Revision 1/11/91

UNDERINVESTMENT IN ON-THE-JOB TRAINING ?

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Working Paper # 91-03

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This paper was prepared for the December 10-1 Conference on Investing in Human Resources sponsored by the RVE National Council for Adult Education, Amsterdam, Netherlands, It is based on research that was funded by the U. S. Department of Education and by grant # USDOL J-9-M-3-0165 from the Employment and Training Administration, U. S. Department of Labor and by the Center for Advanced Human Resource Studies. The opinions and conclusions expressed herein are solely those of the author and should not be construed as representing the opinions or policies of any agency of the United States Government. This paper has not undergone formal review or approval of the faculty of the ILR school. It is intended to make results of Center Research, conferences, and projects available to others interested in human resource management in preliminary form to encourage discussion and suggestions.

1/10/91

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> If the Germans had any secret weapon in the post-1973 economic difficulties, it is the technical competence of their work force, which is in turn **the product of their apprenticeship system**.
>
> --Limprecht and Hayes, 1982, p.139.

> I think that the Japanese education system is not very good....**employer training is much more effective**.
>
> --Yutaka Kosai, President, Japan Center for Economic Research, 1989

> The heart of this new [flexible] manufacturing landscape is the management of manufacturing projects: selecting them, creating teams to work on them, and <u>managing workers' intellectual development</u>.
>
> --Ramchandran Jaikumar, 1986, p. 75.

A growing number of commentators are pointing to employer sponsored training (OJT) as a critical ingredient in a nation's competitiveness. American employers appear to devote less time and resources to the training of entry level blue collar, clerical and service employees than employers in Germany and Japan (Limprecht and Hayes 1982, Mincer and Higuchi 1988, Koike 1984, Noll et al 1984, Wiederhold-Fritz 1985). In the United States, only 33 percent of workers with 1 to 5 years of tenure report having received skill improvement training from their current employer (Hollenbeck and Wilkie 1985). Analyzing 1982 NLS-Youth data, Parsons (1985) reports that only 34 to 40 percent of the young workers in clerical, operative, service and laborer jobs reported that it was "very true" that "the skills [I am] learning would be valuable in getting a better job." The payoffs to getting jobs which offer training appear to be very high, however. In Parson's study, having a high learning job rather than a no learning job in 1979 increased a male youth's 1982 wage rate by 13.7 percent. While the 1980 job had no such effect, the 1981 job raised wages by 7.2 percent when it was a high learning job rather than a no learning job.

If the payoffs to such jobs are so substantial, why aren't such jobs more common? If one were to put this question to an employer, he would point to the high turnover rates of youth as the primary reason why he cannot afford to train new employees more intensely. For American workers with less than one year of tenure, the probability of a separation in the next 12 months is 59 percent. Since comparably defined turnover is only 20 percent in the United Kingdom and 24 percent in Japan, national differences in turnover could be a major reason for the low levels of training investment in the US, if the employer's explanation is right (OECD, 1984, Table 33 and 34).

The theory of on-the-job training says, however, that if training is general, turnover propensities should not matter. The worker pays the full costs of the training and reaps the full benefits whether or not there is subsequent turnover, so the decision to undertake training should be independent of prospective turnover. The problem with this prediction is that analyses of large representative data sets generally fail to confirm it. In Parson's (1985, table 7.6) study, when a youth reported that it was "very true" that "the skills [I am] learning would be valuable in getting a better job", his job paid on average 2.4 to 14 percent more than when the above statement was "not at all true" even with an extensive set of controls for schooling and academic achievement included in the model. Bishop and Kang (1988) have conducted another test of this hypothesis in the 1984 follow up of the High School and Beyond seniors by regressing the log of the deflated starting wage of the current or most recent job on indicators of the receipt of employer sponsored training. Here again, the jobs offering some training rather than none or which offer greater amounts of training paid higher starting wage rates even when a whole array of human capital characteristics were controlled. For females the positive effect of receiving training on the starting wage was statistically significant. Adding dummies for occupation and industry did not change the results appreciably.

It could be argued, however, that these findings do not constitute a decisive refutation of the proposition that workers pay all of the costs of general training. Hiring decision makers are probably better at assessing the ability of job candidates than econometricians who are limited to the information in the NLS or HSB data file. The positive association between wages and training arises, it could be argued, because workers who are highly able (in ways not observed by the analyst) are both paid more and also recruited for jobs that require large amounts of training.

