Industry Wage Differences and Intra-Industry Mobility of Workers

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This paper develops a simple model of intra-industry mobility of workers as a function of skills and industry rents to identify the causes of industry wage differences, rents or skills. Workers in an industry paying high rents are more likely to be mobile within their industries relative to across industries as the rents outside the industry are lower. In contrast, workers with greater amounts of general skills do not necessarily have a stronger tendency to remain within the same industry as their skills are equally valued in all industries, although industry specific skills, have the same effect as the rents in limiting interindustry mobility. The overall combined effect of these skills on intra-industry mobility is smaller as various skills are linked with each other commonly through basic ability of workers. This identification scheme is applied to the Panel Study of Income Dynamics (PSID) and the evidence is generally consistent with the skill interpretation of industry rents. (*JEL* Classifications: J31, J63)

I. Introduction

It is well known to economists that wages differ among industries; workers with similar qualification (in terms of education, experience, and occupation) earn different wages depending on industries they are affiliated with (Slichter 1950; Krueger and Summers 1987, 1988; Katz and Summers 1989). In most data and specifications, the inter-industry wage differences explain 7% to 18% of overall earnings dispersion,

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and such differences have been persistent for an extended period of time (Allen 1995). Less well known, however, is what causes such wage differences. This paper attempts to identify the source of industry wage differences.

One interpretation of industry wage differences is that they represent the efficiency-wage type rents. In shirking models, higher wages are paid in an attempt to prevent workers from opportunistic behaviors (Shapiro and Stiglitz 1984); high wages would discourage shirking as potential shirkers are afraid to lose them. Firms may also find it profitable to pay high wages to reduce worker-initiated job turnovers as unexpected turnovers are costly to firms (Stiglitz 1974). Further, high wages may induce greater worker efforts as such goodwill on firm's part enhances worker morale (Akerlof 1984; Akerlof and Yellen 1988). Despite the varying causes, these models share the important implication that such wage premiums represent rents attached to *jobs*, not directly explained by worker quality or skills. Consequently more workers are attracted to those jobs paying higher wages and excess labor supply arises.

An alternative interpretation is that unobserved differences (unobserved by econometricians) in worker skills account for the wage differences. High ability workers are paid more and high-wage firms and industries are those that, on average, employ talented (high skilled) workers. Systematic entry of high ability workers into these firms and industries provoked by technology and/or worker-job match (Gibbons and Katz 1992; Krueger 1993; Kim 1998).

Many empirical studies have investigated these hypotheses in different ways with varying results. On the one hand, Katz and Summers(1989) and Krueger and Summers(1988) show that industry wage premiums are negatively correlated with quit rates and positively correlated with average job tenures. They interpret the results in favor of the rent-based explanation as workers earning high rents would not quit their jobs as often as those earning lower (or no) rents. On the other hand, Murphy and Topel(1987) emphasize the importance of worker skills by showing that the wage gains of a typical worker switching into a high wage industry are at most 30% of the wage differences implied by cross-sectional wage comparisons. They conclude that more than 70% of the implied industry premiums are attached to *workers*, not to jobs. Murphy and Topel(1988) also show that a reasonable, though hypothetical, degree of sorting on unobservable quality can explain almost all of the industry premiums as reflecting skill differences. Gibbons and Katz(1992) and Kim(1998) provide some evidence that worker sorting based on match-quality is the likely cause of the wage differences.

Among the evidence cited in this dispute, it has to be understood that the negative correlation between industry wage premiums and quit rates is not necessarily inconsistent with the skill-based explanation. High skilled workers are likely to be more productive in investing in firm specific skills and thus they are less likely to quit (e. g. Hall 1989; Mortensen 1978; Pencavel 1972; Topel and Ward 1991). Further when worker-job match is an important determinant of worker productivity, abler workers (on well matched jobs) are less likely to quit as the gains from better matches are larger for them. Thus the (often-cited) negative correlation can also arise when the industry premiums reflect worker ability differences between industries.

This paper puts forth a more exclusive test which focuses on intra-industry mobility of workers, not just on worker mobility among jobs. When industry wage differences represent rents, wage offers from that industry induce mobility by workers, and more so than do wage offers from industries paying lower or no rents. Consequently intra-industry mobility is *relatively* more frequent in high rent industries than in low rent industries. In contrast when wages do not contain such rent components, intra-industry mobility of workers is equally likely in both high and low wage industries as the wage offer distributions for a given worker do not differ among industries.[1] This contrast between rents and skills is the basis of the test conducted in this paper.

This paper is organized in the following way. In the next section, a simple model of intra-industry mobility is developed. In Section III, the data and empirical strategy are described. Section IV lists the empirical results, and the final section concludes with remarks on the caveats.

[1]Presence of specific skills complicates the discussion because industry specific skills, per se, have the same effect as industry rents. The model in this paper uses an identifying assumption to distinguish the effects of industry-specific skills from those of rents. See Section II for a fuller discussion.

