A Theory of Career Mobility

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This paper analyzes theoretically and empirically the role and significance of occupational mobility in the labor market focusing on individuals' careers. It provides additional dimensions to the analysis of investment in human capital, wage differences across individuals, and the relationships among promotions, quits, and interfirm occupational mobility. It is shown that part of the returns to education is in the form of higher probabilities of occupational upgrading, within or across firms. Given an origin occupation, schooling increases the likelihood of occupational upgrading. Furthermore, workers who are not promoted despite a high probability of promotion are more likely to quit.

I. Introduction

Occupational mobility is an outstanding characteristic of the American labor market; very few workers perform the same task throughout their working lives.¹

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The economic literature pertaining to the role of occupations in the labor market has, for the most part, focused on occupational choice. Studies of occupational mobility have been conducted within a job-matching framework in which occupational mobility is assumed to be the outcome of changes in the information set, market conditions, or workers' characteristics (e.g., Miller 1984). With the notable exception of Rosen (1972), the fact that job mobility is an integral part of workers' careers, however, has been virtually neglected.\(^2\)

This paper analyzes theoretically and empirically the role as well as the significance of the phenomenon of occupational mobility in the labor market focusing on individuals' careers.\(^3\) The study provides an additional dimension to the existing analysis of prominent labor market phenomena including investment in human capital, wage profile differences across individuals, and the relationships among promotions, quits, and interfirm occupational mobility.

An econometric model of career mobility is presented and several implications of the theory are tested. The relationships among occupational mobility, returns to schooling, and firm separation are analyzed. The effects of different characteristics on the probability of career mobility are estimated, and the differences are examined between workers who move along their career path within the firm and those who do so by moving across firms.

The introduction of the concept of occupations and occupational mobility into the study of investment in human capital and labor mobility explicitly captures heterogeneity in human capital. Namely, skills are to a large extent occupation specific, and their transferability across jobs is limited.\(^4\) Constraints are therefore added to the process of investment in human capital and to the movement across several activities over the life cycle. The implications of these constraints on the optimal time path of investment in human capital and on workers' mobility across firms are examined.

It is shown that, as the theory predicts, part of the return to education is in the form of a higher probability of occupational upgrading,

\(^2\) In Rosen's model, jobs/occupations differ by the amount of on-the-job training they provide. The realization of an optimal path of investment in human capital, over the life cycle, might involve jobs/occupational mobility.

\(^3\) Spiller (1977) defines "career line" or "job trajectory" as "a work history that is common to a portion of the labor force" (p. 551). Following Slocum (1974), he uses the term "career" to refer to an individual's job history and the terms "career line" and "job trajectory" to denote an empirical regularity in the labor force. Sommers and Eck (1977) use the term "career ladder," which they define as "a series of occupations forming a path of advancement, usually through gaining skills and experience, to a higher status occupation" (p. 5).

\(^4\) Weiss (1971) analyzes the implications of occupation-specific skills on investment in human capital.
within or across firms. Given an occupation of origin, schooling increases the likelihood of occupational upgrading. Furthermore, workers who are not promoted despite a high expected probability of promotion are more likely to quit the firm.

II. A Theory of Career Mobility

This section constructs a theoretical model of optimal career choice, firm separation, and occupational mobility. The model is characterized by a variety of occupations that are available for individuals within as well as across firms. Occupations are related to each other by the transferability of skills. In the presence of differences in ability (and therefore schooling) across individuals, the sequence of occupations that forms the individuals' optimal career path may differ.

Individuals' optimal career paths may involve intrafirm mobility as well as interfirm mobility. Intrafirm career mobility (''promotion'') is subject to the employer's decision, whereas interfirm mobility and its optimal timing are determined by the individuals who choose the optimal quitting time so as to maximize their expected lifetime earnings. Intrafirm career mobility is uncertain. The probability of promotion is a function of schooling, ability, and job experience. The optimal investment in human capital as well as the optimal quitting time maximize the individual's expected lifetime income.

Since the focus of the discussion is the transferability of skills across occupations, we ignore the effect of on-the-job training on the wage in the occupation, considering only the effect of accumulated human capital on the probability of promotion and the wages in succeeding occupations. Thus it is assumed that wages are constant while one works in the same occupation and wage growth occurs solely through occupational mobility. Wages, however, vary across individuals because of differences in ability, education, and experience accumulated in previous occupations.

A. The Model

Consider an economy in which individuals wish to allocate their finite lifetime, $T$, between education and various feasible occupations so as to maximize their expected lifetime income, $E(Y)$:

$$E(Y) = \int_0^T e^{-rt}E(w_t) \, dt,$$

where $r$ is the rate of interest on borrowing and lending in the existing perfect capital market. The rate of interest is constant over time.
1. Education

Education provides individuals with human capital, which subsequently raises their future earnings through two channels: directly, via the potential returns to schooling in certain occupations, and indirectly, through the improvement in their career path. The costs of education are solely the forgone earnings.

Individuals who attend the education system for a period of $t$, years acquire a level of human capital $H_e$. The term $H_e = H_e(t_e; a)$, where $H_e$ is an increasing function of individuals' natural ability, $a$, as well as of years of schooling.

2. Occupations

The economy is characterized by a variety of occupations that differ in the required levels and types of human capital. There are $n$ types of firms in the economy, $j = 1, 2, 3, \ldots, n$, several of each type. Each type of firm offers a series of two occupations.

Occupation 1 in a type $j$ firm may be joined at any point in time by individuals whose ability level exceeds $a_j$. The ability requirement increases with the firm type, that is, $a_{j+1} > a_j$. The wage rate in occupation 1 in a type $j$ firm, $w_j^1$, is a function of the individual's level of education, $t_e$, as well as the individual's ability: $w_j^1 = w_j^1(t_e; a)$. Given education and ability, the wage in occupation 1 in a type $j$ firm is higher than that offered in occupation 1 in a type $j - 1$ firm.

Occupation 2 in a type $j$ firm can be obtained either through promotion from occupation 1 in the same firm (i.e., intrafirm mobility) or via mobility from occupation 2 in a type $j - 1$ firm (i.e., interfirm mobility). A promotion decision is made after an individual has spent a constant time interval, $\alpha > 0$, in occupation 1 in a particular firm of type $j$. The decision is final in this particular firm. However, individuals may try once again in another firm of type $j$. Those individuals will be considered for promotion after an additional period of length $\beta \geq 0$.

The probability of promotion from occupation 1 to 2 in every firm of type $j$, $P_j^1$, is positively related to the level of human capital obtained in school, $H_e$, that obtained through experience in occupation 1 in type $j$ firms, $H_1$, and ability, $a$. Thus $P_j^1 = P_j^1(t_e, H_1; a)$. In turn, $H_1$

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[5] Clearly, the direct cost of education could be incorporated into the analysis, and an alternative assumption in which it is not possible to generate education without the completion of school (no partial credit) could have been employed. These alterations will have no effect on the qualitative results.

[6] This simplifying assumption captures the notion that the likelihood of promotion declines beyond a certain point in time.
an increasing function of education, ability, and time spent in occupation 1 of type \( j \) firms.

