EFFECTS OF LABOR MARKET STRUCTURE

ON JOB-SHIFT PATTERNS

by

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A recurring theme in the literature on labor market structure is that different labor markets are characterized by different patterns of job mobility. For example, Doeringer and Piore (1971, p. 40) regard stability of employment as "the most salient feature of the internal labor market." Kerr (1954, pp. 95-96) contrasts "structureless" markets that lack "barriers to the mobility of workers" with institutional markets in which entrance, movement and exit are constrained by rules. Spilerman (1977) emphasizes career lines, noting how these may depend not only on personal characteristics but also on the occupation, industry and firm of a person's port of entry.

Not everyone agrees that job-shift patterns reflect differences in labor market structure. Some attribute these differences to various labor market imperfections: search costs (Oi, 1962), specific investments (Becker, 1964), uncertainty (Becker et al., 1977), and so forth. Others (e.g., Heckman and Willis, 1977; Doeringer and Piore, 1971, pp. 175-176) associate differences in job-shift patterns with differences in workers: in nonmarket productivity, in preferences for leisure versus money and prestige, and so forth. Even those who attribute differences in job-shift patterns to labor market structure do not agree on the boundaries of labor markets or on the reasons why occupants of certain kinds of jobs have similar job-shift patterns.

Resolution of these disagreements requires an explanation of the forms of labor market structure and of the consequences of these forms for job-shift patterns. It also requires translation of verbal explanations into testable models, data that allow competing explanations to be tested, and a method for organizing the data so that consequences of competing arguments can confront one another. This paper reports research that attempts to begin resolving these disagreements. It is organized as follows. Section I contains definitions of basic terms. Section II reviews several theories of labor market structure and suggests hypotheses about job shifts congruent with these explanations. Section III describes the models, methods and data used in testing these hypotheses. Section IV reports the results.

I. BASIC TERMS

Labor Market. Consider a system with uncoerced exchanges between three kinds of parties: employees (A), employers (B), and consumers (C). Suppose A performs tasks for B in return for money, B exchanges the products of A's labor with C for money, and A and C do not exchange directly with one another. "Labor market" refers to the first set of exchanges; "product market" refers to the second set of exchanges. According to this definition, the labor market does not include those who consume what they produce (e.g., peasants), those who are not paid for their labor (e.g., slaves, prisoners, volunteers), and those who exchange their labor directly with the consumer (e.g., those who are self-employed).

Labor Market Structure. Variability in usage makes it somewhat difficult to define labor market structure.[1] This variability, more than disagreements about actual empirical relationships, seems to be a major source of arguments about whether the United States has a single labor market, dual markets, or multiple (segmented) markets. An accurate tally is probably unimportant. What matters is the answer to the questions underlying these debates. In particular, is there a single process by which people are allocated to jobs and rewards are distributed among them? Or, are there several different processes? If several, what are they, and how and why do they arise? In this paper "labor market structure" refers to the basic features and patterns of the processes that allocate people to differentially rewarded positions in the labor market.

II. ALTERNATIVE EXPLANATIONS

A fundamental -- but usually implicit -- premise of traditional microeconomic theory of the labor market is that the main conditions surrounding a particular job-person match are flexible. That is, if desired, an employer can readily raise or lower an employee's wage rate, and either the employer or the employee can terminate the match at any time.

In recent years some economists and sociologists (e.g., Thurow, 1975; Sorensen, 1977a; Sorensen and Kalleberg, 1981) have claimed that in many sectors of the U.S. economy, the conditions of employment are inflexible. In particular, they assert that employers cannot readily adjust an employee's wage rate (especially down) and that the right to terminate job-person matches has been relinquished by employers, though not by employees.[2]

For these notions to have general theoretical value, proponents of each view must explain why employment is flexible or inflexible. They must also explain how each type of employment condition accounts for three well-documented empirical generalizations: (1) a positive cross-sectional correlation between job rewards (e.g., occupational prestige, the wage rate) and personal resources (e.g., education, genetic endowments); (2) an increase in job rewards over a person's life cycle; (3) greater employment stability of persons holding jobs with greater rewards.[3]

In this paper I make only passing remarks about the implications of each type of employment for the first and second generalizations, and I attend only briefly to arguments about why employment is flexible or inflexible. Instead, I concentrate on comparing implications of flexible and inflexible employment for job-shift patterns.

1. Flexible Employment

Perfect Competition. Because of its simplicity and theoretical centrality, I begin with the explanation that assumes a single, perfectly competitive market for labor. A number of premises, in addition to flexible employment, underlie this explanation. One is that goods exchanged in the market are homogeneous: people are equally productive, and jobs are equally attractive as long as they pay the same wage. A second is that buyers and sellers have perfect information about the goods and prices offered in the market: no one is uncertain about the outcome of any possible exchange. A third is that the market contains many buyers and sellers: alone no one can determine prices.[4]

When employment is flexible, these postulates imply that there is a single price for labor (i.e., a single wage rate) in a short-run equilibrium. The first empirical generalization mentioned earlier contradicts this, as Adam Smith and other early economists recognized.

Microeconomists commonly alter the first premise to assume that workers vary in productivity (according to their education, strength, and so forth) and that jobs vary in nonpecuniary ways (in prestige, working conditions, and so forth). The modified set of assumptions predicts a postive covariation between job rewards and personal resources in equilibrium; it is usually termed "marginal productivity theory" because it predicts that each laborer's marginal utility (his reward) equals his marginal product (a function of his resources) in equilibrium. But this set of assumptions still cannot explain the second generalization mentioned above: the typical rise in job rewards over a person's life cycle.

Both the first and second generalizations are explained by human capital theory, an extension of marginal productivity theory. Human capital theory postulates that workers invest in their resources (productive capacity) as long as their expected return on these investments exceeds their expected direct and indirect costs. Human capital theory predicts that workers invest heavily in training (some formal and some on-the-job) when they are young and reap the benefits in the form of increased wages as they become older. Furthermore, those who invest heavily in their resources during youth have age-earnings curves that rise more steeply than the curves of those whose investments are smaller.

But what are the implications of marginal productivity theory and human capital theory for job shifts? In equilibrium, job shifts do not occur because no one can improve upon his present situation. Thus, the occurrence of a job shift implies that either the employer or the employee is not in equilibrium. Marginal productivity theory suggests a list of exogenous changes causing disequilibrium, but it does not explain _why_ or _how frequently_ disequilibrating changes occur. Out of ignorance one might hypothesize that these disequilibrating events, and the job shifts generated by them, occur at a random rate α that does not depend on characteristics of jobs or jobholders (see Sorensen and Tuma, 1981).[5]

Imperfect Competition. Various imperfections have been postulated so that human capital theory will predict differential stability that accords with the third empirical generalization mentioned earlier. A good example is the explanation of marital stability offered by Becker, Landes and Michael (1977), hereafter referred to as BLM. Because BLM make only tangential remarks about job stability, I translate their arguments about marital stability into arguments about the stability of job-person matches.

BLM's key assumptions are the absence of perfect information and the costliness of searching, which leads to the name "imperfect competition" for their modification of human capital theory. Employers must use observable indicators of a person's resources to select employees (see also Spence, 1974); similarly, laborers must use observable indicators of a job's rewards to select jobs. Some mismatches occur, even in equilibrium, partly because indicators are not perfectly reliable and partly because search is costly. A shift occurs when a mismatch is discovered and both partners gain from the shift. This conclusion is important because exogenous changes in the social system need not be invoked to explain the existence of mobility.

BLM also consider the determinants of stability. Their argument has several components; I concentrate on those aspects suggesting effects of rewards and resources on job shifts.[6] They reason that stability increases with the expected gains from a match and decreases with unexpected gains (the discrepancy between actual and expected gains), assuming expected and unexpected gains do not have a strong negative correlation.[7] Expected gains rise with increases in traits positively associated in an optimal sorting of all potential exchange partners in the system (Becker, 1974). Since the skill level of a job and a person's education are complementary traits, they are positively associated in an optimal sorting. Therefore, employment stability is hypothesized to increase with personal resources and job rewards, assuming job rewards partly reflect a job's skill level. Another way of stating this hypothesis is that:

> Under imperfect competition, the rate of leaving a job falls as job rewards and personal resources rise.

In sum, imperfect competition predicts the third empirical generalization, as well as the first two.

Although BLM explain differential stability of matches, they have little to say about the level of rewards in successive matches, perhaps because they are discussing marriages. But flexible employment has clear implications for the difference between rewards of the jobs entered and left (hereafter called the <u>change in rewards</u>): it is zero on the average. Rewards rise (decline) if a person's resources rise (decline), but this occurs within a job because employment is flexible. According to this theoretical perspective, job shifts are not necessary to obtain rewards commensurate with one's resources. Shifts occur because mismatches are discovered and can be resolved. On average gains balance losses, as long as each partner is equally likely to benefit from newly acquired information and from unexpected gains.

To be concrete, suppose that the change in rewards is divided into three categories: a gain, a loss, and no change. The above discussion suggests the hypothesis that:

> Under imperfect competition, the rate of a job shift leading to a gain (an upward shift) equals the rate of a job shift leading to a loss (a downward shift).

