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Effects of Industry-Specific Human Capital on Wages and Mobility

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I. Instrouction

A positive association between earnings and job tenure(length of service on current job) and a negative association between the probability of job separation and job tenure are two common cross-section observations reported in the empirical labor economics literature. Although various competing models of labor market dynamics can explain these relationships, probably the most widely accepted is an explanation provided by the human capital theory.¹⁾

The human capital theory, which argues that a worker's productivity rises as he accumulates human capital through training, makes a distinction between general

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1) Other interpretations of the above relations include Jovanovic's(1979) matching model, Lazear's (1981) agency model, Salop and Salop's(1976) screening model, and Harris and Holmstrom's(1982) insurance model.

regardless of where he is employed, while firm-specific training increases a person's productivity only in the firm where he is trained. It is on-the-job training that leads a worker with longer job tenure to earn higher wages than a comparable worker with less job tenure, and the former has, to the extent that human capital contains firm-specific components, a lower propensity to separate than the latter.

One may well argue however that firm-specific and general human capital are two extreme types of human capital in terms of across-job transferability, and hence cannot adequately represent a worker's productive skills. A candidate to fill the gap is industry-specific human capital, which is transferable across firms when a worker changes jobs within a given industry. Ryoo(1992) uses a duration model to investigate the job-changing behavior of young male workers and finds that a worker's industry tenure raises the hazard rates of intra-industry job changes, but lowers the hazard rates of inter-industry job changes. One possibility, as suggested by Ryoo, is that, due to the presence of industry-specific human capital, workers face better wage offers from potential employers when they search for a new job in their current industry than in other industries.

A few recent studies investigate the potential role of industry-specific components of workers' skills in the determination of wages. Kim(1992) addresses industry-specific skills in analyzing inter-industry wage differentials and Carrington and Zaman(1994), who investigate inter-industry wage reductions of displaced workers, postulate that "a worker's earnings power is much more firm-specific in some industries than in others".(p. 273)

Neal(1995) is so far the most explicit study on the role of industry-specific skills in wage determination. Neal analyzes the Displaced Workers Surveys (DWS) to find that workers who switch industries following displacement usually suffer greater losses than observationally similar workers who find new jobs in their predisplacement industry and that among switchers wage losses are strongly correlated with predisplacement measures of work experience and job tenure. He concludes that "workers apparently receive compensation for some skills that are neither completely general nor firm-specific but rather specific to their industry or line of work".(p. 653)

This paper pursues further to investigate the wage-raising effect of industry-specific

skills. The data analyzed here, the Survey of Income and Program Participation(SIPP), have some advantages over the DWS data used in Neal. Most importantly, SIPP allows to compute worker's industry tenure more accurately. Also, SIPP provides information on the length of unemployment spells between jobs, during which skills may erode.

In this paper, wage equations are estimated for three groups of workers; stayers, intra-industry movers, and inter-industry movers. The focus is on the effect of industry tenure on(next-period) wage rates. The human capital theory predicts that if skills contain industry-specific components, then industry tenure raises wage rates of intra-industry movers but not wage rates of inter-industry movers. This prediction is found to be supported by estimation results. Furthermore, the finding that the impact of industry tenure on wages varies across sectors provides one explanation for inter-industry wage differentials.

The remainder of this paper is organized as follows: Section II describes and summarizes the data. Section III contains estimation results and their implications. Section IV concludes the paper.

II. Data

The data come from the 1984 panel of the Survey of Income and Program Participation.²⁾ In this study, in part for reasons pertaining to data collection, workers are assumed to make their decisions on job changes in a 4-month interval, to be referred hereafter to as a period. To focus on inter-firm mobility, being unemployed is not included as one of valid job mobility options. This exclusion is desirable since the effect of being unemployed on wages, which may work through skill erosions and a stigma effect, can be removed. Workers thus have three options regarding their job mobility: stay, move within an industry, and move across industries. Due to the lack of information, however, no distinction is made between voluntary and involuntary

2) The same data have been analyzed in Ryoo(1992), which is referred to for details on the data.

turnover.

Some discussion about the treatment of multiple job holders is in order. A multiple job holder is observed if a worker holds more than one job concurrently or if the worker changes jobs within a four-month-long reference period. In this analysis, multiple job holders in any period are assigned their most important job in that period. The most important job is defined as the one worked the most days during the period.³⁾

For the industry classification to be used in determining the type of job changes, i.e., intra-industry job change and inter-industry job change, the three-digit codes of 1980 Census of Population Industry Classification Systems are used to have 14 major industries. For the list of these industries and the 1980 census industry classification codes, see Appendix 1.

The sample actually used comprises 1400 young male workers, who are employed and aged between 21 and 30 as of the end of wave 3 of the SIPP, which makes the first period in this study.⁴⁾ These workers are considered as being at the risk of changing jobs across periods, and they are followed through the end of the survey unless they either leave the sample or make a transition to states other than paid employment before the completion of the survey. See table 1 for the distribution of workers by period and mobility. The decrease in the number of workers at risk is largely due to sample reductions made by the Bureau of the Census, and, of the original 1400 workers, only 778 workers(55.6%) remain at risk as of period 5(wave 7 of SIPP), for example.