II. Model of Intra-Industry Mobility

I construct a simple hazard model in which voluntary job separation (quit) occurs when a worker receives a wage offer that dominates his/her current wages. A worker's wage consists of industry rent and various skill components including general, firm-specific, and industry specific skills.[2] The important identifying assumption used here is that these skill components are assumed to be commonly based on the worker's basic ability. Denoting worker i's basic ability μ_i, the worker earns $W_j(\mu_i)$ in industry j as in equation (1).

$$W_j(\mu_i) = \mu_i + \alpha\mu_i + \theta\mu_i + R_i + \epsilon_{ij}. \tag{1}$$

The first component, μ_i, represents general skills that are equally valued in all sectors of economy.[3] The next two terms, $\alpha\mu_i$ and $\theta\mu_i$, represent firm-specific and industry-specific skills, and R_j represent the rents paid in industry j. The last term is error term, ϵ_{ij}, which has zero mean.[4]

A worker is assumed to receive one wage offer in each period, and the offer may come from within his/her current industry or from outside. The within-industry wage offers, on average, may differ from the outside offers in two components, industry-specific skills and industry rents. For worker i in industry j, the within-industry wage offer, $W_{oj}(\mu_i)$, and the outside offer (denoted as industry k), $W_{ok}(\mu_i)$, have the following forms.

$$\begin{aligned} W_{oj}(\mu_i) &= \mu_i + \theta\mu_i + R_j + \epsilon_{oij} \\ W_{ok}(\mu_i) &= \mu_i + R_k + \epsilon_{oik} \end{aligned} \tag{2}$$

The subscript "o" stands for "offers" and it distinguishes wage offers from the wage currently earned by the worker. Neither offer contains the compensation for firm-specific skills as they are useless outside the current firm, but the within-industry offer carries the compensation for industry-specific skills, $\theta\mu$. Both types

[2]It is assumed that skills are known to both worker and his/her employer(s), and the value of skills are reflected in wages. Not all the skills, however, are observable to econometricians, giving rise to the possibility that skill differences are reflected in the wage differences.

[3]For simplicity, the unit of ability is normalized so that a worker's general skills can be denoted as his/her ability.

[4]Worker-job matching is not directly addressed in the model, only implicit in the error terms. See Section V for the discussion on matching.

of offers contain industry rents, R_j and R_k, which are commonly paid in all firms within each industry. The error terms, ϵ_{oik} and ϵ_{oij}, are orthogonal to each other and assumed to have a common distribution function, F, which is also the same for all workers.[5]

I now derive the probability of intra- and inter-industry mobilities, denoted as q_s and q_m, respectively. As job separation occurs when a dominating offer arrives, each probability is calculated below for worker i in industry j.

$$\begin{aligned} q_{sj}(\mu_i) &= \pi_j\{1-F(\alpha\mu_i + \epsilon_{ij})\} \\ q_{mj}(\mu_i) &= (1-\pi_j)[1-F\{(R_j-R_k) + \theta\mu_i + \alpha\mu_i + \epsilon_{ij}\}]. \end{aligned} \tag{3}$$

π_j is the probability that the given offer is from within the industry, and $1-\pi_j$ is the probability that it is from outside.

Equation (3) indicates that higher ability discourages mobility through firm-specific skills, which motivates this paper; both intra-industry and inter-industry mobilities are lower for high ability workers. It is also evident in equation (3) that rents reduce inter-industry mobility but not intra-industry mobility, while ability reduces *both* types of mobilities through firm-specific skills (and also through industry-specific skills in the case of inter-industry mobility). The differential effects of rents and ability on intra-industry mobility are the basis of the test which investigates the relationship between the estimated industry premiums and intra-industry mobility to identify the cause of industry wage differences.

The model is further elaborated to draw the implications on the empirical relationship between the industry premiums and the mobilities which are directly applicable to the data. Denoting the mean ability of workers in industry j as μ^j, equation (3) can be re-written as below.

$$\begin{aligned} q_{sj}(\mu_j) &= \pi_j\,[1-F\{\alpha(\mu^j + \Delta\mu_{ij}) + \epsilon_{ij}\}] \\ q_{mj}(\mu_i) &= (1-\pi_j)[1-F\{(R_j-R_k) + (\theta+\alpha)(\mu^j + \Delta\mu_{ij}) + \epsilon_{ij}\}]. \end{aligned} \tag{4}$$

[5]Rents may vary among firms within industries, in which case each firm's deviation from industry mean rents is reflected in the residual terms. This presents two problems; first, it may cause heteroscadasticity in the wage residuals and the offer distributions, and second, the residuals become some mixture of (unobservable) skills and rents so that the interpretation of the effects of residuals on mobilities calls for extra care. The problem of heteroscadasticity may also arise due to worker sorting based on job match quality. Econometric treatment of heteroscadasticity is explained in Section IV where the results are discussed.