The rate of a shift with no change in rewards (a lateral shift) may occur at a different rate than upward and downward shifts because of special conditions of a job.[8]

It is also possible to tease out hypotheses about the effects of rewards and resources on rates of upward, downward and lateral shifts. Let D represent the difference between the rewards obtained in a job and those expected on the basis of a person's resources. As argued above, adding the assumption of imperfect information to human-capital theory implies that D has a random (symmetric) distribution with a mean of zero. For positive D, the employee is overrewarded; for negative D, underrewarded. Because of regression towards the mean, shifts are more likely to be downward when D is positive and upward when D is negative. But, other things being equal, D is an increasing function of observable job rewards and a decreasing function of an employee's observable resources. These ideas lead to the following hypotheses:

> Under imperfect competition, the rate of a downward shift increases with job rewards and decreases with personal resources. In contrast, the rate of an upward shift decreases with job rewards and increases with personal resources.

A hint of this argument, similar to one sketched by Tuma (1976), appears in BLM's paper (1977, p. 1145).

Although imperfect competition does predict the third generalization and does generate hypotheses about effects of rewards and resources on the rate of upward and downward shifts, it is important to stress that <u>mobility places no major role in the process by which rewards are differentially distributed among people</u>. In contrast, mobility is central if employment is inflexible, as outlined below.

2. <u>Inflexible Employment</u>

Under conditions of inflexible employment, employers terminate employees only rarely and do not adjust wages to the productivity of jobholders in the short run. Because of this, employers have a strong incentive to hire the "best" people -- those with the most personal resources. Similarly, employees have a strong incentive to accept the "best" jobs -- those with the greatest rewards. Thus, the assumption of inflexible employment also predicts the first empirical generalization: a positive correlation between rewards and resources in a cross-section.

When employment is inflexible, an employee leaves a job only because of access to a better job; hence the gain from a job shift is positive on the average. Rewards rise over the life cycle for people who shift jobs, but not for those who remain in the same job. Thus, the assumption of inflexible employment predicts the second empirical generalization, too. More importantly, <u>when employment is inflexible, job shifts are the fundamental means by which people increase job rewards</u>.

Job Competition. Thurow (1975) assumes that jobs with the highest rewards require the most skills and the longest training period. He argues that people are allocated to jobs with different training requirements on the basis of their personal resources, which serve primarily as indicators of their trainability, and not of their existing productivity. Training occurs mainly on the job, or, as Thurow puts it, jobs are training slots. Implicitly Thurow assumes that employment conditions are inflexible.

Thurow mainly wishes to show that job competition predicts a positive correlation between rewards and resources and a rise in rewards over the life cycle. He gives little attention to its implications for job-shift patterns. Nevertheless, his remarks clearly imply that the change in rewards from shifting jobs, D, is positive on the average. This implies that:

> Under job competition, the rate of an upward shift is much larger than the rate of a downward shift.

Given Thurow's lack of interest in job shifts, it is not surprising that the implications of his arguments for the effects of rewards and resources on rates of job shifts are ambiguous. According to one possible interpretation, personal resources both increase with work experience and depend on the kinds of jobs held in the past. This suggests that the increase in resources from on-the-job training rises with the skill level of the job, as indicated by its rewards. Therefore, as a person's resources and training increase, a shift to a job with more rewards (i.e., one providing more training) becomes more likely. This interpretation leads to the hypothesis that:

> Under job competition, the rate of an upward shift increases with resources at the start of the job, such as education and length of work experience, and with job rewards, which indicate the level of skills that can be acquired in on-the-job training.

Note that according to this hypothesis, the effects of rewards on the rate of an upward shift are exactly opposite those predicted by imperfect competition. The "rich" (those in highly rewarded jobs) are those most likely to become "richer" (promoted to more highly rewarded jobs).

Vacancy Competition. As mentioned above, it is not completely clear from Thurow's remarks whether he claims that acquired resources (as indicated by job rewards and work experience) influence employers' selection of persons to fill jobs. Sorensen (1977a) assumes explicitly that they do not, i.e., that resources are fixed over a person's career. He contends that people compete for vacancies in jobs with the highest rewards, a process that he calls "vacancy competition."

In Sorensen's model people entering the labor market are distributed randomly among jobs according to their level of resources. He assumes that rewards of the first job are positively correlated with a person's resources, but lower than expected.[9] Over time opportunities to change jobs occur. Since employment is inflexible, workers wait for an opportunity to move to a better job. This means that:

> Under vacancy competition, the rate of a downward shift is virtually zero.

How rapidly individuals move to better jobs depends on the rate at which vacancies in better jobs occur, which in turn depends on the rewards of their current jobs, their fixed resources, and the overall rate at which vacancies in the system are generated. Sorensen shows that his assumptions imply that as work experience increases,[10] job rewards rise on average and the rate of mobility falls. The decline in the rate of mobility with increasing work experience reflects a decreasing gap between actual and expected rewards, and <u>not</u> an increase in personal resources, as posited by human capital theory. In short, it is a spurious effect. This implication can be summarized as follows:

> Under vacancy competition, work experience has no effect on the rate of a job shift when fixed resources and current job rewards are controlled.

In contrast, personal resources and current job rewards have genuine (nonspurious) influences on the rate of shifts to better jobs:

> Under vacancy competition, the rate of an upward shift rises with fixed resources and declines with current job rewards.

Note that the pattern of effects of rewards and resources on the rate of an upward shift is the same under vacancy competition as under imperfect competition, except for the effect of work experience. The two theories differ primarily in their implications for the rate of a downward shift. According to imperfect competition, this rate equals (at least roughly) the rate of an upward shift; according to vacancy competition, it is negligible.

The assumptions of job and vacancy competition have only indirect implications for the rate of leaving a job. Since both arguments imply that the rate of a downward shift is much smaller than the rate of an upward shift, both imply that the rate of leaving a job is primarily determined by the rate of an upward shift. This suggests the hypothesis that:

> Under job and vacancy competition, effects of rewards, resources and experience on the rate of leaving a job are the same as their effects on the rate of an upward shift.

3. <u>When is Employment Flexible/Inflexible</u>?

Most proponents of marginal productivity theory (and extensions of it, such as human capital theory) assume that this theory applies equally well to all people and all jobs in the United States. On the other hand, the literature on dual and segmented labor markets claims that the process of labor allocation and reward distribution varies within the United States. A full explanation of why one set of assumptions applies to some jobs but not others is beyond the scope of this paper. It could also not be tested with the available data (described in Section III), which provide fairly extensive information on attributes of persons but only rudimentary information on their jobs. Consequently, I concentrate on those situations identifiable with available data for which one set of assumptions rather than the other seems likely to apply.

I contend that conditions of employment tend to be flexible in small firms and inflexible in large firms, and consequently that patterns of job shifts in small firms resemble those predicted by imperfect competition, while patterns of job shifts in large firms resemble those predicted by job or vacancy competition.

The reasons given by Thurow (1975) and by Sorensen and Kalleberg (1981) for the development of inflexible employment suggest that it occurs primarily in large firms with a complex division of labor. In such firms, production often depends on the smooth and synchronous meshing of many people's skills, personalities and actions. These interdependencies make it costly to supervise and difficult to evaluate any one person's contribution to the firm's product. They also increase the chance that successful work performance requires knowledge specific to the work setting.

When supervision and evaluation of an individual's work are difficult, employers often find it useful to develop job ladders -- jobs with increasing rewards linked by a promotion schedule -- to motivate workers to perform at their capacity. When a firm has job ladders, adjusting one person's wages within a job because of exceptional performance (assuming exceptional performance can be identified) undermines the system of incentives provided by these job ladders. In contrast, promoting a high performer not only rewards the person but also helps to institutionalize and legitimate a system of incentives founded on job ladders. In this fashion wages become linked to jobs rather than to individual productivity.

Wage rigidity is only one aspect of employment inflexibility. The other is control over the termination of a job. Thurow (1975, pp. 81-84) argues that employers relinquish control over the termination of employment so that coworkers will assent to training and sharing specific knowledge with one another. Firm-specific knowledge seems likely to increase with a firm's size, other things being equal. In addition, medium and large firms are much more likely than small ones to be the target of unionization, which has traditionally limited the employer's ability to terminate any particular job-person match, except during a brief probationary period or for carefully circumscribed causes.[11]

An employer's ability to retain control over the conditions of employment for a single job-person match seems much greater in small firms than in large ones. First, with few employees to train and supervise, an owner/manager may not need to delegate these tasks to an employee's coworkers. Furthermore, both successes and mistakes may be more visible and more easily tagged to one person in a small firm than in a large one.[12] In addition, a small firm may simply not have enough jobs to create job ladders to motivate employees' performances, even if the employer should want to use this system of incentives. Consequently, an employer in a small firm seems more likely to rely on immediate rewards like raises and bonuses. Finally, in a small firm very few people are likely to have similar job titles, in which case one person's wages may be adjusted to match productivity without other employees feeling that their opportunities or worth have been downgraded.