In this analysis, each worker-period is treated as one observation. Note that for a given worker-period to be included as a valid observation, the worker's job mobility decision across current and immediately following periods should be observed. This means that a worker's last period in the SIPP cannot make a valid case. Also, since unemployment is, as mentioned above, not included as a valid mobility option, those who are observed to remain unemployed throughout any given period are treated as if

3) This means that jobs which last for up to four months may be omitted from the analysis. For example, if a spell of a job, which lasts no more than four months, lies evenly divided across two periods, then in each of the two periods, the job may be determined as "unimportant" and hence can be ignored.

4) Each wave of the SIPP is four months long, and individuals in the Survey are interviewed for up to 9 waves.

Table 1. Workers by period and mobility

Period	SIPP wave	No. of workers at risk	Mobility		
			Stay	Move within an industry	Move across industries
1	3	1,400	1,274(91.0)	67(4.8)	59(4.2)
2	4	1,071	966(90.2)	59(5.5)	46(4.3)
3	5	890	802(90.1)	57(6.4)	31(3.5)
4	6	828	645(77.9)	122(14.7)	61(7.4)
5	7	778	674(86.6)	56(7.2)	48(6.2)
6	8	540	461(85.4)	56(10.4)	23(4.3)
Total		5,507	4,822(87.6)	417(7.6)	268(4.9)

Note : Numbers in parentheses are percentages.

they left the SIPP right before the start of the period of unemployment.

As shown in table 1, the total number of individual-period observations used in the estimation is 5507. Of these, 685 observations(12.4%) experience a job change, which is defined as occurring when a worker changes his employers across adjacent periods. There are 417 cases(7.6%) of intra-industry job changes and 268 cases(4.9%) of inter-industry job changes.⁵⁾

Definitions of variables are given in Appendix 2. The two numbers, 1 and 2, coming at the end of some variables indicate that the corresponding variables pertain to the periods before and after job change decisions, respectively. Values of three labor-market-related variables, i.e., job tenure, industry tenure, and labor market experience, all measured in periods(1 period = 4 months), increase by 1 each period except that job tenure is reset at 1 when a worker changes his jobs, and industry tenure is reset at 1 when a worker moves across industries. These three variables are measured as of the period before job change decisions.

This paper attempts to investigate the role of industry-specific skills in workers' wage determination and mobility decisions. The importance of industry-specific skills, however, may well vary across industries.⁶⁾ One way of handling the possible

5) In terms of workers, of the total of 1400 workers in the sample, 406 workers(29.0%) experience at least one job change during the up-to-two-year-long interval, and 181 workers(12.9%) change their jobs more than once during the interval.

6) In fact, in a two-stage estimation of wage equations not shown here, where regressions are run

inter-industry differences in the importance of industry-specific skills is to run a separate regression for each industry. The grouping of observations into each of the 14 industries, however, results in too small number of job changes in each industry to yield reliable estimates. The strategy taken in this paper is to group the industries into two sectors, a manufacturing sector and a service sector. Industries 1 through 5 make the manufacturing sector and the rest of the industries are grouped together to form the non-manufacturing or service sector, and empirical analyses are performed for each of the two sectors.⁷⁾

The difference between the manufacturing and service sectors in the importance of industry-specific skills in wage determination, if accepted, can shed some light on the across-industry wage differentials well established in the literature. Krueger and Summers(1988), for example, report that, even after controlling for important characteristics of workers and firms including job tenure, sizable positive wage premiums are found in some industries mostly belonging to the manufacturing sector(a notable exception is the transportation and public utilities industry). It is plausible that industry-specific human capital, the importance of which may vary across industries, affects the magnitude of rents to be shared between firms and workers, resulting in industry wage differentials.

Tables 2a and 2b show summary statistics by mobility type of selected variables for the manufacturing sector and the service sector respectively.⁸⁾

for the entire sample of 5507 observations, industry tenure has a significant effect on either mobility but not on wages. This result, however, should not imply that industry-specific skills are not important in wage determination.

- 7) The grouping of observations is based on the industry a worker belongs to before his/her mobility decision is realized. Therefore, observations in the manufacturing sector, for example, include workers who move from the manufacturing sector to the service sector.
- 8) It is also plausible to define occupation-specific human capital instead of industry-specific human capital. The decomposition of movers by both industry and occupation is shown in the table below. Although this table shows that movers remain in the same occupation than in the same industry after job changes, it does not follow that workers in this sample are relatively more attached to their occupations than to their industries, because the decomposition uses a finer classification for industries(14 categories) than for occupations(6 categories). For the classification of occupations, see Appendix 2.

Table 2a. Summary statistics: Selected variables, Manufacturing sector

Variables	Stay		Move within an industry		Move across industries	
	Mean	SD	Mean	SD	Mean	SD
AGE	26.75	2.83	26.63	2.65	26.60	2.89
EDUCATION	12.31	2.08	12.23	1.87	12.17	1.89
SMSA1	.431		.448		.478	
SMSA2	.430		.443		.489	
FULL_TIME1	.980		.967		.911	
FULL_TIME2	.974		.967		.944	
HOURLY1	.791		.885		.756	
HOURLY2	.782		.885		.744	
FIRST_JOB1	.221		.066		.067	
LAYOFF1	.021		.044		.022	
SERVICE2	0.0		0.0		.600	
JOB_TENURE	13.08	10.11	5.20	6.39	5.39	6.57
IND_TENURE	15.02	10.08	9.79	8.23	7.44	7.60
EXPERIENCE	25.91	9.67	25.50	8.66	24.66	9.37
LNWAGE1	2.112	.41	2.105	.38	1.868	.51
LNWAGE2	2.135	.41	2.114	.35	1.906	.44
SELECTION	.181	.15	1.665	.40	1.948	.43
Sample size	2,231		183		90	