Unobserved heterogeneity no doubt contributes to the positive association between training and starting wage rates, but to transform a large negative structural relationship into the statistically significant positive relationships just described, sorting of more able job applicants into high training jobs would have to be very powerful indeed. If such a selection process were operating, access to training should depend on ability factors that are visible to the analyst as well as on factors that are not visible to the analyst. Yet models estimated by Parsons (1985) and by Bishop and Kang (1988) failed to find large effects of ability proxies such as test scores, grades, and being a disciplined student on the probability of receiving training.

One possible explanation of these anomalous findings is that the training is specific and the employer is financing all of its costs. But standard models of the sharing of the costs of specific training do not predict that employers pay all of its costs and some of the new revisionist theories--Salop and Salop's (1976) adverse selection theory--predict that employers pay none of the costs of specific training. A specific training explanation of the these findings is particularly perplexing when to all outward appearances the training is largely general.

Empirical tests of the theory of on-the-job training have been severely hampered by the absence of data on the key theoretical constructs of the theory--general training, specific training and productivity growth. Data on wage growth and turnover have been used to test various propositions of the theory, but definitive results have been elusive because the large number of unobservables result in there being at least two explanations for any given set of phenomena (Garen, 1987). This paper strives to overcome some of the limitations of previous research by analyzing the first large-scale data set to contain measures of the time devoted to training activities during the first three months on the job, who does the training, the generality of training and the productivity and wage rates of the employees both during and after the receipt of training.

Part I of the paper is an analysis of American data on on-the-job training (OJT) of new hires. Tabulations of OJT costs and outcomes by occupation and establishment size are presented in section 1.1. Training's impact on productivity growth is analyzed in section 1.2 and its impact on wage growth is analyzed in section 1.3. The discussion centers on how the productivity effects of training compare with it's wage rate effects and how these comparisons depend on who provides the training and its generality. Section 1.4 summarizes the findings for the United States. The analysis clearly implies that employers are contributing to the costs of training that develops skills which are useful at many firms. Studies of apprenticeship programs in Germany and Great Britain confirm this finding.

Part II of the paper begins by offering an explanation of why American employers invest less in the training of their employees than Japanese and German employers. It concludes with a discussion of the reasons why, from society's point of view, employers and employees underinvest in on-the-job training.

Part III of the paper discusses how the government might encourage workers and employers to increase their investments in on-the-job training.

PART I--ANALYSIS OF AMERICAN DATA ON TRAINING

1.1 Estimates of the Magnitude of On-the-Job Training of New Hires

Let us begin by examining the magnitude of training investments in newly hired workers. The data which form the basis of discussion come from a survey of 3,412 employers sponsored by the National Institute on Education (NIE) and the National Center for Research in Vocational Education (NCRVE) conducted between February and June 1982. Most of the respondents were the owner/manager of small firms who were quite familiar with the performance of each of the firm's employees. Seventy percent of the establishments had fewer than 50 employees, and only 12 percent had more than 200 employees.

How Training Varies with Occupation

The impact of occupation on the amount of on-the-job training typically received by a new employee is examined in table 1. The first four rows of the table describe the average number of hours devoted to four distinct training activities during the first 3 months after being hired. Even jobs that are thought to require little skill--service jobs--seem to involve a considerable amount of training during the first 3 months: an average of 33 hours of watching others, 5.7 hours of formal training, 35 hours of informal training by management and 17 hours of training by coworkers. Other occupations devote considerably more time to training. The distribution of training activities is similar across occupations, however. The typical trainee spends most of his training time watching others do the job or being shown the job by a supervisor. Roughly equal amounts of time are spent in each. Informal training by coworkers is next most important and formal training provided by specialized training personnel accounts for an average of only 5 to 10 percent of the time new hires are engaged in a training activities.

These estimates of the incidence and extent of skill upgrading training are much higher than those generated by surveys of corporate training directors and workers. Training directors are able to describe the formal training programs offered by their company but are typically not aware of the full extent of the informal training that occurs on the shop floor. Surveys of workers about their training experiences have been handicapped by the way questions were posed. The January 1983 CPS, for example, asked "Since you obtained your present job, did you take training to improve your skills." The problem with this question is that one does not **take** informal training. Most informal training occurs in the context of normal supervision or in response to a worker's request for an explanation or assistance from coworkers or supervisor. As one might anticipate, this question results in a significant under estimate of the extent of informal training; only a third of the respondents reported they had received any skill upgrading training and only about 40 percent of the skill training taken was reported to be informal. This suggests that the CPS survey fails to pick up much of the informal OJT that workers receive.

