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JOB TRAINING, WAGE GROWTH, AND LABOR TURNOVER

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ABSTRACT

Using explicit information on timing and duration of job training in panels of PSID men, I find negative effects of training on turnover and positive effects on wage growth in the firm and over longer periods (1968 to 1983). Wages of trainees grow 4-6% faster per year over periods of training compared to other workers or periods. Wage trajectories _in_ the firm and _across_ firms over longer periods are steeper for workers who engage in more training.

These results are explainable by a positive correlation between general and firm-specific components of training. So is the apparent paradox that frequent movers' wages grow less in the long run than those of less frequent movers (stayers), despite wage gains in moving.

Mobility wage gains are reduced by worker investment in training in the new firm. These mobility (search and matching) gains appear to contribute to job attachment in the presence of such investments.

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1. Introduction

Until recently, the absence of empirical measures of job training has made much of the human capital analysis of wage structures largely indirect. Levels of school education are important in analyzing levels of life-time earnings, but not shapes of wage profiles. These are affected by time patterns of postschool (working life) human capital investments (Becker 1964, Ben-Porath 1967). Training or learning on the job is understood to be of major substantive importance among such investments. The idea that job investments contain elements of firm-specificity introduced by Becker (1962) and Oi (1962) produces a link between human capital investments and inter-firm labor mobility,[1] or labor turnover. These ideas were elaborated and applied by Kuratani (1973) and Hashimoto (1980). Completing the syllogism, Mincer and Jovanovic (1981) proposed a duality relation between slopes of tenure-wage profiles and labor turnover (firm separation rates). The duality hypothesis has proven useful in analyzing inter-occupational, inter-industry, and inter-country differences in turnover.[2]

The emphasis on human capital in producing an indirect relation between wage growth and labor mobility does not preclude the possible validity of direct effects of upward sloping wage profiles on turnover. Such effects are envisaged in work incentive models (Lazear, 1981) and in selectivity models (Salop, 1976). Individual growth in productivity, due to skill training or otherwise, plays no role in these models. No empirical evidence has emerged to discriminate between them and the specific capital hypothesis. One reason is the lack of measures of productivity, another is the conceptual ambiguity between tenure and life-time wage profiles in the work incentive models.

Another interpretation of duality which both limits the upward slope in wages to an initial "probation" period in the firm and relates the length of stay in the firm to the magnitude of the initial boost in wages is the "matching" hypothesis of Jovanovic (1979). As is true of the other theories, matching and specific capital hypotheses are, in principle, not mutually exclusive. Indeed, there are reasons to believe that training is more likely to be undertaken the more successful the match, since worker-firm complementarity should raise both current productivity and returns to training. For this reason, training and trainability are themselves likely to be important matching (and screening) criteria. If this reasoning is correct, matching and specific capital models may be difficult to distinguish, even when additional information on training is available.

The purpose of the present study is to take advantage of the availability of information on the incidence and timing of training in conjunction with information on wage profiles and mobility behavior of workers in the PSID panel micro-data. Short (within the firms) and longer-run effects of training on mobility and on wages are estimated in PSID panel data which cover intervals as long as 15 years (1968 to 1983). Estimates of individual changes over time are especially useful in reducing vulnerability to heterogeneity biases which are likely to affect cross sections.

Aside from PSID data, job training information is also available in other data sets, such as the National Longitudinal Panels, and in a recent Current Population Survey (1983). Fragmentary evidence on the positive effect of training on wages appears in these and other data sets. Systematic studies of wage structures in relation to training begin with Duncan and Hoffman (1978) and Brown (1983) who used PSID data, Parsons (1986) who used NLS Young Men's Panels, and Lillard and Tan (1986) who used the CPS and NLS data in a comprehensive and detailed analysis.[3]

The present study extends these efforts in two directions: (1) It analyzes effects of training on mobility, that is on length of tenure in the firm in which training was received and on the frequency of job change over longer periods of time, and (2) it looks at effects of training on changes in wages over time, distinguishing in-firm and across-firm wage effects. Although the main reliance is on the PSID data, findings or data from other studies are used or cited where relevant.

The study confirms empirically the validity of human capital factors in producing wage-turnover duality. The question about reality and importance of other hypotheses is not thereby resolved, but some implications regarding alternative interpretations are considered in the empirical context.

Although job training information lets some light into the black box, it cannot fully illuminate it. This is so not only because the data are imperfect, but also because a direct measurable distinction between general (transferable) and specific human capital investments is not available. A working assumption which obviates this problem is that, at the firm level, training, even if largely transferable to other firms, per force contains some elements of firm specificity. Since the greatest opportunities for training are likely to exist in firms in which training processes are closely related to and integrated with their production processes, we may infer a positive relation between volumes of general and specific training received in firms. Hence the hypothesis that the larger the volume of training in the firm, the steeper the growth of wages of trainees, and the stronger their attachment to the firm.

Two implications are notable: (1) The relevant tenure wage profile in the firm need not be netted out from the experience profile, as the two are not independent, and indeed, (2) workers who invest more on the job have steeper wage profiles and move less frequently. If mobility gains of the more frequent movers do not compensate - an assumption verified in this study - both their tenure-wage profiles and their long-run wage trajectories are flatter. The paradox that mobility is undertaken for wage gain, yet wages of frequent movers grow less in the long run, is thus resolved.

Empirical work reported here is based on PSID data, and is restricted to white male heads of households, up to age 60, excluding students and self-employed. Section 2 presents information on cumulative patterns (up to 23 years) of individual inter-firm mobility, on annual separations rates, and on the distribution of job training across workers reported in the 1976 and 1978 PSID surveys. Job training is shown in section 3 to be positively related to length of tenure and negatively to current and longer run mobility behavior. Section 4 provides evidence on the positive effects of training on wage growth in the firm, and Section 5 over longer periods. Section 6 contains concluding remarks.

