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Length Of Service And The Operation Of Internal Labor Markets

by

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WP #1394-83 January, 1983

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Everyone knows that employees with more years of service at a company normally receive higher pay than comparable employees who have spent less time with the same firm.[1] Within the economics profession, the conventional wisdom of the 1960s and 1970s has been that the observed higher relative earnings of employees with longer service reflect greater accumulation of human capital through on-the-job training and thus higher relative productivity.[2] There are, however, numerous other plausible explanations for the higher relative earnings of employees with longer service in which relative productivity plays a much less significant role. For instance, Jacob Mincer recognized the possibility that the positive association between job tenure and earnings might only "reflect the prevalence of institutional arrangements such as seniority provisions in employment practices." He then implicitly describes one approach to testing the human capital belief: "Such practices, however, do not contradict the productivity-augmenting hypothesis, unless it can be shown that growth of earnings under seniority provisions is largely independent of productivity growth."[3]

Although the test required to establish empirically that the human capital explanation of the company service-earnings profile is superior to alternative models in which other factors determine earnings growth seems straightforward, there is no evidence demonstrating that tenure-earnings differentials <u>can</u> in fact be explained by tenure-productivity differentials. As a result, important beliefs about earnings differentials and related labor market phenomena have been held without any apparent empirical foundation.

Our work on the operation of enterprise internal labor markets has produced very strong evidence that at least the within-grade or within-job fraction of the observed return to years of company service (40 to 80 percent of the total return to company service in the settings for which we have seen data) cannot be explained on the basis of an underlying relationship between service and productivity. Furthermore, we have collected survey data which imply that years of service play a significant role in promotion decisions for a very large fraction of our country's workforce; for those employees, the cross-grade or cross-job earnings differential associated with service must also be considered at least in part a return to service per se. It would thus appear that junior workers are typically paid less, and senior workers more, than the value of their marginal product. One might expect this sort of deferred compensation scheme to be accompanied by constraints on firms' ability to cheat workers out of the return promised for the "second half" of their work lives; we have gathered evidence that senior employees at most U.S. firms do in fact enjoy substantial protection against being involuntarily terminated. Our results raise the intriguing question of why senior workers receive higher earnings than their junior peers, even though they are no more productive.

The remainder of this paper discusses how the facts just stated were discovered and the necessity for the collection of additional facts if we are to hold empirically-based beliefs about why service per se plays such an important role in private sector U.S. enterprises.

The Facts on Service-Earnings Differentials Within Grades or Jobs

To determine whether service-earnings differentials can be explained by service-productivity differentials, it is necessary to search for measures of individuals' relative contributions to their firms. We looked first at the computerized personnel files for exempt (roughly, managerial and professional) employees of four major U.S. corporations; each file had information on individuals' job performance, company service, and earnings. At three of these companies the performance ratings were done by the employee's immediate supervisor; at the fourth, in addition to the immediate supervisor's rating, there was a ranking of each employee relative to others in an appropriate comparison group. Later, Halasz gained access to a comparable data set for a sample of nonexempt salaried employees.[4]

Under all of the companies' evaluation procedures, supervisors are instructed to base their rating or ranking on how well an individual, in the year of evaluation, is carrying out the responsibilities of his or her job. Thus, a performance review should reflect an employee's current level of performance relative to the level of performance deemed normal for someone in his or her position. It follows that the relative contributions of employees can be assessed from their performance ratings only if the employees hold similar jobs.

For compensation purposes, most companies assess the relative importance and difficulty of their myriad exempt and nonexempt salaried positions and group them into grade levels. Thus, it seems reasonable to assume that within a grade level, a higher performance rating implies higher productivity. It is for this reason that we, and Halasz, were forced to look within grades in

doing our analysis of the determinants of service-earnings differentials. Fortunately, however, the portion of the total return to years of service occurring within grade was between 40 and 50 percent of the total differential for our four samples of white, male, exempt employees and 50 percent for Halasz's sample of nonexempt salaried employees.

The key finding of these analyses was that none of the substantial, within-grade, service-earnings differentials could be explained by a within-grade, service-performance differential. Contrary to what would be expected under the on-the-job training model, while greater service moved employees toward the upper tail of the earnings distribution for their grade level, it did not move them toward the upper tail of the relevant performance distribution. Once employees are assigned to grades, the salary advantage that accrues with company service appears to be automatic, and hence, independent of productivity.