The wage rate in occupation 2 in a type \( j \) firm, \( w_2^j \), is an increasing function of the individual’s education, \( H_e \), human capital obtained in occupation 2 in a type \( j - 1 \) firm, \( H_2^{j-1} \), and ability. Individuals who quit occupation 2 in a type \( j - 1 \) firm and join occupation 2 in a type \( j \) firm are rewarded for job experience acquired in occupation 2 in a type \( j - 1 \) firm. However, regardless of the acquired level of experience, given ability and schooling, their wages are lower than those of individuals who were promoted within the firm: \( w_2^j = w_2^j(H_2^{j-1}, t_i; a) \), where \( H_2^{j-1} \) is an increasing function of time spent in occupation 2 in firm \( j - 1 \), education, and ability.

Given \((t_i, a)\), irrespective of the level of \( H_2^{j-1} \), the wage rate in a type \( j \) firm is higher in occupation 2 than in occupation 1, and the wage in occupation 2 in a type \( j \) firm is higher than that offered in occupation 2 in a type \( j - 1 \) firm. Moreover, to truncate the number of feasible career paths further, it is assumed that for any \( H_2^{j-1} \), given \((t_i, a)\), \( w_2^{j+1} < w_2^j < w_2^{j+2} \). The wage structure is depicted in figure 1 for a given value of the vector \((H_2^{j-1}, t_i, a)\).

3. Feasible Career Paths

A career path is a series of occupations, characterized by the transferability of skills and experience from one to another, that form a feasible working career. Consider individuals whose career paths are limited, for simplicity, to three jobs. (A job transition is defined as a change of occupation or a firm.) Individuals with ability level \( a^j \) may start their career in any firm of a type \( h, h \leq j \). Suppose that a firm of
entry is chosen optimally. Given \( t \) years of schooling, individuals who start their working lives in a firm of type \( h \) earn the wage rate \( w^h_1 \) until the promotion decision date.\(^7\) Given the outcome of the promotion decision, several feasible careers may be optimal.

1. If promotion is approved, individuals move to occupation 2 in the firm, obtaining a wage rate \( w^h_2 \). They remain in this occupation until the optimal quitting time to move to occupation 2 in firm \( h + 1 \). If quitting is indeed optimal, they join this occupation and remain there until the end of their working career, earning the wage rate \( w^{h+1}_2 \).

2. If promotion is not approved, individuals may find either of the following paths optimal: (a) remain in occupation 1 in the firm of origin or (b) quit in favor of another firm of the same type, obtaining the same wage, \( w^h_1 \), for an additional \( \beta \) years until a promotion decision will be made.\(^8\) Then with probability \( P^h \) (which is an increasing function of the length of time spent in occupation 1, \( \alpha + \beta \)), promotion will be approved, and they will move to occupation 2 and will be paid the wage rate \( w^h_2 \). Otherwise, they will remain in occupation 1.

If promotion is approved, the optimal quitting time is a function of the costs associated with quitting as well as the contribution of the current job experience to the wage in occupation 2 in firm \( h + 1 \), \( w^{h+1}_2 \). If promotion is not approved, the decision whether and when to quit (in order to try to obtain a promotion in a different firm of the same type) is determined by the costs associated with quitting as well as the probability of promotion in a type \( h \) firm.\(^9\)

B. The Individuals’ Optimization

Individuals wish to choose the level of schooling and a feasible career path so as to maximize the present value of their expected lifetime earnings. The optimal values are derived using the method of a backward solution.

\(^7\) The current version of the paper excludes for the sake of brevity the possibility of quitting prior to the promotion decision. If the wage in occupation 1 would have been an increasing function of experience in other occupations, the possibility of quitting prior to the promotion decision would have existed, adding to the richness of the model. See Galor and Sicherman (1988) for a discussion of this possibility.

\(^8\) The necessary tenure in the new firm for a promotion, \( \beta \), may be longer or shorter than that in the original firm, \( \alpha > 0 \). Furthermore, \( \beta \) may be equal to zero, in which case promotion in the new firm may be considered without actual attendance.

\(^9\) If promotion is not approved, the possibility that quitting to a lower-level firm will be beneficial is excluded under the assumption that the cost of quitting to a lower-level firm is sufficiently large. Quitting to move to occupation 1 in a higher-level firm (when promotion is not approved) is excluded as well. Mobility cost to a different type of firm is assumed to be significantly larger than that to a different firm of the same type.
1. The Optimal Career Path

Consider individuals who spend their initial $t_i$ years in the education system and then join occupation 1 in a type $j$ firm.

Promotion is approved.—Individuals who are promoted at the promotion decision date $t_i + \alpha$, who find it beneficial to quit, wish to choose the optimal quitting time from firm $j$, $\gamma_{\Gamma_j}^i$, so as to maximize the value (at $t = 0$) of their future earnings, $V_p(\gamma_{\Gamma_j}^i; t_i, a)$.

Let $C_p$ be the present value (evaluated at time 0) of the costs associated with quitting occupation 2 in firm $j$ to move to occupation 2 in firm $j + 1$; $C_p$ is independent of the quitting time. The individual's maximization problem is therefore

$$\max_{\gamma_{\Gamma_j}^i} V_p(\gamma_{\Gamma_j}^i; t_i, a) = \int_{t_i + \alpha}^{\gamma_{\Gamma_j}^i} e^{-rt} w_2^j(t_i, a) \, dt$$

$$+ \int_{\gamma_{\Gamma_j}^i}^{T} e^{-rt} w_2^{j+1}(\gamma_{\Gamma_j}^i; t_i, a) \, dt - C_p$$

subject to $t_i + \alpha \leq \gamma_{\Gamma_j}^i \leq T$. The term $V_p(\gamma_{\Gamma_j}^i; t_i, a)$ is assumed to be twice continuously differentiable and strictly concave in $\gamma_{\Gamma_j}^i$. Thus for an internal optimum—that is, $t_i + \alpha < (\gamma_{\Gamma_j}^i)^* < T$—a necessary and sufficient condition for the maximization problem is

$$e^{-r(\gamma_{\Gamma_j}^i)^*} [w_2^{j+1}(\gamma_{\Gamma_j}^i)^* - w_2^j] = \left[ e^{-r(\gamma_{\Gamma_j}^i)^*} - e^{-rT} \right] \frac{\partial (w_2^{j+1}(\gamma_{\Gamma_j}^i)^*)}{\partial \gamma_{\Gamma_j}^i},$$

where $(w_2^{j+1}(\gamma_{\Gamma_j}^i)^*)^* = w_2^{j+1}[(\gamma_{\Gamma_j}^i)^*, t_i, a]$.

The optimal quitting time is characterized, therefore, by the equalization of the present value of the direct loss of income resulting from the delay in joining occupation 2 in a type $j + 1$ firm (i.e., the present value of the difference between the wages in occupation 2 in type $j$ and $j + 1$ firms) and the present value of the additional stream of income in occupation 2 in a type $j + 1$ firm because of the lengthening of the experience in occupation 2 in a type $j$ firm.