Some interesting contrasts are immediately apparent between workers in the two sectors. Workers in the two sectors are not different in their age. As expected, however, a higher proportion of jobs in the service sector than in the manufacturing sector are located in metropolitan areas, while hourly-paid jobs are more common in the manufacturing sector. The proportion of part-time workers is very low in both

	Move within an occupation	Move across occupations	Total
Move within an industry	337 (49.2%)	80 (11.7%)	417 (60.9%)
Move across industries	13 (20.9%)	125 (18.2%)	268 (39.1%)
Total	480 (70.1%)	205 (29.9%)	685 (100.0%)

Table 2b. Summary statistics: Selected variables, Service sector

Variables	Stay		Move within an industry		Move across industries	
	Mean	SD	Mean	SD	Mean	SD
AGE	26.78	2.85	26.79	2.93	26.30	2.95
EDUCATION	13.10	2.43	13.12	2.44	12.82	2.41
SMSA1	.593		.692		.612	
SMSA2	.594		.684		.596	
FULL_TIME1	.952		.906		.882	
FULL_TIME2	.955		.923		.888	
HOURLY1	.527		.470		.646	
HOURLY2	.516		.517		.719	
FIRST_JOB1	.222		.094		.067	
LAYOFF1	.007		.004		.022	
SERVICE2	1.0		1.0		.612	
JOB_TENURE	11.17	8.88	4.79	5.77	4.89	6.23
IND_TENURE	12.90	8.98	9.20	7.68	6.62	7.07
EXPERIENCE	24.36	10.14	23.66	10.38	22.07	9.59
LNWAGE1	1.998	.51	1.913	.62	1.813	.54
LNWAGE2	2.027	.55	1.934	.58	1.836	.55
SELECTION	.223	.16	1.686	.36	1.799	.38
Sample size	2,591		234		178	

sectors, and it is particularly so in the manufacturing sector. A layoff is also a rare phenomenon for the workers in this sample, and especially for those in the service sector.

The number of years of formal schooling is slightly lower among workers in the manufacturing sector than among workers in the service sector. Workers in the manufacturing sector have longer job tenure and industry tenure than those in the service sector, which implies that the former, who on average get a higher wage rate than their counterparts in the service sector, are in general less mobile than the latter. In fact, in the manufacturing sector, 7.3 percent and 3.6 percent of (individual-period) observations experience intra- and inter-industry job changes, while in the service sector, the corresponding proportions are 7.8 percent and 5.9 percent respectively.

Note also that education level, total experience, and wage rates have a larger

variation in the service sector than in the manufacturing sector, which suggests that workers in the service sector are relatively less homogeneous than those in the manufacturing sector. We now turn to the comparison of stayers and movers in each of the two sectors.

In each sector, workers who make different decisions on job mobility do not show any discernible differences in their age and education level. In both sectors, workers in a metropolitan area are more likely to change their jobs, and the proportion of part-time workers is higher among both types of movers than among stayers.

In both sectors, the average job tenure of stayers is considerably longer than that of movers, while the two types of movers are not different in their job tenure. Stayers also have longer industry tenure than movers, and among movers, intra-industry movers accumulate longer industry tenure than inter-industry movers before they change jobs. Intra-industry movers are only marginally different from stayers in their labor market experience, while inter-industry movers have slightly lower market experience than the other two types of workers. The wage rates, both before and after a job change, of inter-industry movers are on average lower than those of other groups of workers. This is not surprising since inter-industry movers on average have, among others, the least education and labor market experience and since they are more likely to be part-time workers.

Note in passing that the wage gains of movers are not smaller than the across-period wage gains of stayers, particularly in the manufacturing sector. This is consistent with the findings by Bartel and Borjas(1981), Mincer and Jovanovic(1981), and Mincer(1986), and supports the argument of search while employed. That is, job changes in an early stage of one's career are associated with a wage gain due to mobility, which almost compensates a possible loss of specific human capital. We now move to the empirical results.

III. Empirical results

It may be useful, before discussing formal estimation results, to check briefly how workers' mobility changes as their job tenure and industry tenure increase. Tables 3a and 3b contain workers' mobility by job tenure and industry tenure, respectively. Table 3a shows a familiar negative association between mobility and job tenure. Over one fourth of the cases with no more than one year of job tenure experience job changes across periods. In contrast, less than 5 percent of the cases with job tenure of 3 years or more change their jobs across periods.⁹⁾

Table 3b shows a similar negative relationship between mobility and industry tenure. A comparison of tables 3a and 3b, however, reveals an interesting feature of the two types of job changes. Table 3a shows that both types of job changes decline as job tenure progresses, and that the declining pattern is more or less similar for the two types of job changes. In contrast, table 3b shows that the negative relationship between mobility and industry tenure is much stronger for inter-industry movements than for intra-industry movements : the proportion of inter-industry movers declines at a much higher rate than that of intra-industry movers as industry tenure increases. This relatively strong negative relationship between inter-industry mobility and industry tenure suggests the presence of industry-specific components of a typical worker's productivity.

To analyze more thoroughly the effect of industry-specific human capital(as represented by industry tenure) on wage and job mobility of workers, we now turn to the two-stage estimation results, obtained using a model with polychotomous choice

9) The proportions of job changes shown here are lower than those reported in previous studies, most of which analyze workers' job mobility during a year or a longer period. The job mobility of workers studied here is more comparable to the job-to-job mobility reported by Topel(1986), who analyzes job changes of young workers on a quarterly basis. Topel reports that slightly less than 4% of workers with about 7 years of labor market experience change their jobs across quarters during the third year at their jobs.

