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DO EMPLOYERS SHARE THE COSTS AND BENEFITS OF GENERAL TRAINING ?

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ABSTRACT

This paper presents evidence that during the first year or so of a worker's tenure, wages rise more slowly than productivity net of training costs when training is predominantly general and that many employers are, in effect, induced to share the costs and benefits of general on-the-job training with their employees. This occurs for three reasons. First, sorting, high job search costs and the reputational damages that result from premature separations make a dismissed worker's next best alternative decidedly unattractive and this causes workers to prefer front loaded compensation packages which reduce the likelihood of involuntary terminations. Second, since most young workers are liquidity constrained and cannot afford to self-finance general training, employers take advantage of their better access to credit and take over the financing of a portion of the costs of general on-the-job training. Finally, the minimum wage and union contracts prevent young workers from agreeing to the low starting wages that would be necessary if they were to self-finance general on-the-job training.

Analysis of data comparing the growth of compensation to the growth of productivity net of training costs in jobs reported to involve skills that were useful at other firms found that during the first two years of tenure that net productivity grows on average 4 to 5 times faster than compensation. While the effective specificity of training that is reported to be useful elsewhere accounts for a portion of this difference, it does not account for all of it. Consequently, one or more of the forces listed above is probably contributing to the front-loading of compensation during the first year or so on a job.

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One of the central propositions of the human capital theory of on-the-job training is that workers pay for and receive all the benefits of general training. Since general training raises a worker's ability to be productive in other organizations as well as the one providing the training, training firms must pay a wage commensurate with the trained worker's new higher level of productivity if they are to prevent the loss of their trained workers. Since the workers, not the firm, get the benefits of the training, "firms [will] provide general training only if they [do] not have to pay any of the costs" (Becker 1962 p. 13). Since the training is of value to prospective trainees, equilibrium in the training market requires that "employees pay for general on-the-job training by receiving wages below what could be received elsewhere" (Becker 1962 p. 13) in a job offering no training. Thus, the theory predicts that when training is general, each worker's wage must equal that worker's productivity net of training costs (the opportunity costs of the time others spend training the employee). Since training investments typically diminish with tenure, wage rates should rise more rapidly than productivity as tenure increases.

Lazear's (1981) agency model of employment contracts provides still another reason for expecting very low initial wages which then rise rapidly with tenure. In jobs where effort is difficult to monitor, this model predicts that workers are initially paid a wage that is below productivity net of training costs in order to generate a performance bond. The purpose of this bond is to insure that anyone fired for shirking suffers a serious loss, one that is great enough to deter shirking. The employees who are retained by the firm have this performance bond repaid to them in the form of a wage in the final period which exceeds the worker's productivity. As a result, wages rise more rapidly than productivity net of training costs.

This paper presents evidence contradicting the general validity of these predictions. It argues on both theoretical and empirical grounds that during the first year or so of a worker's tenure, wages rise more slowly than productivity net of training costs when training is entirely general. Many employers are, in effect, induced to share the costs and benefits of general on-the-job training with their employees. This occurs for three reasons.

First, sorting, high job search costs and the reputational damages that result from premature separations make a dismissed worker's next best alternative decidedly unattractive and this causes workers to prefer front loaded compensation packages which reduce the likelihood of involuntary terminations. Second, since most young workers are liquidity constrained and cannot afford to self-finance general training, employers take advantage of their better access to credit and take over the financing of a portion of the costs of general on-the-job training. Finally, the minimum wage and union contracts prevent young workers from agreeing to the low starting wages that would be necessary if they were to self-finance general on-the-job training. The first section of the paper explains why these three factors cause compensation to be front loaded and evaluates their substantive importance. In the process it provides a summary of a theory of employer finance of general training that is formally presented elsewhere (Bishop and Kang 1984, 1988). It proposes to test this theory by comparing wage growth in the first year of tenure on a job to the growth of productivity net of training costs. The second section of the paper reviews previous empirical research comparing rates of growth of wages and productivity. Section 3 describes a unique data set from which it is possible to derive estimates of the relative growth rates of wages and productivity net of training costs early in a worker's tenure at a firm. Section 4 compares the calculated growth rate of productivity net of training costs to the growth of real wages with tenure for jobs whose training appears to be predominantly general. The paper concludes with a summary and discussion of policy implications.