If it is assumed that individuals who are indifferent between quitting and not quitting remain in the firm, quitting will take place if and only if

$$V_p((\gamma_{\Gamma_j}^i)^*; t_i, a) > \int_{t_i + \alpha}^{T} e^{-rt} w_2^j(t_i, a) \, dt.$$  

Promotion is denied.—Individuals who are not promoted at the promotion decision date, $t_i + \alpha$, may either quit to go to another firm of the same type, where an additional promotion attempt will be made after a period of length $\beta$, or remain in occupation 1 in the same firm.
The present value (evaluated at time $t = 0$) of the future earnings of individuals who do not quit the firm, $V_{nq}(t, a)$, is

$$V_{nq}(t, a) = \int_{t}^{T} e^{-r \tau} w_1^j(t, a) \, d\tau,$$

whereas the present value of the future earnings of individuals who quit the firm, $V_q^j(t, a)$, is

$$V_q^j(t, a) = \int_{t}^{T} e^{-r \tau} w_1^j(t, a) \, d\tau + P^j(t, \alpha + \beta, a)$$

$$\times \int_{t + \alpha + \beta}^{T} e^{-r \sigma} [w_2^j(t, a) - w_1^j(t, a)] \, d\tau - C_{np},$$

where $C_{np}$ is the present value (evaluated at time 0) of the cost associated with quitting occupation 1 in a type $j$ firm to go to another firm of type $j$. Thus if promotion is not approved, an individual will quit the firm if and only if $V_q^j(t, a) > V_{nq}(t, a)$.

Corollary 1. The higher is the probability of promotion, the greater is the possibility of quitting if promotion is not approved.

The corollary follows immediately from equations (5) and (6).\(^\text{10}\)

2. Optimal Schooling

Individuals determine the optimal level of schooling, $t_s$, so as to maximize the present value of their expected lifetime earnings, $M(t_s; (\gamma_p^j)^*, a)$:

$$\max_{t_s > 0} M(t_s; (\gamma_p^j)^*, a) = \int_{t_s}^{t_s + \alpha} e^{-r \tau} w_1 \, d\tau$$

$$+ \{P^j(t_s; \alpha, a)V_p[t_s; (\gamma_p^j)^*, a]$$

$$+ \{1 - P^j(t_s; \alpha, a)]S_{np}^j(t_s; a)\},$$

where $S_{np}^j(t_s; a) = \max[V_{nq}(t_s; a), V_q^j(t_s; a)]$ is the present value of the future earnings of an individual who was not promoted.

The term $M(t_s; (\gamma_p^j)^*, a)$, which is twice continuously differentiable in $t_s$, is assumed to be strictly concave in $t_s$. Consider an internal solution for the optimal schooling level. A marginal increase in the optimal schooling time results in the equalization of the gains and losses

\(^{10}\)Corollary 1 is based on the assumption that a denial of promotion is firm specific (e.g., a bad match or limited vacancies), thus not affecting the likelihood of promotion in other firms. If such a denial indicates a lower likelihood of promotion in other firms, the likelihood of quitting will also be lower. This corollary is discussed and tested empirically in Sec. III.
in the present values of expected future earnings. The gains are due to the improvement in the probability of promotion and the increase in the wage rate in occupation 2 in a type \( j + 1 \) firm, whereas the losses are due to the delay in the beginning of the working career in the various occupations.

3. The Optimal Level of Entry

Consider the discussion in Section IIA3. Individuals who are characterized by an ability level \( a_j \) may start their working careers in occupation 1 of any firm of type \( h \) as long as \( h \leq j \). As was postulated earlier, given the education level, the wage rate in occupation 1 is higher in a higher-level firm. Nevertheless, individuals may consider a lower-level firm in which the direct return to schooling is lower if in those firms, for a given level of schooling, the probability of promotion is higher and, subsequently, so is the probability of obtaining higher future wages.

An initial entry at a firm of level \( j - 3 \) or lower is nonbeneficial. The highest possible wage rate that may result from this type of career is lower than the initial (and thus certain) wage rate obtained in occupation 1 in firm \( j \). Initial entry at a firm of level \( j, j - 1, \) or \( j - 2 \), however, may clearly be beneficial. The optimal level of entry, therefore, is the one under which the value function \( M^{h^*}, h = j, j - 1, \) or \( j - 2 \), as defined by (7), attains its maximum over \( h \).

**Corollary 2.** Individuals may choose an entry level in which the direct returns to schooling are lower than those in other feasible entry levels if the effect of schooling on the probability of promotion is higher in this entry level.

C. Empirical Implications

The theory of career mobility suggests several specific predictions concerning the effects of schooling on wages and firm mobility. While in some occupations the returns to schooling are in the form of higher wages, in other occupations the returns are in terms of higher probabilities of advancing to occupations with higher wages. This hypothesis can explain the observed differences in returns to schooling across occupations. The model suggests that if the returns to schooling are lower while one works in a specific occupation, the effect of schooling on the probability of being promoted from this occupation (within or across firms) will be higher. Similarly, it will be rational for some individuals to spend a portion of their working careers in occupations that require a lower level of schooling than they have acquired. This
observation can serve as a partial explanation for the phenomenon of "overeducation" and is discussed in Sucherman (1987).

The theoretical model provides an ambiguous prediction concerning the unconditional effect of schooling on career mobility. On the one hand, highly educated individuals are able to start their working careers in a higher-level occupation (higher step on the ladder). Their careers, therefore, might involve fewer occupations. On the other hand, highly educated individuals face greater opportunities (longer ladders). The model suggests, therefore, that given an occupation of origin, more educated individuals are more likely to move to a higher-level occupation.

At any point in time, individuals face different probabilities of promotion within the firm, based on personal characteristics and occupation. The model predicts that among individuals who were not promoted, those with a higher probability of promotion are more likely to quit the firm.

Specific human capital and job-matching theories predict a negative effect of tenure on mobility. The presented theory of career mobility, conversely, predicts that there exists a positive effect of tenure on occupational mobility; individuals acquire skills and experience in one occupation in order to be able to move to another occupation. One way to test for the positive duration effect on career mobility is to look only at intrafirm occupation mobility since this type of mobility entails no loss of firm-specific investment.

Unobserved heterogeneity of workers is likely to play an important role in occupational choice and occupational mobility decisions. Such heterogeneity might give rise to occupational mobility because of a matching process discussed earlier. Nevertheless, if a worker samples an occupation and as a result of a bad match makes a transition, there is no reason to assume that he or she will move to a higher-ranked occupation. Bamberger (1986), for instance, shows that when the matching takes place while in school, it may be the case that an optimal sampling will involve a move from a higher- to a lower-level occupation. Therefore, the upward transitions analyzed in this paper are more likely to be the result of career mobility, although it might be that some of those transitions are due to occupational matching. Another implication of unobserved heterogeneity is that firms might use promotions as a screening process. Workers who are not promoted are those whose specific quality is revealed not to be high enough. Nevertheless, the results reported in this paper with regard to interfirrm mobility cannot be fully explained as a screening process.

Occupational matching and screening theories are certainly possible reasons for occupational mobility. Some of the results reported in this paper could very well support some implications of these theo-
ries. As a whole, we find that the empirical findings support the theory of career mobility and its implications. We do not attempt to provide a discriminating test between these theories.

In the next section these empirical predictions are tested. An econometric model of career mobility is constructed and estimated using a large panel data set.

III. An Econometric Model of Career Mobility

A. The Data and Definitions

A sample of male heads of households, aged 18–60, observed annually over the period 1976–81 was drawn from the Panel Study of Income Dynamics (PSID) individuals tape. Individuals reported their occupation at the time of the survey or, if unemployed, the last occupation held. Occupational change is defined to occur when the two-digit occupational category reported by the worker in two successive surveys is different. Because of measurement errors, the measured rate of transitions is expected to be higher than the real rate.