where $\Delta\mu_{ij}(=\mu_i-\mu^J)$ represents worker i's deviation from the mean ability of his/her industry. Partially differentiating equation (4) with respect to the mean ability, μ^J, the following are obtained:

$$\frac{\partial q_{sj}}{\partial \mu^J}=-\pi_J\,\alpha f\{\alpha(\mu^J+\Delta\mu_{ij})+\epsilon_{ij}\}<0$$
$$\frac{\partial q_{mj}}{\partial \mu^J}=-(1-\pi_J)(\theta+\alpha)f(R_j-R_k)+(\theta+\alpha)(\mu^J+\Delta\mu_{ij})+\epsilon_{ij})<0. \quad (5)$$

Under the skill-based explanation, the industry premiums reflect the industry differences in mean ability, $(1+\alpha+\theta)\mu^J$. Thus the empirical relationship between observed industry mean wages and the mobilities is illustrated in the following equations under each hypothesis.

$$\frac{\partial q_{sj}}{\partial\{(1+\alpha+\theta)\mu^J\}}=-\frac{\alpha}{1+\alpha+\theta}\pi_J f\{\alpha(\mu^J+\Delta\mu_{ij})+\epsilon_{ij}\}<0$$
$$\frac{\partial q_{mj}}{\partial\{(1+\alpha+\theta)\mu^J\}}=-\frac{\theta+\alpha}{1+\alpha+\theta}(1-\pi_J)f\{(R_j-R_k)+(\theta+\alpha)(\mu^J+\Delta\mu_{ij})+\epsilon_{ij}\}<0 \quad (6)$$
$$\frac{\partial q_{sj}}{\partial R_j}=0$$
$$\frac{\partial q_{mj}}{\partial R_j}=-(1-\pi_J)f\{(R_j-R_k)+(\theta+\alpha)(\mu^J+\Delta\mu_{ij})+\epsilon_{ij}\}<0.$$

The first two partial derivatives in equation (6) represent the changes of each type of mobilities in response to higher industry mean wages when the differences in mean wages reflect skills differences. These inequalities imply that a worker in high ability industries are less likely to quit his/her industry *ceteris paribus*, that is, when his/her residuals ($\Delta\mu_{ij}$ and ϵ_{ij}) are controlled for.[6] The contrast to be noted is the one between the first and the third inequality in the equation; intra-industry mobility is less likely

[6]As implicit in the partial derivatives, the model in this paper is NOT a general equilibrium model, which needs a fuller discussion on the initial allocation of workers across industries. The main reason why I rely on the partial approach is that it is much simpler, and especially so as the implications have to be applied to the data with limited work history of each individual. The loss of generality in this limited approach does not appear large, however, as the information on initial allocation of workers is partly reflected through the wage residuals (on the previous jobs) in the mobility equations.

among workers in high wage industries relative to those in low wage industries under the skill-based explanation while no such difference exists under the rent-based explanation.

I derive a testable hypothesis also regarding the conditional probability of intra-industry mobility. The conditional probability of intra-industry mobility is defined as $c=q_s/(q_s+q_m)$, and its derivative is $c(1-c)/(dq_s/q_s-dq_m/q_m)$. The empirical relationships between the premiums and the conditional probability are the following under each type of explanations.

$$\frac{\partial c}{\partial R_i}=c(1-c)\frac{f_m}{1-F_m}>0$$
$$\frac{\partial c}{\partial\{(1+\alpha+\theta)\mu^j\}}=-c(1-c)\frac{1}{1+\alpha+\theta}\left\{\frac{\alpha f_s}{1-F_s}-\frac{(\theta+\alpha)f_m}{1-F_m}\right\},\tag{7}$$

where $F_s=F\{\alpha(\mu^J+\Delta\mu_{ij})+\epsilon_{ij}\}$ and $F_m=F\{(R_j-R_k+(\theta+\alpha)\mu^j+\Delta\mu_{ij})+\epsilon_{ij}\}$, and f_s and f_m are the density functions evaluated at each point. Equation (7) shows that industry rents increase the conditional probability of intra-industry mobility as the rents reduce inter-industry mobility while having no effect on intra-industry mobility. Skills, however, have an indeterminate effect on the conditional mobility because of the presence of industry-specific skills that have the same effects as the rents.

Due to this indeterminacy, the test has to rely on the relative magnitudes of the effects of rents and skills, which are illustrated in equation (8).

$$\frac{\partial c}{\partial R_i}-\frac{\partial c}{\partial\{(1+\alpha+\theta)\mu^j\}}$$
$$=c(1-c)\left(\frac{\alpha}{1+\alpha+\theta}\frac{f_s}{1-F_s}+\frac{1}{1+\alpha+\theta}\frac{f_m}{1-F_m}\right)>0.\tag{8}$$