I. Why are Firms Willing to Share the Costs of General Training?

The Bishop and Kang model is an extension and elaboration of Hashimoto's elegant theory of the sharing of the costs and benefits of specific training. It is a two period model in which training costs of $C(g,h)$ are incurred in the first period and the additional general skills (g) and specific skills (h) produced by the training become available in the second period. There are two random elements: ϵ, the stochastic component in the relative utility of alternative employment and ϵ_0, the stochastic component in worker productivity. Workers who leave the firm incur transfer costs of T. At the end of the training period, the firm dismisses workers whose second period

productivity, $P+g+h+\epsilon_0$, is below the second period wage (W^2). Workers quit their job if the utility of alternative employment ($U + \epsilon = P+g-T+\epsilon$) is greater than W^2.

The firm's objective is to maximize the discounted sum of profit from two periods by choosing wage rates in two periods, W^1 and W^2, and the increment in productivity due to general training, g, and the increment in productivity due to specific training, h, subject to the constraint that the wage offer and amount of training are generous enough to attract new hires in a competitive labor market. The firm's expected profit maximization problem when ϵ and ϵ_0 are independent is written as:

$$(1)\quad \underset{g,\, h,\, W^1,\, W^2}{\text{Max}} \quad P - C(g,h) - W^1 + \delta_a[Pr(S)Pr(K)(P+g+h+E(\epsilon_0|K) - W^2)]$$

Subject to the constraint

$$(2)\quad R < W^1 + D_b[Pr(S)Pr(K)W^2 + (1-Pr(K))U + (1-PR(S))Pr(K)(U+E(\epsilon|Q))]$$

where P is the worker's productivity without training

$E(\epsilon_0|K)$ is the expected value of ϵ_0 given that the firm wishes to keep the worker

$E(\epsilon|Q)$ is the conditional expectation of ϵ, the random component in the utility of alternative employment, given that the worker quits the firm

δ_a and δ_b are the discount factor of the firm and worker, respectively $\delta_a > \delta_b$.

Pr(S) is the prior probability the worker is willing to stay with the firm

Pr(K) is the prior probability the firm is willing to keep the worker

R is the level of expected utility the worker can attain in the competitive labor market.

Competitive equilibrium implies zero expected profit from the marginal hire. Manipulating the first order conditions produces the following expressions for the optimal wage rates:

$$(3)\quad W^1 = P - C(g,h) + \delta_a Pr(S)Pr(K)\,\theta[h+T+E(\epsilon_0|K) - E(\epsilon|S)] + \frac{(\delta_a-\delta_b)}{\delta_a\gamma_S+\delta_b\gamma_K}$$

$$(4)\quad W^2 = [P+h+g+E(\epsilon_0|K)] - \theta[h + T + E(\epsilon_0|K) - E(\epsilon|S)] - \frac{(\delta_a-\delta_b)}{\delta_a\gamma_S+\delta_b\gamma_K}$$

where

$\theta = \frac{\delta_b\gamma_K}{\delta_a\gamma_S+\delta_b\gamma_K}$ is the employer's share of the costs of specific human capital investments and of quasi rents.

$E(\epsilon_0|K)$ is the expected value of ϵ_0, the random element in second period productivity, given the firm wishes to keep the worker. $E(\epsilon_0|K)>0$.

$E(\epsilon|S)$ is the conditional expectation of ϵ, the random component of the utility of employment outside the training firm, given the worker wishes to stay in the firm. $E(\epsilon|S) < 0$.

γ_K is the proportionate response of the firm's keep rate with respect to the second period wage times minus one. $\gamma_K > 0$.

γ_S is the proportionate response of the worker's stay rate with respect to the second period wage. $\gamma_S > 0$.