The implicit assumption is that, with those categories, an occupational change will be observed when there is an apparent change in the tasks performed by the worker. Since each category is a combination of a number of detailed occupational titles, it is possible that some individuals move between relatively different occupations in the same category with no change observed, while others move between relatively similar occupations that fall into different categories and a change will be observed. We assume that, on average, workers who move across categories experience a bigger change in tasks than those who move across occupations within a category (see App. A for a list of the 25 categories).

Occupational mobility that is due to career mobility is considered as mobility to a higher-level occupation. We use this criterion in order to

11 The data include a "poverty subsample," but the qualitative results are not affected by its exclusion. A data appendix is available from the authors on request.
12 The extreme assumption that the reported occupation is a pure noise was strongly rejected by comparing the observed transitions per individual with that produced by a binomial process. An indication of the amount of measurement error can be obtained by looking at the number of cases in which individuals report a transition to an occupation held 2 years earlier (although each error in reporting occupation will cause two spurious transitions, only one will be captured in the career mobility models). Fifteen percent of the transitions in the PSID are of such a nature. Nevertheless, it should be clear that such transitions are not necessarily erroneous. While it is expected that part of the upward occupational mobility will take place within the firm (around half of the transitions are such), it is unlikely that one would observe an occupational change without a change in position. On the basis of recoded tenure in position, half of the occupational transitions took place without a change in position. We believe that this contradiction is mainly due to reported errors in tenure in position.
distinguish career mobility from other types of occupational mobility, although it is possible that mobility to a lower-level occupation (based on our ranking) will be part of the worker's career mobility (see App. B for details).

The vertical distance between occupations is measured as the difference in the mean levels of human capital needed to work in the occupations, after required training is completed. These levels are constructed by summing the weighted means of the levels of schooling, (a proxy for) market experience prior to entry to the occupation, and the amounts of training required in order for a worker to be qualified to work in the different occupations. The weights are the estimated coefficients of these variables in a wage regression. For a formal derivation and discussion, see Appendix B.

B. The Model

In this subsection, an econometric model of career mobility is presented and the effects of different characteristics on the probability of mobility are estimated. The distinction between inter- and intrafirm mobility made in the paper enhances the understanding of the interaction between firm and occupational mobility as elements of career development.

At each period an individual will experience one of the three following alternatives described by $j$: move to a higher-level occupation across firms ($j = 1$), get promoted to a higher-level occupation within the firm ($j = 2$), or neither ($j = 0$).

Transition $j$ occurs when the latent variable $Y_{intj}^* > 0$, where

$$Y_{intj}^* = X_m \alpha_j + \gamma_j ED_i + \delta_m + \epsilon_{intj} = Z_{itm} \beta_j + \epsilon_{intj},$$

where $i$ is the individual index, $m$ is the occupational index, $t$ is time (the initial period), $j$ is the alternative, $X_m$ is a vector of individual characteristics that may vary across time, and $ED_i$ is the level of schooling. Parameter $\delta_m$ is an occupation fixed effect. It is assumed to be constant across time and across individuals.

Assuming that $\epsilon$ is logistically distributed gives rise to a multinomial logit model in which the underlying probabilities are

$$P_j = \frac{\exp(Z\beta_j)}{\sum_{k=0}^{\gamma} \exp(Z\beta_k)}, \quad j = 0, 1, 2.$$  

In order to identify the parameters, the normalization $\beta_0 = 0$ is imposed and the estimated parameters are obtained by maximum likelihood. Table 1 reports the estimation results for upward transitions within and across firms.
### TABLE 1

**Maximum Likelihood Multinomial Logit Models of Career Mobility within and across Firms**

<table>
<thead>
<tr>
<th></th>
<th>Controlling for One-Digit Occupational Category</th>
<th>No Control for One-Digit Occupational Category</th>
<th>Career Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Promotion Across Firms</td>
<td>Promotion Across Firms</td>
<td>Controlling for One-Digit Occupational Category</td>
</tr>
<tr>
<td></td>
<td>(1) (2)* (3) (4)*</td>
<td>(5) (6)* (7) (8)*</td>
<td>(9) (10)*</td>
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<tr>
<td><strong>Intercept</strong></td>
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<td>-5.1203 - .19763</td>
<td>-1.2480 - .10862</td>
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<td></td>
<td>(15.8) (11.3)</td>
<td>(11.3) (11.3)</td>
<td>(6.71) (2.02)</td>
</tr>
<tr>
<td><strong>Schooling</strong></td>
<td>.0925 .00777</td>
<td>.1036 .00399</td>
<td>-.04373 -.00359</td>
</tr>
<tr>
<td></td>
<td>(6.42) (4.70)</td>
<td>(4.70) (4.70)</td>
<td>(3.77) (3.79)</td>
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<tr>
<td><strong>Experience</strong></td>
<td>-.0426 -.00204</td>
<td>-.0065 -.00076</td>
<td>-.05321 -.00244</td>
</tr>
<tr>
<td></td>
<td>(3.51) (.36)</td>
<td>(4.67) (.46)</td>
<td>(1.32) (1.32)</td>
</tr>
<tr>
<td><strong>Experience^2</strong></td>
<td>.0006 .0004</td>
<td>.00082 (.86)</td>
<td>-.00023 (.68)</td>
</tr>
<tr>
<td><strong>Tenure</strong></td>
<td>.0026 .00209</td>
<td>-.2357 -.0268</td>
<td>-.00028 .00065</td>
</tr>
<tr>
<td></td>
<td>(2.27) (8.83)</td>
<td>(8.83) (8.83)</td>
<td>(1.11) (1.11)</td>
</tr>
<tr>
<td><strong>Tenure^2</strong></td>
<td>-.0003 .0054</td>
<td>.00011 (6.9)</td>
<td>.00643 (4.63)</td>
</tr>
<tr>
<td><strong>Union</strong></td>
<td>-.1614 -.01153</td>
<td>-.8438 -.0258</td>
<td>.19151 .01824</td>
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<tr>
<td></td>
<td>(2.32) (4.63)</td>
<td>(4.63) (4.63)</td>
<td>(5.98) (5.98)</td>
</tr>
<tr>
<td><strong>SMSA</strong></td>
<td>-.0188 -.00210</td>
<td>.0985 .00425</td>
<td>-.10832 -.00940</td>
</tr>
<tr>
<td></td>
<td>(2.29) (1.01)</td>
<td>(1.01) (1.01)</td>
<td>(1.73) (1.73)</td>
</tr>
<tr>
<td><strong>Married</strong></td>
<td>-.3256 .02967</td>
<td>-.1649 -.00841</td>
<td>.19671 .01893</td>
</tr>
<tr>
<td></td>
<td>(3.79) (1.58)</td>
<td>(1.58) (1.58)</td>
<td>(2.38) (2.38)</td>
</tr>
<tr>
<td><strong>Disabled</strong></td>
<td>.0685 .00798</td>
<td>-.4320 -.01860</td>
<td>.13216 .01322</td>
</tr>
<tr>
<td></td>
<td>(.70) (.283)</td>
<td>(.283) (.283)</td>
<td>(1.39) (1.39)</td>
</tr>
<tr>
<td><strong>Race (1 = black)</strong></td>
<td>-.2560 -.02051</td>
<td>-.5144 -.02068</td>
<td>.16015 .01425</td>
</tr>
<tr>
<td></td>
<td>(5.62) (5.00)</td>
<td>(5.00) (5.00)</td>
<td>(2.41) (2.41)</td>
</tr>
<tr>
<td><strong>Log likelihood</strong></td>
<td>-.9965 -5.332</td>
<td>.149</td>
<td></td>
</tr>
<tr>
<td><strong>Mean of dependent variable (P)</strong></td>
<td>.0986 .0443</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number of observations</strong></td>
<td>13,588</td>
<td>13,324</td>
<td></td>
</tr>
</tbody>
</table>

**Note.** Absolute t-statistics are in parentheses.

* These columns report the estimated derivatives for the probabilities $\{\beta_1 P_j (1 - P_j) \}$. The dependent variables are measured between $t - 1$ and $t$. All level variables are measured in $t - 1$. Excluded are observations with the highest-ranked occupation.
If one aggregates the two types of upward transition into one category ("career mobility"), the model collapses to a standard logit model. The estimation results under this specification are also reported in table 1 (cols. 9–12).