2. Mobility Profiles, Separation Rates, and Job Training

(a) Experience Profiles of Inter-Firm Mobility

Information on the number of inter-firm moves (N) was accumulated over time for each worker in the sample. It was available for all moves since 1958.[4] In the pooled (1968-1981) sample, profiles of mobility show a typically concave shape -- decelerating growth of N with experience, as in Fig. 1 -- with individual inter-firm moves ranging from near zero to 16 over a maximum range of 23 years of experience. Converted into a "mobility rate" (N/X), it has an average of 1 move in over 5 years.[5]

Table 1, col. 1 shows regressions of N on experience (X), specified in linear and quadratic terms and on a number of other characteristics of workers among other variables. The concavity of the profile N(X) portrayed in Fig. 1 appears in the positive coefficient on X and negative on X^2 in col. 1(A). The latter, when doubled, measures the rate of decline of annual (not cumulated) separations (s) with experience $\left(s(x) = \frac{dN}{dX}, \text{and } \frac{dS}{dX} = \frac{d^2N}{dx^2}\right)$. It was found in previous research, based on much shorter time intervals (Mincer and Jovanovic, 1981) that the separation curve s(x) is convex; that is, its decline decelerates with experience. This is verified by the negative coefficient of x and smaller positive coefficient on x^2 in the separation equation (col. 3).[6]

Reasons for the decline of the experience-turnover profile s(x) can be briefly described:[7]

By definition, changes in separation probabilities over the working life can be decomposed into a sum of two factors:

$$\frac{ds}{dx} = \frac{\partial s}{\partial T} \cdot \frac{dT}{dx} + \frac{\partial s}{\partial X}$$

The decline of s(x) with x reflects a decline in the probability of moving as tenure in the firm lengthens ($\frac{\partial s}{\partial T} < 0$), and as workers age, holding tenure levels constant ($\frac{\partial s}{\partial x} < 0$).[8] Both declines are due to increasing opportunity costs of moving. But there are no obvious reasons for corresponding increases in returns to mobility as workers age, and at least one good reason -- a decrease in the payoff period -- to produce (eventually) declining returns. Hence, the decline in s(x) is due to the continuously declining benefit-cost ratio in moving.[9]

The decline of turnover with tenure was postulated to reflect costs of separation which result from the accumulation of firm-specific capital. Such accumulations raise wages in the firm more than elsewhere, so mobility declines as the wage increases.

Fig. 1 Typical Experience-Mobility Profiles

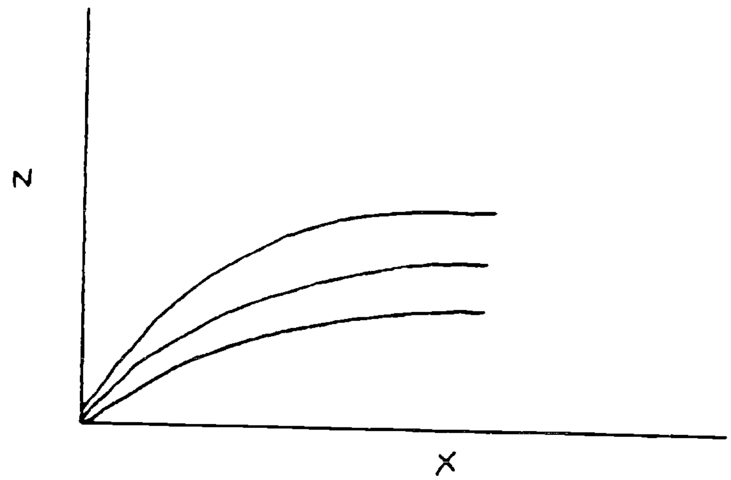


Table 1

Mobility Profiles (N), Mobility Rates ($\frac{N}{X}$) and
and Separation Rates ($S = \frac{dN}{dX}$) by
by Worker Characteristics, pooled 1968-1981.

Variables*	N (A)	(B)	$\frac{N}{X}$	S
C	7.63 (14.5)		1.20 (19.2)	.43 (13.2)
Ed	-.64 (7.9)		-.039 (4.1)	.0144 (2.9)
Ed^2	.022 (6.5)		.0014 (3.6)	-.0012 (5.6)
X	.225 (15.9)	.40 (4.2)	-.035 (20.3)	-.017 (18.8)
X^2	-.0018 (5.1)	-.01 (3.6)	.0006 (14.6)	.0003 (11.2)
X^3		.0001 (3.2)		
Mar	-.71 (5.6)		-.108 (7.2)	-.077 (9.0)
UM	-.30 (3.4)		-.038 (3.7)	-.067 (9.4)
NU	-.08 (2.0)		-.007 (1.1)	-.009 (1.2)

*c-intercept, Ed - years of schooling, X - Labor-force experience, Mar-married, UM - union member, NU - national unemployment rate of men age 35-54.

t-values in parentheses.

(b) Other Variables:

Judging by the regression coefficients on the other independent variables in Table 1, individual profiles of mobility are lowered by education, marital status, and union membership, and by national unemployment.[10] Turnover is larger in metropolitan areas but smaller in the largest cities, and when disabilities are experienced. Most of these findings are familiar as are some of the reasons for them. Thus, the lesser mobility of union workers has been explained by the wage, fringe, and other union benefits (Freeman 1980, Mellow 1981, Mincer 1983). Lesser mobility of married men is, in part, attributable to greater opportunity costs inherent in the presence of family ties, especially in geographic mobility (Mincer 1978). However, married men change jobs less frequently than single men even within local labor markets. The unemployment effect is due to a decline in the probability of job finding which apparently inhibits quits to a greater extent than the increase in layoffs (layoffs terminating by recall do not constitute separations).

Reasons for lesser mobility of the more educated workers have not been investigated in the past. However, a positive association between education and job training is theoretically predictable and has been inferred from differential slopes of experience-profiles of wages (Mincer, 1974), and is shown more directly in Table 2. If training is in part specific, the effect of education follows.[11] A similar association of training and marital status (Table 2) is likely to be a factor, in addition to family ties, in the lesser mobility of married men.

(c) Job Training: Measures and Incidence

Direct information on volumes of job training is provided in the PSID surveys of 1976 and 1978. The measure we use (RQT) is given by respondents' answers to a question: "On a job like yours, how long would it take the average new person to become fully trained and qualified?" The question

Table 2

Factors Associated With Job Training

(1976 and 1978 cross-sections, pooled)

	RQT		RQT/Ten*		Incidence of Training in 1976 job	
	b	t	b	t	b	t
Intercept	-1.52	3.4	.49	2.9	.16	7.0
Ed	.24	6.8	.065	2.5	.014	10.1
X	.107	3.6	-.016	6.4	-.012	8.0
X^2	-.0013	1.6	.005	6.0	.0002	5.4
Mar	.46	1.8	.058	1.5	.011	1.8
Union	-.56	2.9	-.056	1.8	-.023	2.7
R^2	.19		.11		.15	
n	1,216		564		10,916	

followed several other questions about training *prior* to the current job, and it "was intended to measure the volume of the training investment attached to the current job."[12]

Table 2 (Col. 1) shows a regression of the duration of training (RQT) in the 1976 and 1978 jobs on experience, education, marital status, union coverage and other variables in the 1976 and 1978 pooled cross-sections. It appears that training, as measured, increases with working age (experience) and with education, is lengthier among married than single men, and is longer in nonunion than in union jobs. In column 1 of Table 2, the coefficients on x and x^2 are positive and negative, respectively. This indicates that training per job increases with experience in a decelerating fashion.