This result has been challenged on two grounds. First, it has been charged that the estimated service-performance differential is biased downward since a negative partial correlation between years of service and unobserved quality was induced by the necessity of looking only within grade levels. (This bias would be brought about by a promotion system under which merit at least sometimes prevails over seniority, so that longer service within grade implies more times passed over for promotions.) Second, it has been claimed that performance ratings, even for samples of white males, are not valid indicators of relative productivity.

There likely is a negative within-grade correlation between service and ability (largest in absolute value for exempt employees and smallest in

absolute value for unionized hourly workers), so that the estimated within-grade effect of service on performance is probably biased downward. It must be remembered, however, that the estimated within-grade effect of service on earnings is biased downward in the same way. The goal of the analyses of employees' positions in the relevant performance and salary distributions was not to derive consistent estimates of the effect of service on either performance or salary. Rather, they were intended to yield an answer to the question: Can performance explain the substantial within-grade earnings advantage enjoyed by longer-service salaried employees at the firms we have studied? Our answer of "no" does not depend on the consistency of the estimate of the impact of service on performance or on earnings. All that the response depends on is that the difference between these two estimated service effects (which have been made comparable through the construction of the performance and earnings categories used in the models estimated) be a consistent estimate of the difference between the two "true" service effects. We know of no reason why it should not be.

In our previously cited articles on the issue at hand, we go to great lengths to address the most likely criticisms of subjective performance ratings. In light of what we have been able to learn from our review of the relevant personnel literature, from the case studies we have done, and from various analyses with company personnel data, we feel very comfortable assuming that performance ratings are good indicators of employees' relative productivity in the year of evaluation. The diverse evidence we have seen seems to support strongly the interpretation that we have given to our results

concerning the ability of rated performance to explain the within-grade return to years of service.

Further support for our conclusion regarding within-grade service-earnings differentials can be derived from a recent econometric case study done by Yanker in which an "objective" productivity measure is used to conduct an analysis like those just discussed.[5] Yanker examined productivity and earnings data for approximately 400 blue collar employees at a unionized manufacturing plant. The productivity measure used was equal to the time a worker took to do his or her job divided by the standard time for performing the job. The study found that none of the within-job service-earnings differential (80 percent of the total service-earnings differential) could be explained on the basis of more senior workers having higher productivity.

An appendix to this paper summarizes the studies just mentioned, plus twenty-one other studies relating some index of productive value to tenure or age in various settings. These analyses examined employees within disparate occupations: production workers (in the wooden household furniture, footwear, and apparel industries); scientists; engineers; teachers; mail sorters; and office workers. Fourteen of these additional studies used objective measures of productive value including: furniture, shoes, or apparel produced; publications; patents; students' standardized test scores; mail sorted; pages typed; items filed; or cards punched. This research provides support for the proposition that, beyond a typically short orientation period, those who have greater than average service typically perform no better or less well than those with similar assignments who have less than average service. When

considered together with the evidence from various sources that wages have a strong positive relationship with tenure within occupational group, these investigations strongly imply that more (less) senior employees are generally paid more (less) than the value of their marginal product. Extant evidence on service-productivity differentials seems to have the same implication about the role of productivity in explaining within-grade or within-job service-earnings differentials whether the index of relative productive value is based on an "objective" measure or on a "subjective" performance rating.

The Facts on the Role of Service per se in Promotion Decisions

To determine whether the 20 to 60 percent of the monetary return to years of company service that occurs across grades can be explained in terms of a service-productivity differential, it is necessary to understand the role of service independent of productivity in promotion decisions. To take a step in this direction, we surveyed a randomly selected sample of 1025 Standard and Poor's companies about, among other things, the conditions under which a junior employee would be promoted ahead of a senior coworkers who was not as good a performer.[6] The question asked was:

> In actual practice, are junior employees promoted instead of more senior employees who want the job?
>
> ( ) Yes, if it is believed that the junior employee will do better than the senior employee on the next job or on later jobs.
> ( ) Yes, if it is believed that the junior employee will do significantly better than the senior employee on the next job or on later jobs.
> ( ) No, never