Unfortunately, the available data lack information on firm size. They do record, however, whether a job shift involves a change of employer. Because a small firm has few jobs that can become vacant, most intrafirm shifts are likely to occur in large firms and not in small ones. Shifts originating in small firms are likely to be shifts to another firm. Of course, some interfirm shifts originate in large firms; nevertheless, firm size and type of shift are probably associated.[13] This supplementary assumption leads to the hypothesis that:

Patterns of intrafirm job shifts resemble those predicted by job or vacancy competition, while patterns of interfirm shifts resemble those predicted by imperfect competition.

4. Other Issues

Reflection on labor allocation by employers hiring from within and without the firm suggests several subsidiary hypotheses worth examining. When a firm hires an outsider, it must rely heavily on a few easily observed indicators of trainability and productivity, in particular, level and kind of schooling. Such indicators may be screening devices (Spence, 1974), but poor ones. When a firm promotes an insider, it can not only use easily observed indicators but also assess the person's performance in a similar (though perhaps less skilled) job.[14] In an analogous fashion, a person evaluating job opportunities must rely on easily observed indicators of jobs rewards, such as prestige and the wage rate, more when jobs are in different firms than when they are in the same firm as his current job. This reasoning suggests the following hypotheses:

(1) The effects of easily observed indicators of job rewards and personal resources on the rate of an upward shift are smaller for intrafirm shifts than for interfirm shifts.

(2) The effect of ability (a less easily measured characteristic) on the rate of an upward shift is larger for intrafirm shifts than for interfirm shifts.

(3) Easily observed characteristics of persons and jobs (e.g., education, the wage rate, and so forth) explain variation in the rate of upward shifts out of a firm better than variation in the rate within a firm.

Parental advantages are often regarded as additional personal resources. As is well known (see, for example, Blau and Duncan, 1967), parental advantages are important determinants of an individual's educational level and measured mental ability as an adult. Net of their effect on such indicators of labor productivity as schooling and mental ability, however, parental advantages seem to increase an individual's opportunities in the labor market mainly through their impact on information about "good" jobs (Granovetter, 1974). Since such information is not usually relevant for intrafirm job shifts, this suggests the following hypothesis:

> When rewards and other personal resources are controlled, parental advantages increase the rate of upward interfirm job shifts, decrease the rate of downward interfirm jobs shifts, and have no effect on the rate of intrafirm job shifts.

III. RESEARCH METHODS

1. Data

The hypotheses in Section II are tested using life histories collected by James S. Coleman and Peter H. Rossi to study the educational, familial, residential and work experiences of U.S. men (see Blum et al., 1969). The universe is the total population of 30-39 year-old males residing in the United States in 1968. There were two samples: a national probability sample and a supplementary sample of blacks. Interviews were conducted in January of 1969 and completed for a total of 1589 men (822 whites, 738 blacks, and 29 others). The rate of interview completion was 76.1% for the national sample and 78.2% for the supplementary sample. Results reported below are based on analyses of the data on white men only.

Because the arguments discussed earlier pertain to shifts from jobs in which a person works as an uncoerced wage-laborer, I excluded data on periods of self-employment and military service.[15] I also eliminated data on jobs in agriculture because the wage rate and prestige of agricultural and nonagricultural jobs are probably incommensurate. Thus, I analyzed only data on shifts from full-time jobs in the civilian nonagricultural labor force (CNALF). I did not include jobs entered prior to school completion because such jobs may be left for reasons quite unrelated to the issues considered in this paper.

Data problems necessitated exclusion of data on some of respondents' full-time jobs in the CNALF. I dropped data when information was missing on variables (see Table 1) needed to estimate the models considered in this paper. In addition, I omitted 192 jobs "nested" within another job, that is, ones that begin after, but end before, some other job. Using these selection criteria, I retained for analysis data on 3,484 jobs of 713 white men.

[Table 1 about here]

The basic explanatory variables discussed in Section II are job rewards and personal resources. Table 1 gives definitions and simple descriptive statistics for the measures of rewards and resources used in the analyses.

One measure of job rewards is the wage rate (in dollars per hour). This is, of course, the indicator preferred by economists. Another aspect of a job's rewards is its occupational prestige, which is measured here by Siegel's (1970) score. Prestige reflects many nonpecuniary values associated with an occupation, as well as its monetary value (Goldthorpe and Hope, 1972). Not surprisingly, the wage rate and prestige of respondents' jobs are moderately correlated (.395).

The primary measures of personal resources are education (years of completed schooling), a score on a 10-item test of verbal ability, and father's education (years of completed schooling). The correlation between (own) education and verbal ability is .634. The correlation between father's education and these other measures of personal resources are considerably smaller, though still substantial. Father's education and the respondent's education are correlated .388, while father's education and the respondent's verbal ability are correlated .324.

Time (in years) since school completion is also included in Table 1 and in some unreported analyses. Economists often call this variable "labor force experience" under the assumption that it measures general skills acquired through working (see, for example, Mincer, 1974). But this variable measures acquired work experience imperfectly because it includes time out of work since school completion. Time in jobs (since school completion), which seems to be a better measure of a person's acquired resources than total time since school completion (or total time since labor force entry), is also included in Table 1 and in some of the analyses I performed. Below I report results solely for this measure of experience; however, findings are quite comparable when (total) time since school completion is used instead.

One unresolved complication arises because age and time in jobs have a very high positive correlation (.822).[16] Still another arises because the sample design forces a high positive correlation between the historical period and time in jobs (.713).[17] Because of this high collinearity, age and historical period are not included in the analyses reported below. As a result, the effect of time in jobs on job-shift rates undoubtedly reflects the effects of age and historical period in part, and therefore must be interpreted with caution.

As indicated in the discussion of estimation below, the main "dependent" variables are the time of job exit and the kind of job shift that occurs. The time of job exit is not known for jobs held by respondents at the interview (16.7% of all job-person matches analyzed), but the method of estimation still allows information on these matches to be used in the analysis; see Section 3 below.

Some hypotheses mentioned in Section II pertain to the kind of job shift that occurs, in particular, whether the rewards in the job entered are greater, the same, or less than the rewards in the job left. Table 1 also defines the variable used to describe the change in rewards. Note that changes in both occupational prestige and the wage rate are distinguished, and that the "same" reward is treated as a change less than 5%. Reporting error makes it difficult to be confident that a very small change is really a gain or a loss. The choice of 5% is arbitrary; naturally results would be somewhat different for another choice.[18]

As I mentioned earlier, the data lack information on firm size, but do indicate whether a job shift involves a change of employers. In some empirical analyses, I distinguish between intra- and interfirm shifts, assuming that the former originate in large firms and that most of the latter originate in small firms. It should be kept in mind, however, that some interfirm shifts originate in large firms, which weakens testing of the hypotheses. This means that a comparison of patterns of intra- and interfirm shifts provides a conservative test of the hypotheses discussed in Section II.

2. Modeling Job-Shift Patterns

As mentioned in the introduction, Doeringer and Piore (1971) focus on "stability of employment." Kerr (1954) is concerned with "barriers to mobility." Spilerman (1977) emphasizes "career lines" -- the relative frequency of holding different kinds of jobs in a certain order. All of these are important aspects of job-shift patterns, and models of job shifts should have implications for each aspect.

Continuous-time stochastic models of change in categorical variables have implications for all of the above aspects of job-shift patterns. Such models can be defined in terms of assumptions about three random variables relevant to job-shift patterns:[19] $N(t)$, the number of jobs ever held at time t; Y_n, a categorical variable denoting characteristics of the nth job; and T_n, the time of entering the nth job.

One relevant concept is the survivor function for the (n-1)th job, $j = y_{n-1}$, which gives the probability that a person still "survives" in this job at some time t:

$$G_j(t|t_{n-1}) = Pr[T_n > t|T_{n-1} = t_{n-1}, Y_{n-1} = y_{n-1} = j] \qquad (1)$$

for any positive n, where t_0 and y_0 are the starting time and state of the process, respectively. The survivor function equals 1 when $t = t_{n-1}$ and tends to fall towards zero as $t - t_{n-1}$ increases. It is zero for $t < t_{n-1}$.

The above definition of a survivor function implicitly assumes that the time of leaving the (n-1)th job depends only on attributes of this job, y_{n-1}, and the time it was entered, t_{n-1}. This assumption, which is a form of Markov assumption, is not intrinsically necessary. However, it simplifies analyses and serves as a useful baseline.

The exit rate, the instantaneous rate of leaving the (n-1)th job, which has characteristics $j = y_{n-1}$, is defined as:

$$h_j(t|t_{n-1}) = \lim_{\Delta t \downarrow 0} \frac{G_j(t|t_{n-1}) - G_j(t+\Delta t|t_{n-1})}{G_j(t|t_{n-1})\,\Delta t} \tag{2}$$

The numerator in (2) cannot be negative because $G_j(t|t_{n-1})$ cannot increase as t increases. Both terms of the denominator are also nonnegative; consequently, an exit rate must be nonnegative. In theory it can take any positive value, but I assume that it is always finite. A large exit rate in a job j means that people leave this kind of job rapidly.