The increase of training (RQT) with experience may seem puzzling: according to human capital theory, investments in human capital, especially if measured in time units, as RQT is, must decline over the life-cycle -- for good theoretical reasons, and if such investments are to imply a concave growth of wages over the life-cycle. There is no inconsistency, however, if we realize that RQT is an investment volume per job, not per year. A rough adjustment to convert RQT into a rate per year is to divide it by the length of tenure on the job on which the training was received. When this is done, the regression of RQT/Ten shows a negative coefficient on x and a much smaller positive coefficient on x^2 (col. 2 of Table 2). This means that the rate of training per year declines with experience, at a diminishing rate.[13]

The decline of training with experience is also apparent in col. 3 in which the dependent variable is the incidence of training in 1976 job. Given the length of training (RQT) and the assumption that it started with the start of the current position, we assign a value 1 if the worker received training during the year, 0 if not. the sample for col. 3 is almost twice as large as that of col. 2, as it includes all those in the 1976 job whether or not they left it prior to 1983. The truncated sample of col. 2 contains workers with shorter completed tenure, and significantly, with shorter average training (Mean RQT = 1.8) than the complete sample (mean RQT = 2.4). It is also worth noting that the respective coefficients on X and X^2 imply that training reaches a minimum at X = 16 in col. (2) and X = 30 in col. (3).

The net positive coefficients of education in the RQT regression of Table 2 correspond to the negative coefficient of this variable in the mobility regressions. The interpretation is that job training with its firm specific elements, being positively related to schooling, reduces mobility at progressively higher levels of schooling. The same inference is applicable to marital status. However, lesser mobility of union workers is not a consequence of their job training, as they engage in <u>less</u> training than non-union workers. Here the effects of wage-premia and of other rents received by union workers appear to play the major role in inhibiting mobility.[14]

There are several shortcomings in the measures of "years of required training on the current job" (RQT) in the PSID: the total period of training, "for the average new worker on this job," is a blunt measure of the individual training periods. Moreover, the intensity of training, that is the actual amount of time devoted to training during the year or week, is not indicated.

Supplementary information on intensity is available in a 1980 study of PSID time budgets by Duncan and Stafford. It contains data on the proportion of workers who were engaged in job training during the survey week and the average weekly hours spent in training by those engaged in it. Appendix Table 1 provides a check on the decline in training over experience (here age), and the increase in training with education, both of which were indicated in our regression in Table 2. Both percent engaged and their hours decline with age, and increase with education (up to college). Note, however, that the data are not standardized for other characteristics, consequently the gross effects may be exaggerated, as younger people are on average more educated.

We tried to check our inferences based on the rather imperfect measures of training in the PSID with results in other studies based on other sources of data. Lillard and Tan (1986) analyzed the distribution of training across workers in larger and in some respects more detailed CPS and NLS samples. The training measure there is its incidence during the year between surveys, and it is distinguishable by its locus. Since firm-specificity is more likely to be found in company training rather than in outside sources (e.g. business, vocational courses), and because it is the larger part of job training, we show their regressions of company training in 3 data sets in Appendix Table 2.

Despite minor differences in some of the variables, the estimated regression coefficients on education, experience, and marital status in Table A2 are similar to those based on PSID data.

3. Effects of Job Training on Turnover

(a) Attachment to the 1976 Firm.

Effects of training in the 1976 job on the probability of leaving the firm in which training was received are observed in Table 3. In panel (A) the dependent variable is the completed length of the 1976 job, which is observable in close to a half of the PSID sample whose tenure was listed in 1976. A little over a half of the 1976 sample changed jobs by 1983. The effects of RQT reported in 1976 on the length of completed tenure were positive and significant, despite the truncation which selects shorter tenured workers into the sample.

The same is true of an alternative measure of training shown in the second row. This measure, e_{RQT}, which is the percent growth of wages over the training interval RQT, was constructed in an attempt to combine intensity with length of training. It relies on the observed effect of training on wage growth, shown in section (4) below. Despite severe errors of measurement which beset both measures of training, the effects appear to be significant, even if biased downward.

The information is extended beyond the truncation in panel (B). Here the dependent variable is the probability of staying in the 1976 firm beyond 1983. Again, the effect of training (RQT) is positive and significant. In both panels, the sample is also split between younger and older workers. The training effects apparently increase with age. There are no effects for young workers (working age $\leq$ 12 in 1982, in panel B). In the upper panel, the young workers are 6 years older (working age $\leq$ 12 in 1976) and the effects on (truncated) completed tenure are positive but smaller than the effect at older ages.

These age differences in effects of training are clearly not due to differential intensity of training. The latter <u>declines</u> with age, as was shown in Table A1, and is presumably, though imperfectly, captured in the $\dot{e}_{RQT}$ variable. More likely the age differences reflect lesser specificities of training and of work experience among younger workers:

Table 3

(A) Effects of Training on the Duration of Tenure

Training Variables	All	Younger[a]	Older
$RQT_{>6}$	.63	.48	.86
	(3.9)	(3.0)	(2.5)
$\dot{e}_{RQT}$	2.89	1.91	3.06
	(4.0)	(4.4)	(1.6)
n	564	330	234

(B) Effects of Training on the Probability of Staying in the 1976 firm beyond 1983

	All	Younger[b]	Older
$RQT_{>6}$	.018	.001	.019
	(2.9)	(.14)	(2.5)
n	1,437	550	887

(A) Tenure Completed by 1983.

$\dot{e}_{RQT}$ = Growth of wages over the training period.

[a] Younger, if experience in 76 was $\leq$ 12.

[b] Younger, if experience in 82 was $\leq$ 12.

Other RHS variables as in preceding Tables, shown in Appendix Tables A3A and A3B.

