7-1-1996

# What We Know About Employer-Provided Training: A Review of Literature

John H. Bishop
*Cornell University*, jhb5@comell.edu

# What We Know About Employer-Provided Training: A Review of Literature

**Abstract**
While the importance of on-the-job training is recognized by everyone, it is a phenomenon that is very difficult to study. Most training is informal and hard to measure and its effects on productivity are even more difficult to quantify. An elegant theory explaining how the quantity of training is determined and who pays for and benefits from it has been available for more than a third of a century (Becker 1962). However, the absence of data on the key theoretical constructs of the theory--general training, specific training, informal training and productivity growth--means that the only predictions of the theory that have been tested relate to the effects of formal training and tenure (interpreted as a proxy for informal training) on wage growth and turnover. Until recently, definitive tests of the OJT theory were infeasible because the large number of unobservables meant that any given phenomena had many alternative explanations (Garen, 1988). New data sets with improved measures of OJT are at last becoming available and consequently there has been a good deal of progress recently in testing OJT theory. This paper provides a review of this work.

**Keywords**
employee, employer, training, skill, pay, benefit, wage, productivity, work, review, American, OJT

**Disciplines**
Human Resources Management

**Comments**
**Suggested Citation**
Bishop, J. H. (1996). *What we know about employer-provided training: A review of literature* (CAHRS Working Paper #96-09). Ithaca, NY: Cornell University, School of Industrial and Labor Relations, Center for Advanced Human Resource Studies.
http://digitalcommons.ilr.cornell.edu/cahrswp/180

CAHRS
Center for Advanced Human Resource Studies

CAHRS / Cornell University
187 Ives Hall
Ithaca, NY 14853-3901 USA
Tel. 607 255-9358
www.ilr.cornell.edu/CAHRS/

WORKING PAPER SERIES

# What We Know About Employer-Provided Training: A Review of Literature

**John H. Bishop**

**Working Paper 96-09**

ilr School of Industrial and Labor Relations
CORNELL UNIVERSITY
*Advancing the World of Work*

# What We Know About Employer-Provided Training: A Review of the Literature

**John H. Bishop**
Cornell University

New York State School of Industrial and Labor Relations
Cornell University
Ithaca, New York 14853
office: 607-255-2742
fax: 607-255-1836
home: 607-257-1402
e-mail: jhb5@comell.edu

http://www.ilr.cornell.edu/CAHRS

Working Paper #96-09

July, 1996

The writing of this paper was supported by grants from the Office of the Assistant Secretary for Policy, Department of Labor and the Center on Educational Quality of the Work Force, supported by the Office of Educational Research and Improvement of the Department of Labor. This paper has not undergone formal review or approval of the faculty of the ILR School. It is intended to make results of research, conferences, and projects available to others interested in human resource management in preliminary form to encourage discussion and suggestions.

TABLE OF CONTENTS

## WHAT WE KNOW ABOUT EMPLOYER SPONSORED TRAINING

While the importance of on-the-job training is recognized by everyone, it is a phenomenon that is very difficult to study. Most training is informal and hard to measure and its effects on productivity are even more difficult to quantify. An elegant theory explaining how the quantity of training is determined and who pays for and benefits from it has been available for more than a third of a century (Becker 1962). However, the absence of data on the key theoretical constructs of the theory--general training, specific training, informal training and productivity growth--means that the only predictions of the theory that have been tested relate to the effects of formal training and tenure (interpreted as a proxy for informal training) on wage growth and turnover. Until recently, definitive tests of the OJT theory were infeasible because the large number of unobservables meant that any given phenomena had many alternative explanations (Garen, 1988). New data sets with improved measures of OJT are at last becoming available and consequently there has been a good deal of progress recently in testing OJT theory. This paper provides a review of this work.

Employers arrange for and pay for training because it raises productivity; not because it raises wages. Policy maker's interest in training derives primarily from its effect on productivity; not its effect on wages. The two effects are generally not the same. Consequently, this review of the literature will pay particular attention to studies of the productivity effects of employer training. The paper begins by describing which firms offer and which workers get on-the-job training. The next two sections examine the effects of on-the-job training on wages and productivity. Section 4 examines why young German and Japanese workers receive more on-the-job training than American workers? Section 5 examines whether from society's point of view workers and employers under invest in training. Section 6 reviews the evidence on whether, as predicted by the standard theory of OJT, workers pay all of the costs and receive all of the benefits of on-the-job training that yields skills useful at other firms. The review concludes that employers are sharing the costs and benefits of general OJT. Section 7 discusses a variety of theoretical explanations for cost sharing of this phenomenon. Section 8 examines whether schools should withdraw from the occupational training market and leave the job to employers.