The fifth row of the table merges the information on time devoted to particular types of training into a single overall estimate of investment in training during the first 3 months on the job. The index values the time that managers, coworkers and the trainee devote to training and express it in terms of hours of trainee time. Training investment for service jobs is estimated to be 130 hours implying that the time invested in training a typical newly hired service worker in the first 3 months is equal in value to about 25 percent (130/520) of that worker's potential productivity during that period. Investments in training are considerably greater in other occupations. Retail (and service sector) sales and blue collar jobs have a mean index of 185 to 200 hours respectively or 35 to 38 percent of the new employee's potential productivity. Clerical jobs typically required the equivalent of about 235 hours of training or about 45 percent of the new worker's potential output. Professional, managerial and sales representatives outside the retail and service sectors required the equivalent of about 300 hours of on-the-job training or nearly 60 percent of the new worker's potential output.

The sixth row of the table reports the geometric mean of the answers to the question "How many weeks does it take for a new employee hired for this position to become fully trained and qualified if he or she has no previous experience in this job, but has the necessary school-provided training." Service jobs are reported to require an average of only 3 to 4 weeks of training, retail sales and clerical jobs slightly under 7 weeks, and professional and managerial over 10 weeks.[1]

The reported productivity of new employees increases quite rapidly (by roughly a third) during the first month or so at the firm (see row 7). Despite the much greater time interval, the percentage increases between the first quarter and the end of the second year (see row 8) are smaller than those during the earlier period for blue collar, service, clerical and sales jobs. For these occupations training investments and learning by doing seem to be large in the first few months on the job but to diminish rapidly thereafter. In the higher level, managerial and professional jobs, reported increases in productivity are larger between the third and 24th month than in the first few months. This reflects the more prolonged training period for these occupations. The occupations which devote the least time to training--the service occupations--are the occupations with the smallest increase in productivity with tenure. The reported productivity of service workers improves an average of 28 percent in the first month or so and a further 17 percent in the next 21 months. Occupations for which a lot of time is devoted to training in the first 3 months--professionals, clerical workers, managers and sale representatives outside of retail and service industries--also seem to have larger than average increases in reported productivity as the worker gains in tenure. Clerical workers, for instance, are reported to be improving their productivity by 40 percent in the first month or so and by a further 32 percent by the end of the second year on the job.

These very rapid rates of productivity growth suggest that the total rates of return (combining both worker and employer benefits and costs) may be extremely high during the first months of employment. For clerical workers the total costs of training during the first 3 months are 235 hours or .113 of a year's output by a worker whose skill level is equal to that of a new employee. Since this figure is an upper bound on the investment that contributed to the 40 percent gain during the first months on the job, the average rate of return must be above 354% per year (.40/.113). Since the intensity of training investment falls with tenure at the firm, the cost of training investment during the next 21 months cannot have exceeded .7875 (1.75*235/520) of a year's productivity by a newly hired worker. This implies that the average rate of return to training investments during this 21 month period exceeds 40% per year (.32/.7875). However, marginal rates of return to training investment are lower and some of the gain in productivity results from learning by doing and not from training. Multivariate cross section models of productivity growth which yield evidence on the marginal productivity of training are presented in section 2 of the paper.

<u>How Training Varies with Establishment Size</u>

The relationship between establishment size and the time devoted to training typical new employees is curvilinear (see table 2). The very largest and very smallest (10 or fewer employers) establishments invest the greatest amount of time in training. Managers average 59 hours training a new employee at the smallest establishments and only 44 hours at establishments with 11 to 50 employees. The very smallest establishment invest 43 percent of a new hire's potential productivity (224 hours) during the first 3 months in training while the next largest size category (11-50 employees) invests only 35 percent of the new hire's time. Those with more than 200 employees invest 48 percent of the new hires time in training. The curvilinearity remains when other determinants of training are controlled. Reflecting the pattern of investment in training, wage increases also exhibit a curvilinear pattern being bigger in the very smallest and very largest establishments.