Finding a successful match on productivity and training requires repeated employment trials (job shopping) which takes time, and the probability that the current match will not be a lifetime job is very high in any case. Consequently, the payoff period to specific training is substantially shorter than the payoff period to general (transferable) training. Hence, the bulk of general training investments is incurred as early as possible, while specific investments may actually grow over the first decade or so. At any rate the specific content of training can be expected to grow over time in the individual life-time allocation of human capital investments.

It is also worth noting in the regressions of Appendix Tables 3A and B that the coefficients of the experience variables behave as the training variables do: they increase in size and significance with age. The reasons are presumably similar, especially as the training variables are unlikely to capture all the learning processes on the job. Education has a positive effect on firm attachment, net of training, especially at early ages: More efficient job search or more intensive screening of younger job applicants may well be the cause.[15] Marriage and union variables are also positive, as expected.

(b) Longer-run effects of training on turnover

While training obtained in the firm reduces the worker's probability of leaving it, it need not follow that it also reduces his turnover in subsequent (or previous) employments. Workers who received little or no training in their 1976 jobs may have received more training in prior or later jobs.

It appears, indeed, that workers who received training in the 1976 job had lesser turnover over longer periods. Table 4 shows a negative effect of the 1976 training variables RQT and of $\dot{e}$(RQT) on numbers of moves (N) over the period 1968-1983.

Table 4

Effects of Training Reported in 1976 on Number of Separations[a] (N) in the 1968 - 1982 Period

Training Variables	All	Young[b] ($X \leq 12$)	Older ($X>12$)
RQT	-.072 (2.4)	-.126 (2.4)	-.051 (1.6)
$\dot{e}_{RQT}$	-.85 (3.8)	-.78 (1.8)	-.97 (3.8)
n	1471	777	694

Other RHS variables as before (Table A4).

[a] Per year in sample, multiplied by 15.

[b] X in 1976.

There are at least two reasons for the persistence of the effect of training reported in 1976 over long periods of time. Training takes place relatively early on the particular job, and the average tenure in 1976 was 7.7

years. Completed tenure is expected to last longer than currently observed tenure.[16] Consequently effects of training on mobility extend over a range of years before and after 1976. Secondly, persistence is predicted by a life-time optimization hypothesis on human capital investment behavior. Workers with better abilities and opportunities (though both are, in part, stochastic) tend to invest more in their human capital both at school and in a successive series of jobs. This is one reason for the observed positive correlation between schooling and job training in Table 2. The serial correlation of training in successive jobs was tested by regressing the volume of training attached to 1978 jobs of those who left their 1976 job (about one-third of the workers) between 1976 and 1978, with reported training attached to their prior, 1976 jobs. The result of the regression is shown in the first column of Table 4A:

Table 4A

Persistence of Training Across Jobs

	RQT_{78}		RQT_{76}		$Learning_{76}$	
Indep. Var.	b	t	b	t	b	t
RQT_{76}	.29	6.4				
Prior Training			.18	1.6	.078	2.2

Other right hand variables as in Table 2.

The correlation is clearly positive, and it is probably biased downward: the information comes only from workers who have recently joined the new firm, and positions with training need not start immediately at entry into the new firm.

The PSID data contain other measures of training which permit observation on the persistence of training. One is an answer to the question whether training was needed prior to entry into the current job (Prior Training). The other is an answer to the question whether currently (in 1976) there was a learning content in the worker's job which could help in promotions or in getting a better job (Learning 1976). As the second and third rows of Table 5 show, the correlation between RQT_{76} and Prior Training was positive as was that between Learning and Prior Training. The coefficients shown in Table 4A are net of other independent variables. Their effects are similar to those shown in col. 1 of Table 2.

The persistence of training over time can also be inferred from the NLS data on the incidence of training provided by Lillard and Tan (1986). Appendix Table A4A shows the reported incidence of training over intervals of varying lengths, and incidence predicted on the assumption of serial independence (Bernoulli trials):

It is clear that the lengthening of intervals increases incidence much less than would be predicted by random trials: the same individuals tend to receive repeated (or continuing) training over longer periods.

A similar test is used in the lower panel of Table A4 which covers successive annual periods. Again, more than twice the proportions predicted on the basis of randomness receive lengthy (3 to 8 years) training.[17]

Although the persistence of mobility behavior is related to the persistence of training, one cannot rule out reverse causality:

A possible, and to some extent, plausible alternative interpretation of the same findings (in Table 4) is that workers who do not move much tend to receive more training, as well as, or rather than conversely: If employers invest in specific capital and if their turnover and hiring costs are large for this or for additional reasons, they have incentives to select less mobile workers.

If so, the mobility of workers is not reduced by more training - it was less frequent even before. To test this proposition, we regress separations between 1976 and 1983 on training, holding prior mobility frequency (between 58 and 75) constant. The results in Table 4B show that the post 1976 mobility is reduced, by training, given prior mobility. At the same time, there is a positive serial correlation in turnover behavior as shown by the coefficient on the prior mobility variable. This may imply some degree of selection in hiring, or effects of persistent earlier training.

The negative effects of training on separations are stronger in the older subsample, and they appear to be symmetric in quits and in layoffs. These effects as well as the coefficients of other independent variables in regression 4B are shown in Table A4B.

Table 4B

Effects of Training on Separations (1976-1983)

Conditional on Prior Mobility

Indep. Variables	RQT_{76}	Prior Training[a]	Prior Mobility[b]
b	-.005	-.014	.242
t	(2.6)	(1.6)	(8.8)

[a] Dummy Variable (1,0) whether prior training was required for entry into 1976 job.

[b] Frequency (per year) of interfirm moves prior to 1976.

4. Job Training and Wage Growth in the Firm

That greater volumes of job training imply steeper wage profiles, on the job, and over longer experience is a theorem in human capital analysis. The availability of the training measures in the PSID makes it possible to observe more directly individual wage differences and growth in relation to the observed volumes of their training.

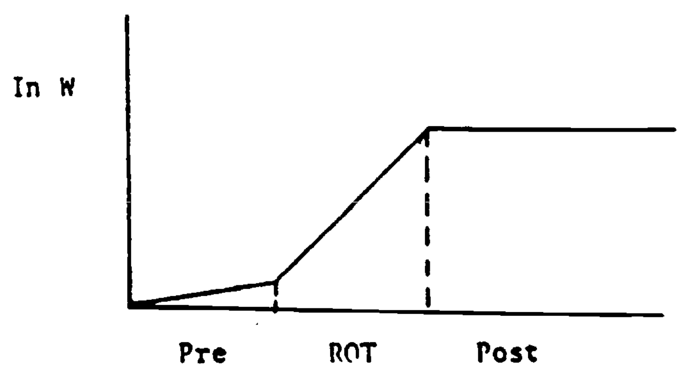
A positive relation between measured volumes of training and wage profiles was observed by Duncan and

Hoffman (1978), Gronau (1982), Brown in an unpublished paper (1983), and Parsons (1986).