## I. THE INCIDENCE OF EMPLOYER PROVIDED TRAINING?

Many household surveys now ask questions about formal training provided by employers, so a good deal is known about who receives formal training (Lillard and Tan 1986, Tan et al 1991, Mincer and Higuchi 1988, Mincer 1989a, Bartel and Sicherman 1993, Lynch

1992; Black and Garen 1989; Barron, Berger and Black 1993a, 1993b; Black, Berger and Barron 1993, Veum 1993).

### 1.1 Who Gets Formal Training?

**Holding other worker characteristics constant, the likelihood and amount of formal training in a given year is higher for workers:**

Job Characteristics

--in high value added jobs where the individual has great responsibility

--in cognitively complex jobs (eg. professional, technical and managerial jobs)

--in sales jobs for complicated, changing and customized products

--who use expensive machinery on their job. The elasticity of response was .066 for training intensity and .081 for weeks to become fully trained and qualified (Bishop 1991).

--in regular non-temporary jobs

--in full time jobs (Bishop 1991, Barron, Berger and Black 1993b) In a multi-variate model explaining variations in training intensity across jobs in the same broad occupational group, a 10 percent increase in hours worked per week is associated with a 7 percent increase in training time.[1] When, however, one compares two individuals doing the same job at the same firm, hours worked per week had no effect on training time. Both of these results suggest that the demand for training may be inelastic (Bishop 1991).

--in jobs where the skills learned are not useful at many other firms in the community (Bishop 1991). This suggests that training intensity rises when firms have monopsonistic power in the local labor market.

Firm Characteristics

--at larger establishments (Barron, Black and Lowenstein 1987, 1989; Bishop 1991, Haber, Cordes and Barth 1988; Idson and Holtmann 1993)

--at large unionized manufacturing establishments. Managers of large unionized establishments reported spending $1121 per worker (42.5 hours per year) on the training of bargaining unit employees or about 4.5 percent of annual earnings (Katz and Keefe 1993)

--at firms which have multiple establishments (Bishop 1991, Barron, Berger and Black 1993)

--at companies employing flexible or high performance production systems (Kochan and Osterman 1991, MacDuffie and Kochan 1993, Katz and Keefe 1993).

--in industries or firms experiencing rapid technological progress and rapid output growth (Lillard and Tan 1986, Tan 1987, Tan et al 1991, Mincer and Higuchi 1988, Mincer 1989, Bartel & Sicherman 1993).[2]

--in firms which have not experienced a competitive crisis in the last decade. Large unionized firms that have experienced a crisis perceive a greater need to increase training but currently invest about 20 percent less per worker than comparable firms that have not experienced a crisis (Katz and Keefe 1993).

--in industries which have established industry standardized and certified training

--at firms that have long probationary periods for new hires (Bishop 1991).

--at firms where firing an employee is reported to be difficult once the probationary period is over (Bishop 1991).

--in industries with low unemployment rates (Bartel and Sicherman 1993). Training appears to increase when demand for an industry's product is strong and capacity utilization is high.

--located in areas of low unemployment. (One study found that young people received less training when unemployment was high and older workers received more training.) Another study found that firms saying it was "hard to find reliable unskilled workers" provided 24 percent more training to its typical new hire than firms that reported no problem finding reliable unskilled workers (Bishop 1991). The findings regarding the effect of the unemployment rate suggest that new hire training is procyclical.

--located in metropolitan areas

--located outside the South

Worker Characteristics

-with many years of education--in particular workers who have completed high school or college

--who scored well on tests assessing verbal, mathematical and technical competence when they were in school and who have been out of school for many years. For people aged 24 to 33, the impact of a population standard deviation increase in all subtests, increased the incidence of company training by about 36 percent, holding schooling, experience, tenure and firm size constant. (Bartel and Sichermen 1993). For workers who have just left school, there is no such relationship (Bishop and Kang 1984, 1988, 1996; Parsons 1990)

--with vocational training that is relevant to their current job (Bishop 1991)

--who are recently hired (it declines with age and tenure on the job)

--who are expected to have low rates of turnover

--who are male (Lynch 1992, Veum 1993, Barron, Berger and Black 1993d)

--who are married (Lynch 1992, Mincer 1989)

--who are white (Lynch 1992, Veum 1993, Barron, Berger and Black 1993d)

Receipt of training is positively correlated with the social class of one's parents but the correlation is much weaker than the correlation between years of schooling and parental social class.