The responses to this query are summarized in Table 1. They indicate that 76 percent of private sector, nonagricultural, nonconstruction, unionized hourly employees work in settings where senior employees are favored substantially when promotion decisions are made; for nonunion hourly employees, the comparable estimate is 56 percent; for non-exempt salaried employees, 59 percent; and for exempt salaried employees, 48 percent. Overall, we estimate that perhaps 60 percent of our country's private sector, nonagricultural, nonconstruction employees work in settings where senior employees are favored substantially in the promotion process.[7] Hence, for this large part of the U.S. workforce, it appears that the piece of the total monetary return to seniority that can be linked to senior employees who have been promoted to better-paying jobs than are held by otherwise comparable junior employees is to a significant extent a reward to seniority per se, rather than simply a reward for higher productivity. Moreover, it should be noted that the 60 percent figure estimates the fraction of the private sector, nonagricultural, nonconstruction workforce employed where senior employees seem to be favored substantially in promotion choices; the percentage working where senior employees are favored at all is likely to be much greater. This is because in many settings senior employees can be expected to have a significantly higher probability of being promoted than their junior colleagues when the comparisons are limited to those with the same productivity.

Hence, it appears that only just over a third of private sector nonagricultural, nonconstruction employment in the United States is found in settings where the sole monetary return to seniority per se is the substantial premium that occurs within grade level or job category; the other nearly two-thirds

TABLE 1

SUMMARY OF RESPONSES TO SURVEY QUESTIONS PERTAINING TO WHETHER JUNIOR EMPLOYEES ARE TYPICALLY PROMOTED INSTEAD OF SENIOR EMPLOYEES[a]

	Number of Responses for Indicated Group	Junior Employees Promoted Ahead of Senior Employees If Expected to Do Better on the Next Job or on Later Jobs	Junior Employees Promoted Ahead of Senior Employees If Expected to Do Significantly Better on the Next Job or on Later Jobs	Junior Employees Never Promoted Ahead of Senior Employees
Hourly employees covered by a collective bargaining agreement	135	23.7	43.0	33.3
Hourly employees not covered by a collective bargaining agreement	158	44.3	41.1	14.6
Nonexempt salaried employees	74	40.5	44.6	14.9
Exempt employees	25	52.0	48.0	0.0

[a]The survey on which these results are based was sent to a sample of 1,025 private sector, nonagricultural nonconstruction companies randomly selected from the 1981 Standard and Poor's Register. Respondents were requested to provide information for the one largest group of employees affected by their personnel decisions; this group could consist of hourly, nonexempt salaried or exempt employees. A separate question asked whether a majority of the employees in this group was covered by a collective bargaining agreement; no observations for covered nonexempt salaried employees or covered exempt employees were included in the tabulations.

appears to be found where the earnings advantage associated with seniority independent of productivity occurs both as a result of the assignments given to employees and as a result of the way they are paid for doing a given task.

The Facts on the Role of Service per se in Termination Decisions

We would expect that the compensation scheme found at most U.S. workplaces would go hand-in-hand with a provision designed to protect workers from being cheated out of the return promised for the "second half" of their work lives. To determine the extent to which protection of this nature conditioned firms' decision making about which employees to terminate when some could not be retained, we also asked the following question of our randomly selected sample of firms:[2]

> In the event of a workforce reduction, are senior employees permanently laid off in place of junior employees?
>
> ( ) Yes, if it is believed that the junior employee will be worth more on net to the company than the senior employee.
> ( ) Yes, if it is believed that the junior employee will be worth <u>significantly</u> more on net to the company than the senior employee.
> ( ) No, never.

The expression "worth more on net" was used to mean "worth more considering both performance and earnings, today and in the future." The "significantly more on net" and the "no, never" responses are thus consistent with the statement that the firm can be expected to incur significant short-run costs to protect its senior workers' earnings claims.

The answers from the survey respondents who had witnessed involuntary terminations are summarized in Table 2. They indicate that approximately 85 percent of U.S. private sector, nonagricultural, nonconstruction employees

TABLE 2

SUMMARY OF RESPONSES TO SURVEY QUESTIONS PERTAINING TO WHETHER SENIOR EMPLOYEES ARE PERMANENTLY LAID OFF IN PLACE OF JUNIOR EMPLOYEES[a]

	Number of Responses for Indicated Group	Senior Employee Permanently Laid Off If Junior Employee Believed to Be Worth More on Net	Senior Employee Permanently Laid Off If Junior Employee Believed to Be Worth Significantly More on Net	Senior Employee Never Permanently Laid Off in Place of Junior Employee
Hourly employees covered by a collective bargaining agreement	73	2.7%	13.7%	83.6%
Hourly employees not covered by a collective bargaining agreement	71	14.1%	43.7%	42.3%
Nonexempt salaried employees	16	18.8%	50.0%	31.3%
Exempt employees	5	20.0%	80.0%	0.0%