Quasi Rents Generated by Sorting, Job Search Costs and Damaged Reputations

In most matches between a worker and a firm there is a substantial difference between the average productivity of workers who stick with the firm and the expected utility of alternative employment of those who wish to stay at the firm but are nevertheless terminated involuntarily. This difference, the quasi rent associated with the match, is given by the expression:

$$(5)\quad \text{Quasi Rent} = [h + T + E(\epsilon_0|K) - E(\epsilon|S)]$$

By sharing these quasi rents, both parties try to induce the other to maintain the contract. The 2nd, 3rd and 4th terms inside the bracketed expression are positive and non*trivial in magnitude. Even when training is entirely general (h=0), this makes it optimal for the firm to pay wages which exceed productivity minus training costs in the first period and to offer a wage in the second period which is correspondingly lower than productivity in the second period. In effect, the firm pays part of the costs of general training and the rate of wage growth is considerably below the rate of growth of productivity net of training costs.

The third and fourth terms of the bracketed expression capture the effect of sorting on the quasi rent. As the worker and the firm learn more about the quality of the match, the unsuccessful matches tend to be terminated. The workers who discover that they do not like the job or that they have better opportunities elsewhere quit and the workers who are the least productive on

the job are fired or induced to quit. As a result, the average quality of the match is higher among long tenure workers than among new hires[1]. For the jobs examined in the employer survey analyzed in this paper, this sorting effect has been estimated to raise average productivity by a minimum of 2.6 percent between the third and seventeenth month on the job (Bishop 1988).

Another reason why substantial quasi rents inhere in most matches between worker and firm are the costs of transferring to another firm, T. Transfer costs include the costs of finding and adjusting to another job, the damage to the worker and the employer's reputation from premature separations and the costs of recruiting and selecting a replacement. For most jobs, a worker's expected transfer costs of finding another job if terminated involuntarily are considerably larger than the firm's expected costs of recruiting and selecting a replacement if there is an unanticipated quit. When the small and medium sized firms surveyed for this paper hired for nonsupervisory positions, they considered on average only nine applications, interviewed only five of the applicants and devoted a total of only 10 hours of staff time to the task of filling one position. They filled new positions an average of 16 days after beginning the search. In 55 percent of the cases the firm had advance notice of the opening, so the job was not uncovered during much of the search.

Workers, on the other hand, face very high transfer costs if they are involuntarily terminated. There are two reasons for this. First, finding another job takes a great deal of time and is psychologically stressful and second a discharge does severe damage to a worker's reputation. Involuntarily terminated workers seldom have another job lined up so they immediately enter the ranks of the unemployed. Dynarski and Sheffrin (1987) have calculated that the expected length of a spell of unemployment was 10.3 weeks in 1980-81 for the household heads in the Panel Study of Income Dynamics data. Using 1974 CPS data, Clark and Summers (1979) calculated that if unemployed workers did not leave the labor force, it took on average 12.6 weeks for teenagers to find another job and 16.2 weeks for those over 20 years of age to find another job. Blau and Robins' (1985) analysis of longitudinal data from the Employment Opportunity Pilot Projects found that it took on average 25 to 36 weeks for unemployed welfare recipients to find a job and 15 to 20 weeks for unemployed workers not on welfare to find a job. If the termination is a dismissal or a layoff occurring after only a few months on the job, the individual may not be

eligible for unemployment insurance. Thus, losing a job generally results in the loss of between two and six months worth of earnings; a considerably greater loss than the 10 hours of staff time that are typically devoted to filling nonsupervisory positions. These costs are the natural consequences of involuntary turnover. They have not been generated by a Lazear type bonding contract.

When involuntarily terminated workers find another job, it typically pays less. In the National Longitudinal Survey, young men who changed employers between 1967 and 1973 subsequent to an involuntary separation experienced a 3 percent decline in their wage rate over the two year measurement period. For the mature mens sample the wage decline was 10 percent. These effects appear to persist for many years. Models were estimated in which dummies for a separation between 1969 and 1971 were used to predict wage growth during 1967-69 and 1971-73 as well as for 1969-71. The workers who were involuntarily terminated between 1969 and 1971 experienced a sharp deceleration in their wage growth which persisted into 1971-73 (Bartel and Borjas 1981). Analyzing a five year time interval in PSID data, Ruhm (1987) found that involuntary terminations lowered the wage growth of male heads of household by 13.6 percent but had no significant effect on the wage growth of female heads of household. The wage reductions experienced by involuntarily terminated workers arise partly because the individual's specific human capital is now worthless, partly because of Lazear type bonding contracts (if they do indeed exist) and partly because a dismissal is a signal which severely damages a worker's reputation.