The above inequality implies that, although the conditional intra-industry mobility may also rise with industry mean wages when the wages refleck skills, it does less so relative to when the wages reflect industry rents. The intuition behind this inequality can be seen by comparing the following two extreme cases. First suppose that industry variation in mean wages reflect industry-specific skills only. Then the conditional probability of intra-industry mobility increases with industry mean wages as the skills reduce inter-industry mobility while having no effect on intra-industry mobility. Second suppose that there are no industry-specific skills ($\theta = 0$). In this case, the conditional probability is simply π_j and unaffected by the wage differences. As industry specific skills are allowed by increasing θ from 0, the effects of higher mean wages on the conditional probability is the weighted average of these two extreme cases. The overall ability effect thus must be smaller than the effect of industry rents.[7]

III. Data and Empirical Strategy

The empirical results documented in this paper are based on the information about prime age male individuals drawn from the 1976-85 waves of the Panel Study of Income Dynamics (PSID).[8] It includes work history of individuals such as turnover incidence and industry transitions. One potentially important drawback in the data is that workers retiring from their jobs are not distinguished from those who quit their jobs. I attempt to resolve this problem by limiting quits as those followed by subsequent employment and also limiting the sample to reasonably young workers (25-55 years old). The final sample consists of 3,983 individuals and 23,920 person-year observations. Some major statistics from this sample are reported in Table 1.

Two important empirical strategies are noteworthy. The implication on the conditional probability of intra-industry mobility takes the form of an inequality between the rents and the skills effects. To implement this inequality into empirical test, first, the key regressors of mobility equations have to be normalized in a common unit, and second, a benchmark estimate for the effect of rents has to be established to which the estimate of the effect of industry premiums is to be compared to determine whether the premiums reflect skills or rents.

[7]Industry premiums can arise from inter-industry differences in θ's. In that case, the variations in industry premiums reflect those in θ's, whose effects on intra-industry mobility are the same as rents. Our test fails in this case.

[8]Questions asked in the survey underwent some changes between 1975 and 1976, which affected key variables in the current analysis. For example, in earlier years, each interviewee was asked whether he or she belonged to any union. From 1976 on, the survey asks whether the job was covered by collective contract. The latter question appears to be more relevant in estimating union premiums and union job transition, and the earlier observations are excluded.

TABLE 1

INDUSTRY SUMMARY: MALES FROM 1976-85 WAVES OF PSID

Industry	Number of obs.	Log Hourly Wages	School	Experience*	Union Shares	Quit Rates	Intra-Industry**
Mining	344	2.398	12.6	14.95	26.5	8.3	4.1
Manufacturing Durable	5,191	2.281	11.8	17.35	41.9	5.8	2.6
Manufacturing Non-Durable	2,708	2.173	11.7	16.66	34.3	4.9	1.6
Construction	2,110	2.079	11.0	15.31	28.2	10.1	4.6
Transportation	1,585	2.282	11.8	17.08	45.5	7.7	2.8
Communication	441	2.456	13.0	14.99	53.7	6.2	2.3
Utility	746	2.254	12.1	16.67	42.2	3.3	0.7
Retail Trades	2,479	2.015	12.4	15.52	18.6	13.5	5.6
Wholesale Trades	818	2.192	12.6	16.26	20.8	9.0	1.3
F.I.R.E.	831	2.346	14.1	16.66	6.7	13.5	6.1
Business and Repair Service	912	2.056	12.3	14.61	16.2	14.0	3.9
Personal Service	698	2.044	12.4	16.77	25.4	12.4	5.0
Professional Service	2,623	2.219	14.4	17.34	24.2	8.2	3.5
Public Administration	2,634	2.198	13.0	15.52	33.6	4.2	1.1
Total	23,920	2.196	12.4	16.41	31.5	7.9	3.1

Note : School, experience are measured in year.
Union shares, quit rates, and stay rates (intra-industry mobility) are measured in percentages.

* : Market experience is imputed as age-years of schooling - 6.

** : The rate of intra-industry mobility.

To normalize the units of regressors, each regressor is measured in terms of log hourly wages, calculated from the estimates of OLS wage regressions. The wage equation is estimated as a function of various worker and job characteristics including industry and occupation indicator variables, and individual wages are decomposed using the predicted values into components attributable to each regressor. These wage components are then used as the regressors in the mobility (hazard) equations. The standard errors obtained in this second stage regression are known to be under-reported, and I correct them following Murphy and Topel (1985).

To obtain the benchmark estimate of the effects of rents on mobilities, a rent component that varies across industries is needed in the mobility equations. I choose the (estimated) industry level union wage premiums for the purpose. Though obviously an imperfect choice, it is based on the observation that many economists consider at least some parts of the union premium as representing pure rents (e. g. Rees 1977; Freeman and Medoff 1979). To the extent that industry level variation in union premiums represents variation in rents earned by the corresponding union members, the union premiums will affect intra-industry mobility in the same way as do industry rents, and provide a consistent estimate of the effects of rents. It is possible, however, that other parts of union premiums represent skill variation. Many union activities enhance worker productivity, for example, through efficient grievance procedure (Freeman and Medoff 1979), or high union premiums are matched by higher productivity of workers through lower employment or selective employment. As the estimated effect of union premiums on conditional intra- industry mobility will be biased toward zero in this case, the resulting estimate constitutes a *lower* bound for the rent effect, and it actually increases the power of the test.