[a]These results are based on the same survey as the results reported in Table 1. There are fewer observations on firms' permanent layoff practices than on firms' promotion practices because only respondents who had witnessed a reduction in force could describe their firms' permanent layoff practices.

work in settings where senior employees do in fact enjoy substantially greater protection against job loss than junior employees doing similar work.[9] Importantly, there appear to be substantial differences between union and nonunion settings in this regard. Rules protecting senior workers against being permanently laid off before their junior coworkers appear to be both more prevalent and stronger under trade unions. For hourly employees, almost 100 percent of the responses pertaining to groups covered by collective bargaining implied that seniority in and of itself receives substantial weight in termination decisions, while only 85 percent of the responses pertaining to noncovered groups indicated that this is the case. As for "strength," while 84 percent of our survey responses that pertained to unionized hourly employees indicated that a senior worker would never be involuntarily terminated before a junior worker, the same was true for only 42 percent of the responses pertaining to nonunion hourly employees.

The Facts to Be Collected

An explanation of why senior workers doing a given job in U.S. corporations receive higher salaries than their junior, but no less valuable, coworkers remains to be documented. At present, there are a number of theories that might be considered consistent with our findings. One group of potential explanations revolves around the notion that employers and employees may enter into implicit contracts that provide that earnings be deferred toward the end of the worklife. Firms may offer such contracts: (1) to deter quits or behavior that would lead to discharge;[10] (2) to discourage workers with high propensities to quit from seeking employment with the firm;[11] (3) to

improve morale by giving employees regular raises, and (4) to insure relatively risk-averse employees against slow earnings growth that might otherwise be associated with slow productivity growth.[12] A second type of explanation might be that such contracts avoid the unpleasantness felt by a supervisor who has to fire or reduce the relative salary of a long-time subordinate. A third issue that deserves mention is that societal beliefs -- for example, the idea that elders should be respected -- may condition employees' beliefs concerning "just" relative compensation.

Unfortunately, at this point, all of these theories suffer the same deficiency as the human capital theory about the service-earnings profile: absence of an empirical basis. More facts concerning enterprise internal labor markets must be forthcoming if we are to do more than guess about why service independent of productivity is rewarded so highly in the pricing and allocation of labor. We must remember that statements with no factual basis are conjectures, no matter how empirical they may sound. Empiricism requires data.

FOOTNOTES

[1]We should emphasize that all the discussion and evidence presented in this paper refers to enterprise internal labor markets, Doeringer and Piore (1971), pp. 2-4, explores the distinction between enterprise and craft internal labor markets.

[2]The human capital model of investment in on-the-job training is laid out in Becker (1964), pp. 13-37.

[3]Mincer (1974), p. 12. Mincer has seniority provisions under collective bargaining agreements in mind when he makes this statement, but his logic applies equally well in other institutional settings.

[4]See Medoff (1977), Medoff and Abraham (1980, 1981), and Halasz (1980).

[5]See Yanker (1980).

[6]See Abraham and Medoff (1982a) for a fuller discussion of these survey results.

[7]This very rough estimate was obtained by weighting the estimates for union hourly employees, nonunion hourly employees and salaried employees by the fractions of private sector, nonagricultural, nonconstruction employment in each of these same three groups. The employment figures were derived from the May 1978 Current Population Survey (CPS): union members paid by the hour, 17 percent; nonmembers paid by the hour, 43 percent; and nonhourly employees, 40 percent, of which 8 percent were union and 92 percent were nonunion. There was no way to distinguish nonexempt and exempt salaried employment on the CPS.

[8]See Abraham and Medoff (1982b) for a fuller discussion of these survey results.

[9] This very rough estimate was derived using the approach described in footnote 7.

[10]For development of a model along these lines, see Becker and Stigler (1974) and Lazear (1979).

[11] See Salop and Salop (1976) and Viscusi (1978).

[12]Models with much this flavor have been developed by Harris and Holmstrom (1981) and Ioannides and Pissarides (1982).