Table 3a. Mobility by job tenure

Job tenure	Stay	Move within an industry	Move across industries	Total
3 periods and less	1,107 (73.0)	253 (16.7)	156 (10.3)	1,516 (100.0)
4~6 periods	656 (83.4)	77 (9.8)	54 (6.9)	787 (100.0)
7~9 periods	551 (93.7)	20 (3.4)	17 (2.9)	588 (100.0)
10~15 periods	1049 (94.9)	35 (3.2)	21 (1.9)	1,105 (100.0)
16~21 periods	676 (95.9)	18 (2.6)	11 (1.6)	705 (100.0)
22~27 periods	335 (96.0)	8 (2.3)	6 (1.7)	349 (100.0)
28 periods and above	448 (98.0)	6 (1.4)	3 (.7)	457 (100.0)
Total	4,822 (87.6)	417 (7.6)	268 (4.9)	5,507 (100.0)

Note : Numbers in parentheses are percentages.

Table 3b. Mobility by industry tenure

Job tenure	Stay	Move within an industry	Move across industries	Total
3 periods and less	685 (74.7)	114 (12.4)	118 (12.9)	917 (100.0)
4~6 periods	658 (81.2)	95 (11.7)	57 (7.0)	810 (100.0)
7~9 periods	559 (88.0)	51 (8.0)	25 (3.9)	635 (100.0)
10~15 periods	1,086 (91.2)	68 (5.7)	37 (3.1)	1,191 (100.0)
16~21 periods	835 (93.2)	44 (4.9)	17 (1.9)	896 (100.0)
22~27 periods	465 (92.5)	31 (6.2)	7 (1.4)	503 (100.0)
28 periods and above	534 (96.2)	14 (2.5)	7 (1.3)	555 (100.0)
Total	4,822 (87.6)	417 (7.6)	268 (4.9)	5,507 (100.0)

Note : Numbers in parentheses are percentages.

selectivity due to Lee, Maddala, and Trost(1980) and Lee(1983).¹⁰⁾

1. Estimation results of job change decisions

Table 4 displays the estimation results of a trinomial logit model of job mobility for the manufacturing sector and the service sector. The staying option is the reference alternative, and hence the coefficients of explanatory variables are to be interpreted as the difference between coefficients of each of the two moving options and those of the staying option.

In both sectors, neither race nor marital status has a statistically significant effect on workers' job mobility, and workers with different levels of schooling are not different in their propensity to experience either type of job changes. As expected, a full-time status lowers the probability of job changes. The effect on job mobility of being paid hourly wage rates, however, is different in the two sectors. Its effect on intra-industry mobility, for example, is positive in the manufacturing sector, but negative in the service sector. It may reflect the observation that due to the differences in production technologies it usually takes longer to become a skilled worker in the manufacturing sector than in the service sector, which in turn implies that it pays more for hourly-paid workers, who generally fall in lower rankings in job hierarchy, in the manufacturing sector than in the service sector to stay in their current industry further developing their skills.

Workers in a metropolitan area are in general more likely to change their jobs than workers in a non-metropolitan area, and this effect is the strongest for the intra-industry mobility of workers in the service sector. This may reflect the differences in offer arrival rates, job search costs, and costs associated with moving. Both costs are expected to be higher in a non-metropolitan area. One reason for a higher cost of moving in a non-metropolitan area is that a higher proportion of job changes in a non-metropolitan area involve a relocation of residence.

10) The left-censoring and relatively short observation period of the SIPP make inapplicable the conditional logit maximum likelihood estimation suggested for panel data by Chamberlain (1980).

Table 4. Job mobility equation estimates

	Manufacturing		Service sector	
	Move within an industry	Move across industries	Move within an industry	Move across industries
CONSTANT	-2.7541** (.9671)	.8023 (1.0757)	-.2994 (.6651)	-.4027 (.7535)
NONWHITE	-.0191 (.2794)	.1418 (.3546)	-.0981 (.2256)	.0274 (.2434)
MARRIED	-.0369 (.1719)	.2959 (.2428)	.1385 (.1563)	.2203 (.1770)
EDUCATION	.0160 (.0465)	.0032 (.0612)	-.0311 (.0357)	-.0161 (.0401)
SMSA1	.0708 (.1662)	.3317 (.2313)	.4235** (.1564)	.1611 (.1689)
FULL_TIME1	-.0813 (.4707)	1.2135** (.4553)	-.5572* (.2753)	-.5257 (.2816)
HOURLY1	.7494** (.2836)	-.0394 (.3022)	-.3423* (.1618)	.2135 (.1897)
FIRST_JOB1	.0177 (.3382)	-.2779 (.4825)	-.0787 (.2585)	-.7226* (.3281)
LAYOFF1	.8276 (.4224)	.1282 (.7613)	-.4228 (1.0554)	.8028 (.6004)
JOB_TENURE	-.1566** (.0176)	-.0849** (.0308)	-.1679** (.0171)	-.0883* (.0238)
IND_TENURE	.0217 (.0131)	-.0510* (.0255)	.0344** (.0117)	-.0460* (.0195)
EXPERIENCE	.0240* (.0099)	.0303* (.0137)	.0051 (.0081)	.0029 (.0091)
UNEMP_RATE2	-.0692 (.0487)	-.0752 (.0675)	-.0384 (.0435)	-.0163 (.0479)
LNWAGE1	.1900 (.2392)	-1.1043** (.2639)	-.1174 (.1514)	-.3304 (.1751)
PROFESSION1	.0836 (.3750)	.5198 (.4555)	-.0532 (.2421)	-.0127 (.2778)
TECHNICAL1	-.6772 (.4228)	-.4884 (.5147)	-.0804 (.1981)	-.4843* (.2429)
PRODUCTION1	.1903 (.1764)	.1266 (.2531)	-.2609 (.2523)	.1051 (.2389)
Log-Likelihood	-895.0		-1,316.1	
Sample size	2,504		3,003	

Note : For variable definitions, see Appendix 2.