IV. Estimation of Mobility Equation

I first estimate the wage equation, the result from which is used decomposing wages in normalized units. The dependent variable in the wage equation is log real hourly earnings. Hourly earnings are calculated by dividing annual earnings by annual hours and deflating it with the PCE deflator from the national product and income accounts. The regressors include education, job tenure, imputed market experience (age-schooling-6), race indicator, marriage indicator, 9 occupation indicator and 14 industry indicator variables.[9] 14 industry by union indicator variables are also added to estimate industry level union wage premiums. This equation may be estimated separately for each year, but I opt to use the whole sample with several year indicator variables for more precise estimates.[10] The estimates for industry premiums and union premiums from this equation are reported in Table 2. The estimates conform to those estimated in previous studies (for example, Katz and Summers 1989).

The implications draw in the model section regarding job mobility can be summarized in three. First, abler workers are also less likely to quit their jobs, rendering invalid the negative correlation between industry premiums and turnover rates that has been considered exlusively supporting the rent-based explanation. Second, the industry premiums would have no effect on intra-industry mobility under the rent-based explanation while it would reduce the mobility under the skill-based explanation. Third, the conditional probability of intra-industry mobility given a quit would rise less with the premiums when they reflect skills relative to when they represent rents. These implications are evaluated in the data.

The probability of job mobility is estimated by logistic regression and the result is reported in Table 3. Column (1) of the table shows that quit rates are inversely related to (observed) skills as well. Skill variables such as education, experience and tenure, reduce quit incidence. Evaluated at the mean, one additional year of schooling reduces it by 0.3 percentage points, one additional year of market experience reduces it by 0.15 percentage points, and one additional year of tenure reduces it by 1 percentage point.[11]

The table also shows that workers on (union) covered jobs are

[9]The 9 occupational categories are professional, managerial, sales, clerical, craftsmen, operatives, transport equipment operatives, unskilled laborers, and service workers. For industrial categories, see Table 1.

[10]Precision in the estimates at this first stages is important in estimating the second stage equation (Murphy and Topel 1985) and I choose to sacrifice flexibility in estimates for precision. To my best knowledge, estimating the equation separately does not yield qualitatively different results but it increases standard errors in the second stage regression.

[11]These marginal effects are calculated by multiplying the coefficients to $P(1-P)$ where P is the mean probability of quits.

TABLE 2

ESTIMATED PREMIUMS FROM OLS WAGE EQUATION

Industry	Industry Premiums	Union Premiums	Employment Share
Mining	0.318 (0.029)	0.192 (0.051)	1.5%
Manufacturing Durables	0.143 (0.013)	0.210 (0.012)	21.9%
Manufacturing Nondurables	0.103 (0.015)	0.196 (0.017)	11.4%
Construction	0.040 (0.016)	0.465 (0.022)	8.4%
Transportation	0.145 (0.018)	0.286 (0.021)	6.7%
Communication	0.196 (0.031)	0.149 (0.040)	1.9%
Public Utilities	0.080 (0.023)	0.245 (0.031)	3.1%
Retail Trades	-0.066 (0.014)	0.372 (0.023)	10.3%
Wholesale Trades	0.086 (0.019)	0.188 (0.038)	3.4%
F.I.R.E.	0.124 (0.019)	0.054 (0.064)	3.5%
Business Repair & Services	0.028 (0.019)	0.167 (0.041)	3.7%
Personal Services	-0.030 (0.021)	0.299 (0.039)	2.8%
Professional Services	-0.090 (0.015)	0.142 (0.020)	11.0%
Public Administration		0.275 (0.018)	10.3%

Note : Standard errors are in parentheses.
Wage equation includes education, experience, job tenure, demographic controls and occupation controls.

TABLE 3
PROBABILITY OF QUITTING JOB
PSID, 1976-1985 WAVES : MALE ONLY
(N = 23,920)

Variables	(1)	(2)	(3)
School (in years)	-0.037 (0.010)	-0.031 (0.014)	0.020 (0.014)
Experience (in years)	-0.023 (0.003)	-0.025 (0.003)	-0.020 (0.003)
Tenure (in years)	-0.148 (0.007)	-0.135 (0.008)	-0.119 (0.008)
Race Dummy (white = 1)	-0.403 (0.059)	-0.420 (0.060)	-0.508 (0.062)
Marrital Status (married = 1)	-0.283 (0.061)	-0.211 (0.061)	-0.113 (0.063)
Union Dummy (1 if union-covered job)	-0.664 (0.068)	-0.607 (0.071)	-0.418 (0.073)
Log Hourly Earnings	–	–	-0.696 (0.053)
Industry Control (14 industry dummies)	No	Yes	Yes
Occupation Control (7 occupation dummies)	No	Yes	Yes
-2 log likelihood	11,840.27	11,673.14	13,859.34

Notes : Method of estimation, Logistic regression
Dependent variable, quit=1 if quit in the previous year, 0 else
Asymptotic standard errors are in parentheses.

less likely to quit, which is rather a well-known fact. In column (2), industry and occupation controls are added to the specification and consequently the estimates reduce in size with little qualitative changes. Finally when the wages on previous jobs are added to the model (column (3)), the coefficients again become smaller but most of them are still significant.[12] These results indicate in a very straight-forward way that skills also reduce job mobility.