The conditional probability of moving from job $j = y_{n-1}$ to job $k = y_n$ at time t, given $T_{n-1} = t_{n-1}$ and $T_n = t$ is denoted by $m_{jk}(t|t_{n-1})$ and is defined as:

$$m_{jk}(t|t_{n-1}) = \Pr[Y_n = k|T_n = t,\ T_{n-1} = t_{n-1},\ Y_{n-1} = j] \tag{3}$$

One can put the exit rate and the conditional transition probability together to define the rate of shifting from one job j to another k:

$$r_{jk}(t|t_{n-1}) = h_j(t|t_{n-1})\, m_{jk}(t|t_{n-1}) \tag{4}$$

These mathematical concepts parallel substantive notions mentioned earlier. "Stability of employment" in a job of type j implies that the exit rate, $h_j(t|t_{n-1})$, is small. "Barriers to mobility" between two kinds of jobs j and k connotes that $m_{jk}(t|t_{n-1})$ is very low, which implies that the rate of a shift from j to k, $r_{jk}(t|t_{n-1})$, is comparatively small. "Career lines" can also be described in terms of transition rates; however, describing them may require that these rates depend on characteristics of previous jobs. This substantive issue calls for attention to the definition of the categories that Y_n can take (its so-called state space), but the modeling strategy remains the same. Finally, the rate of upward (downward) mobility refers to the rate of moving from a job with some level of rewards to another whose rewards are higher (lower), i.e., $r_{jk}(t|t_{n-1})$, where the rewards of a job in category k are higher (lower) than those of a job in category j.

3. Forms of Models Estimated

The arguments in Section II suggest that the rate of shifting from a job of type j to a job of type k for some individual i may depend on attributes of i (at the start of the job), j and k, but does not depend on time:[20]

$$r_{ijk}(t|t_{n-1}) = r_{ijk} \tag{5}$$

The various explanations considered in Section II generate different hypotheses about the direction of effects of variables on job-shift rates, but not the specific form of the relationship. I consider two forms. In Form A (discussed at some length in Tuma et al., 1979), I assume that job-shift rates are log-linear functions of observed i, j and k. In Form B, I assume that a job-shift rate is the product of two terms, one identical to that in Form A, and the other a gamma-distributed random disturbance, ϵ_{ijk}, whose mean is 1 and whose variance is σ_{ijk}^2.[21] Each form has four versions, which express the various hypotheses discussed in Section II. Table 2 lists the four versions of each form and gives each one a "model number" that provides a short-hand designation for the particular assumptions specified in Table 2. Below I comment briefly on each form.

[Table 2 about here]

Form A. Models with Form A imply that the completed duration in a job has an exponential distribution and that the mean completed duration in a job is the inverse of the rate of leaving the job. They also imply that the distribution of the number of job shifts in a given time interval has a compound Poisson distribution; however, in general its exact form cannot be written explicitly without knowing the joint distribution of the explanatory variables. Model IVA, which distinguishes among the kinds of jobs entered, implies that the conditional probability of a transition from one kind of job to another has a logit distribution (i.e., is a log-linear function of the explanatory variables). Thus, it allows the probabilities of various job sequences to be calculated.

Form B. Most previously-proposed models of transition rates have depended either on observable characteristics of persons and jobs (see, for example, Coleman, 1964; Spilerman, 1972a; Tuma, 1976) or on unobservable characteristics (see, for example, Silcock, 1954; Blumen et al., 1955; Spilerman, 1972b). Models with Form B combine these features.[22] Such models let one examine the effects of observed characteristics on transition rates without making the unrealistic assumption that one has specified _all_ determinants of each rate. Furthermore, the proportional reduction in the variance, σ^2_{ijk}, that results from adding explanatory variables to a model provides an indicator of the fit of a model to the data. (If the fit is perfect, σ^2_{ijk} is zero.)

The assumption that the random disturbance is gamma-distributed follows the suggestions of Silcock (1954) and Spilerman (1972b), neither of whom included observable variables in their models.[23] A gamma distribution has the advantage that it can range over all positive values (as can transition rates) and can assume a variety of shapes, from highly skewed to nearly normal. One can derive implications for the same kinds of quantities that I discussed above for Form A, but the results are more complicated. Selected implications are derived in the appendix.

One well known implication of allowing unobservable heterogeneity in transition rates is that every transition rate declines with duration (the length of time since the last shift), even in a population with identical observable characteristics (see, for example, McFarland, 1970). A less well known implication is that the population-level odds of entering one state (e.g., kind of job) rather than another depend on duration.

One would like to distinguish the effects of unobserved heterogeneity in a population from the true duration-dependence of transition rates. In principle, unobserved heterogeneity can be distinguished from genuine duration-dependence _if_ one has a priori knowledge of the functional form of either the duration dependence or the unobserved heterogeneity. For example, unobserved characteristics of persons or jobs that have the same effect on every transition rate can be detected by allowing the random disturbances (the ϵ_{ijk}'s) to covary for the successive jobs of person i and for successive occupants of job j. This strategy, which has been used very successfully in linear variance-components models, is difficult to implement in the case of models of transition rates and has not been attempted in this paper. Consequently, interpreting estimates of σ_{ijk} for various models is ambiguous: it may reflect unobserved heterogeneity, as assumed in Form B, or it may reflect time-dependence in each individual's transition rates. The discussion and presentation of results in Section IV largely ignores this ambiguity, but readers should keep it in mind.

4. Estimation

Coefficients of variables are estimated by the method of maximum likelihood, which gives asymptotically unbiased, minimum-variance estimators under very weak regularity conditions on a probability distribution function (Dhrymes, 1970). The general form of the likelihood when event-history data are available for an independent random sample of I individuals is (see Tuma et al., 1979):

$$\mathcal{L} = \prod_{i=1}^{I} \prod_{n=1}^{\infty} \prod_{j=1}^{\Psi} G_j(u_{in}|t_{i,n-1}, x_{ijk}) \qquad (6)$$

$$\prod_{k=1}^{\Psi} r_{ijk}(u_{in}|t_{i,n-1}, x_{ijk})^{w_{in}v_{i,n-1,j}v_{ink}}$$

where i denotes an individual; n the number of an event; $j = y_{i,n-1}$ the kind of job individual i entered at the (n-1)th event; Ψ the total number of kinds of jobs distinguished; $t_{i,n-1}$ the time individual i enters the nth job; u_{in} the observed duration in the nth job; x_{ijk} a vector of observed explanatory variables describing i, j and k; w_{in} a dummy variable that equals 1 if individual i's nth event is observed; v_{ink} a dummy variable that equals 1 if individual i's nth event consists of a shift to k. The forms of $r_{ijk}(\cdot)$ and of the survivor function, $G_j(\cdot)$, are determined by the model assumed to describe the process of shifting jobs.

The variables x_{ijk}, w_{in}, v_{ink}, and t_{in} are obtained from the data as described in Table 1. x_{ijk} stands for the various indicators of rewards and resources of individual i in a job of type j. The variable w_{in} is labelled "Job Left" in Table 1, while v_{ink} comes from the variable labelled "Change in Rewards." The variables "Date Job Entered" and "Last Date in Job" give the information on, respectively, $t_{i,n-1}$ and t_{in} for person i's nth job. The observed duration in the nth job, u_{in}, is calculated as the difference between "Last Date in Job" and "Date Job Entered". The likelihood equation in (6), which is general, allows transition rates and survivor functions to depend on n. Table 1 does not mention n, the number of the event (i.e., the number of jobs held) because the explanations discussed in Section II assume n is irrelevant to the job-shifting process.

Maximum likelihood (ML) estimation has several advantages. In particular, it lets one use censored observations on respondents' jobs, i.e., their jobs at the time of the interview, which have not yet ended. Deleting observations on such jobs can bias estimates of transition rates seriously (Sorensen, 1977b; Tuma and Hannan, 1978) because the average completed length is longer for censored jobs than for jobs with an observed termination date (Feller, 1968). By including a probabilitistic statement for censored observations, ML estimation usually provides estimators with desirable properties, even when samples are only medium in size and the proportion of censored observations is high. In the analyses reported below, the number of job-person matches is large (3484) and the proportion of censored matches is small (0.167). Consequently, censoring probably makes a negligible contribution to bias in findings reported below.

ML estimation also has advantages in terms of the kinds of hypotheses tests that it allows. First, one can test the relative fit of nested models. Suppose we have a model Ω_1, such as one of those in Table 2, and constrain q parameters in it to take certain values (perhaps that some members of the vector α_{jk} are zero or that α_{jk} does not depend on j or k). Call the constrained model Ω_0 (the null hypothesis). The likelihood ratio, λ, is defined as $\max(\mathcal{L}_1)/\max(\mathcal{L}_0)$ and has the property that $-2 \log_e \lambda$ is asymptotically distributed as χ^2 with q degrees of freedom under the null hypothesis. The hypothesis expressed by the constrained model, Ω_0, is rejected if the observed value of $-2 \log_e \lambda$ exceeds the critical value of χ^2 with q degrees of freedom for the selected significance level.