The unemployment durations and wage reductions reported above are for <u>all</u> involuntarily terminated workers as a group. While no study reported separate estimates of the effects of discharges and layoffs, one suspects that those discharged experience longer spells of unemployment and bigger wage declines than those laid off. Prior to making a final hiring decision, most employers contact a job candidate's previous employers and are, consequently, likely to find out about the discharge. If the job seeker does not include the employer who discharged him in his employment history, there is a long stretch of nonemployment that must somehow be explained. Discharged employees are reported to be 25 percent less productive during their 2nd and 3rd month of employment than the workers who end up staying with a firm for a year or more (Bishop 1988). In some cases this productivity disadvantage is specific to the

match, but it is difficult for other employers to assess whether that is the case so if they know a job applicant was fired by a previous employer, they are unlikely to hire him/her.

Since the costs of a discharge are so severe, job seekers would be expected to prefer employers and employment contracts which minimize risks of discharge and layoff and which promise that bad recommendations will not be given. Promises not to give bad oral recommendations are not enforceable, however, so workers seek contracts which minimize the risk of dismissal and layoff. Seniority protection, grievance procedures and enforceable promises to dismiss a worker only after certain procedures are followed are one way to accomplish this but in nonunion settings there are always ways of forcing an unwanted employee out. A more reliable way of reducing the risk of dismissal and layoff is to have the employer put up a bond which is forfeited if the worker is laid off or dismissed. Workers, therefore, prefer employment contracts containing a front loaded compensation package in which the employer pays most of the costs of specific training and contributes toward the costs of general training when training is general rather than specific. There are, of course, countervailing forces such as the desire to reduce the number of trained employees who quit and to reduce shirking, so the form of the contract depends on how the various forces balance out in equation 3 and 4.

The magnitude of quasi rents vary across workers so the supply of trained labor with respect to their wage is not infinitely elastic. Consequently, while preventing other firms from hiring away trained labor is an important objective in setting the second period wage, there is room for other factors to play a role as well (Glick and Feuer 1984). The other factors that can now influence the wage profile are differential access to capital markets and constraints on wage setting due to unions and wage minimums.

The Effects of Workers Being Liquidity Constrained

The second force tending to lower wage growth below the growth of productivity net of training costs is the fact that most workers receiving substantial amounts of general training discount the future much more heavily than their employers. This force is represented by the term on the far right hand side of equations 3 and 4 where it results in $\delta_a - \delta_b > 0$. Most young workers (the ones who have the greatest need for general training) are liquidity constrained--that is they are unable to shift as much consumption

from the future into the present as they would like because they have neither assets which could be depleted nor access to credit at reasonable terms. Half of households headed by someone under the age of 25 have less than $746 in financial assets and 19 percent have no financial assets at all. Half of households headed by someone between 25 and 34 have less than $1514 in financial assets and 13 percent have none (Survey of Consumer Finances 1984). Subsidized or guaranteed student loans are not available to finance on-the-job training and banks will not lend money for this purpose without collateral. Borrowing against the equity in one's home is a possibility for some but only 34 percent of households with heads under the age of 35 own a home and many of the houses have been owned for only a short while so the equity that can be borrowed against is small. Even with collateral, the loans available to individuals usually carry higher interest rates than those charged businesses. Studies of the willingness of consumers to substitute consumption over time have all concluded that the intertemporal elasticity of substitution is no higher than one and most studies conclude it is .5 or below (Friend and Blume 1975; Hall 1988; Hubbard and Judd 1986). A substitution elasticity of .5 implies that reducing a liquidity constrained worker's wage by one half (in order to pay for general training) roughly quadruples the worker's marginal utility of consumption. Such a worker would be willing to give up four dollars of future income in return for one dollar of current income. The liquidity constraint phenomenon has little effect on the wage profile of jobs requiring no training and which, therefore, have a flat productivity profile. Where significant general training is occurring, however, it comes into play and results in an employment contract in which the employer shares the costs of general training.[2]

In addition, the progressive nature of the personal income tax means that workers often face higher marginal tax rates on the fruits of training investments than they are paying when they incur the costs of such investments. Firms, on the other hand, train continuously, so the marginal tax rates faced when the costs of training are incurred and expensed are no different from those faced during the payoff period. These two factors result in firms being more willing than workers to trade off future earnings for present earnings. The compensation packages that result from the asymmetric access to capital markets and the progressive tax structure reflect the worker's strong

preference for compensation now rather than later. In effect, firms offer new hires a loan that will be canceled if a separation occurs. Firms do not require repayment of the loan when separations occur for the same reasons that banks do not offer large unsecured loans without a government guarantee of payment. The administrative costs of obtaining repayment are extremely high and bankruptcy is a real option for someone with zero assets.