Reported increases in productivity do not, however, have a curvilinear pattern. Rather there is a consistent tendency for the reported increases in productivity to be larger at the larger establishments. The very smallest establishments report a 29 percent productivity increase in the first few months and a further 26 percent increase by the end of the second year. The largest establishments report a 49 percent increase in the first few months and a 34 percent increase during the next 21 months. Such a dramatic contrast between the pattern of training investments (input) and training outcomes is unusual. The relationship between training investment measured in time units (line 5 of tables 1 and 2) and returns to that investment, the increase in productivity (line 7 or line 8) is described by:

$$(1) \quad \frac{P_{2YR}-P_{1Q}}{P_{1Q}} = \% P = AR_j\Theta_j(\text{Total Training Investment})$$

where

AR_j is the average rate of return on dollars of investment in the training of stayers in the j^{th} job/establishment and

Θ_j is the opportunity cost of training time in the j^{th} job/establishment.

The lower percentage productivity growth to investment ratio of tiny establishments implies that either they have a lower AR_j or a lower Θ_j. It is unlikely that tiny establishments have lower AR_j for they have higher turnover and poorer access to capital markets. The probable explanation of their small % P is a lower opportunity cost of time devoted to training (Θ_j). Opportunity costs are likely to be lower because small establishments are unable to spread the risk of stochastic demand as well as larger establishments and so must typically operate with a higher ratio of capacity (staff on hand) to demand (staff interacting with a customer or engaged in production). Scheduling of training is also probably more flexible so training can be done during periods of slack work when opportunity costs are low.

1.2 Impact of Training on Worker Productivity

New employees experience dramatic increases in productivity in the first 2 years of employment at a firm. A part of this productivity increase is due to learning by doing and would occur even if no training is provided. Formal and informal training is responsible for a major portion of the productivity growth, however. In this section, an effort will be made to determine which training methods are most effective and to measure the marginal impact of an increase in training investment.

The 1982 Employer Survey distinguished four different types of employer-provided training: (1) formal training (provided by a training professional), (2) time spent watching others do the job, (3) informal on-the-job training by supervisors, and (4) informal on-the-job training by co-workers. The impact of training on productivity growth of typical new employees was estimated by regressing productivity growth during the first 2 years on the hours spent in each training activity. Since diminishing returns are to be expected, the square of the total cost of training was included in the model. Productivity growth during the first 2 years was defined in 2 different ways: the log of the productivity growth ratio and the change in productivity ratings on a 0-100 scale.[2]

The measures of time spent in specific training activities in the first 3 months on the job are measures of training intensity rather than of aggregate training investment during the first 2 years on the job. Consequently, the reported required length of training--the log of the number of weeks it takes for a new employee to become fully trained and qualified--was also included in the model. A large set of controls for job, occupation, and firm characteristics was included in each model: dummies for occupation, the specific vocational preparation (SVP), and the general educational development (GED) that the Dictionary of Occupational Titles (DOT) specified is necessary for the job, percent of work force skilled, percent of work force who are crafts workers, the importance of vocational education in selection, cost of machinery, unionization, hours worked per week, and characteristics of the hires (i.e., percent under age 25), and an employer response that it is hard to find reliable unskilled workers. When outcomes for particular individuals were being modeled, the new hires' education, sex, and work experience were included in the structural model.

The specification used was the following:

$$(2) \qquad P_{2YR} - P_{2WK} = \underline{AX} + a_1 \ln L + a_2 T_F + a_3 T_S + a_4 T_C + a_5 T_W + a_6 T^2 + u$$

where $\underline{X}$= a vector of control variables ($\underline{A}$ is a vector of coefficients on these control variables)

lnL = logarithm of the required length of training

T_F = Hours devoted to formal training during the first 3 months ('00s).

T_S = Hours spent in informal training by supervisors during the first 3 months ('00s).

T_C = Hours spent in informal training by coworkers during the first 3 months ('00s).

T_W = Hours spent in training by watching others do the work during the first 3 months ('00s).

T = Training Intensity is a weighted sum of the four different types of training where the weight reflect the assumed costliness of this form of training.
$T = 1.8*T_F + 1.5*T_S + T_C + .8*T_W$.

P_{2YR} = Productivity of the typical worker at the end of 2 years. In the linear models P_{2YR} is the productivity rating on the 0 to 100 scale divided by 80, the mean productivity rating for workers with two years of tenure. In the logarithmic models, P_{2YR} is the logarithm of the productivity rating plus 5.