One can also test whether a single variable affects a transition rate. The inverse of the Fisher information matrix -- the matrix of second partial derivatives of $\log_e \mathcal{L}$ with respect to the parameters in a model -- provides an estimate of the variance-covariance matrix of parameters. A parameter's standard error is estimated by the square root of a parameter's estimated variance. Since ML estimators are asymptotically normal, one can then perform either F- or t-tests for a significant difference between estimated and hypothesized values of a parameter.

An iterative procedure must be used to find the values of parameters that maximize $\mathcal{L}$ in equation (6) for all models in Table 2 except IA and IIIA. ML estimates can be written explicitly for these. For Model IA,

$$\alpha = \text{(Mean of JOB LEFT)/(Mean Observed Duration in a Job)}, \tag{7}$$

and for Model IIIA,

$$\alpha_{jk} = \frac{\text{(Fraction of Moves from a Job of Type j to a Job of Type k)}}{\text{(Mean Observed Duration in a Job of Type j)}}. \tag{8}$$

Suppose that job shifts are patternless, implying that α_{jk} does not depend on j or k, i.e.,

$$\alpha_{jk} = \alpha/\Psi . \tag{9}$$

It is important to note that the maximum of $\mathcal{L}$ depends on Ψ even if (9) is true and the type of job entered is totally due to "luck". The maximum of $\mathcal{L}$ for Model IA equals the maximum of $\mathcal{L}$ for Model IIIA multiplied by Ψ. A likelihood ratio test of Model IIIA against IA must allow for this fact.

IV. RESULTS

In spite of ample previous evidence that employment stability depends on characteristics of jobs and persons (see footnote 3), it is useful to begin by demonstrating this. This procedure lets one begin with a simple model and introduce complexity gradually.

Table 3 reports estimates for several models of the rate of leaving a job, hereafter called the exit rate. The models referenced in Table 3 are alike in ignoring the outcome of a job shift, but differ in other respects.

[Table 3 about here]

Model IA assumes that the exit rate is a constant, α, which applies to all jobs shifts. (Recall that this model is suggested by human capital theory under the assumptions of perfect information, costless search, and random exogenous disequilibrating events.) From (7) the ML estimate of α is .385 per year. Under the assumption that the exit rate is a constant, the average completed duration in a job is the inverse of the exit rate, or 2.60 years.

Model IB assumes that the exit rate has a gamma distribution within the population from which the sample was drawn but is a constant for any given job-person match. This is exactly the model proposed by Silcock (1954). Table 3 says that the estimated average exit rate is .595 per year, and that the estimated variance in the exit rate is .570. Silcock's formula (1954, p. 435) implies that the average completed duration in a job is $[.595 - .595(.570)]^{-1} = 3.41$ years. Thus, the average duration in a job is higher in Model IB than in IA, even though the mean exit rate is higher in Model IB than in IA. This occurs because Model IB predicts that some job-person matches are extremely stable. These very stable matches raise the average completed duration more than enough to compensate for the increase in the average exit rate.

Model IA can be viewed as having the same form as Model IB except that a constraint has been imposed, namely, that the variance in the exit rate is identically zero. Thus, a likelihood ratio test comparing Models IA and IB indicates whether the exit rate varies significantly within the population sampled. The value of χ^2 for this test, which has one degree of freedom, is 386.2, implying that Model IA can be rejected at any reasonable level of significance. (The probability that x^2 with one degree of freedom exceeds 10.8 is .001.)

The heterogeneity in exit rates that leads Model IA to be rejected may arise from effects of attributes of jobs or persons. Model IIA permits the exit rate to depend on personal resources, job rewards and time in jobs. The likelihood ratio test of Model IIA versus Model IA is significant at the .001 level, and most variables included in Model IIA affect the exit rate significantly (.05 level).

Model IIB has the same form as Model IIA but does not constrain the variance in the exit rate to be zero, as IIA does. The likelihood ratio test of Model IIB versus any other model referenced in Table 3 (each of which is nested within IIB) is statistically significant at the .001 level. But in spite of these impressively small significance levels, the addition of the six variables has reduced the variance in the exit rate by only 7.1 percent. Thus, the improvement in fit obtained by allowing the exit rate to depend on rewards, resources and time in jobs is modest by customary standards. Not surprisingly, the overall pattern of effects of the explanatory variables is extremely similar to that found for Model IIA.

The estimates for both Models IIA and IIB indicate that the exit rate is smaller for jobs with greater prestige and higher wages. This finding agrees with the implications of imperfect and vacancy competition, but not job competition. Assuming time in jobs measures acquired resources (recall its correlation with age and historical period, however), its effect implies that the exit rate falls as resources rise. This result supports the hypothesis predicted by imperfect competition, but not those predicted by job and vacancy competition. In contrast, the effects of fixed resources -- father's education and ability -- have the opposite sign: the exit rate increases significantly as these resources increase. These findings fit the predictions of job and vacancy competition, but not imperfect competition. In sum, the pattern of effects of rewards, fixed resources, and time in jobs on the exit rate does not entirely support any of the three arguments outlined in Section II.

These mixed results are not surprising if, as I argued in Section II.3, employment is flexible in some jobs and inflexible in others. A better test of these arguments is obtained by distinguishing between jobs governed by flexible and inflexible employment. Recall that I argued that in the United States, intrafirm job shifts are mainly shifts from jobs governed by inflexible employment, while interfirm shifts are a mixture of shifts from jobs governed by flexible and inflexible employment. I also pointed out the importance of considering whether the change in rewards accompanying a job shift is positive, negative, or zero; these distinctions are helpful in testing the theories of imperfect, job and vacancy competition.

For these reasons, the rest of the analysis concentrates on interfirm and intrafirm job shifts. In these analyses I ignore the roughly 9-10% of shifts from a job within the CNALF to a job outside the CNALF (e.g., to military service or to agricultural jobs) because the prestige and wages of jobs outside the CNALF are measured very poorly. I also focus only on shifts to jobs entered within six months after exit from the previous job.[24] Of all shifts from a job within the CNALF to another job in the CNALF, 3.2% did not occur within this time interval.

To study effects of labor-market structure on job shifts with different reward changes, one must first select a measure of the change in rewards. Simplicity makes it appealing to focus on changes in _either_ prestige _or_ wages. Given the moderately high correlation between a job's wage rate and its prestige in these data (.395), this strategy might sound satisfactory because it suggests that prestige and wage changes are _also_ moderately correlated. But this is not the case. Based on an absolute scale, changes in prestige and the wage rate are correlated .087; based on a percentage scale, they are correlated .035.

Table 4 reports the joint relative frequency distribution of prestige and wage changes, where a "gain" means that the job entered has a prestige (wage) more than 5% higher than the job left and a "loss" means that the job entered has a prestige (wage) more than 5% lower than the job left. ("Same" is a residual category.)

[Table 4 about here]

Look first at the rows and columns labelled "Out." Each entry with this heading gives the fraction of shifts within the CNALF but _out_ of the firm that are of the type indicated. For example, of the shifts to another firm within the CNALF, 18.7% led to both prestige and wage gains, while only 12.2% led to both prestige and wage losses. Table 4 also gives the joint distribution of reward changes for shifts with_in_ a firm, which have the heading "In." If each type of change in rewards were equally likely, every entry would be 1/9 = .111. One would not expect this value, given the marginal distributions for prestige and wage changes, which favor a gain, especially in the wage rate.[25]

In terms of testing my arguments, the more important issue is the degree of similarity between the distribution of changes in rewards for shifts within and out of a firm. The hypothesis that the distribution of changes in rewards is the same for interfirm and intrafirm shifts can be rejected at the .01 level (χ^2 with 9 degrees of freedom = 265.6).[26] This hypothesis can also be rejected at the same level even when lateral job shifts are excluded and when only job shifts involving gains and losses are included. Thus, it seems clear that the pattern of gains and losses in job rewards differs for interfirm and intrafirm job shifts.

How these patterns differ is of considerable interest for the issues discussed in Section II. The fraction of certain shifts is very similar both within and out of a firm: shifts with both a prestige and a wage gain, and shifts with the same wage and either a presige gain or loss. But there are also some very marked differences. There is a much smaller proportion of shifts within than out of a firm that involve a wage loss, a prestige loss, both a wage and prestige loss, or a gain in one and a loss in the other. On the other hand, there is a much larger proportion of shifts within than out of a firm that involve no change in either prestige or the wage, and that involve a wage gain but no change in prestige.

The nature of the differences found in Table 4 is consistent with the hypothesis that the conditions of employment within large firms are more inflexible than those in small firms. (As discussed earlier, this assumes that shifts within small firms are a very small proportion of intrafirm shifts.) The joint distribution of prestige and wage changes is much more nearly balanced for interfirm shifts than for intrafirm shifts.

Nevertheless, the fraction of gains outweighs the fraction of losses even for shifts out of a firm. One would not expect this imbalance if employment conditions were flexible. This finding may arise because some interfirm shifts are from jobs in large firms, in which employment is inflexible.