Constraints on Wage Setting: Legal and Contractual

The third force that tends to lower wage growth below the growth of productivity net of training costs is legal and contractual constraints on the starting wage rate. For entry level jobs obtained by young workers, the minimum wage is an important source of such rigidity in the United States and in those European countries with similar legislation (Hashimoto 1982). In European countries that have lower minimum wages for youth (eg. Netherlands) or no governmental legislation (eg. Germany) and in adult jobs where legislated minimums are not a binding constraint, collective bargaining agreements are an alternative mechanism for mandating a flat wage profile. Most unions appear to prefer flat wage profiles. The motive might be to maintain solidarity between workers or to restrict access to the occupation by discouraging the provision of general occupational training. The reasons for a collective worker preference for flat wage profiles is not analyzed, the desire is treated as an exogenous constraint on the structure of an optimal contract.

Thus, the Bishop/Kang model offers three different reasons why employers may share the costs and benefits of general training and therefore why wages may rise less rapidly during the first year on the job than productivity net of training costs when training is entirely general. The theory of general on-the-job training predicts, instead, that when training is entirely general (ie. h=0), wages will rise at the same rate as productivity net of training costs. The Salop/Salop (1976) and Nickell (1976) adverse selection models predict that wages will rise at the same rate as productivity net of training costs even when much of training is specific to the firm[3]. Agency theory goes even further and predicts that wages will grow more rapidly than productivity net of training costs when training is entirely general. Consequently, a comparison of these growth rates is a natural and powerful way to test the efficacy of these competing theories. This paper provides such a comparison of wage and productivity net of training cost growth rates during the first year on the job

for a sample of 1493 workers hired by small and medium sized establishments during 1980 and 1981. The next section of the paper reviews previous empirical research on the subject.

II. Previous Research on the Effects of Tenure on Productivity and Wages.

Medoff and Abraham (1981) were the first to analyze data in which it is possible to compare the growth of wages and productivity with tenure. Using micro-data on long tenure employees from the personnel records of four large U.S. corporations, Medoff and Abraham found that, within a grade level, experience was positively associated with wage rates but negatively associated with performance ratings. They concluded that, "under the assumption that rated performance is a valid indicator of relative productivity, our results imply that a substantial fraction of the return to experience among the groups we are studying is unrelated to productivity" (p. 187). Medoff and Abraham also reviewed a number of other studies and concluded that the association between seniority in a job and productivity is curvilinear. During the initial very short orientation/training period there was a positive association. Once this training period was over, however, there tended to be a negative association between tenure and productivity among those who occupy a particular job (i.e., have not been promoted to greater responsibility). Almost all the studies were conducted in large corporations and almost all of the workers included in these studies had many years of tenure at the firm. These findings suggest that Lazear's agency model is one of the explanations of the rise of wage rates with tenure at large firms once the initial 1-5 year learning period is completed[4].

It is not clear, however, that the finding that wages rise more rapidly than productivity extends to small firms or to workers with only a year or so of tenure. Small firms are significantly different from large firms. Turnover is higher in small firms and more contingent on performance so the sorting explanation of wage and productivity growth should be more relevant to small firms than to large firms (Bishop 1988). Monitoring problems are not as severe at small firms so Lazear's agency theory explanation for backloading compensation is less applicable at these firms. Reinforcing this is the fact that small firms do not have well established reputations which might be

damaged by reneging on a Lazear type bonding contract. As a result, workers may be reluctant to enter into such contracts with small firms. The circumstances are also different in the first year of employment for turnover is higher, training is greater and productivity is rising rather than falling.