A more comprehensive empirical exploration of the relation between training and the wage structure is available in the study by Lillard and Tan (1986). The study utilizes CPS cross-sections and NLS panels. It contains measures both of incidence and of hours of training. The effects of training on wages is strong in cross-section wage functions. In the NLS panel of young men the effects are strongest for company (in-house) training.[18]

Brown's study had shown that, when the tenure profile of wages is decomposed into three segments (see figure below),

Fig. 2



wages grow slowly before the training period (Pre), rapidly during training (RQT), and level off after it (Post). The pre-training period may actually contain some training, but this was not reported in the data. It is clear that the usually observed concavity of the tenure-wage profile is due to the completion of RQT.

We have replicated the regressions with tenure decomposed into the three segments in the 1976 and 1978 cross-sections. The regression coefficients in Table (5A) show that wage growth during the training period is most rapid (4 to 5% per year), it is only 1 to 2% in the prior

Table 5A

The Tenure-Wage Profile Components

(1976 and 1978 Cross-sections)

	1976		1978	
Segments	b	t	b	t
Pre-pos	.012	7.9	.021	11.5
D(TICP)	.042	5.5	.054	9.1
(1-D)RQT	.054	7.6	.047	8.4
(1-D)Post	.008	1.8	.012	6.8
R^2	.28		.34	

Note: D = 1, when in training; TICP = tenure in current position. Other RHS variables as in the other regressions. Experience was measured at the start of tenure.

Table 5B

Effects of Training on Year-to-Year Wage Growth

Variable:	RQT_{76} Pooled Sample	RQT Incidence in 1976	Learning in 1976
b	.044	.067	.064
t	(3.9)	(4.6)	(4.3)

* Dummy = 1, when training or learning during the year.

period, and about 1% thereafter. Wage growth is somewhat steeper when previous (before the current job) rather than total experience is held constant.

In order to detect effects of RQT on wage growth rather than on wage differentials in the cross-section, we observe changes in wages of the 1976 workers over time.

This is done in Table (5B).

The dependent variable is the year to year growth in (real) wages of workers in the 1976 job whether or not their tenure was completed. RQT and Learning are (1,0) dummies. The coefficient in the left-hand column measures the effects of reported training compared to no or unreported training each year between 1968 and 1982. This RQT coefficient shows that a year of training increased wage growth by 4.4%. When restricted to the 1975-1976 period (col. 2) the effect was 6.7%. The Learning variable (col. 3) showed a similar effect, 6.4%. None of the other independent variables were significant, including a very small negative and decelerating effect of prior experience, measured at the start of tenure in the 1976 job. Perhaps surprisingly, the training coefficients are no smaller than those shown in the cross-section.

The effect of training on wage growth is greater at younger ages (9.5% for $x \leq 12$, 3.6% for $x > 12$), reflecting greater intensity of training among young workers, a fact shown in Table 2B in terms of age differences in weekly hours of job training. In this respect Table 5 is a first in documenting empirically the importance of job training or learning in producing the upward sloping and concave experience-wage profiles.

5. Training, Turnover, and Wage Growth in the Long Run

We now turn our attention to effects of job training on wage growth in wage trajectories which transcend tenure in one firm. A positive effect is expected on the human capital hypothesis, given largely transferable skills and some persistence in training. Using the longest interval - from 1968 to 1983 - in our PSID data, we found a positive effect, even though our training measure (e_{RQT}) is observed only in the 1976 job. The measure we use is the growth of wages over the training period, which reflects both the length and intensity of training. Table 6 (upper row) shows the coefficient of this variable in the regression in which the dependent variable is the difference between the 1983 and the first observed (log) wage in the interval divided by the length of the interval.

Table 6

Training, Turnover, and Annual Wage Growth, 1968-1983

	All		Younger		Older	
Variable	b	t	b	t	b	t
$\dot{e}_{RQT}$	.028	4.9	.031	3.2	.020	2.7
AN[a]	-.028	2.5	-.025	1.0	-.036	3.4
Prior Trng.[b]	.010	2.5	.015	1.8	.009	2.3

[a] Frequency of separations per year (same as the dependent variable in Table 4). $\dot{e}_{RQT}$ is an alternative variable in the regression shown in Table A6.

[b] Same variable as in Tables 4A and 4B.

Other RHS variables as before.

The effects of training on the long-run wage trajectory accord with expectations, given that most of the training is likely to be transferable across firms. A more interesting question regarding the firm-specificity of training is whether the slope of the wage trajectory is flatter for the more frequent movers: the hypothesis that general and specific training are positively linked in one package has this implication. The second row of Table 6 answers this question. The coefficients of (AN) are negative and significant for all and especially beyond the first decade of working life. Apparently, for the young workers who are not yet settled into long-term jobs, training is largely general, so wages grow as a result of training, but effects on turnover are weak. Both effects are pronounced for older workers.

We should note that these findings hold also for the slope of the wage trajectory which excludes tenure effects: An independent dummy variable (Tenure 83 minus Beginning Tenure (in 1968 or later) $\leq$ 1) included in the regression was not significant, and had no effect on the coefficients shown in Table 6. In other words, slopes of experience-wage profiles which reflect only transferable human capital were also steeper for the less frequent movers. This is consistent with our hypothesis that larger investments in human capital contain larger transferable and firm-specific components.

The findings in the second row of Table 6 implies that per-year growth of wages within firms is smaller when tenure in the firm is, on average, shorter. This finding has recently become controversial in the econometric literature, but is not likely to be an artifact in our approach. Especially after account is taken of an important qualification. A qualification is required because the wage change analyzed in Table 8 includes gains due to inter-firm moves: Total wage change over an interval is the sum of intra-firm growth and of inter-firm (mobility) wage changes (m). A sufficient condition for the conclusion to be correct, is that the sum of mobility gains (defined as wage change between starting wage on the new job and last wage on the previous job) should not be greater for the less frequent movers. Put another way, the sufficient condition is that the elasticity of m (mobility wage gain) with respect to N (frequency of moving) is either positive or, if negative, less than unity (in absolute value).