Even though the distributions of reward changes for intra- and interfirm shifts are strikingly different, the effects of rewards and resources on the rate of a job shift could be the same. To examine this issue, I estimated Models IVA and IVB for the rate of a job shift for all 18 types of shifts. Space limitations prevent me from reporting these results in their entirety.[27] I focus on two main types of reward changes for shifts within and out of a firm: those with a gain in both prestige and the wage rate (upward shifts), and those with a loss in both (downward shifts). I also make occasional remarks about those with no change in both (lateral shifts). Results for Model IVB for the four main types of shifts are given in Tables 5 and 6.

[Table 5 about here]

Consider the results for shifts out of a firm. First, the percentage reduction in the variance in the rate that results from including the six observed explanatory variables is quite high for upward interfirm shifts (69%), much smaller for downward interfirm shifts (22%), and still smaller for lateral interfirm shifts (5%). The substantial reduction in the variance for upward interfirm shifts suggests that, to a considerable extent, workers leaving a firm for a better job judge their new job and are judged by their new employers in terms of these observed variables. These variables may explain upward interfirm shifts better than downward interfirm shifts because many downward shifts results from lay-offs due to exogenous changes in demand for the product of the firm left, rather than from firings due to the characteristics of a particular job-person match. Lateral interfirm shifts may occur for various reasons quite unrelated to rewards and resources, so I did not expect the rate of such shifts to depend much on these six variables.

Turn next to the pattern of effects of the six variables on the rate of an upward interfirm shift. As predicted by imperfect competition, this rate rises with personal resources and falls with current job rewards. All effects are significant at the .05 level. Now look at the rate of a downward interfirm shift. As predicted by imperfect competition, this rate tends to decline with resources and rise with rewards.

Thus far we have seen that the results for upward and downward shifts out of a firm agree well with the hypotheses predicted by imperfect competition. This fits my claim that interfirm shifts originate in jobs governed by flexible employment, as well as in some governed by inflexible employment. In contrast, I argued that virtually all intrafirm shifts originate in jobs governed by inflexible employment. The main implication of my argument is that the rate of downward intrafirm shifts is very small. This hypothesis is strongly supported by the results in Table 4, which show that less than 2% of all intrafirm shifts lead to losses in both prestige and wages. In fact, the number of downward intrafirm shifts is so small (12) that the eight parameters of Model IVB cannot be estimated from these data. The rarity of downward intrafirm shifts is clear evidence that intrafirm job shifts are almost always from jobs governed by inflexible employment.

Now consider the effects of the six explanatory variables on the rate of an upward intrafirm shift (the promotion rate, for short): does the observed pattern fit the predictions of job competition, vacancy competition, or neither of these?

Both job and vacancy competition predict that the promotion rate increases with fixed resources. The results support this hypothesis in the case of education, which is usually regarded as a person's primary fixed resource, and verbal ability. Father's education is insignificant, as hypothesized. This is plausible if this variable is a proxy for information about better jobs. (Such information is rarely relevant insofar as intrafirm shifts are concerned.)

Job and vacancy competition differ in their predictions about the effects of job rewards on the promotion rate: the effect is positive according to job competition, but negative according to vacancy competition. Table 5 shows that the promotion rate decreases as prestige and wages rise, although the estimated effect is statistically significant only in the case of prestige. Thus, these results support the prediction of vacancy competition -- not job competition.

A final prediction of vacancy competition is that time in jobs has a negligible effect on the promotion rate when rewards and fixed resources are controlled. The coefficient of this variable does not differ significantly from zero (as predicted by vacancy competition). But it is positive, and it is not appreciably smaller in magnitude than in the case of upward interfirm shifts. Hence it is unclear whether time in jobs measures the gap between actual and expected rewards (as Sorensen claims) or is an indicator of acquired resources (as human capital theorists assert). Further research is necessary to clarify this particular issue.

Next notice the reduction in the variance in the promotion rate that results from inclusion of the six explanatory variables. It is 42.4%, which is considerably lower than the 69.4% reduction in the rate of upward interfirm shifts. These relative values agree with my hypothesis that unobserved attributes of jobs and workers affect the rate of an upward <u>intra</u>firm shift more than the rate of an upward <u>inter</u>firm shift.

Finally, some hypotheses mentioned in Section II.4 concern the effects of easily observed rewards and resources on the promotion rate relative to their effect on the rate of an upward interfirm shift. I argued that easily observed indicators of rewards and resources influence the promotion rate less than the rate of an upward interfirm shift. The findings uniformly support the hypotheses: the magnitude of each easily observed indicator of rewards and resources is greater in the case of the rate of an upward interfirm than in the case of the promotion rate. Moreover, ability has a much larger effect on the promotion rate than on the rate of an upward interfirm shift.

CONCLUSIONS

In this research I have undertaken three main tasks: (1) I have examined the implications for job-shift patterns of several arguments (imperfect competition, job competition, and vacancy competition) about the way people with varying resources (e.g., education, ability) are allocated to jobs with different rewards (e.g., prestige, wages). (2) I have proposed an extension of existing methods of analyzing job shifts. (3) I have used the proposed method on data on job shifts of white males ages 30-39 in 1968 to test hypotheses arising from various arguments. In discussing each of the three tasks, I reached a number of different conclusions -- far too many to summarize all of them here. I shall mention only the most important points.

1. Employment conditions surrounding a job may be flexible or inflexible. Flexible employment means that an employer can freely adjust a worker's wage and terminate his job; inflexible employment means that an employer is constrained (if not completely prevented) in taking either course of action. When employment is flexible, a person's gain from a job shift is zero on the average, and mobility, though an interesting phenomenon, is not terribly important for understanding the distribution of rewards among persons or over one person's career. When employment is inflexible, a person's gain from a job shift is positive on the average, and mobility is of fundamental importance for understanding the distribution of rewards. Whether employment is flexible or inflexible, hypotheses can be derived concerning the effects of rewards, resources, and work experience on employment stability and the relative frequency of different kinds of jobs shifts.

2. These hypotheses can be translated into models of the instantanoues rate of a shift from one kind of job to another. Previous models have

assumed that the rate of a job shift depends <u>either</u> on observable variables <u>or</u> on unobservable variables. I propose combining these assumptions. In this way one avoids the unrealistic assumption that the model of the rate of a job shift has been specified perfectly. It also lets one estimate the proportion of variance in the rates within some population that is explained by some set of observed explanatory variables.

3. For young white men in the United States, the proportion of job shifts accompanied by gains (in either prestige or wages) exceed those accompanied by losses. This tendency is especially marked for intrafirm shifts but also noticeable for interfirm shifts. This finding is consistent with the argument that employment tends to be inflexible in large firms and flexible in small ones, assuming that intrafirm shifts originate mainly in large firms and that interfirm shifts originate partly in small firms and partly in large ones.

I examined the effects of several fixed resources (verbal ability, own education, father's education), two job rewards (prestige and wages), and time in jobs (an acquired resource according to human capital theory) on rates of upward and downward shifts within and between firms. The findings for interfirm shifts agree well with hypotheses predicted by imperfect competition, which assumes employment is flexible. In addition, the results for intrafirm shifts support all but one hypothesis predicted by vacancy competition, which assumes employment is inflexible.

Overall these findings imply that mobility is <u>not</u> just an interesting side issue in understanding the distribution of rewards in the United States. Shifting jobs may not be the only mechanism by which people increase their job rewards, but it is certainly one such mechanism, apparently an important one.

APPENDIX A

This appendix outlines implications of the assumption that the instantaneous rate of a transition from state j to state k for some individual i, r_{ijk}, is the product of two terms: A_{ijk}, a function of observable variables describing i, j and k; and ϵ_{ijk}, a gamma-distributed random disturbance representing pure noise (including unobservable characteristics of i, j and k that are uncorrelated with the observable variables in A_{ijk}). Thus, I assume that

$$r_{ijk} = A_{ijk}\,\epsilon_{ijk} \tag{A.1}$$

where

$$E[\epsilon_{ijk}] = 1 \tag{A.2}$$

$$\mathrm{Var}(\epsilon_{ijk}) = \sigma^2_{ijk} = 1/B_{ijk} \tag{A.3}$$

$$\mathrm{Cov}(A_{ijk},\epsilon_{ijk}) = 0 \tag{A.4}$$

$$f(\epsilon_{ijk}) = \frac{B_{ijk}^{\;B_{ijk}}}{\Gamma(B_{ijk})}\,\epsilon_{ijk}^{\;B_{ijk}-1}\,\exp[\,-\,B_{ijk}\,\epsilon_{ijk}] \tag{A.5}$$

for all i, j and k.

In this paper I also assume that $B_{ijk} = B_{jk}$ for any particular j and k and for all i, and that $\log_e A_{ijk} = \log_e r_{ijk}$ as specified for one of the models with Form A in Table 2 (i.e., IA, IIA, IIIA, or IVA). The steps that follow do not depend on the functional form relating A_{ijk} to observed explanatory variables. Moreover, it could be assumed, for example, that

$$\log_e B_{ijk} = \beta_{jk}' x_{ijk} \tag{A.6}$$

which would imply that the variance in the transition rate from j to k depends on the vector of observed variables x_{ijk}. The ensuing derivations are expressed in terms of A_{ijk} and B_{ijk} to retain generality.