In fact, there is an abundance of evidence that in the first few months on a job, productivity rises dramatically while wages are rising only modestly. Industrial engineers have found that the learning curve for many jobs is such that new hires make almost no contribution to output for many weeks and often take a year or more to reach the productivity standard (King 1964, Talbot and Ellis 1969). If all this learning were firm specific and employers financed all of its costs, this pattern might be consistent with standard theory. But standard models of the sharing of the costs of specific training do not predict that employers pay all of its costs and, indeed, adverse selection theory predicts that employers pay none of the costs of specific training. The specific training explanation of the flat wage profile is particularly suspect when to all outward appearances much of the training is useful at other firms (as it is when a new secretary spends the first few weeks on a job learning Word Perfect, a word processing program used by many other employers).

Studies of who pays the costs of apprenticeship training in three different nations--Germany, Great Britain, and the United States--all contradict the claim that employers will not share in the costs of general training (Noll et al 1984; Ryan 1980; Jones 1985; Weiderhold-Fritz 1985). Despite the transferable character of the training and high turnover rates, these studies concluded that employers made large investments that were not recovered during the apprenticeship. A welding apprenticeship program at a major U.S. shipyard was the subject of the first of these studies (Ryan 1980). The wage profile was quite flat--starting at $3.99 and topping out at $5.26 after about two years on the job--even though the investments in general training were very considerable. Inexperienced new hires spent 36 days in vestibule training before beginning work. During the first week following vestibule training, the trainee's output net of repair requirements was less than 10 percent of an experienced worker's output. Thirty-seven weeks after being hired it reached a level of 55 percent and at 60 weeks a level of 80 percent of an experienced workers output. Despite the fact that the local economy was in deep recession, monthly separation rates were extremely high:

10.8 percent for beginners and 6.3 percent for those with 12 to 24 months of tenure. The shipyard accounted for about one-fifth of the welding jobs in the area. When trained welders left the shipyard, they typically found better paying welding jobs at other local employers. This evidence clearly establishes that the shipbuilding company was contributing to the costs of general training.

The study of German apprenticeship training by the Bundersinstitut fur Berufsforschung found that in 1980 training costs ranged from a high of 25,200 DM per year for telecommunications technician apprentices to 2400 DM for apprentice gardeners and averaged 10,300 DM or $5668 per year at 1980 exchange rates. The apprentice's contribution to output, which was netted out to arrive at the above figure, averaged 6700 DM per year (Weiderhold-Fritz 1985). Jones's (1985) study of apprentice training in the engineering industry in Great Britain found that the employer's training costs were 1.31 times the annual payroll costs of a skilled worker and the apprentice's contribution to output (which was netted out in calculating the estimate of employer costs) was 1.26 times the payroll costs of a skilled worker. Thus even major upward revisions of these estimates of the apprentice's contribution to output would not change the basic conclusion that employers appear to be sharing the costs of general training. While the German and British studies have large enough samples to make generalizations possible, a case study of one occupation at one firm is much too small a data base for generalizations about the U.S. This paper tests whether Ryan's finding that employers appear to share the costs of general on-the-job training can be replicated in a larger and more representative sample of U.S. jobs.

III. Data

An employer survey sponsored by the National Institute of Education and the National Center for Research in Vocational Education conducted between February and June 1982 provides the basis for our test of these theories. Each of the 3412 surveyed employers was asked a series of questions about "the last new employee your company hired prior to August 1981 regardless of whether that person is still employed by your company." In order to minimize problems of recall and of adjusting actual starting wage rates for inflation since the date of hire, the sample employed in this paper is a subset of 1493 employers who

hired someone after July 1980 and answered all the questions about wage rates,productivity and training. Most of the respondents were the owners/managers of the small establishments (70 percent had fewer than 50 employees) who were quite familiar with the performance of each of the firm's employees.