As discussed earlier, unobserved heterogeneity may be a determinant of mobility. To the extent that such unobservables are correlated with observables (e.g., schooling and tenure), our estimates are likely to be biased.\textsuperscript{13}

Another estimation problem might arise because of misreporting of occupational changes (see n. 12). However, it can be shown that if the errors in reported occupations are random, the estimated coefficients will be biased toward zero, thus weakening the reported results. Focusing on upward transitions will only reduce the amount of errors without causing any additional bias.

1. Schooling and Career Mobility

The theory of career mobility predicts two opposite effects of schooling on career mobility. Since more educated workers can start their working careers in a higher-level occupation, their careers might involve a smaller number of distinct occupations than those of less educated workers. In addition, high-skill careers might involve fewer changes in tasks over time, which will cause more educated workers to have fewer transitions. On the other hand, as predicted by the model, given the occupation of origin, more educated workers are more likely to move to a higher-level occupation (within or across firms).

Without a control for occupation of origin (table 1, col. 11), schooling has a negative effect on career mobility. This result indicates that careers of more educated workers are more likely to be composed of a smaller number of distinct occupations. If we control for one-digit occupation of origin, schooling has a positive effect on career mobility within and across firms.\textsuperscript{14} Given firm separation, more educated workers are more likely to quit than to be laid off, but schooling increases the likelihood of upward mobility in the case of both quits and layoffs (not shown here).

The schooling effect on the probability of career mobility will vary, depending on the type of career and the occupation the worker is in.

\textsuperscript{13} In the maximum likelihood estimates, in the presence of individuals' fixed effects, even with no correlation between the fixed effects and other covariates, the estimation results of these covariates are likely to be inconsistent.

\textsuperscript{14} A similar observation is made with regard to black workers. On average, they are more likely to move to a higher-level occupation. If we control for occupation of origin, the race dummy becomes negative. See Galor and Sicherman (1988) for a discussion on race and other variables in the career mobility models.
In the next subsection, we analyze the differences in the returns to schooling across occupations.

2. The Effect of Schooling on Wage and on the Probability of Promotion

As suggested by the theoretical analysis, at some stages of a working career we might observe that workers with different levels of human capital have the same wages within a specific occupation. In other words, the estimated short-run returns to schooling, when workers are observed while at that stage, will be relatively low.

Human capital theory is a life cycle theory, and returns to schooling should be estimated accordingly. Therefore, we suggest that the observed differences in returns to schooling across occupations may possibly be due to the differences in promotion probabilities across occupations.

In the following, we test the hypothesis that if the return to human capital (schooling) is lower while one is working in a specific occupation, the effect of schooling on the probability of being promoted from that occupation will be higher. Consider the following fixed-effect models:

\[
Y_{int} = X_{it} \beta_1 + \gamma_m ED_i + \delta_m + \epsilon_{int}, \quad (10)
\]

\[
\ln(W_{int}) = X_{it} \beta_2 + \alpha_m ED_i + \mu_m + \epsilon'_{int}. \quad (10')
\]

Equation (10) is a career mobility equation in which the schooling effect (\(\gamma_m\)) is occupation specific. Equation (10') is a standard wage regression. As in equation (10), the schooling effect (\(\alpha_m\)) is occupation specific.

The following equation is implied by our hypothesis and will be tested empirically:

\[
\text{corr}(\alpha_m, \gamma_m) < 0. \quad (11)
\]

Estimates of \(\alpha_m\) and \(\delta_m\) are presented in table 2.

The estimated correlation between the effect of schooling on wage in the occupation and its effect on the probability of moving to a higher-level occupation is \(-.61\) and is highly significant. (The probability that the correlation is different from zero is .9985.)