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APPENDIX

SUMMARY OF STUDIES PERTAINING TO THE RELATIONSHIP OF TENURE, EXPERIENCE AND AGE TO PRODUCTIVITY [a]

Subject Group and Study	Methodology and Conclusions
Recently-hired first line supervisors at a manufacturing plant (Brown [1982]).	Performance ratings for approximately 200 persons hired over a six year period were used in the analysis. Other factors the same, years in supervisory position had a positive effect on rated performance. However, the mean amount of company service among those in the sample was only three years.
Exempt employees at a large manufacturing firm (Medoff and Abraham [1981]).	Data on salary, performance rating assigned by supervisor, job grade level and individual characteristics for approximately 8,000 white male employees at a large company were taken from that company's computerized personnel file. Approximately 40 percent of the higher earnings associated with seniority took the form of higher earnings within grade level. While additional company service beyond the mean amount increased the probability of being towards the top of the within-grade-level salary distribution, it decreased the probability of being towards the top of the within-grade-level performance distribution. In addition, analysis of longitudinal data on pay and performance revealed that, for those staying in the same job grade level over time, relative within-grade-level salary rose but relative within-grade-level rated performance fell.
Production and warehouse employees at a nonunion manufacturing plant (Halasz [1980]).	Salary, performance rating, job grade level and information on individual characteristics were taken from approximately 300 non-exempt employees' personnel records. For these employees, approximately 50 percent of the return to seniority took the form of higher earnings within grade level. Additional company service beyond the mean amount increased the probability of being towards the top of the within-grade-level salary distribution but decreased the probability of being towards the top of the within-grade-level performance distribution.
Exempt employees at two large manufacturing firms (Medoff and Abraham [1980]).	Cross-sectional results virtually identical to those reported in Medoff and Abraham (1981) were obtained with data for several thousand white male employees at each of two large manufacturing firms.

SUMMARY OF STUDIES PERTAINING TO THE RELATIONSHIP OF TENURE, EXPERIENCE AND AGE TO PRODUCTIVITY[a]
(continued)

Subject Group and Study	Methodology and Conclusions
Blue collar employees at a unionized manufacturing plant (Yanker [1980]).	Data on hourly rate of pay, productivity, job grade level and individual characteristics for approximately 400 workers were taken from their personnel records. The productivity measure was equal to the time the worker took to do his/her job divided by the standard time for performing the job. Approximately 80 percent of the earnings return to seniority occurred within job grade level; none of this within-grade-level return could be explained on the basis of more senior workers having higher productivity.
Scientists (Cole [1978]).	Cross-sectional data for a random sample of U.S. scientists in six disciplines showed a peak among those aged 40 to 44 both in mean number of papers published and in the importance of published works as measured by number of citations. However, all differences in mean output between adjacent age groups were very small. Longitudinal data for the cohort of U.S. mathematicians who got their Ph.D.'s between 1947 and 1950 showed no relationship between time since receiving Ph.D. and either number of publications or number of citations to those publications.
Airline managers (Medoff [1977]).	Cross-sectional results very similar to those in Medoff and Abraham (1981) were obtained using data for approximately 800 managers employed by an airline.
Sixth grade teachers (Summers and Wolfe [1977]).	The change between third grade and sixth grade in individual students' composite achievement score on the Iowa Test of Basic Skills was used as a measure of educational output. Sixth grade teachers' experience was measured in years, up to 11 years. A total of 627 usable observations were obtained. Controlling for other factors, students whose third-grade scores were above the norm benefited from additional sixth-grade teacher experience, but among those with third-grade scores below the norm, additional teacher experience was associated with smaller changes in test score.
Scientists and engineers (Hall and Mansfield [1975]).	Performance data was collected for 290 researchers in 22 research and development organizations using questionnaires which asked people to rate their own performance relative to others in similar positions by placing themselves on a 7-point

(continued)

SUMMARY OF STUDIES PERTAINING TO THE RELATIONSHIP OF TENURE, EXPERIENCE AND AGE TO PRODUCTIVITY [a]
(continued)