P_{2WK} = Productivity of the typical worker during the first 2 weeks. In the linear models P_{2WK} is the productivity rating on the 0 to 100 scale divided by 80, the mean productivity rating for workers with two years of tenure. In the logarithmic models, P_{2WK} is the logarithm of the productivity rating plus 5.

The results of estimating various versions of equation 2 are reported in table 3. The regression with the logged productivity growth as dependent variable is in column 1. Regressions predicting the linear measure of productivity growth are in columns 2 and 3. In both models, the coefficient on the square term is negative and statistically significant indicating that there are diminishing returns to training intensity. When the square of total training intensity is included in the model, all four of the linear terms for a particular form of training have positive and statistically significant effects on productivity growth. The effect of training intensity on productivity is quite large. An increase in any of the training activities from 0 to 100 hours raises the worker's productivity by 13 to 15 percent in the logarithmic models and by 4.6 to 7.7 percent (calculated at the mean level of productivity at the end of two years) in the linear models. Clearly when training intensity is low, increases in its intensity will produce large increases in worker productivity.[3]

An alternative approach to estimating the impacts of training is to examine the productivity growth of particular new hires. Column 3 of Table 3 presents results using productivity data on a particular new hire rather than a typical new hire. Missing data reduces sample sizes by about 100. The variance of productivity growth across firms is larger when actual individuals are the data rather than typical individuals. R squares of the models are slightly higher, however, because characteristics of the worker (age, schooling, gender, previous relevant work experience and relevant vocational training) and the worker's tenure at the time of the interview are included in the structural model of productivity growth. The training variables used in these models were for a typical new hire rather than for that particular new hire. Comparisons of the coefficients in column 3 and 2 reveal that substituting data on productivity growth outcomes of particular individuals for data on typical hires and controlling for personal characteristics does not change the estimated effects of training.

The impacts of each type of training are remarkably similar. This was not anticipated because some forms of training (e.g., formal training) have higher hourly costs than others (e.g., watching others do the work), and this was expected to result in the more expensive forms of training having larger impacts on productivity than the cheaper forms. Measured in the units of productivity of a worker with 2 years of tenure on the job, the hourly cost of learning by watching others is .8. Formal training with a cost factor of 1.8 is the most expensive because it requires the time of both the trainee and the trainer. The cost of informal training by supervisors (a cost factor of 1.5) and by co-workers (cost factor of 1.0) lies between these two extremes because the trainee is engaged in production, and only the time of the supervisor and co-worker must be charged off as a cost of training. Given these estimates of the relative costs of different forms of training, the results presented in column one imply that informal training has higher rates of return than formal training. A further implication is that within the informal training category, co-worker training and training yourself by watching others have the highest rate of return.[4]

Factors Influencing the Marginal Payoff to Training

Theory suggests that the impact of an additional hour of training on productivity growth, $P'(I_j)$, will be higher at companies with high required rates of return (r_j), high separation rates (s_j), high skill obsolescence rates (δ_j) and high opportunity costs of training time (Θ_j). Since workers reap benefits from training even when there is a separation, training investments should, in theory, be carried further (ie. to a point where marginal benefits are lower) when a job requires general skills rather than specific skills (ie. as $g \rightarrow 1$). This suggests that an hour of general training will typically have a smaller effect on productivity growth than an hour of specific training. On the other hand, training that is general must, in theory, be financed by the worker not the firm. Since young entry level workers are generally liquidity constrained, the rates of return required by workers are likely to be considerably higher than the rates of return required by employers. This has the opposite implication. The inability of workers to finance general training may substantially depress such investment and marginal payoffs to such investment may be very high as a result. The relative importance of these two effects can be tested by interacting training intensity with a measure of the proportion of skills that are general (g).

Another job characteristic that is likely to influence the marginal product of an hour of training is the size of the establishment. Large establishments are likely to have higher opportunity costs of training time (Θ) and to be more efficient trainers (because of economies of scale).

This suggests that marginal impacts of training may be higher at large establishments than small establishments. Formal training is considerably more common at large establishments and this suggests that the marginal impact of formal training may be particularly high at these establishments. To examine these issues, the models were respecified so as to allow for interactions between training intensity and the generality of training, the size of the establishment, and the share of training that was formal, watching others, and informal OJT by a co-worker. The specification used was the following:

(3) $P_{2YR}-P_{2WK} = \underline{BX} + b_1 lnL + b_2 lnT + b_3 lnT*E + \underline{b_4} lnT*\underline{S} + b_5 lnT*g + v$

where $\underline{X}$ = a vector of control variables

*ln*L = logarithm of the required length of training

*ln*T = logarithm of training intensity during the first 3 months

E = logarithm of (Employment/18.5)

$\underline{S}$ = a vector of shares of training that are formal, watching others, and informal OJT by co-workers. The excluded category is informal OJT by managers and supervisors.

g = the proportion of the skills learned useful at other firms.