Together (A.1) and (A.5) imply that each transition rate r_{ijk} is gamma-distributed with probability density:

$$f(r_{ijk}) = f(\epsilon_{ijk}) \frac{d\epsilon_{ijk}}{dr_{ijk}} \tag{A.7}$$

$$f(r_{ijk}) = \frac{(B_{ijk}/A_{ijk})^{B_{ijk}}}{\Gamma(B_{ijk})} r_{ijk}^{(B_{ijk}-1)} \exp[-B_{ijk} r_{ijk}/A_{ijk}] \tag{A.8}$$

The above expression implies that the rate r_{ijk} has the following mean and variance:

$$E[r_{ijk}] = A_{ijk} \tag{A.9}$$

$$\mathrm{Var}(r_{ijk}) = A_{ijk}^2/B_{ijk} \tag{A.10}$$

Since transition rates are unobservable variables, (A.8) cannot be used to estimate A_{ijk} and B_{ijk} directly. However, (A.8) can be used to deduce the probability density of various observable variables. Given data on one of these observable variables, the method of maximum likelihood can then be used to estimate A_{ijk} and B_{ijk}.

I assume that event history data are available so that one knows the number, timing, and sequence of events. More concretely, I assume that the values of t_n, the time of the nth event, and y_n, the state entered at the nth event, are observed for n = 0 to some number that varies from case to case. The observations on the times of successive events provide information on the duration in a state $j = y_{n-1}$ because $u_n = t_n - t_{n-1}$. Below I sketch the derivation of the probability density of t_n and the expected value of r_{ijk} in the population.

Because r_{ijk} is a constant for any i, j and k by the assumption in (A.1), the time of leaving the (n-1)th job, t_{n-1}, conditional on the type of job $j = y_{n-1}$ and the time of entry t_{n-1}, has an exponential distribution with probability density:

$$f_j(t_n|t_{n-1},h_{ij}) = h_{ij} \exp[- h_{ij} (t_n-t_{n-1})] \qquad (A.11)$$

$$= h_{ij} \exp[- h_{ij} u_n]$$

where

$$h_{ij} = \sum_{k=1}^{\Psi} r_{ijk} \qquad (A.12)$$

Note that (A.11) is a <u>conditional</u> density: the distribution of t_n depends on the unobservable hazard function h_{ij} as given by (A.12), as well as on t_{n-1}. But to estimate parameters from data, one needs a density of t_n that depends only on observables. This can be obtained by multiplying the conditional density in (A.11) times the probability density of the hazard function, and then integrating over all possible values of each h_{ijk} (i.e., from 0 to ∞).

$$f_j(t_n|t_{n-1}) = \int f_j(t_n|t_{n-1},h_{ij}) f(h_{ij}) dh_{ij} \qquad (A.13)$$

Equation (A.11) provides the first term within the integral. The second term is the probability density of the hazard function for individual i in state j, which has not yet been specified. (Equation (A.8) gives only the probability density for a <u>particular</u> transition rate.)

Though it is reasonable to assume that in general transition rates to different states are <u>not</u> statistically independent, i.e., that the disturbances for different transition rates are correlated, the succeeding steps in the derivation are enormously simplified by assuming statistical independence. Then the probability density of the hazard function is just the product of the probability densities for transition rates from the state j to all possible states:

$$f(h_{ij}) = \prod_{k=1}^{\Psi} f(r_{ijk}) \tag{A.14}$$

where (A.8) gives $f(r_{ijk})$. Similarly

$$dh_{ij} = \prod_{k=1}^{\Psi} dr_{ijk} \tag{A.15}$$

Thus, the single integration in (A.13) becomes a multiple, Ψ-fold integration.

One need only substitute (A.11), (A.14) and (A.15) into (A.13) and integrate to obtain a probability density for t_n that does not depend on any unobservables. Numerous tedious but straightforward steps yield:

$$f_j(t_n|t_{n-1}) = \sum_{k=1}^{\Psi} \frac{A_{ijk}\, B_{ijk}}{A_{ijk}\, u_n + B_{ijk}} \prod_{k=1}^{\Psi} \frac{B_{ijk}}{A_{ijk}\, u_n + B_{ijk}} \tag{A.16}$$

Equation (A.16) implies that the survivor function for a case i selected at random is:

$$G_j(t_n|t_{n-1}) = \prod_{k=1}^{\Psi} \frac{B_{ijk}}{A_{ijk}\, u_n + B_{ijk}} \tag{A.17}$$

Moreover, the unconditional rate of leaving j at time t_n is related to the probability density function for t_n and the survivor function at t_n as follows:

$$f_j(t_n|t_{n-1})/G_j(t_n|t_{n-1}) = h_{ij}(t_n|t_{n-1}) \tag{A.18}$$

$$= \sum_{k=1}^{\Psi} r_{ijk}(t_n|t_{n-1}) \tag{A.19}$$

So (A.16) through (A.19) imply that the rate of leaving j (the hazard function) for a randomly selected case i is:

$$h_{ij}(t_n|t_{n-1}) = \sum_{k=1}^{\Psi} \frac{A_{ijk}\, B_{ijk}}{A_{ijk}\, u_n + B_{ijk}} \tag{A.20}$$

It can be shown in an analogous fashion that for a randomly selected case i

$$r_{ijk}(t_n|t_{n-1}) = \frac{A_{ijk}\, B_{ijk}}{A_{ijk}\, u_n + B_{ijk}} \tag{A.21}$$

FOOTNOTES

1. For a useful discussion of ways of defining labor market structure, see Althauser and Kalleberg, 1981.

2. Sorensen and Kalleberg (1981) and Sorensen and Tuma (1981) distinguish between "open" and "closed" employment. An employer is free to terminate an employee's job in the former, but not in the latter. These authors implicitly assume that wage rigidity accompanies closed employment and that wage flexibility is present when employment is open. But this need not be the case. I use a different terminology to emphasize that <u>both</u> rigid wages <u>and</u> closed employment are necessary for the conclusions reached about inflexible employment below.

3. For evidence of the first, see Blau and Duncan, 1967. For evidence of the second, see Mincer, 1974. Byrne (1975) and Hayghe (1975) give evidence of the third. Numerous other sources could be cited.

4. An additional assumption is that buyers and sellers maximize utility: employers maximize profits, and workers maximize utility that depends on leisure, money, and occasionally other, nonpecuniary values.

5. The rate of a job shift is analogous to the probability of the shift per unit of time among those at risk of the shift. A formal definition is given in equation (4) below.

6. Another aspect deals with investments specific to the match, e.g., job-specific training. BLM argue that stability of the match increases with specific investments. See also Becker, 1964; Tuma, 1976. This

argument also suggests that the rate of a shift declines as the duration of the match increases. Tuma (1976) and Sorensen and Tuma (1981) have estimated models in which the rate of a job shift declines as duration increases. Technical difficulties precluded studying these issues in this paper (see footnote 20 below).

7. Perhaps surprisingly, BLM argue that even positive unexpected gains (i.e., "windfalls") decrease stability. They argue that the match is no longer optimal after a windfall, which makes the match unstable.

8. For example, the organization of the construction industry leads to a much higher rate of lateral shifts in that industry than in most others.

9. Sorensen (1977a) does not explain why initial job rewards are lower than expected for a given level of resources. If labor-market entrants are dependent upon vacancies in jobs whose rewards are commensurate with their resources, their alternatives may be to wait until a suitable job becomes available or to accept a job whose rewards are less than they expect. Given these two alternatives, most individuals will choose the latter -- as long as this choice does not prevent them from obtaining a better job later.

10. Sorensen (1977a) refers to "time in the labor force" rather than "work experience." The two concepts are equivalent when employment is continuous once the labor force is entered, which Sorensen assumes. In reality and in the data analyzed, employment is not continuous. In my opinion the notion of "work experience," by which I mean "time in

jobs," fits Sorensen's arguments better than "total time in the labor force" when employment is discontinuous. Consequently, I have substituted "work experience" for "time in the labor force" in my discussion of vacancy competition. Further pertinent discussion appears in the description of the data in Section III.

11. The lay-off rate may be high in certain industries, and lay-offs probably lead to a high proportion of downward shifts. However, lay-offs are not triggered by characteristics of a particular job-person match but by a temporary slackened demand for a firm's product.

12. Jobs at the highest rungs of a large firm bear many similarities to jobs in small firms insofar as flexibility of employment is concerned. For example, top executives appear much more likely than those in middle management to be demoted or fired if their job performance does not meet expectations.

13. Leigh (1976) has compared gains of blacks and whites who shift industries and who remain in the same industry. For both races he finds that movers tend to gain more than stayers. Unfortunately, he does not report effects of variables indicating the resources of workers, although they were included in his analysis.

14. March and March (1978) have developed a model of intrafirm shifts based on the assumption that performance records on the job are the criterion used by employers in allocating employees to different jobs.

15. Although in principle military service can be uncoerced, many respondents may have been drafted because their military service occurred in the era of the Korean War.