Subject Group and Study	Methodology and Conclusions
	scale ranging from "in top 5%" to "in the lower 25%". The same questionnaire was readministered to 90 of the researchers two years later. Cross-sectional analyses of the two sets of responses found self-rated performance to be uncorrelated with seniority.
Inner-city third grade teachers (Murnane [1975]).	Progress made during third grade in math and in reading by each of approximately 900 black students was measured using changes in the students' standard scores on Metropolitan Achievement Tests. Controlling for other factors, the biggest improvement in students' test scores was observed for teachers with three to four years of experience. Teachers with five or more years of experience were found to be no more effective or less effective than teachers with three or four years of experience.
Engineers in technology-based commercial industries (Dalton and Thompson [1971]).	Three measures of performance were collected for approximately 2,500 design and development engineers at six companies: (1) performance ratings done by management; (2) management evaluations of the complexity of engineers' assignments; and (3) engineers' own assessments of what happens to the productivity of those doing technical work as they age. Rated performance was highest for those aged 31 to 35 and fell sharply thereafter. Those 26 to 30 performed the most complex tasks, with older engineers doing much less complex work. The engineers themselves said peak productivity for those doing technical work occurred at age 38. However, salaries were substantially higher for those in each successive age bracket through the 41 to 45 year-old group and were level beyond age 45.
Second and third grade teachers (Hanushek [1970])	Cross-sectional data from a survey covering 1,061 third-grade students in a large California school system was used. Individual students' third grade Stanford Achievement test scores were used as a measure of educational output. Controlling for students' first grade test scores and other relevant factors, neither second grade teachers' experience nor third grade teachers' experience was found to have any significant effect on third grade test score.

SUMMARY OF STUDIES PERTAINING TO THE RELATIONSHIP OF TENURE, EXPERIENCE AND AGE TO PRODUCTIVITY[a]
(continued)

Subject Group and Study	Methodology and Conclusions
Male production managers (Tenopyr [1969]).	Data was collected on 113 male production managers in one division of a rocket engine development and manufacturing concern. The study focused on how well various tests of leadership potential predict managerial success, but included a correlation analysis of seniority versus performance. Two measures of performance were used: (1) immediate supervisors were asked to check descriptive statements about each manager and integral weights from 0 to 4 were applied in scoring the checklists; and (2) the company's labor relations staff rated the manager's handling of employee relations matters on a 7-interval scale. For the 86 subjects for whom both performance measures were available, seniority was not found to be significantly correlated with either rating.
Research scientists (Eiduson [1966]).	Longitudinal data on average number of papers published per year during each of two successive five-year periods was collected for 40 research scientists ranging in age from their 30's to their 60's. Subjects' curriculum vitae were the source of the publication information. Productivity was steady for those aged 30 to 39 at the end of the first five-year period, grew slightly for those aged 40 to 49, and fell off for those aged 50 or greater.
Research chemists (Stewart and Sparks [1966]).	Number of patent memoranda, number of patent applications and number of patents issued were used as measures of productivity. Altogether 962 man-years worth of data for 89 men in one division of a large industrial scientific research organization were collected. Each of these 962 man-years was treated was treated as a separate observation in a cross-sectional analysis. All three patent variables were positively correlated with length of service; however, the positive association between patent activity and length of service was much weaker beyond 10 years of service than prior to that cutoff.
Employees of one multi-department firm (Svetik, Prien, and Barnet [1966]).	Supervisors were asked to complete a performance evaluation of each of their subordinates, rating them on "overall effectiveness," which was not explicitly defined. A significant negative correlation was found between these ratings and individual employees' length of service. The supervisors' ratings were also negatively correlated with salary.

SUMMARY OF STUDIES PERTAINING TO THE RELATIONSHIP OF TENURE, EXPERIENCE AND AGE TO PRODUCTIVITY
(continued)

Subject Group and Study	Methodology and Conclusions
Federal mail sorters (Bureau of Labor Statistics [1964]).	Production records covering an eight-week period for approximately 6,000 workers in twelve cities were analyzed. An index of performance was computed for each worker by dividing his/her production score by the average production score of all workers aged 35 to 44 doing similar work in the same city. Those with less than six months service had the lowest average performance index; beyond six months, length of service seemed to be unimportant.
Scientists and engineers in research laboratories (Pelz [1964]).	Five measures of current performance were collected for a cross-section of 1,311 scientists and engineers working in 11 research laboratories: (1) contribution to scientific knowledge, as judged by colleagues; (2) overall usefulness to laboratory, again as judged by colleagues; (3) published papers; (4) patent applications; and (5) unpublished papers. All the performance measures were for the five-year period prior to the date of the study. For those in research laboratories, measured performance typically was highest among those aged 35-44 as of the time of the study; for those in development laboratories, the peak occurred among those 45 to 49. Performance among those immediately beyond the peak age group was sharply lower. A second peak in performance was evident 10 to 15 years beyond the first performance peak.
Office workers doing routine work such as typing, filing, posting, sorting and card punching (Bureau of Labor Statistics [1960]).	Data on physical volume of production per hour worked over an observation period of 4 to 12 weeks was collected for approximately 6,000 workers in 5 federal agencies and 21 private companies. An index of performance was computed for each worker by taking the ratio of his/her output to the average output of those aged 35 to 44 employed at the same firm and doing comparable work. Among workers with 9 months or more experience on the job, there was practically no difference in the mean value of the performance index across age groups, either within occupational groups or when an average was taken across the occupational groups. A large proportion of those included in the sample were under incentive payment schemes. However, the results looked very similar for those under incentive and those under time payment plans.