Numbers in parentheses are standard errors.

* Significant at the 5 percent level.

** Significant at the 1 percent level.

Jobs held for the first time in one's career do not have a higher propensity to terminate than other jobs, which is at odds with the findings by others (for example Topel(1986) p.221). In the manufacturing sector, workers who experience a layoff are marginally more likely to move within an industry. No evidence of across-occupation differences in job mobility is found except that workers in the second occupation category (Technical, Sales, and Administrative) are marginally more attached to their jobs than comparable workers in other occupation categories.

The unemployment rate in the state of residence has an expected negative sign for both types of job mobility. Its effect, however, is not statistically significant. This may be due to the fact that workers analyzed in this study are restricted to those who do not experience, for example, long-term unemployment even when they change jobs. This means that their qualification is superior to that of an average worker, and hence an adverse impact on job mobility of a bad demand condition in a regional labor market is not great for these workers.

Note that the current wage rate has a negative effect on inter-industry mobility, but does not deter intra-industry mobility. One possible explanation is that a worker with higher current wage faces more favorable outside offers. As will be shown below, this effect is much stronger for a worker who seeks his new job in his current industry than in other industries. It suggests that the separation-detering effect of higher wage which operates through a higher reservation offer may be mitigated by its favorable effect on outside wage offers for an intra-industry mover but not for an inter-industry mover.

Job tenure is found to have a very strong negative impact on both types of job mobility in both sectors, confirming the raw tabulations of table 3a.¹¹⁾ This effect can be attributed to at least three components. The first component is the accumulation of job-specific human capital or the better perception of worker-firm match quality. Since this component is already incorporated in the determination of the current wage rate, it is not clear to what degree this effect remains when the current wage rate, may it be

11) It is interesting to note that in both sectors the separation-detering effects of job tenure are stronger for intra-than for inter-industry mobility, but, when combined with those of industry tenure, are almost the same irrespective of mobility type and sector. No easy explanations can be supplied for this finding.

an imperfect measure of productivity, is conditioned upon. The second reason why longer job tenure is associated with lower job mobility is that non-wage benefits such as fringe benefits, which are not controlled for in the estimation, are positively correlated with job seniority. For example, Allen et al.(1989) report that the mean job duration for workers employed by firms providing pensions was more than twice as long as that for workers on jobs without pensions. The third factor operates through workers' self-selection in terms of their unobservable and innate propensity to change jobs. Workers who have accumulated longer job tenure are on average those with a lower propensity to separate, and hence, other things being equal, these workers are less likely to change their jobs.

In both sectors, industry tenure raises intra-industry mobility, but lowers inter-industry mobility, although its effect on intra-industry mobility in the manufacturing sector is not statistically significant. This finding agrees with that in Ryoo(1992), and suggests the presence of industry-specific human capital.¹²⁾ Whether the effect of industry tenure on mobility operates through its effect on outside wage offers, as discussed in introduction, will be explicitly investigated in the following section.

2. Estimation results of wage equations

In the second stage, subsequent-period wage equations are estimated for each of the three groups of workers classified based on their decisions on job changes. Tables 5a and 5b contain the two-stage wage equation estimates for the manufacturing sector and the service sector, respectively. Workers' self-selection in terms of their job mobility decisions is taken into account by including the correction term to be constructed using the trinomial logit estimates of the mobility equation for each sector shown in table 4. The estimates in tables 5a and 5b can thus be interpreted as the effect of each explanatory variable on the wages offered by potential employers

12) Another plausible explanation is that with time in an industry a worker may develop contacts and information that are industry-specific and hence reduce his/her search costs in the industry relative to those across industries. This, however, cannot explain the finding in the following subsection that industry tenure raises wages of intra-industry movers.

Table 5a. Wage equation estimates: Manufacturing sector

	Stay	Move within an industry	Move across industries
CONSTANT	.1829** (.0656)	-.7533 (.4045)	.4779 (.4549)
NONWHITE	-.0151 (.0194)	-.1029 (.0635)	.0499 (.1172)
EDUCATION	.0117** (.0030)	.0120 (.0114)	.0372 (.0229)
SMSA2	.0372** (.0109)	.0283 (.0375)	.0295 (.0854)
FULL_TIME2	.0760* (.0335)	-.0300 (.0983)	.2908 (.1638)
HOURLY2	.0263 (.0150)	.3474** (.0702)	.0766 (.1006)
FIRST_JOB1	-.0205 (.0165)	-.1941* (.0770)	-.4769** (.1714)
LAYOFF1	.0165 (.0375)	.3013** (.1109)	-.3188 (.2786)
SERVICE2	- -	- -	-.1876* (.0853)
JOB_TENURE	.0048** (.0019)	-.0455** (.0125)	.0139 (.0120)
IND_TENURE	-.0002 (.0012)	.0150** (.0037)	-.0076 (.0098)
EXPERIENCE	.0001 (.0009)	.0069* (.0029)	.0068 (.0056)
UNEMP_RATE2	-.0015 (.0032)	-.0376** (.0123)	-.0171 (.0232)
LNWAGE1	.7503** (.0149)	.6526** (.0516)	.2432 (.1500)
PROFESSION2	.0883** (.0226)	.2648** (.0768)	.8296** (.2052)
TECHNICAL2	.0601** (.0215)	.0592 (.1033)	-.0195 (.1327)
PRODUCTION2	.0299* (.0121)	.0610 (.0394)	.1228 (.0983)
SELECTION	.2428** (.0856)	.7229** (.1834)	.0865 (.2150)
R ²	.6528	.6116	.5455
Sample size	2,231	183	90

