for workers having tenure $t$, varying $m$ involves varying the date of entry into the firm. Entry can occur from class 0 to either class 0 or 1, and from class 1 to class 0. Those who enter class 0 are more likely to be mobile later. Parts (a) and (b) follow easily. When $m=t$, all workers enter the firm into class 0 (i.e., at the outset of working life). Thus they are more likely to move than are those who are one period older and who thus enter into both class 0 and class 1 (part (a)). But for still older workers (part (b)), longer working life prior to entry implies on average greater "separation" by the data. That is, those who enter at an older age are more likely to have entered from class 1, and therefore will more probably enter into class 0. The likelihood of exit $t$ periods later is larger.

Part (ii) can be understood in the same way as the previous tenure profiles and needs no further discussion.

How does this square with the available data? The data (Table 5) do not offer any information specifically on very short tenures, so the best which can be hoped for is examination of part (iib) and part (ii).
Percent Moving During 1971-73†

<table>
<thead>
<tr>
<th>Experience (Years)</th>
<th>0-1</th>
<th>1-3</th>
<th>3-5</th>
<th>5-7</th>
<th>7-9</th>
<th>9-11</th>
<th>11-15</th>
<th>15-19</th>
<th>19+</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>.73</td>
<td>.58</td>
<td>.28</td>
<td>.07</td>
<td>.12</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-9</td>
<td>.77</td>
<td>.60</td>
<td>.38</td>
<td>.08</td>
<td>.07</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Young Men NLS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-29</td>
<td>.46</td>
<td>.16</td>
<td>.22</td>
<td>.10</td>
<td>.19</td>
<td>.04</td>
<td>.03</td>
<td>.06</td>
<td>.04</td>
</tr>
<tr>
<td>30-34</td>
<td>.40</td>
<td>.20</td>
<td>.15</td>
<td>.10</td>
<td>.16</td>
<td>.12</td>
<td>.04</td>
<td>.06</td>
<td>.06</td>
</tr>
<tr>
<td>35-39</td>
<td>.51</td>
<td>.19</td>
<td>.19</td>
<td>.11</td>
<td>.08</td>
<td>.08</td>
<td>.06</td>
<td>.04</td>
<td>.04</td>
</tr>
<tr>
<td>40-44</td>
<td>.43</td>
<td>.20</td>
<td>.10</td>
<td>.10</td>
<td>.11</td>
<td>.13</td>
<td>.05</td>
<td>.05</td>
<td>.06</td>
</tr>
<tr>
<td>(b) Older Men NLS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

†Source: Same as panel (b) of Table 4.

For the young men, given tenure, older workers are more mobile in five of the six tenure classes. Turning to the older men, for whom it seems unlikely that person-specific information is much of an issue in any case, of the 27 possible comparisons, 13 yield greater mobility with age given tenure, 2 yield no difference, and 12 yield reduced mobility.

In terms of part (b), the tenure profiles (given age) are almost invariably downward sloping.

While not providing strong support for the theory, the data are hardly inconsistent with Proposition 5. In particular, that part (i) of Proposition 5 is not overthrown and is encouraging evidence.
Footnotes

1 In what follows below the model will be "run forward" one period. Workers of age 4 are therefore ignored.

2 That X is observed twice in each period is merely a simply way to mimic a richer information structure wherein information obtained within one period may be of differing degrees of informativeness. This is not possible with a single realization.

3 From now on, class number will replace Ω.

4 These probabilities involve the joint event of proceeding from i to j without changing firms. In particular they do not represent the probability of proceeding from i to j given no change of firm type.

5 In what follows much of the discussion will involve classes 0 and 1. Class -1 is included by symmetry.

6 In this and all results to follow, the Propositions refer to those values of w, m, t and μ for which both sides of the relevant inequality are positive.

7 Intuitively, movement from class 0 to class 1 involves transversing one information class, but moving from class 1 to class 0 in another firm requires transversing one information class as well as receiving a favorable flip of the coin.
Bibliography