The estimation results of (unconditional) intra-industry mobility are reported in Table 4. The regressors are mostly the same as in Table 3 except that they are now measured in the unit of log (hourly) wages. Further, industry union premiums, industry premiums and occupation premiums are now continuous variable created by assigning to each worker the coefficients on his/her relevant indicator variables in the wage equation; for example, the industry premiums are calculated as $\sum_j \beta_j D_{ij}$ for worker i where β_j is the coefficient on industry indicator variable D_{ij} in the wage equation. The residuals from the wage regression are also added to the mobility equation as the implications are based on partial derivatives (see equation (6)).

With the exception of occupation premiums, most skill variables reduce intra-industry mobility as well as inter-industry mobility. As indicated in the first two columns, the industry premiums reduce both intra- and inter-industry mobilities, which pattern is consistent with the skill-based explanation[13]; the hypothesis that the coefficient on industry premiums is 0 is easily rejected in the first column, and so is the hypothesis that other skill variables have 0 coefficients. Separating non-union workers from union-covered job holders does not change the results qualitatively. Industry premiums have negative coefficients in both samples although they are not significant in the union sample. Industry union premiums similarly reduce inter-industry mobility

[12]Topel and Ward(1992) show that market experience increases quit incidence once wages are controlled for. The departure of our results from theirs, still negative coefficient on market experience in column(3), may arise from the differences in age composition in data. They focus on young workers in job-shopping stage but our sample includes older workers.

[13]A couple of points are noteworthy. First, the random terms in wage offers may be heteroscadastic as they carry some information on work-sorting, in which case the estimates will be inconsistent. The conditional moment test (Pagan and Vella 1989) indeed rejects homoscadasticity at 5% risk. I correct this problem by including up to 4th order polynomials of the wage residuals until homoscadasticity is not rejected. The empirical results reported in this section and in the following sections are based on this "corrected" estimates. Second, as mentioned in the previous section, the standard errors of the estimates are corrected following the formulae in Murphy and Topel(1985).

TABLE 4

INTRA- AND INTER-INDUSTRY MOBILITY

Mobility Type*	All		Union		Non-union	
	Intra	Inter	Intra	Inter	Intra	Inter
Union	-1.00 (0.29)	-0.20 (0.24)				
Union Wage Premium	1.78 (1.01)	-1.57 (0.96)	2.17 (1.11)	-1.84 (0.99)		
Industry Wage Premium	-0.88 (0.44)	-1.21 (0.36)	-1.18 (1.24)	-2.11 (0.93)	-0.84 (0.45)	-1.08 (0.38)
Occupation Premium	0.73 (0.37)	-1.62 (0.35)	-0.97 (1.03)	-1.28 (0.83)	0.93 (0.40)	-1.72 (0.33)
Education	-0.54 (0.29)	0.35 (0.25)	-1.20 (0.78)	-0.23 (0.71)	-0.50 (0.32)	0.42 (0.28)
Experience	-1.33 (0.42)	-2.17 (0.34)	-2.73 (1.17)	-4.80 (0.97)	-1.16 (0.44)	-1.77 (0.37)
Tenure	-7.82 (0.63)	-7.90 (0.55)	-5.47 (1.31)	-6.08 (1.16)	-8.38 (0.71)	-8.21 (0.63)
Individual Errors	-0.27 (0.11)	-1.01 (0.10)	-1.11 (0.35)	-1.88 (0.30)	-0.19 (0.10)	-0.88 (0.09)
-2 log likelihood	6,180.2	8,009.9	1,059.9	1,376.2	5,052.3	6,606.1
N	23,920		6,917		17,003	

Notes : Higher order polynomials of wage residuals are included in regressions.
Corrected asymptotic standard errors are in parenthesis.
Mobility Type, intra=1 if quit for a job in the same industry, 0 else
inter=1 if quit for a job outside the industry, 0 else

but they *increase* intra-industry mobility.[14] The results do not change qualitatively when industry size and year indicator variables are added to the equation in an incomplete attempt to control for offer arrival rates and business cycles.

I now turn to the estimation of conditional probability of intra-industry mobility given a quit, and 1,861 quit incidences are sampled for the purpose from the original sample. The regressors are measured again in log wage units, and the dependent variable takes 1 if a worker quits for a job within the same industry and 0 if the worker quits for a job outside the industry. The logistic estimation results are reported in Table 5.

[14]This positive effect does not directly follow from the model in Section II. This anomaly appears to arise from the failure to properly control for industry variation in offer arrival rates. More discussion is given in Section V regarding this result.