A regression of m_i on N_i, with the other independent variables as before, showed a negative coefficient of less than .1% with t-values close to zero. Thus the wage gain per move was about the same for frequent and infrequent movers, so the differences in intra-firm wage growth between "stayers" and "movers" were actually greater than the differences in total growth shown in the coefficients of AN in Table 6.

A numerical example illustrates these results: At the observed mean, individual wage growth was 3.1% per year. Wage gain per move (m_1) was 2.2%, and the average number of moves 2.25 (probably an underestimate). Thus wage growth over the 15-year period was 46% of which 5% were mobility gains. Growth <u>within</u> jobs was therefore 41%. According to the coefficient on AN in Table 6, doubling of moves would reduce growth over the 15 years by 2.25 x .028 = 6.1%, while doubling mobility gains to 10%. Hence wages of workers who move twice as frequently as the average would grow 40% (compared to the 46% average) over the period, while their growth within jobs would be 30% (compared to the 41% average).

On average, mobility gains accounted for less than 20% of total growth over the period. The bulk of the rise in the life-cycle wage trajectory cannot be directly ascribed to mobility. Indeed, the opposite is true: long-term growth of wages (total and intra-firm) is flatter for the more frequent movers, even though they gain from repeated mobility.

Training or Matching?

The findings concerning the relation between mobility wage gains (m) and frequencies of wage change (N) warrant further discussion as they shed additional light on labor market processes that we are exploring. Theoretically, we expect a negative relation - or what is its equivalent - a positive relation between the wage gain in moving to a new firm and the length of stay in the new firm as a result of a successful job search and match, or of anticipated job training in the new firm. Given some degree of specificity to be expected in training, the expected payoff period to search would be longer the more training is contemplated. Hence higher reservation wages and greater wage gains would be expected in such moves.[19]

Now, if the job change does not involve job training on the next job, the observed m equals m^*, the true search (and matching) gain. However, if training is involved, m differs from m^*. Indeed $m = m^* - k$ where k is the worker training cost (measured in percent reduction of the new starting wage). Given m^*, the more training, the larger k and the smaller m. In that case the relation between m and N would become positive.

More generally,

$$\mathrm{Cov}\ (m,N) = \mathrm{Cov}\ (m^* - k,\ N) = \mathrm{Cov}\ (m^*,\ N) - \mathrm{Cov}\ (k,\ N)$$

If training is not involved only the first term matters and the sign of Cov(m,N) is negative as a result of pure search or match gains m^*. If prospective training is involved, the second term matters, and is positive since Cov (k,N) < 0 and the sign of Cov(m,N) is positive if search or match behavior is unimportant.

We found a practically zero effect of N on m when $m = m_1 = \ln W_0 - \ln W_{-1}$. Here W_0 is hourly earnings in the year the job started and W_{-1} in the preceding year. This implies either that the two factors are at play and offset each other, or that neither matters. However, our evidence in sections 3 and 4 that training affects mobility suggests that both matter.

When m is defined as $m = m_2 = \ln W_1 - \ln W_0$, its coefficient on N is larger (-.107) and marginally significant (t=1.7). This might suggest a somewhat stronger role for job matching. However, while m_1 includes wages observed during the early months on the new job, m_2 includes more than a year of wage growth on the new job which may reflect a considerable amount of job training (almost half of the RQT's are less than a year) rather than job matching as such.

At any rate, the evidence is consistent with a partial role of matching in affecting the duration of tenure, provided initial wages are reduced in consequence of training. Although this evidence on the initial reduction in wages due to costs of training is indirect, it has not been previously observed. Tests involving initial wage levels are vulnerable to selectivity biases: if more able individuals are selected or select themselves to training, their starting wages on the new job as well as the previous wages are higher, compared to those of other workers. The wage differential we use to describe matching gains eliminates this "personal" component.

A more direct test is to observe whether workers moving to a job with training accept a reduction in their potential wage gain.

Let K be the measure of training:

$$Cov(m,k) = Cov(m^*,K) - Cov(k,K)$$

Since k reflects the volume of training K, $Cov(k,K) > 0$, the sign of $Cov(m,K) < 0$ if the correlation between the pure matching or search gain and training is small.

We regressed e_{RQT} which measures training in terms of wage growth over the training period on m (alongside other independent variables) and found it to be negative. The partial regression coefficient on m_1 was -.075 (t=2.4). Since $m_1 = \ln W_0 - \ln W_{-1}$, and $e = \ln W_T - \ln W_0$ we shifted e to

$\ln W_{T+1} - \ln W_1$, in order to avoid a spurious negative correlation due to errors in W_0.[20]

This is a strong result, both because e_{RQT} is (in part deliberately) mismeasured and because Cov(m^*,e) is likely to be positive, if more successful search (larger m*) is followed by training.

7. Conclusions

Using short and long-run wage changes in PSID panels which cover intervals as long as 15 years and information on within firm job training we were able to estimate negative effects of job training on turnover and positive effects on wage growth in the firm and over longer periods. The turnover effects are consistent with the view that (1) in-firm job training contains elements of firm-specificity, whose amount is positively related to the volume of total training, and (2) training investments of workers are to some extent persistent across firms.

Assumption (2) is standard in human capital theory in which individual abilities and opportunities tend to be long lasting: it is supported by empirical evidence of a positive serial correlation in training and in turnover. The training variable does not distinguish general from specific components, but the positive correlation between them produces both job duration effects and the effects of wage growth within firms (during the training period), and in the longer-run experience profiles.

Although wage growth may be largely a result of general (transferable) training, its negative relation with turnover indicates an effect of the correlated presence of specific components. A possible qualification to this inference is that workers with an exogenously low propensity to move may tend to acquire more training rather than conversely. If so, training would not reduce turnover which is low to begin with. Although our findings tend to reject this implication, they do not rule out a two-way causality.

The correlation between general and specific componencs of training explains also the apparent paradox that while, on average, mobility wage gains are positive, frequent movers grow less in the long run than stayers do. The former tend to be less engaged in training, and so their moves are more frequent because they are less costly.[21]

At the most basic level, we confirm empirically the human capital hypotheses that training increases wage growth over the period of training, and that job training or learning is a major factor in producing the typically increasing and decelerating long-run individual wage trajectory.