SUMMARY OF STUDIES PERTAINING TO THE RELATIONSHIP OF TENURE, EXPERIENCE AND AGE TO PRODUCTIVITY
(continued)

Subject Group and Study	Methodology and Conclusions
Technical employees in a large research and engineering firm (Oberg [1960]).	Performance of approximately 900 technical employees in one firm was estimated using cross-sectional data on individuals' positions in the annual order-of-merit rankings of technical employees. These rankings were done on a department by department basis for salary administration purposes. The criterion used in ranking was the workers' "present value to the company." This criterion was not defined more precisely. Among those doing research and development work, performance was highest for those 30 to 35 and fell off gradually thereafter. Among those doing engineering work, performance fell off for those aged 32 through 50, then showed a second peak for those in their 50's.
Retail sales personnel (Canadian Department of Labor [1959]).	The dollar volume of sales for clerks in two large department stores were used to form performance ratings of 1 through 4, depending on each individuals' quartile position in the distribution of dollar sales for his/her department. At one store, mean rated performance was lower for those with less than 3 years' service than for those in the longer service groups, and weakly but positively related to service thereafter. At the second store, mean rated performance was lower for those with less than 6 years' service than for those with more service and again weakly but positively related to service thereafter.
Production workers in the wood household furniture industry and the footwear industry (Bureau of Labor Statistics [1957]).	For approximately 5,100 workers in 15 footwear establishments and 11 furniture establishments, output per worker-hour was measured using average straight time hourly piecework earnings. The production index used for comparison purposes was each individual's average hourly earnings divided by the mean of average hourly earnings for those of the same sex in the 35 to 44 age group doing the same job in the same plant. In both industries and for both sexes, the mean value of the production index was highest for those aged 25 to 34 and fell beyond that age group.
Production workers in the footwear industry and the clothing industry (Bureau of Labor Statistics [1956]).	Piecework earnings data for 933 workers in the footwear industry and 1,284 workers in the clothing industry were studied. The data were used to create a production index like that used in Bureau of Labor Statistics (1957). The mean value of this production index was stable for all age groups through age 54 and approximately 10 percent lower for those aged 55 to 64.

SUMMARY OF STUDIES PERTAINING TO THE RELATIONSHIP OF TENURE, EXPERIENCE AND AGE TO PRODUCTIVITY
(continued)

Subject Group and Study	Methodology and Conclusions
Outstanding people in a variety of professional occupations (Lehman [1953]).	The goal of this study was to identify the age by which numerous individuals in various fields had done their best work or achieved their highest average rate of productivity. In the majority of occupations, it was found that the individuals' best work had been done by age 40. However, it should be emphasized that the study focused on selected outstanding individuals rather than on a representative sampling of members of any occupation.
Shopcraft railroad employees (Mater [1941]).	Relative speed of work for a cross-section of 701 employees of one railroad was used as a measure of worker efficiency. Holding age constant, efficiency appeared to peak at about 10 years of service and fall thereafter.
Employees of large New England manufacturing companies (Palmer and Brownell [1939]).	Records on productivity of workers at six companies were broken down into a comparison of productivity by age groups for 172 textile weavers, 127 textile spinners and 147 workers in nonferrous metal manufacturing. The records did not show any tendency for productivity to vary with age.

[a]This summary includes all the studies we know of from which inferences can be drawn concerning the relationship between individuals' age or experience and their productivity. For the sake of keeping the list of manageable size, we have excluded studies which related mean group age or experience to group output. However, the conclusions of the studies based on group data do not seem to differ much from the conclusions of those based on individual data.

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