The survey asked the employer (or in larger firms the immediate supervisor) to report on productivity of the typical individual hired in the job after 2 weeks, during the next 11 weeks and at the end of 2 years at the firm. The supervisor was asked to do the rating on a "scale of zero to 100 where 100 equals the maximum productivity rating any of your employees in (NAME'S) position can obtain and zero is absolutely no productivity by your employee." For the full data set at the mean values of these indexes of reported productivity were 49.0 for the first 2 weeks, 64.6 for the next 11 weeks and 81.4 at the time of the interview. The questions asking for a rating of the productivity of particular workers had remarkably low 4.4 percent nonresponse rate.[6]

The interview questions about the productivity of recently hired employees do not measure productivity in any absolute sense and therefore are not comparable across firms or across jobs in a firm. Rather, they are intended as ratio scale indicators of the relative productivity of individual workers at different points in time. This is a crucial assumption and the sensitivity of results to changes in this assumption will be carefully examined. If these productivity indexes are proportional transformations of true productivity plus a random error, percentage differences in cell means of the productivity index will be unbiased estimators of percentage differences in true productivity. If the variations in the productivity scores assigned by supervisors exaggerate the proportionate variations in the true productivity, our estimates of percentage increases in productivity during the first year on the job will be biased downward. Even though it is possible for a worker's true productivity to be negative, the scale was defined as having a lower limit of zero. Floors and ceilings on a scale typically cause measurement errors to be negatively correlated with the true value. If this is the case, our estimates of percentage increases in productivity during the first year will be biased downward. In our view, this latter type of bias is more likely than the former.[7] The sensitivity of the main findings concerning the proportionality

assumption will be tested by presenting estimates of the growth of productivity net of training costs that are based on 3 alternative assumptions: proportionate differences in productivity are in fact 50 percent of those reported, equal to those reported and 150 percent of those reported.

Data were also obtained on the amount of time that is devoted to four different kinds of training activities during the first 3 months on the job. A training time index was constructed by first valuing trainer and trainee time relative to that of workers with two years of tenure in that job and then combining the time invested in training activities during the first 3 months on the job.[8]

IV. Results

The key issue is how the growth rates of wages and productivity net of training cost compare when training is predominantly general. Consequently, a measure of the generality of training is needed so that the sample of jobs for hypothesis testing can be limited to those which provide a great deal of general training. The question which provides us with such a measure is, "How many of the skills learned by new employees in this job are useful outside this company?" Fifty-nine percent responded "almost all," 13 percent responded "most," and only 7.5 percent answered "almost none." The employers were next asked how many other local firms made use of the general skills that were developed in their training. The jobs that offer the most general skill training are defined to be those reported to have "almost all" of their skills useful at other firms and 16 or more other firms in the local labor market that in fact use these skills. Data for these jobs are presented in the first column of table 1. The second column presents data for the jobs where almost all of the training was useful in other firms, but here the number of such firms in the locality was small enough (below 16) to suggest that employers might have some monopsony power. The groupings for the other three columns are based only on the generality of the skills developed without regard to the size of the local market for these skills.

The first two rows of the table present estimates of the real wage increase in the first one or two years at the job. The starting wage is for a period averaging 13 months prior to the interview, so real wage increases were calculated by dividing the actual wage increases reported for the sampled new hires by 1.071, the increase in the economy wide hourly wage (excluding

overtime) between April 1981 and May 1982. Jobs which offer training in skills which are at least in part useful at other firms appear to command real wage increases of only 5 to 6 percent in the first year and 2 to 6 percent in the second year at the job (see columns 1 to 4). The increase in the real wage is much smaller (essentially zero for the two year wage growth figure) in the jobs involving highly specific skills (see column 5). Thus, jobs offering general training do have higher rates of real wage growth than jobs offering only specific training, as predicted by theory. We now turn to the related issue of whether the real wage growth that occurs in jobs offering considerable general training is as large as is predicted by standard theory?

[Table 1 about here]

The percentage increases in productivity during the first two years at the job reported in lines 3 and 4 of Table 1 are quite large. The gain in productivity was 26 to 30 percent during the first three months (between an initial average for the first two weeks and an average for weeks 3 through 13) and another 19 to 25 percent by the end of the second year at the job. The productivity gains were largest in jobs with training that developed skills of some generality. The increase in the worker's reported productivity is clearly considerably greater than the 8 to 12 percent increase in the worker's real wage during the first two years at these jobs. This occurs even at the jobs in which training was reported to be almost entirely general and for which there are many local firms that also need the skills in question.