Several recent studies[22] concluded that the "tenure effect" on wage growth, net of growth with experience, is quite small, save for a short initial boost in wages, which is interpreted as a reflection of a successful match. It is this boost, presumably, rather than specific training that is responsible for longer tenure. Several responses to these propositions are in order:

(1) It is a truism that, if we define the experience-wage trajectory as the locus of starting wages in successive jobs (firms), and ignore wage changes in the transitions, the average rate of growth over complete tenure in the firm must be identical to the average rate of growth in the same interval over the experience trajectory.

What our analysis shows is that the more training the steeper are both the experience and tenure profiles of wages and the longer is tenure. Although the rate of growth within the firm cannot be greater than over corresponding experience, the increase in wages <u>over the training period</u> is clearly greater, as human capital theory predicts.

(2) Observed wage changes in transitions do not change, but rather reinforce these conclusions, since the contribution (sum) of mobility gains to total wage growth of more frequent movers is substantially greater than the corresponding (sum of) mobility gains of less frequent movers.

(3) To distinguish between matching and training effects we used information on the wage gains in moving and related them to frequencies of moving and to growth of wages over the training period. The analyses yield the following conclusions: (a) Matching alone does not explain job duration nor wage growth within and across firms. If it

plays a role, it is a factor in addition to training. (b) Effects of training on turnover and wage growth are significant whether or not training is related to matching. (c) Mobility gains are reduced by worker investments in training, again regardless of the presence or absence of a relation between training and matching.

In some of the literature the absence of a net tenure effect on wages is ascribed to a predominant (exclusive?) firm share in specific training costs. Our data (not shown here) cast doubt on this possibility in view of an apparently symmetric effects of training on quits and on layoffs. Moreover we found that frequent movers - in whom less is invested - do not show a greater tendency toward layoffs than infrequent movers. These findings also suggest that, if matching is important, matching gains must be shared by workers and firms.

It is not clear what light, if any, our finding sheds on the work-incentive hypothesis popularized by Lazear (1979, 1981). The hypothesis is silent on the timing of wage growth within the firm, and it ignores the distinction between tenure and experience. The work-incentive hypothesis does not represent a contradiction of the human capital hypothesis in principle, but no attempt was made to assess its contribution to our findings.

Finally, the usual word of caution is especially relevant in this kind of study: Our information on training, tenure, and wage changes is beset by a host of errors. The findings are tentative, albeit suggestive. Although they are likely to contain perhaps different but equally troubling errors, other data sets should be used to replicate the analyses. In the longer run, more accurate data in relevant detail, should provide clear answers to the questions we investigated in the present study.

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Notes

1. Of course, the specificity is not restricted to firms and to inter-firm mobility. Occupation, region and industry specificities affect corresponding types of mobility.

2. See Sicherman (1987) and Mincer and Higuchi (1987).

3. A survey of firm data was utilized by Bishop (1980).

4. This includes retrospective information provided in the 1968 survey.

5. The frequency of moving is underestimated in this data set, since at most one job change can be ascertained between two annual surveys.

6. The quadratic form of s(x) implies a cubic for N(x), and this is verified in col. (B) of Table 1. The cubic form has only minor effects on the coefficients of the other variables.

7. A more thorough explanation of factors underlying the decline and covexity of s(x) can be found in Mincer and Jovanovic (1981).

8. In cross-section, an observed negative relation between turnover and tenure may be an artifact of heterogeneity, without <u>any</u> tenure dependence. If so, for the individuals over time, and observed changes over the working life would be due to aging effects only: However, experience-turnover profiles decline much more steeply than the declines due to aging (i.e., declines in separation rates with experience, <u>at the same levels of tenure</u>). This is evidence of the

reality of the asserted "tenure-dependence" despite the heterogeneity bias. See Mincer and Jovanovic (1981).

9. Actual declines in mobility gains are observed and analyzed in Mincer (1986).

10. The unemployment rate of adult males ages 35-54 was used, in order to abstract from changes in the demographic composition of the labor force.

11. Negative effects of education on turnover are reduced when training effects are accounted for, but not eliminated (Mincer, 1987).

12. A check on whether the RQT measures in the PSID refer to the length of current training in the firm or to total (cumulated) on-the-job training needed for the particular job was performed by N. Sicherman (1987). A comparison by detailed occupation in PSID responses with DOT (Dictionary of Occupational Titles) estimates supports the assertion that RQT is not a cumulative measure antedating the current firm for most occupations, except for a minority of highly skilled professional occupations where RQT is overstated. When added to probably sizable errors of measurement this discrepancy creates an additional downward bias on estimates of effects of RQT in statistical regressions.

13. Both RQT and RQT/Ten level off at about two decades of work experiences. The quadratic smoothing function forces peaks and troughs at about that time. The regression of RQT divided by completed tenure in the 1976 job was restricted

to a subsample of workers (about half of the total) who left their 1976 job by 1983.

14. For evidence and analysis see Mincer (1983).

15. For further analysis, see Mincer (1988).

16. See Akerloff and Main (1980).

17. Here the predictions are based on the observed average annual incidence of 12%. With several thousand observations in samples, statistical significance is strong.

18. Table A.7, op. cit. There the effect of an additional year of training is a 15% increase in wages. The effect of training (higher-wage level after training) decays over a period of 13 years - due to depreciation of human capital or to job change which erodes firm-specific capital.

19. Optimal search is given by:

$$\frac{1}{i}\left[1-\left(\frac{1}{1+i}\right)^{T}\right]\cdot P_a(\bar{W}_a-W_a)=C$$

Here i is the discount rate, T is the expected payoff period which is at least equal to expected tenure in the new firm, Pa the probability of finding an acceptable vacancy, Wa the reservation wage, $\bar{W}a$ the mean wage of W $\geq$ Wa, and C the cost of search. In our case, a higher T (and probably lower i of larger human capital investor) raises Wa, given C.

20. T denotes the last period of training. As was suspected, the coefficient of m2 was positive, which confounds the distinction between training and matching.

21. For evidence, see Mincer (1986).

22. Altonji and Shakotko (1986), Abraham and Farber (1987), and Marshall and Zarkin (1987). Topel (1987), however, rejects their findings in a recent econometric study.

Appendix Tables

Table A1

Job Training in Survey Week
(1976 PSID Survey)

Age	% Engaged	Their Hours	Average* Hours		Education	%Engaged	Their Hours	Average* Hours
< 25	76	12.7	9.7		0-8	39	3.1	1.2
25-34	72	9.3	6.7		9-11	56	8.2	4.6
35-44	58	8.1	4.7		12	59	9.6	5.6
45-54	48	2.5	1.2		13-15	71	9.7	6.9
55-64	29	3.9	1.1		16+	58	7.2	4.2

*The third column is the product of the first two columns, yielding average hours in training of all workers.