See table 4 notes.

Table 5b. Wage equation estimates: Service sector

	Stay	Move within an industry	Move across industries
CONSTANT	.3563** (.1017)	.5406 (.5055)	.0109 (.4249)
NONWHITE	-.0393 (.0250)	.0161 (.0865)	-.0779 (.0912)
EDUCATION	.0211** (.0043)	.0310* (.0140)	.0268 (.0155)
SMSA2	.0601** (.0176)	.0231 (.0883)	.0200 (.0634)
FULL_TIME2	.1014* (.0411)	.1035 (.1111)	.1729 (.1047)
HOURLY2	.0060 (.0178)	.0255 (.0689)	.4059** (.0877)
FIRST_JOB1	-.0225 (.0230)	-.0633 (.1146)	-.1948 (.1408)
LAYOFF1	.0070 (.1000)	.2032 (.4090)	-.3694 (.2318)
SERVICE2	- -	- -	-.1527* (.0663)
JOB_TENURE	.0011 (.0030)	.0044 (.0243)	.0073 (.0107)
IND_TENURE	-.0017 (.0020)	-.0032 (.0074)	-.0028 (.0090)
EXPERIENCE	.0045** (.0010)	.0017 (.0031)	-.0001 (.0034)
UNEMP_RATE2	-.0029 (.0048)	-.0097 (.0171)	.0062 (.0182)
LNWAGE1	.5978** (.0185)	.5965** (.0492)	.5413** (.0751)
PROFESSION2	.0624* (.0274)	.1727 (.0922)	.5119** (.1148)
TECHNICAL2	.0562* (.0221)	.0495 (.0759)	.2574* (.1054)
PRODUCTION2	.0951** (.0257)	.1779 (.0985)	.0167 (.0859)
SELECTION	-.2158 (.1190)	-.1823 (.3503)	-.0075 (.2398)
R ²	.4546	.5682	.5366
Sample size	2,591	234	178

See table 4 notes.

including current ones.

Estimation results show that workers with more education in general face better wage offers than comparable workers with less education and that jobs in metropolitan areas offer higher wages, possibly reflecting a higher cost of living in those areas.

It is interesting to note that workers who separate from their first career jobs get lower wage offers from their potential new employers than those who experienced prior job changes, although this effect is not statistically significant in the service sector. Also, among intra-industry movers, being laid off prior to a job change is associated with higher wages at a new job in the manufacturing sector, but not in the service sector. These two results are unexpected and hard to explain.

In both sectors, the lagged wage rate is the most important determinant of both the inside and outside wage offers except for inter-industry movers in the manufacturing sector, for whom it is not even statistically significant. Interestingly enough, in both sectors its importance is the biggest for stayers and the smallest for inter-industry movers, although the differences are much smaller in the service sector.¹³⁾

Occupation dummies control for possible across-occupation differences in wage structures. The data show that there are considerable wage differences across occupation groups. Wage rates are generally higher in the three occupation groups included in the estimation than in the excluded occupation groups, and it is particularly so in the first occupation group (Professional and Managerial).

The estimated coefficients on the selection correction terms indicate the extent of worker self-selection. The data show that there is a strong positive self-selection among stayers and intra-industry movers in the manufacturing sector. These workers are those who get better than average inside or outside wage offers. In contrast, no evidence of self-selection is found for workers in the service sector.

Job tenure, industry tenure, and total experience have qualitatively different effects on wage offers depending on workers' mobility choice. Job tenure has a statistically

13) These estimates are not directly comparable with those reported in previous studies of wage determination mechanisms, since most of previous studies do not condition on workers' lagged wage rates. Mortensen and Neumann (1989) are a rare exception. In analyzing year-to-year wage changes of workers, they include both wage and job tenure at previous jobs in the estimation of the wage rate at new jobs of movers, but do not control for a possible self-selection. Their coefficient estimates, ranging between .45 and .66, of lagged wage are close to those shown here.

significant impact on wage offers for stayers and intra-industry movers in the manufacturing sector only. Its effect however is qualitatively different: it is positive for stayers but negative for intra-industry movers. For movers, the estimated coefficient of job tenure measures the effect of job tenure at the immediately previous job on the wage rate at a new job. The negative coefficient of job tenure for intra-industry movers in the manufacturing sector, obtained with the self-selection and lagged wage rate conditioned upon, is consistent with the job-specific training theory. That is, a worker's wage rate at his previous job is an overestimate of his productivity at his new job to the extent that a portion of human capital accumulated is job-specific and hence valuable only at his previous job.¹⁴⁾¹⁵⁾

The strong positive impact of industry tenure on outside wage offers found for intra-industry movers in the manufacturing sector supports the maintained hypothesis that a worker's human capital contains industry-specific components. It is industry-specific human capital, which continues to be productive even after a job change as long as one remains in the same industry, that deters workers from switching to different industries in the same way as job-specific human capital discourages workers from changing jobs.