The results of estimating various versions of equation 3 are reported in tables 4. These models provide evidence on the effect of the generality of training and establishment size on the marginal product of training. The coefficient on the interaction between the generality of training and training intensity is positive but very close to zero. The two effects discussed above appear to have canceled each other out. It appears that the difficulties that workers face in financing general training are as severe a barrier to investment in general training as high separation rates are to investments in specific training.

The coefficient on size interacted with training is positive and highly significant in both the logarithmic (column 2) and linear (column 5) model of productivity growth. The logarithmic results imply that the elasticity of productivity with respect to training is 0.092 at establishments with 19 employees and about 0.115 for companies with 200 employees. The positive and significant coefficient on interactions between intensity of training and the share that is part of a formal training program or that is watching others do the work implies that these forms of training have significantly larger effects on productivity growth than OJT by supervisors, the excluded training category. Clearly, the earlier conclusion that marginal rates of return to watching others and to co-worker OJT are higher than marginal rates of return to supervisor OJT is pretty robust with respect to substantial changes in specification (alternative ways of defining the independent variable, alternative ways of specifying the training variables and the use of productivity growth of particular new hires rather than a typical new hire as the dependent variable). Findings regarding the payoff to formal training, on the other hand, appear to depend upon specification.

Table 4 also presents tests of the hypothesis that the size of the establishment differentially effects the rate of return to training. While coefficients on interactions between training and size are not significant in the particular worker models, interactions between formal training and size are significant in the typical worker specifications. As hypothesized, the payoff to formal training increases more rapidly with establishment size than the payoffs to other forms of training. These results help explain why formal training programs are more common at large companies than at small companies. In the linear typical worker specification, watching others do the work seems to be a less effective learning technique at large companies than at smaller companies. The coefficients on this variable in other specifications are negative but not significantly different from zero.

Illustrative estimates of marginal rates of return for each form of training are reported in table 5. Because the period for which training intensity is measured is much shorter than the period over which productivity growth is measured, these estimates must be based on a maintained assumption about how changes in our measure of training intensity during the first 3 months relate to changes in total hours in that training activity over the course of the rest of the 2-year period. When the two year productivity gain of the typical new hire is being analyzed, a unit increase in a training activity during the first 3 months was assumed to be associated with a further 2-unit increase in that training activity during the rest of the 2-year period.[5] When the productivity gain during the first fourteen months for a particular new hire is being analyzed, a unit increase in a training activity during the first 3 months was assumed to be associated with a 1.2 unit increase in that training activity during the remainder of the first year on the job.

The RORs are the ratio of the yearly increase in productivity divided by an estimate of the cost of the training investments that produced the productivity increase. Turnover and skill obsolescence are not incorporated into the estimate. As an example of the calculation, the formula for formal OJT using the coefficients from the linear model in table 3 for training intensity equal to 300 hours was as follows:

$$[(.046 - .0049*3*2)*2000\ ] \ / \ [3*100*1.8] = .0615$$

where 3 is the change in training over the 2-year period that is associated with a 1-unit change in training intensity during the first 3 months and 1.8 is the assumed cost factor for formal training.

The estimated marginal rates of return diminish as the intensity of training increases. The mean training intensity for the first 3 months expressed in units of the time of trained workers is 148 hours. As intensity during the first 3 months rises from 100 hours to 300 hours (double the mean), the marginal rate of return (ROR) for informal OJT by co-workers drops from 43-45 percent to 16-32 percent in the two linear models for new hires presented in table 3 and 4. The linear model's ROR drops from 36-59 percent to 18-20 percent for watching others and from 26-28 percent to 9-17 percent for training by supervisors. The ROR of formal OJT is estimated to drop from 13-27 percent at 100 hours to 6-9 percent at 300 hours. Estimated rates of return for particular workers are generally slightly higher than those calculated for the typical worker. Estimated rates of return calculated from models based on logarithmic specifications are considerably higher than those based on linear specifications of productivity growth. At the training intensities that typically prevail during the first quarter, marginal rates of return seem to be very high. These marginal RORs are not adjusted for turnover or obsolescence and are, therefore, not directly comparable to the real rates of return to schooling and financial assets that typically lie in the range from 5 to 10 percent. If all training investments are specific to the firm and must, therefore, be written off if there is turnover, RORs of 30 percent or more may be required to induce the firm to invest in specific training.