Source: Duncan and Stafford (1980).

Table A2

Incidence of Company Training

Variables*	CPS Men (1983)	NLS Young Men (1973-1980)	NLS Mature Men (1967-1971)
Education			
< 12	-.48 (7.1)	-.44 (6.2)	-.33 (4.8)
13-15	.23 (5.9)	.30 (6.8)	.19 (2.4)
16	.48 (11.0)	.45 (8.8)	.11 (.9)
17+	.31 (7.0)	.26 (4.9)	-.08 (.7)
Nonwhite	-.25 (4.8)	-.17 (3.9)	-.22 (3.1)
Union	-.09 (1.8)	-.06 (1.2)	-.59 (3.4)
X	-.008 (4.0)	+.009 (2.2)	-.016 (3.2)
Tenure	.034 (11.2)		.004 (2.0)
Mar	.39 (5.2)		
NU		-.02 (.1)	.014 (2.8)

Source: Lillard and Tan (1986).

Table A3

(A) Completed Tenure in 1976 Firm[1]

Variables	All M	All b	All t	Younger[2] M	Younger[2] b	Younger[2] t	Older[2] M	Older[2] b	Older[2] t
Intercept	8.8[3]	-11.46	2.7	4.8[3]	3.46	.8	14.4[3]	-41.96	4.2
RQT76	2.0	.63	3.9	1.73	.48	3.0	2.61	.86	2.5
Educ76	12.5	1.35	2.0	13.2	-.40	.6	11.8	.68	.6
$Educ^2$		-.05	1.7		.018	.7		-.02	.4
Prior X	11.2	.71	5.6	5.8	.29	1.1	24.5	3.6	4.8
$(Prior\ X)^2$		-.006	1.6		.005	.2		-.06	4.2
Mar 76	.88	1.40	1.4	.85	1.20	2.1	.92	1.37	.5
Union 76	.22	2.25	2.8	.16	1.63	2.9	.32	2.55	1.6
$\dot{e}_{RQT}$	.096	2.89	4.0	.123	1.91	4.4	.056	3.06	1.6
R^2			.35			.16			.21
n	564			330			234		

Note: RQT and $\dot{e}_{RQT}$ used alternatively. Coefficients of other variables not very diffierent. Prior X defined at start of 1976 job.

1 Tenure completed before 1983.

2 Younger, if experience in 1976 was no more than 12 years.

3 Mean of dependent variable.

Table A3 - continued

(B) Probability of Staying in the 1976 Firm Beyond 1983

	All			Younger[1]			Older		
Variables	M	b	t	M	b	t	M	b	t
Intercept	.436[2]	.014	.14	.271[2]	.005	.03	.539[2]	.13	.9
Educ	12.8	.019	3.6	12.8	.020	2.8	12.7	.016	2.4
P_2X	10.2	.015	4.2	6.9	-.016	2.6	12.3	.006	1.2
$(P_2X)^2$		-.0006	5.3		.0002	1.0		-.0003	1.7
Mar	.89	.088	2.1	.84	.011	.2	.93	.12	1.9
Union	.29	.20	6.7		.17	4.0	.30	.22	5.6
RQT	2.09	.018	2.9	1.76	.001	.14	2.30	.019	2.5
R^2			.08			.11			.07
n	1437			550			887		

1 Younger, if experience in 1982 was no more than 12 years.

2 Mean of dependent variable.

Table A4

Effects of Training on Separations (N), 1968-1982

Variables	All b	All t	Younger b	Younger t	Older b	Older t
c^a	7.0	16.3	8.4	12.0	7.8	8.5
RQT	-.072	2.4	-.126	2.4	-.051	1.6
Ed	-.210	7.4	-.34	8.1	-.105	3.6
X^b	-.013	6.0	n.s.		-.27	4.2
X^2	.0012	2.4	n.s.		.005	3.4
Mar	-.181	1.9	n.s.		-.54	1.9
Union	-.87	6.2	-1.06	4.8	-.57	3.4
n	1,471		777		694	
N^c	2.25		3.00		1.45	

[a] Intercept [b] In 1976 [c] Average number of separations over the period.
Means of other variables as in Table A3(B), except for X.

Table A4A

(1) Incidence of Training in Intervals of Varying Length in the NLS

Length of Interval (yrs.)	Young Men Observed %	Young Men Predicted[1] %	Old Men Observed %	Old Men Predicted %
1	24.3			
2	29.7	42	10.2	
4				19
5			17.2	
6				27

[1] Predicted figures are rounded

(2) Cumulated Annual Incidence of Training in the NLS (Young Men Cohorts)

Number of periods in which training was received	0	1	2	3 to 8
Observed %	37.2	25.0	14.2	23.6
Predicted %	35	38	17	10

Table A-4B

Probability of Separating in 1976-1983

(Effects of Training and of Prior Mobility)

Variables	b	t		
c	.43	13.5		
Ed	-.012	8.1		
X^a	-.006	5.7		
X^2	.0001	2.8	Quits	Layoffs
RQT^b	-.005	2.6	-.0025 (1.7)	-.0022 (1.9)
Mar	-.064	5.5		
Union	[illegible]	[illegible]		
P_2 Training [c]	-.014	1.6		
Sep (1968-76)	.242	8.8	Younger	Older
e_{RQT} [b]	-.044	1.7	n.s.	-.077 (2.1)
n	759			

[a] Experience at start of 1976 job

[b] Alternative variables

[c] Training needed to enter 1976 job

Table A6

Average Annual Wage Growth, 1968-1983

	All		Younger		Older	
Variables	b	t	b	t	b	t
c	.115	6.3	.143	2.8	.121	3.8
AN	-.028	2.5	-.025	1.0	-.036	3.4
Ed		n.s.		n.s.	.0007	1.4
X_{82}	-.006	6.3	-.006	2.2	-.007	3.3
X^2_{82}	.00008	4.3		n.s.	.0001	2.8
Mar_{82}		n.s.		n.s.		n.s.
$Union_{82}$	.010	n.s.		n.s.	.011	3.3
n	777		275		502	

c = intercept; n.s. = not significant

Note: 1. When Prior Training is included, the coefficients of AN are slightly reduced.

2. In the upper row of Table 6, e_{RQT} replaces AN. Replacement by RQT yielded no significance.