Lines 5 through 9 of Table 1 report answers to questions about the number of hours devoted to four distinct training activities. During the first three months, training for jobs with the most general training and many local competitors involved an average of 49 hours watching others do the job, 9.6 hours in formal training, 52 hours in informal training by management, and 25.6 hours in informal training by co-workers. The time devoted to training had a value equivalent to 147 hours of an already trained co-worker's time or about 28.3 percent of the output that a co-worker would produce in 3 months. As long as some of the skills taught are general, the required training time seems unrelated to the reported degree of generality. However, jobs reported to teach almost no skills useful in other firms required less training --118 rather than 147 hours in the first 3 months.

Line 10 of the table presents the average costs of training in the first

hires were 26 percent less productive than workers with 2 years of tenure, they were not factoring into that calculation the fact that about 11 percent of the new hire's time was spent in a training activity which produced virtually no output. Under these assumptions, the calculated logarithmic increase in productivity net of training costs for jobs with the most general training is 51 percent which is 6 times the corresponding increase in real wages [51/8.3].

The estimates reported in lines 14 through 16 of the table make the more conservative assumption that there was double counting--that the lower productivity reported for new workers reflects in part the portion of their time that was devoted to formal training and watching others do the work. Line 14 was obtained by substituting line 11 for line 10 in the calculation described in the previous paragraph. Under these more conservative assumptions, the logarithmic growth of productivity net of training costs is 44 percent in the jobs requiring the most general training or 5 times the rate of increase of real wages.

The sensitivity of these estimates to changes in assumptions about the scaling of the productivity index can be examined by comparing line 14 to lines 15 and 16. Line 15 of the table presents estimates that are based on the assumption that the reports of productivity differences supplied by our respondents exaggerate true proportionate differences in productivity by a factor of two. This assumption implies that the coefficient of variation of productivity of job incumbents is 6.5 percent, not the 13 percent that our respondents reported it to be and not the 19 percent that studies using hard data on output have found on average. Even under this very extreme assumption, productivity net of training costs for the most general jobs still grows three times faster than the real wage--25.4 percent rather than 8.3 percent. Line 16 of the table presents estimates that are based on the assumption that proportionate differences in true productivity between new and experienced workers are 50 percent greater than those reported (ie. that the coefficient of variation is 19.5). Under these assumptions, the growth of net productivity in jobs with the most general training is 8 times greater than the growth of wage rates.

Tests of our central hypothesis -- that productivity net of training costs rise more rapidly than compensation during the first 2 years of tenure even in the jobs with the most general training -- are presented in table 2. The null

hypothesis actually tested was: Is the ratio of productivity net of training cost in the first 3 months to productivity net of training cost at the end of 2 years, NP_{Q1}/NP_{2yr}, equal to or greater than the ratio of hourly compensation at these 2 points in time, RC_{Q1}/RC_{2yr}? The hypothesis was tested under different maintained assumptions about double counting and the scaling of relative productivity. The estimate of the ratio of real compensation at the start to real compensation after two years was the inverse of the exp(.083) (from line 2 of Table 1 adjusted for differences between the growth rates of wages and compensation.

The first column of table 2 reports hypothesis tests that are conditional on the maintained assumption that compensation grows 1 percent less than wages during the first two years (possibly because the value of medical benefits does not increase in the second year of employment). The second column of the table reports hypothesis tests under a maintained assumption that compensation rises 4 percent faster than wage rates during the first 2 years on a job (possibly because new employees are not eligible for paid vacation or sick leave until they have been at the firm for a whole year)[10]. An offer of two weeks of paid vacation raises the effective wage by four percent, so a firm which offers 2 weeks of paid vacation to employees with 2 years of tenure but none to new hires effectively raises the growth of compensation 4 percent above the growth of wages. This is not very common so it would appear that 4 percent is an upper bound on the differential between the growth of compensation and wages during the first two years on a job.

[Table 2 about here]

The t-statistics reported in the table imply a decisive rejection of the hypothesis that in jobs involving training in skills almost all of which reported to be useful at other firms that compensation rises at a rate that is greater than or equal to the rise in productivity net of training costs. This is a robust finding. Even when all of the maintained assumptions are selected to favor the hypothesis--compensation increases 4 percent faster than wage rates in the first two years on the job, conservative assumptions are made regarding double counting, and the true increase in relative productivity with tenure is only half of the amount reported by our respondents--, the hypothesi is rejected by a wide margin.

Clearly, during the first year or so on a job, wages grow much more slowl