1.3 Impact of Training on Wage Growth

The costs and benefits of investments in on-the-job training are shared by employer and employee. This implies that jobs with a great deal of training will tend to have lower starting wage rates than would otherwise be predicted and higher wage rates once the training is completed. In other words, jobs with a heavy training component--either because it requires great skill or because the people being hired for it are completely inexperienced--will have higher rates of wage growth than other jobs. The more general the training the greater will be the share of training costs that is paid by the new employee and the greater will be the resulting rate of wage growth. Since some types of training are more effective than others, some are more general than others and some are more visible to other employers than others, one would expect different types of training to have different effects on wage growth. Are the impacts of different types of training on wage growth similar in pattern to their impacts on productivity growth? Or, is the pattern of wage growth responses to different types of training more influenced by the generality and visibility of the specific type of training?

These issues were addressed by estimating wage growth counterparts to the productivity growth models presented in tables 3 and 4. The first dependent variable studied was the log of the ratio of the firm's current wage for a worker with 2 years of tenure to the actual starting wage of a person who had recently been hired for the position. Models predicting this variable control for the effects of wage inflation by including the date of hire and it's square in the specification. The results are presented in column 4 of table 3.

The second dependent variable is the log of the ratio of the current wage rate (or most recent wage if there has been a separation) and the starting wage rate for a particular new employee who was hired on average 14 months earlier. The models predicting this variable are presented in column 5 of table 3, column 3 and 4 of table 4. The third dependent variable is the difference in dollars and cents between the current (or most recent) wage rate and the starting wage rate of a particular new hire. These models control tenure of the worker on the date for which wages are reported. The results of predicting this measure of wage growth are reported in column 6 of table 4. All three models contain controls for the characteristics of the new hire, the occupation, SVP, and GED of the job, percent of craft workers and percent of skilled workers at the firm, the cost of machinery used in the job, unionization, importance of vocational training in selection, percentage of the firm's work force under age 25, and reported difficulty in finding reliable unskilled workers.

The first conclusion that can be drawn from an examination of the wage growth results is that training does have the hypothesized positive effect on wage growth. The effect is statistically significant in almost all of the models. Comparisons of these coefficients with the estimates of the impact of training on productivity growth, however, reveal that training has a much smaller impact on wage growth than it has on productivity growth. In table 3, an increase in informal training from 0 to 100 hours raises productivity of typical employees by 13 to 15 percent in the logarithmic model and 5.3 to 7.7 percent in the linear model, but raises wage rates by only 0.1 to 2.0 percent. A doubling of the length of training raises productivity by 2.2 to 4.8 percent, but wage rates rise only 0.7 percent.

In Table 4's logarithmic models for a particular individual, doubling the length of training increases productivity growth by 3.6 percent and increases wage growth by only 0.5 percent. Doubling the intensity of training, increases productivity growth by 8 percent but raises wage growth by only 1.1 percent. Productivity growth effects of training are also considerably greater than the wage growth effects in the linear models reported in column 5 and 6.

For findings such as these, the first explanation that comes to mind is that the training is specific and the firm is paying most of its costs and reaping most of its benefits. Since skills are thought to be more specific at large companies, the fact that the gap between the productivity and wage effects of training was largest at big establishments provides further support for the skill specificity explanation. Furthermore, table 4 indicates that wage effects of training were indeed smaller when the skills being taught were reported to be specific to the firm as Becker's theory predicts. The problem with this explanation, however, is that most employers reported that most of the skills developed were useful at other firms. When training was done by managers and the skills were reported to be entirely general, doubling training intensity raised productivity by 6.7 percent but wages by only 0.8 percent in the logarithmic model reported in columns 2 and 4 of table 4. In the linear model in column 5 and 6 of table 4, doubling training intensity raised productivity by 3 percent while increasing wage growth by only 0.96 percent. Analysis of data on the typical new hire produces very similar findings. These results appear to contradict an important prediction of Becker's theory--**when training is general, its impact on wage growth should equal or exceed its impact on productivity growth**. Even though employers claim the skills they are teaching are