16. Age and time since school completion are correlated .832.

17. Historical period and time since school completion are correlated .720.

18. Another approach that I have not yet explored is to assume that the change in rewards is a metric variable with some postulated distribution.

19. I use capital letters to denote random variables and lower case letters to indicate their realizations.

20. Time-independence is an admittedly unrealistic assumption. It is easy to formulate arguments why job-shift rates depend on age, duration, and historical period. (For such arguments, see Tuma, 1976.) But it is beyond the scope of this paper to encompass these arguments or to include these variables.

21. This assumption implies that the coefficient of variation in the rate is σ_{ijk}.

22. Michael C. Keeley first suggested this to me. Since I wrote the first version of this paper, Heckman and his associates (Heckman and Borjas, 1980; Flinn and Heckman, 1982) have also proposed models that combine these features.

23. Both Silcock and Spilerman assume that only the rate of leaving a job has a random disturbance.

24. I imposed a maximum length on the interval between successive jobs because I think that the kind of job held previously has a declining

impact on changes in rewards as this interval lengthens. Clearly the choice of a six-month maximum is arbitrary.

25. Given the small correlation between prestige and wage changes (whether measured on absolute or percentage scales), one might expect cell entries for intra- and interfirm shifts to be close to the product of the marginals in Table 4, indicating that prestige and wage changes are statistically independent. This null hypothesis can be rejected at the .05 level (χ^2 with 4 degrees of freedom = 46.58 for interfirm shifts, and 18.68 for intrafirm shifts). The main deviations from statistical independence seem to occur because the same changes in prestige and wages occur much more often than independence predicts. This finding does not, of course, contradict the finding of a small correlation between the two kinds of changes.

26. I also tested the hypothesis that the <u>rates</u> of these nine types of changes in rewards are the same for interfirm and intrafirm job shifts. This hypothesis can also be rejected at well below the .01 level (χ^2 with 9 degrees of freedom = 2522.0).

27. There are other reasons for not reporting these. In particular, it is difficult to know whether a move involving a gain in one reward and a loss in the other should be considered a net gain, a net loss, or no change. Consequently, it is difficult to know whether the results for these shifts support a hypothesis or not.

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Table 1. Variables used in the analysis: definitions, means, and standard deviations.[a]

Variable	Definition	White men Mean	White men S.D.
Father's eduation	Father's years of completed schooling	8.34	3.53
Verbal ability	Number of correct numbers on a 10-item word-recognition test, adjusted for missing values on single items	5.99	1.87
Education	Years of completed schooling at start of job	11.82	2.81
Prestige	Siegel (1970) prestige score for job	36.47	13.88
Wage rate	Estimated wage in dollars per hour at start of job. Calculated as: $\frac{12(\text{Monthly earnings in \$})}{52(\text{Aver. weekly hours worked})}$	2.18	1.11
Years in jobs	Total years in previous jobs since schooling completed	6.35	5.32
Years since school	Total years since school completed	7.02	5.59
Duration in job (years)	Last date in job—first date (based on reported year and month for each date)	2.17	2.65
Job left (dummy variable)	1 if job exist observed 0 otherwise	0.83	
Number of individuals		713	713
Number of matches		3484	3484

[a]Reported means and standard deviations are for matches, not individuals.

Table 2. Models for the rate of a job shift.

Model number	Assumption
IA	The rate of leaving each job j is the same for each individual i. $\log_e h_{ij} = a$
IB	The mean rate of leaving a job does not depend on characteristics of individual i or of job j. However, the rate varies due to random error ("luck", etc.), which has variance σ^2. $\log_e h_{ij} = a + \log_e \varepsilon_{ij}, \quad E(\varepsilon_{ij}) = 1, \quad Var(\varepsilon_{ij}) = \sigma^2$
IIA	The rate of leaving a job is a log-linear function of x_{ij}—characteristics of individual i and job j. $\log e\ h_{ij} = a'x_{ij}$
IIB	The mean of the rate of leaving a job is a log-linear function of x_{ij}—characteristics of individual i and job j. The rate varies due to random error, which has variance σ^2. $\log_e h_{ij} = a'x_{ij} + \log_e \varepsilon_{ij}, \quad E(\varepsilon_{ij}) = 1, \quad Var(\varepsilon_{ij}) = \sigma^2$
IIIA	The rate of moving from one job j to another job k is a constant for particular kinds of jobs j and k, but does not depend on characteristics of an individual i. $\log_e r_{ijk} = a_{jk}$
IIIB	The mean rate of moving from one job j to another job k depends on the particular j and k, but does not depend on characteristics of individual i. The rate varies due to random error, which has variance σ^2_{jk}. (In general σ^2_{jk} depends on j and k.) $\log_e r_{ijk} = a_{jk} + \log_e \varepsilon_{ijk}, \quad E(\varepsilon_{ij}) = 1, \quad Var(\varepsilon_{ijk}) = \sigma^2_{jk}$
IVA	The rate of moving from one job j to another job k is a log-linear function of characteristics of individual i and job j; this function may depend on k—the kind of job entered next. $\log_e r_{ijk} = a_{jk}'x_{ij}$
IVB	The mean rate of moving from one job j to another job k is a log-linear function of characteristics of individual i and job j; this function may depend on k—the kind of job entered next. The rate varies due to random error, which has variance σ^2_{jk}. (In general σ^2_{jk} depends on j and k.) $\log_e r_{ijk} = a_{jk}'x_{ij} + \log_e \varepsilon_{ijk}, \quad E(\varepsilon_{ijk}) = 1, \quad Var(\varepsilon_{ijk}) = \sigma^2_{jk}$

Table 3. Leaving a job: estimates of models IA, IB, IIA, and IIB.

	White men	
	A	B
Model I		
Mean rate	.385	.595
Variance, σ^2	0	.507
Chi-square for IB vs. IA:		386.2[c]
(df)		1
Model II		
Constant	-.231	.510
Father's education	.016[c]	.017[b]
Verbal ability	.043[c]	.052[c]
Education	-.002	-.017
Prestige	-.022[c]	-.025[c]
Wages in $/hr	-.070[c]	-.101[c]
Years in jobs	-.025[c]	-.034[c]
Variance, σ^2	0	.453
% decrease in σ^2 (IIB vs. IB)	--	7.1
Chi-square for model: vs. model IA	311.0[c]	706.9[c]
(df)	6	7
vs. model IB		320.7[c]
(df)		6
vs. model IIA		395.9[c]
(df)		1
Number of job-person matches	3484	3484

[a] statistically significant at the .10 level

[b] statistically significant at the .05 level

[c] statistically significant at the .01 level

Table 4. Joint relative frequency distribution of changes in occupational prestige and the wage rate for shifts among jobs in the CHALF (Civilian Nonagricultural Labor Force) by type of move (within and out of a firm).

		White men (1819 out; 640 in)						
		Prestige gain		Prestige same		Prestige loss		
		Out	In	Out	In	Out	In	Marginals
Wage gain	Out	.187		.161		.122		.470
	In		.211		.302		.080	.593
Wage same	Out	.052		.081		.043		.176
	In		.070		.209		.056	.335
Wage loss	Out	.141		.091		.122		.354
	In		.022		.031		.019	.072
Marginals		.380	.303	.333	.542	.287	.155	1.000

Definitions: A "gain" occurs when the job entered has a wage rate (prestige) more than 5% higher than that of the job left. A "loss" occurs when the job entered has a wage rate (prestige) more than 5% lower than that of the job left.

Table 5. Upward and downward job shifts within and out of a firm: estimates of models IIIA, IIIB, and IVB for white men.

	Upward		Downward	
Estimates for:	Out	In	Out	In
Model IIIA				
Mean rate	.045	.018	.029	.002
Variance, σ^2_{jk}	0	0	0	0
Model IIIB				
Mean rate	.083	.025	.045	.002
Variance, σ^2_{jk}	6.330	8.129	6.293	5.630
Chi-square for IIIB vs. IIIA:	70.5[c]	12.4[c]	29.7[c]	.01
(df)	1	1	1	
Estimates for model IVB				
Constant	-.840	-3.428	-1.408	not estd
Father's education	.048[b]	.018	.005	
Verbal ability	.106[b]	.149[b]	-.115[b]	
Education	.142[c]	.116[b]	-.210[c]	
Prestige	-.100[c]	-.075[c]	.035[c]	
Wages in $/hr	-.838[c]	-.166	.133	
Years in jobs	.030[b]	.025	-.058[c]	
Variance, σ^2_{jk}	1.936	4.681	4.906	
% decrease in σ^2_{jk} (IVB vs. IIIB)	69.4	42.4	22.0	not calcd
Chi-square for model:				
vs. model IIIA	438.5[c]	78.5[c]	75.9[c]	not estd
(df)	7	7	7	7
vs. model IIIB	368.0[c]	66.1[c]	46.2[c]	not calcd
(df)	6	6	6	6
vs. model IVA	42.2[c]	9.4[c]	31.7	0
(df)	1	1	1	1
Number of shifts	340	135	222	12

Number of job-person matches = 3484

[a] statistically significant at the .10 level

[b] statistically significant at the .05 level

[c] statistically significant at the .01 level

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