Since each of the coefficients is measured with a different level of error, it can be shown that the measured correlation given above is underestimated. This result is based on the assumption that the estimation errors are independent. Since the two sets of returns are derived from the same sample, this assumption might not hold. In order to ensure such an independence, we divided the data into two random subsamples and reestimated the regressions using a different subsample for each regression. The estimated correlation between the two
<table>
<thead>
<tr>
<th>Occupational Category</th>
<th>CAREER MOBILITY MODEL*</th>
<th>WAGE MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient (1)</td>
<td>Probability (2)</td>
</tr>
<tr>
<td>10 Physicians, dentists†</td>
<td>.05784</td>
<td>.0073</td>
</tr>
<tr>
<td></td>
<td>(.94)</td>
<td></td>
</tr>
<tr>
<td>11 Other medical and paramedical</td>
<td>-.06144</td>
<td>-.0078</td>
</tr>
<tr>
<td></td>
<td>(.82)</td>
<td></td>
</tr>
<tr>
<td>12 Teachers, primary and secondary schools</td>
<td>.02647</td>
<td>.0033</td>
</tr>
<tr>
<td></td>
<td>(.45)</td>
<td></td>
</tr>
<tr>
<td>13 Teachers (college), social scientists, librarians, and archivists</td>
<td>-.06757</td>
<td>-.0086</td>
</tr>
<tr>
<td></td>
<td>(.84)</td>
<td></td>
</tr>
<tr>
<td>14 Architects, chemists, engineers, and physical and biological scientists</td>
<td>-.14642</td>
<td>-.0186</td>
</tr>
<tr>
<td></td>
<td>(1.73)</td>
<td></td>
</tr>
<tr>
<td>15 Technicians</td>
<td>.1175</td>
<td>.0149</td>
</tr>
<tr>
<td></td>
<td>(1.84)</td>
<td></td>
</tr>
<tr>
<td>17 Public advisors</td>
<td>.05762</td>
<td>.0073</td>
</tr>
<tr>
<td></td>
<td>(.95)</td>
<td></td>
</tr>
<tr>
<td>18 Judges, lawyers</td>
<td>-.33584</td>
<td>-.0426</td>
</tr>
<tr>
<td></td>
<td>(.98)</td>
<td></td>
</tr>
<tr>
<td>19 Professional, technical, and kindred workers not listed above</td>
<td>.1564</td>
<td>.0198</td>
</tr>
<tr>
<td></td>
<td>(2.69)</td>
<td></td>
</tr>
<tr>
<td>20 Managers, officials, and proprietors (except farm), not self-employed</td>
<td>.3885</td>
<td>.0493</td>
</tr>
<tr>
<td></td>
<td>(5.15)</td>
<td></td>
</tr>
<tr>
<td>31 Like 29, self-employed (unincorporated businesses)</td>
<td>.2153</td>
<td>.0273</td>
</tr>
<tr>
<td></td>
<td>(3.26)</td>
<td></td>
</tr>
<tr>
<td>40 Secretaries, stenographers, and typists</td>
<td>.1138</td>
<td>.0144</td>
</tr>
<tr>
<td></td>
<td>(2.19)</td>
<td></td>
</tr>
<tr>
<td>41 Other clerical workers</td>
<td>.1426</td>
<td>.0181</td>
</tr>
<tr>
<td></td>
<td>(3.48)</td>
<td></td>
</tr>
<tr>
<td>45 Sales workers</td>
<td>.07513</td>
<td>.0095</td>
</tr>
<tr>
<td></td>
<td>(1.98)</td>
<td></td>
</tr>
<tr>
<td>50 Foremen not elsewhere classified</td>
<td>.2164</td>
<td>.0274</td>
</tr>
<tr>
<td></td>
<td>(6.08)</td>
<td></td>
</tr>
<tr>
<td>51 Other craftsmen and kindred workers</td>
<td>.1953</td>
<td>.0248</td>
</tr>
<tr>
<td></td>
<td>(5.85)</td>
<td></td>
</tr>
<tr>
<td>52 Government protective service workers (fire, police, marshals, and constables)</td>
<td>.1176</td>
<td>.0149</td>
</tr>
<tr>
<td></td>
<td>(2.71)</td>
<td></td>
</tr>
<tr>
<td>55 Members of the armed forces</td>
<td>.06732</td>
<td>.0085</td>
</tr>
<tr>
<td></td>
<td>(4.3)</td>
<td></td>
</tr>
<tr>
<td>61 Transport equipment operatives</td>
<td>.05677</td>
<td>.0072</td>
</tr>
<tr>
<td></td>
<td>(2.32)</td>
<td></td>
</tr>
<tr>
<td>62 Operatives, except transport</td>
<td>.1198</td>
<td>.0152</td>
</tr>
<tr>
<td></td>
<td>(5.09)</td>
<td></td>
</tr>
<tr>
<td>70 Unskilled laborers (nonfarm)</td>
<td>.1101</td>
<td>.0140</td>
</tr>
<tr>
<td></td>
<td>(5.18)</td>
<td></td>
</tr>
<tr>
<td>71 Farm laborers and foremen</td>
<td>.08899</td>
<td>.0113</td>
</tr>
<tr>
<td></td>
<td>(3.12)</td>
<td></td>
</tr>
<tr>
<td>73 Other service workers</td>
<td>.04436</td>
<td>.0056</td>
</tr>
<tr>
<td></td>
<td>(2.17)</td>
<td></td>
</tr>
<tr>
<td>80 Farmers (owners and tenants) and managers</td>
<td>.06254</td>
<td>.0079</td>
</tr>
<tr>
<td></td>
<td>(.30)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Absolute t-statistics are in parentheses.  
* The logit parameter estimates are in col. 1, and the derivatives for the probabilities are reported in col. 2, calculated as \(\phi (1 - \phi)\).  
† Observations in which the highest-level occupation is observed are excluded. The other independent variables are market experience, firm tenure, union membership, race, SMSA, if married, if disabled, and occupation of origin.
sets of returns this time was $-0.53$ and was again significantly different from zero. The reduction in the correlation is the result of avoiding the positive correlation between the regressions' estimated errors and the increase in the standard errors of the estimated coefficients due to the smaller number of observations.

3. Quitting and Career Mobility

Economic theory suggests that a worker will quit his job if the expected present value of his future earnings if he stays in the firm is lower than if he leaves the firm. Most of the work that we are aware of relates quitting decisions to changes in the economy or imperfect information. Quitting as a result of a bad match and finding out the existence of a better job in another firm are examples of imperfect information (or the arrival of new information) concerning opportunities and the nature of the firm. Changes in the economy might make the worker reevaluate his position and cause him to quit.

The theory of career mobility presented here suggests an additional reason for mobility (in the spirit of Rosen [1972]): Quitting is a device by which workers realize an optimal path of a chosen career. When a career that a worker considers his best choice cannot be realized in one firm (and the loss of firm-specific human capital is taken into account), quitting will be part of the worker's optimal (ex ante) career path. What is unique to this type of quitting is that it may be planned in advance by the worker.

Some stages of the career are uncertain. We presented this uncertainty as the probability of being promoted inside the organization. The actual quitting time, conditioned on the promotion decision, will differ from the initial expected quitting time. The theoretical result that this section tests empirically is the effect of the promotion decision on the worker's decision to quit. Our hypothesis is that the higher the expected probability of promotion a worker has, the larger the effect of not being promoted on the decision to quit.

There are many reasons why workers who have high expected probabilities of promotion are not promoted. One reason is that there are not enough vacancies for the higher position (or the worker has reached the highest position available in the firm). Another reason might be unobserved heterogeneity or a bad match. If the reason for the bad match is firm specific, the worker might decide to quit.

On the other hand, a realization that the reason for not being promoted will also hold in other firms might induce the worker to stay (if he is not laid off before) in the same occupation/position within the firm.

We call those workers who have a high expected probability of being promoted but are not promoted the "disappointed workers."
The higher the level of expected probability of promotion, given no promotion, the higher the level of disappointment.

We predict that the higher the level of disappointment, the more likely the worker is to quit. We next test this hypothesis empirically.

For each worker at each period, we estimate the probability of promotion, based on the promotion model estimated earlier. We then see whether the worker is promoted or not. For those workers who are not promoted (the disappointed), we "look into the future" and see if and when they quit. We continue to follow those workers as long as they stay in the firm and are not promoted. The hypothesis tested is that the higher the level of disappointment (defined earlier), the higher the likelihood of observing an early quit. It should be noted that the structure of the data set (one observation each year) does not allow us to observe those workers who quit very early. The reason is that we estimate the probability of promotion for the year interval and define "no promotion" only if the worker stayed in the firm until the next survey. Therefore, the workers who expect, with high probability in the beginning of the period, to be promoted and are not might quit during the period, and for those workers one cannot say whether they were not promoted.

We now present a nonparametric measure to test our model. Let $Y_{it} = 1$ if individual $i$ is promoted between $t - 1$ and $t$, and 0 otherwise; $\tilde{P}_{it} = \text{prob}(Y_{it} = 1)$ be the expected probability that the worker will be promoted, based on observed characteristics at $t - 1$ (using the estimated coefficients reported in table 1, col. 1); $Q_{i,t+j} = 1$ if $i$ quit between $t+j-1$ and $t+j$, and 0 if not; and $D_{it} = (\tilde{P}_{it}|Y_{it} = 0)$ be defined as the level of disappointment.

The hypothesis is that the rank correlation between $D_{it}$ and $Q_{i,t+j}$ is positive and will decrease as $j$ is increasing. In other words, $\text{corr}(D_{it}, Q_{i,t+1}) > \text{corr}(D_{it}, Q_{i,t+2}) > \text{corr}(D_{it}, Q_{i,t+3}) > \text{corr}(D_{it}, Q_{i,t+4})$. The number of surveys in the data set allows us to observe a maximum of four periods to the future. The estimation results using Spearman correlation are reported in the following table.