TABLE 5
CONDITIONAL PROBABILITY OF INTRA-INDUSTRY MOBILITY GIVEN A QUIT

Variables	All	Union	Nonunion
Union	-0.77 (0.39)		
Union Wage Premiums	3.46 (1.44)	3.90 (1.57)	
Industry Wage Premium	0.32 (0.54)	1.46 (1.62)	0.15 (0.56)
Occupation Premiums	2.16 (0.47)	0.50 (1.31)	2.39 (0.53)
Education	-0.79 (0.39)	-1.26 (1.02)	-0.76 (0.45)
Experience	0.79 (0.54)	1.47 (1.53)	0.60 (0.58)
Tenure	0.16 (0.72)	1.27 (1.72)	-0.09 (0.80)
Individual Errors	0.63 (0.19)	1.66 (0.51)	0.59 (0.19)
Union Wage Premium - Industry Premium	3.14 (1.51)	2.44 (1.76)	–
-2 log likelihood	2,428.5	344.8	2,063.7
N	1,861	279	1,582

Notes : All the regressors are measured in terms of wage rate.
Other controls are marital status, race and year dummies and higher order polynomials of wage residuals.
Corrected asymptotic standard errors are in parentheses.
Dependent variable, 1 if stayed in the same industry
0 if moved into other industries

Union wage premiums, the (true) rent variable, have a significantly positive effect while industry premiums have a negligible effect and so do most skill variables.[15] The hypothesis that the coefficients on union premiums and on industry premiums are the same is convincingly rejected at 5% level ($\chi^2=4.21$). Separating the sample into union and non-union workers does not change the results

[15]The exceptions are the occupation premiums and the wage residuals, which have significantly positive coefficients. See Section V for the discussion of these exceptions.

qualitatively. These results, jointly with those reported in Table 4, indicate that industry premiums are more likely to reflect ability variation of workers across industries, or at least that not all the premiums are rents.

Though very roughly, it can be calculated how much of the premiums reflects worker ability. Assuming that the skill effect is 0 as indicated by the theory and the practice – most skill variables have the coefficients not significantly different from 0 in Table 5 – and using the coefficient on the union premiums as the benchmark rent effect, the first column in Table 5 indicates that roughly 90% ($\approx$(3.46 – 0.32)/3.46) of the premiums are skill-based. When the estimates in column (2) are used, a similar calculation implies that roughly 60% of the premiums are skill-based. The estimates by Murphy and Topel(1987), who find that roughly 70% of the premiums are skills, fall in the range implied by the above estimates.

V. Caveats and Concluding Remarks

This paper reconsiders the evidence that has been argued in favor of the efficiency-wage type rent interpretation of industry premiums, the negative correlation between the premiums and turnover rates (Krueger and Summers 1988; Katz and Summers 1989). This paper explores the possibility that such negative correlation arises between skills and the premiums, and shows that observed worker skills are also inversely related to turnover rate through firm-specific and/or industry-specific skills. To the extent that both observable and unobservable skills share similar properties, this finding may be extended to unobservable skills, rendering reasonable doubts to the validity of the evidence. Given the doubts, intra- industry mobility is investigated in an attempt to produce a more exclusive test. The results are generally consistent with the skill-based interpretation of industry wage differences, but the analysis produces some puzzling results as well, which appear to arise partly from incomplete control of offer arrival rates and from the narrowness of the pure ability-based model of Section II.

Gibbons and Katz(1992) raise a similar issue on the limitations of pure ability-based model and they provide a few examples to show that a simple and pure ability-based model cannot explain *all* the observed pattern of industry premiums and related mobilities.

Kim(1992) also emphasizes the importance of matching in understanding industry wage differences. In these matching models, the output of a worker varies among jobs depending on the match, and some industries provide a greater number of jobs better matched to skilled workers while others provide jobs better matched to unskilled workers. Workers initially sort into industries but mismatches occur either due to imperfect information or to costly search process. Workers switch jobs to improve match quality, sometimes switching industries as well, as more information arrives.

Under the circumstances, the offer arrival rates are not necessarily orthogonal to worker characteristics as jobs are not spread over industries and certain jobs are quite concentrated in only a handful of industries (Helwege 1992). Such industrial concentration tends to be stronger in high-skilled jobs as industries differ in outputs and technology, and also in union jobs as most union jobs are concentrated in manufacturing, utility and transportation industries. This leads to the positive correlation between offer arrival rates and worker characteristics, which I consider is reflected the significantly positive coefficients on the occupation premiums and the union premiums in the mobility equations. The positive coefficient of wage residuals can also be interpreted in the same manner as they represent some mixture of individual ability and (firm-level) matching component.