For stayers, however, the estimated coefficients of industry tenure do not seem to support the industry-specific human capital hypothesis. This still can be compromised by noting that, in case of stayers, the differences between industry tenure and job tenure are in general too small (see table 2a) to isolate the effect of industry tenure, which may well be present, from that of job tenure.

In the service sector, on the other hand, no evidence of a favorable effect of industry tenure on outside wage offers for intra-industry movers is found, which

14) This argument is somewhat attenuated by the estimation results (not shown here) that job tenure coefficients in pre-mobility wage equations (with no lagged wage controlled for) of both types of subsequent-period movers are not different from zero, while the corresponding coefficient of their staying counterparts is significantly positive.

15) The negative coefficient is consistent with the predictions of Mortensen and Neumann (1989), who argue that, with previous earnings controlled for, both the job-training and worker-firm matching theories predict that job tenure lowers reservation wages of potential movers. This is so, they argue, because within-firm wage growth in the training case, and room for an improvement in match quality in the matching case, decline over time. Their estimates of tenure coefficients in the subsequent-year earnings equations of movers, however, are nonnegative.

suggests a relatively weaker presence of industry-specific human capital in that sector.¹⁶⁾ The cross-sector difference in the importance of industry-specific skills in wage determination provides one explanation for the across-industry wage differentials reported in previous studies (e.g., Krueger and Summers(1988); Gibbons and Katz(1989)). It is conceivable that a portion of wage premiums, usually found in industries belonging to the manufacturing sector, may be attributable to industry-specific human capital, which is more important, possibly due to the differences in production technologies, in the manufacturing sector than in the service sector.

Recall however that industry tenure has a strong positive effect on intra-industry mobility and a significantly negative effect on inter-industry mobility in the service sector as well as in the manufacturing sector. One possibility is that in the service sector, and presumably in the manufacturing sector as well, a worker with longer industry tenure has a lower search cost and/or a higher offer arrival rate when he seeks his new job in his current industry, which results in higher intra-industry mobility.

Finally, with the lagged wage rate conditioned upon, the effect of labor market experience on wage rates of both stayers and movers is, as expected, not great.¹⁷⁾ It has some positive effect on wage offers for intra-industry movers in the manufacturing sector and stayers in the service sector.

16) Another set of two-stage estimation results, where lagged wage rate is not included in the list of explanatory variables in either stage, were also obtained. The results, however, were not qualitatively different from those shown here. That is, industry tenure was found to raise the probability of intra-industry mobility but lower inter-industry mobility in both the manufacturing and service sectors. It was also found that industry tenure has a positive impact on wages of intra-industry movers in the manufacturing sector, but not in the service sector. The only noticeable difference obtained from this procedure is that, in the (second-stage) wage equation estimations, the absolute values of the coefficients of human-capital-related variables other than job tenure, i.e., education, industry tenure, and labor market experience, increase in the magnitude of three or four, and that labor market experience becomes relatively more important.

17) These results are comparable to Mortensen and Neumann(1989). In many of their estimations of wage equations of job changers, the coefficients of age variable, used as a proxy for labor market experience, become insignificant when wage rates at their previous jobs are added as a separate explanatory variable.

IV. Summary and Conclusions

This paper has attempted to identify industry-specific components of workers' productivity. The hypothesis is that a worker's productive skills have industry-specific as well as job-specific components, and this hypothesis is tested by investigating the effect of industry tenure on wage offers, inside and outside, faced by workers and their mobility.

Data on young male workers from the 1984 panel of the Survey of Income and Program Participation were used to find empirical evidence that can verify the presence of industry-specific human capital. Informal evidence that the negative relationship between turnover and industry tenure is much weaker for intra-industry mobility than for inter-industry mobility suggests the importance of industry-specific human capital.

Estimation results of a more formal econometric analysis indicate that, even when the current wage is conditioned upon, industry tenure raises intra-industry mobility, but lowers inter-industry mobility both in the manufacturing sector and in the service sector. It is also found that, in the manufacturing sector, with the current wage controlled for, job tenure has a negative effect, while industry tenure has a favorable effect on outside wage offers by firms in a worker's current industry.

These findings are consistent with the findings by Neal(1995) and support the presence of industry-specific components of a typical worker's productivity. It is the accumulation of specific human capital that causes wages to rise and mobility to fall. Moreover, human capital contains industry-specific as well as firm-specific components. Job-specific human capital discourages workers from changing jobs and industry-specific human capital deters workers from switching to different industries.

Finally, the finding that among intra-industry movers the accumulated industry tenure has a positive impact on wage offers from potential employers in the manufacturing sector but not in the service sector may provide one explanation for the frequently reported across-industry wage differentials. That is, wage premiums, usually

found in industries belonging to the manufacturing sector, may be attributable, at least in part, to industry-specific human capital, which is more valuable, possibly due to the differences in production technologies, in the manufacturing sector than in the service sector.