<table>
<thead>
<tr>
<th>Spearman Correlation Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q_{i,t+1}$</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>$D_{it}$</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Number of observations</td>
</tr>
</tbody>
</table>

The numbers in parentheses are the probabilities that the true correlation is zero. These probability values are obtained by treating $(n - 2)^{1/2}p/(1 - p)^{1/2}$ as coming from a $t$-distribution with $n - 2$ de-
degrees of freedom, where \( p \) is the appropriate correlation. In our case, these values should be taken with a lot of caution.

These results support our hypothesis. The fact that the correlation becomes negative beyond a certain point might be due to the presence of unobserved heterogeneity that is not firm specific, as discussed earlier.

4. Duration Effects on Career Mobility

Specific human capital and job-matching theories predict a negative effect of tenure on mobility.\(^{15}\) The presented theory of career mobility conversely predicts that there exists a positive effect of tenure in occupation on occupational mobility; individuals acquire skills and experience in one occupation in order to be able to move to another occupation. An empirical test for the presence of a positive duration effect on career mobility has to be conducted that controls for firm-specific investment. Such a test can be performed by considering intrafirm mobility.

Since the PSID does not report tenure in occupation, the analysis is limited to the effects of time in the labor force (experience) and time with the present employer (tenure). Replacing firm tenure with tenure in position did not alter the results reported here.

The results reported in table 1 indicate that the effect of tenure on career mobility depends on whether or not the worker changes firms. In column 9, which combines intra- and interfirm mobility, the effect of tenure on mobility is negative. However, column 1 shows a positive effect of tenure on the promotion probability. This observation supports the hypothesis that skills and experience accumulated in prior occupations increase the likelihood of moving to a higher-level occupation.

IV. Summary

This paper analyzes the role as well as the significance of the phenomenon of occupational mobility in the labor market focusing on individuals' careers. The study provides an additional dimension to the existing analysis of prominent labor market phenomena including investment in human capital, differences in wage profiles across individuals, and interfirm mobility. Occupational mobility, defined as a change in tasks performed on the job, is analyzed as an integral part of the worker's career path.

It is shown that more educated individuals have careers that involve

\(^{15}\) Jovanovic's (1979) matching model predicts an initial positive duration effect.
a smaller number of distinct occupations and therefore are less likely
to change occupations (and firms). Within a given occupation, how-
ever, more educated individuals are more likely to move to a higher-
level occupation, within or across firms. This observation explains the
variations in the returns to schooling across occupations. In those
occupations in which the returns to schooling (in terms of wages) are
lower, the effect of schooling on career mobility is larger.

The rate of career mobility decreases with time in the labor market.
With higher levels of experience, career mobility is more likely to
occur within the firm (promotion) than across firms. Within the firm,
firm tenure has a positive effect on career mobility. This observation
confirms the proposition that skills and experience accumulated in
one job/occupation are transferable to other occupations along the
worker's career.

As was demonstrated in the theory presented in this paper, individu-
als' optimal career path may involve intrafirm mobility as well as
interfirm mobility. Intrafirm career mobility (promotion) is subject to
the employer's decision, whereas interfirm mobility and its optimal
timing are determined by the individuals who choose the optimal
quitting time so as to maximize their expected lifetime earnings. In-
trafirm career mobility is uncertain. The probability of promotion is a
function of schooling, ability, and job experience. The optimal in-
vestment in human capital and the optimal quitting time maximize the
individual's expected lifetime income. The optimal quitting time for
individuals who were not promoted occurs earlier than that for indi-
viduals who were promoted. It is shown empirically that among work-
ers who were not promoted, those with a higher probability of promo-
tion are more likely to quit the firm. The higher the probability of a
promotion, the earlier they quit.

Appendix A

Occupational Classification Used in the PSID

Two-Digit Classification

10 Physicians (medical and osteopathic), dentists
18 Judges, lawyers
11 Other medical and paramedical
14 Teachers (college), social scientists, librarians, and archivists
15 Architects, chemists, engineers, and physical and biological scientists
13 Teachers, primary and secondary schools
17 Public advisors
12 Accountants and auditors

16 These are ranked by the level of human capital required to work in the occupation
(see App. B). The occupational codes are those used in the PSID. Occupation 73, private
household workers, was not ranked because of zero observations.
20 Managers, officials, and proprietors (except farm), not self-employed
19 Professional, technical, and kindred workers not listed above
16 Technicians
45 Sales workers
31 Like 20, self-employed (unincorporated businesses)
50 Foremen not elsewhere classified
80 Farmers (owners and tenants) and managers
52 Government protective service workers (fire, police, marshals, and constables)
55 Members of the armed forces
40 Secretaries, stenographers, and typists
51 Other craftsmen and kindred workers
41 Other clerical workers
61 Transport equipment operatives
62 Operatives, except transport
75 Other service workers
70 Unskilled laborers (nonfarm)
71 Farm laborers and foremen

One-Digit Classification (Not Ranked)

10–19 Professional, technical, and kindred workers
20 Managers, officials, or proprietors
30–31 Self-employed businessmen
40–49 Clerical and sales workers
50–52 Craftsmen, foremen, and kindred workers
61–62 Operatives and kindred workers
70–75 Laborers and service workers
80 Farmers and farm managers

Appendix B

The Vertical Ranking of Occupations

The objective of the following analysis is to construct an occupational index that will serve as an indicator for the amount of human capital needed to work in different occupations. Upward occupational mobility based on such an index will reflect an increase in the level of human capital, obtained through schooling, market experience, or other forms of on-the-job training.

The index is derived by first regressing log earnings on a set of variables including, among other things, education, (a proxy for) labor market experience prior to entry into the occupation, and the amount of training required to perform the job. An index of occupational level is computed for each occupation as a weighted average of the occupational means of these three variables, where the weights are the coefficients from the earnings function.

A formal derivation of the ranking is now presented followed by the estimation results. A comparison with other alternative occupational indices is presented followed by a discussion of some of the advantages and weaknesses of our index.

Consider the following wage regression:

$$\ln(W_{ijt}) = X_{ijt}\beta + aE_i + \tau PEXP_{ijt} + \delta TEN_{ijt} + \mu RQT_{ijt} + \epsilon_{ijt}, \quad (B1)$$
where $\mathbf{X}$ is a vector of observed characteristics, $E$ is the worker's level of schooling, $\text{PEXP}$ is market experience prior to entry into the present occupation, $\text{TEN}$ is tenure in the occupation, $\text{RQT}$ is the amount of training the worker received in order to be fully qualified to work in the present occupation, $i$ is the individual's index, $j$ is the occupation index, and $t$ is the time index.

Define the level of human capital the worker needs in order to be qualified to work in the occupation as

$$HC_{ij} = \alpha E_i + \tau \text{PEXP}_{ij} + \mu RQT_{ij}.$$  \hspace{1cm} (B2)

Then the mean level of human capital needed to be fully qualified to work in occupation $j$ is given by

$$HC_j = \frac{\sum_i HC_{ij}}{N_j}.$$  \hspace{1cm} (B3)

and the vertical distance between occupations $k$ and $l$ is given by

$$DV_{kl} = HC_k - HC_l.$$  \hspace{1cm} (B4)

Since tenure in occupation is not reported in the PSID, it was replaced by two alternative proxies, tenure in position and time in the labor force, which can be viewed as lower and upper bounds to tenure in occupation. Appendix A shows the resulting ranking. Estimates of equation (B1) and human capital measures under different specifications are available on request.