This observation enlightens the venue in which further discussion should be placed regarding industry wage differences. The pure rent-based explanation is one extreme which does not appear to have the strong explanatory power as the present value of industry wage differentials is too large to be sustained in a free market with job mobility; the 20% wage differential (between manufacturing and retail trades) amounts to an annual income difference of \$5,000 for an average worker earning \$25,000 per year, and its present value exceeds \$90,000 at 5% interest rate. This is an amount not many workers would willingly turn down. Yet we see many workers leaving high wage industries on the one hand, and we do not see workers forming a long queue for such high wage jobs (for example, manufacturing jobs) on the other hand. The pure skill-based explanation is at the other extreme, and relatively more consistent with the empirical findings documented in this paper and in others as well. As previously noted, however, it has its own limitations as not all the empirical findings are explained by the hypothesis. The matching model, a combination of the two extremes, has the flexibility and richness necessary to explain the observed pattern of mobility (voluntary and involuntary) in a more consistent manner, and it certainly deserves further examination.[16]

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References

Akerlof, George A. "Gift Exchange and Efficiency Wages: Four Views." *American Economic Review* 74 (May 1984): 79-83.

______, and Yellen, Janet. "The Fair Wage/Effort Hypothesis and Unemployment." mimeo, University of California-Berkeley, 1988.

Allen, Steven G. "Updated Notes on the Interindustry Wage Structure, 1890-1990." *Industrial and Labor Relations Review* Vol. 48 No. 2 (January 1995).

Freeman, Richard B., and Medoff, James. "The Two Faces of Unionism." *Public Interest* 57 (1979): 69-73.

Gibbons Robert S., and Katz, Lawrence F. "Does Unmeasured Ability Explain Inter-Industry Wage Differences?" *Review of Economics Studies.* 1992.

Hall, Robert. "Industry Rents and Industrial Policy: Comments and Discussion." *Brookings Paper on Economic Activity*, 1989.

Helwege, Jean., "Sectoral Shifts and Interindustry Wage Differentials," *Journal of Labor Economics* (No. 1 1992).

Katz, Lawrence F., and Summers, Lawrence H. "Industry Rents and Industrial Policy." *Brooking Papers on Economic Activity* 1989.

Kim, Daeil. "Re-interpreting Industry Wage Premiums: Match-Specific Productivity." *Journal of Labor Economics.* 1998, forthcoming.

Krueger, Alan B. "How Computers Have Changed the Wage Structure: Evidence from Microdata, 1984-1989." *Quarterly Journal of Economics* (1993).

[16]Models of compensating differentials do explain some parts of wage variation; for example, high mining wages can be thought as a risk premium, and low wages in service sectors as reflecting more flexible work hours (Rosen 1986). But most studies find that the explanatory power of compensating differentials is limited as a significant portion of industry wage differences remains even after job characteristics are controlled in the wage equations (Krueger and Summers 1988; Murphy and Topel 1987).

______, and Summers, Lawrence H. "Reflections on the Inter-Industry Wage Structure." In Kevin Lang and Jonathan S. Leonard. *Unemployment and the Structure of Labor Markets.* Oxford: Basil Blackwell, 1987.

________. "Efficiency Wages and the Inter-Industry Wage Structure." *Econometrica* 56 (March 1988): 259-94.

Mortensen, Dale. "Specific Capital and Labor Turnover." *Bell Journal of Economics* 9 (Autumn 1978): 572-86.

Murphy, Kevin M., and Topel, Robert H. "Estimation and Inference in Two-Step Econometric Models." *Journal of Business & Economic Statistics* (October 1985): 370-9.

________. "Unemployment, Risk, and Earnings: Testing for Equalizing Wage Differences in the Labor Market." In Kevin Lang and Jonathan S. Leonard. *Unemployment and the structure of Labor Markets*, Oxford: Basil Blackwell, 1987.

________. "Efficiency Wages Reconsidered: Theory and Evidence." mimeo, University of Chicago, 1988.

Pagan, Adrian, and Vella, Frank. "Diagnostic Tests for Models Based on Individual Data: A Survey." *Journal of Applied Econometrics* Vol. 4 (supplement), 1989.

Pencavel, John. "Wages Specific Training, and Labor Turnover in U.S. Manufacturing Industries." *International Economic Review* 13 (February 1972): 53-64.

Rees, Albert. *The Economics of Trade Unions.* revised ed., University of Chicago Press, 1977.

Rosen, Sherwin. "The Theory of Equalizing Differences." in Orley Ashenfelter and Richard Layard, *Handbook of Labor Economics.* Vol. 1, New York: North-Holand, 1986.

Shapiro, Carl, and Stiglitz, Joseph E. "Equilibrium Unemployment as a Worker Discipline Device." *American Economic Review* 74 (June 1984): 433-44.

Slichter, Sumner. "Notes on the Structure of Wages." *Review of Economics and Statistics* XXXII (1950): 80-91.

Stiglitz, Joseph E. "Alternative Theories of Wage Determination and Unemployment in L.C.D.'s: The Labor Turnover Model." *Quarterly Journal of Economics* LXXXVIII (May 1974): 194-227.

Topel, Robert H., and Ward, Michael P. "Job Mobility and the Careers of Young Man." *Quarterly Journal of Economics* 1992.