Appendix 1: Industry classification

Industry	Classification
1. Agriculture, Forestry, and Fisheries	010 - 031
2. Mining	040 - 050
3. Construction	060
4. Non-durable Goods Manufacturing	100 - 222
5. Durable Goods Manufacturing	230 - 392
6. Transportation, Communication, and Other Public Utilities	400 - 472
7. Wholesale Trade	500 - 571
8. Retail Trade	580 - 691
9. Finance, Insurance, and Real Estate	700 - 712
10. Business and Repair services	721 - 760
11. Personal Services	761 - 791
12. Entertainment and Recreational Services	800 - 802
13. Professional and Related Services	812 - 892
14. Public Administration	900 - 991

Appendix 2: Variable definitions

Variable	Definition
Demographic variables:	
NONWHITE	= 1 if nonwhite
AGE	Age as of the end of period
MARRIED	= 1 if married
EDUCATION	Years of schooling as of the end of SIPP
SMSA1(SMSA2)	= 1 if living in a SMSA(Standard Metropolitan Statistical Area) in current(subsequent) period
Work-related variables:	
FULL_TIME1(FULL_TIME2)	= 1 if weekly hours on the job held in current (subsequent) period ≥ 35
HOURLY1 (HOURLY2)	= 1 if paid hourly wage rate on the job held in current (subsequent) period
FIRST_JOB1	= 1 if the job held in current period is the first career job
LAYOFF1	= 1 if laid off in current period
SERVICE2	= 1 if the job held in subsequent period belongs to the service sector
JOB_TENURE	Number of consecutive periods in current job
IND_TENURE	Number of consecutive periods in current industry
EXPERIENCE	Total number of periods in labor market
UNEMP_RATE2	Unemployment rate in the state resided in subsequent period
LNWAGE1(LNWAGE2)	Log of hourly wage rate at the job held in current (subsequent) period
Occupation dummies*:	
PROFESSION1(PROFESSION2)	= 1 if job in current(subsequent) period is Managerial and Professional
TECHNICAL1(TECHNICAL2)	= 1 if job in current(subsequent) period is Technical, Sales, and Administrative
PRODUCTION1(PRODUCTION2)	= 1 if job in current(subsequent) period is Precision production, Craft, and Repair
Self-selection correction term:	
SELECTION	Selection bias correction term(see section III)

* The reference occupation group, to be left out in the estimation, is composed of three occupation categories. They are ① Service, ② Farming, Forestry, and Fishing, and ③ Operators, Fabricators, and Laborers.

REFERENCES

- Allen, Steven, Robert, Clark, and Ann, McDermed, "The Pension Cost of Changing Jobs," NBER Working Paper No. 2935, 1989.
- Bartel, A. and G. Borjas, "Wage Growth and Job Turnover," in *Studies in Labor Markets*, edited by S. Rosen. Chicago: University of Chicago Press, 1981.
- Carrington, William J. and Asad, Zaman, "Interindustry Variation in the Costs of Job Displacement." *Journal of Labor Economics* 12(2), (1994): 243-275.
- Chamberlain, Gary, "Analysis of Covariance with Qualitative Data," *Review of Economic Studies* 47(1980): 225-238.
- Gibbons, Robert, and Lawrence, Katz, "Does Unmeasured Ability Explain Inter-industry Wage Differences?" NBER Working Paper No. 3182, 1989.
- Harris, Milton, and Bengt, Holmstrom, "A Theory of Wage Dynamics," *Review of Economic Studies* 49(1982): 315-333.
- Jovanovic, Boyan. "Job Matching and the Theory of Turnover," *Journal of Political Economy* 87 (1979): 972-990.
- Kim, Dae Il. "Industry Wage Differences: The Unobservable Human Capital Hypothesis", Ph.D. dissertation, University of Chicago, Department of Economics, 1992.
- Krueger, Alan B. and Lawrence H, Summers, "Efficiency Wages and the Interindustry Wage Structure", *Econometrica* 56 (1988): 259-293.
- Lazear, Edward, "Agency, Earnings Profiles, Productivity, and Hours Restrictions," *American Economic Review* 71 (1981): 606-620.
- Lee, Lung-Fei, "Generalized Econometric Models with Selectivity," *Econometrica* 51(2) (1983): 507-512.
- Lee, Lung-Fei, G. Maddala, and R. Trost, "Asymptotic Covariance Matrices of Two-stage Probit and Two-stage Tobit Methods for Simultaneous Equations Models with Selectivity," *Econometrica* 48(2), (1980): 491-503.

- Mincer, Jacob, "Wage Changes in Job Changes," in *Research in Labor Economics*, vol. 8, edited by Ronald G. Ehrenberg. JAI Press, 1986.
- Mincer, Jacob and Boyan, Jovanovic, "Labor Mobility and Wages," in *Studies in Labor Markets*, edited by Sherwin Rosen. Chicago: University of Chicago Press, 1981.
- Mortensen, Dale T. and George R. Neumann, "Interfirm Mobility and Earnings," in *Search Models and Applied Labor Economics*, edited by Nicholas M. Kiefer and George R. Neumann. Cambridge University Press, 1989.
- Neal, Derek, "Industry-Specific Human Capital: Evidence from Displaced Workers", *Journal of Labor Economics* 13(4), (1995): 653-677.
- Ryoo, Keecheol, "An Empirical Study on Industry-Specific Components of Productivity," *Korean Journal of Labor Economics* 15 (1992): 341-365.
- Salop, Joanne, and Steven, Salop, "Self-Selection and Turnover in the Labor Market," *Quarterly Journal of Economics* 91 (1976): 619-627.
- Topel, Robert, "Job Mobility, Search, and Earnings Growth," in *Research in Labor Economics*, edited by Ronald G. Ehrenberg. JAI Press, 1986.