**Occupational Status and Prestige**

Different scales of "occupational status" or "occupational prestige" have been developed by sociologists over the last 60 years. Different methods were used in constructing them, varying from surveys in which individuals were asked to rank occupations' prestige on the basis of personal judgment to more analytical methods that combined prestige with different measures of education and wages. Two examples of such indices are the Duncan socioeconomic status index and the National Opinion Research Center occupational prestige index developed by Paul Siegel and Robert Hodge. Both indices are highly correlated with the vertical ranking developed in this work (see App. table B1).

**Discussion**

The major motivation in deriving the occupational index presented in this Appendix is that occupational upgrading is considered as mobility that is obtained through gaining skills and experience. Therefore, mobility to an occupation that pays higher wages as a compensation for bad working conditions, risk, and so forth or for other reasons such as unionism should not be considered as upward mobility.

Although in deriving the index we implicitly assume that wages are the only form of compensation, the resulting index is superior to other alternatives such as the mean wages per occupation. By basing our ranking on the mean levels of human capital in the occupations, we allow some occupations to be ranked higher than what is reflected by reported wages, assuming implicitly other forms of compensation (see, e.g., farmers).

Our ranking is highly correlated with that obtained by the mean levels of
### Table B1

**Duncan Socioeconomic Index, Siegel Prestige Mean Scores, Mean Wages, and Schooling per Two-Digit Classification**

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Duncan Index</th>
<th>Siegel Prestige</th>
<th>Number of Observations</th>
<th>Wage (^1)</th>
<th>Schooling</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Physicians, dentists</td>
<td>93.247</td>
<td>78.964</td>
<td>59</td>
<td>8.334</td>
<td>16.84</td>
</tr>
<tr>
<td>11 Other medical and paramedical</td>
<td>70.043</td>
<td>54.837</td>
<td>89</td>
<td>4.762</td>
<td>16.28</td>
</tr>
<tr>
<td>12 Accountants and auditors</td>
<td>76.800</td>
<td>55.900</td>
<td>220</td>
<td>5.990</td>
<td>15.54</td>
</tr>
<tr>
<td>13 Teachers, primary and secondary schools</td>
<td>69.697</td>
<td>58.268</td>
<td>308</td>
<td>4.587</td>
<td>16.29</td>
</tr>
<tr>
<td>14 Teachers (college), social scientists, librarians, and archivists</td>
<td>78.721</td>
<td>70.518</td>
<td>176</td>
<td>6.001</td>
<td>16.56</td>
</tr>
<tr>
<td>15 Architects, chemists, engineers, and physical and biological</td>
<td>84.012</td>
<td>65.056</td>
<td>561</td>
<td>6.717</td>
<td>15.63</td>
</tr>
<tr>
<td>scientists</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 Technicians</td>
<td>62.709</td>
<td>52.219</td>
<td>591</td>
<td>5.315</td>
<td>13.84</td>
</tr>
<tr>
<td>17 Public advisors</td>
<td>71.733</td>
<td>57.258</td>
<td>230</td>
<td>4.947</td>
<td>15.01</td>
</tr>
<tr>
<td>18 Judges, lawyers</td>
<td>92.300</td>
<td>75.100</td>
<td>150</td>
<td>7.311</td>
<td>16.92</td>
</tr>
<tr>
<td>19 Professional, technical, and kindred workers not listed above</td>
<td>62.460</td>
<td>50.940</td>
<td>147</td>
<td>5.650</td>
<td>15.43</td>
</tr>
<tr>
<td>20 Managers, officials, and proprietors (except farm), not self-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>employed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31 Like 20, self-employed (unincorporated businesses)</td>
<td>64.066</td>
<td>51.784</td>
<td>2,034</td>
<td>6.177</td>
<td>14.06</td>
</tr>
<tr>
<td>40 Secretaries, stenographers, and typists</td>
<td>...</td>
<td>44.955</td>
<td>550</td>
<td>5.629</td>
<td>12.24</td>
</tr>
<tr>
<td>41 Other clerical workers</td>
<td>44.079</td>
<td>37.464</td>
<td>25</td>
<td>3.463</td>
<td>13.20</td>
</tr>
<tr>
<td>45 Sales workers</td>
<td>54.277</td>
<td>38.660</td>
<td>941</td>
<td>4.018</td>
<td>12.49</td>
</tr>
<tr>
<td>50 Foremen not elsewhere classified</td>
<td>49.700</td>
<td>45.300</td>
<td>842</td>
<td>4.926</td>
<td>13.75</td>
</tr>
<tr>
<td>51 Other craftsmen and kindred workers</td>
<td>28.649</td>
<td>37.387</td>
<td>478</td>
<td>5.049</td>
<td>11.62</td>
</tr>
<tr>
<td>52 Government protective service workers (fire, police, marshals,</td>
<td></td>
<td></td>
<td>3,470</td>
<td>4.224</td>
<td>11.25</td>
</tr>
<tr>
<td>and constables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55 Members of the armed forces</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61 Transport equipment operatives</td>
<td>30.830</td>
<td>37.449</td>
<td>227</td>
<td>4.411</td>
<td>12.42</td>
</tr>
<tr>
<td>62 Operatives, except transport</td>
<td>18.488</td>
<td>30.557</td>
<td>312</td>
<td>3.858</td>
<td>13.15</td>
</tr>
<tr>
<td>70 Unskilled laborers (nonfarm)</td>
<td>19.184</td>
<td>30.075</td>
<td>1,321</td>
<td>3.644</td>
<td>10.85</td>
</tr>
<tr>
<td>71 Farm laborers and foremen</td>
<td>8.799</td>
<td>35.698</td>
<td>2,450</td>
<td>3.677</td>
<td>10.95</td>
</tr>
<tr>
<td>73 Other service workers</td>
<td>7.384</td>
<td>19.593</td>
<td>1,109</td>
<td>3.261</td>
<td>10.06</td>
</tr>
<tr>
<td>80 Farmers (owners and tenants) and managers</td>
<td>14.292</td>
<td>22.468</td>
<td>268</td>
<td>2.814</td>
<td>8.53</td>
</tr>
<tr>
<td></td>
<td>14.676</td>
<td>40.792</td>
<td>370</td>
<td>2.402</td>
<td>11.91</td>
</tr>
</tbody>
</table>

**Note:** The last three columns are taken from the PSID sample of males aged 18–60.

* Taken from Hauser and Featherman (1977). Based on 1970 census detailed occupation codes. The rank correlation between the two rankings is .957. The weights used for the means per two-digit classification are based on the number of workers in each occupation in the 1981 wave of the PSID.

\(^1\) Hourly wage, at the survey date, divided by the implicit price deflator for consumption expenditures (1972 = 100).
schooling (the rank correlation is .95). Nevertheless, it allows occupations reached mainly through experience and on-the-job training to be ranked higher than those based on schooling alone (see, e.g., managers and foremen).

A major weakness of the ranking is that each occupation is an aggregation of more detailed occupations. Therefore, a worker might move to a higher-level occupation considering the detailed occupations but, on the basis of our ranking, will be observed moving to a lower-level occupation. Data limitations do not allow a more detailed (three-digit) occupational ranking.

Our ranking might underrank occupations that are obtained through means of investment that are unobserved (by the econometrician) such as dedication and initiative. It might overrank occupations characterized by low-quality workers (relative to their observed characteristics).

The major objective for deriving an occupational index is to define an occupational ranking. Considering the analysis for which the index is used, we find it superior to alternative rankings used in the literature.

References