**1.2 Estimates of the Amount of Formal On-the-Job Training from Household Surveys**

Only a minority of workers report that they have participated in formal company training programs. When the Current Population Survey (CPS) asked "Did you need specific skills or training to obtain your current job?", 55.4 (55.8) percent reported in 1983 (1991) that they had needed qualifying training. Schools were cited as the source of qualifying training by 29.5 percent of respondents in 1983 and by 32.1 percent in 1991. Informal OJT was the next most common form of qualifying training--cited by 27.9 percent in 19983 and 27.1 percent in 1991 (Bowers and Swaim 1992). Formal company training was the least common form of qualifying training, but its incidence has grown--from 9.6 percent in 1983 to 12.1 percent in 1991.

Respondents were also asked, "Since you obtained your present job, did you take any training to improve your skills?" The proportion responding affirmatively grew from 36.4 percent in 1983 to 41.7 percent in 1991. The incidence of formal company training rose from 12.0 percent to 16.8 percent and informal OJT rose from 15.2 percent to 16.2 percent. Proportions saying they had received skill improvement training at a school rose from 12.1 to 13.1 percent (Bowers and Swaim 1992).

Lynch (1992) reports that in a three year period shortly after completing school, only 4 percent of 16 to 25 year olds received formal on-the-job training lasting more than four weeks. When the definition of formal company training is broadened to include spells of less than four weeks, 21.3 percent of 21 to 29 years olds in 1986 received formal company training in the next five years, 1.5 percent took apprenticeship training and 11 percent went to one or more seminars outside of work. Those receiving formal company training spent an average of 180 hours being trained during the five-year period and those attending seminars devoted 64 hours to it. When the hours devoted to all three forms of training are summed and averaged over the entire NLSY population, the estimates of time devoted to formal company training were 3 hours per year for high school drop outs, 19 hrs/yr for college graduates and 12 hrs/yr overall (Veum 1993).

For women 42 to 57 in 1979, 24.4 percent participated in one or more company training programs during the next ten years. Those who did get company training averaged 176 hours of it. Time devoted to formal company training thus averaged 4.3 hours a year for the Mature Women's cohort of the National Longitudinal Survey (NLS, U.S.BLS 1993b).

Thus, assuming a 2000 hour standard working year, **formal on-the-job training accounts on average for only 0.6 percent of the potential working time** of **young adults and 0.2 percent of the potential working time of mature women.** Is this the full extent of investment in improved skills on the job? NO, it is not.

Formal OJT accounts for only a small part of on-the-job learning. Simple introspection tells us that most learning about one's job comes from watching others do it, from day to day supervision, from asking questions and from getting help when needed. Note, this is not just learning by doing. Time that might otherwise have been used to produce something is being devoted, instead, to learning how to do the job better.

Economists refer to these activities as informal on-the-job training. When, however, one asks workers about "training", they do not think in these terms. 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. As one might anticipate, this question results in a significant under estimate of the "tent of informal training; only 42 percent of the respondents reported they had "taken" any skill upgrading training and about 40 percent of this training was reported to be informal. This means that the questions about training in the CPS, the Survey of Income and Program Participation (SIPP), the NLS and High School and Beyond (HSB) fail to pick up much of the informal OJT that workers receive. Consequently, studies using these data are looking at only one species of tree, not at the whole forest. If we are to really understand how learning on the job occurs both for individuals and for organizations, it will be necessary to change the way we ask questions about training in the CPS and other surveys.[3]

There are, however, two surveys which have taken a different approach. The surveys focused on a randomly selected new hire at randomly selected firms. Detailed questions about training were asked and they were asked of employers not employees. Let us examine the findings of studies based on these data.

### 1.3 Estimates of On-the-Job Training of New Hires based on Employer Surveys

The first survey of this type was the Employment Opportunity Pilot Projects (EOPP) Employer Survey sponsored by the National Center for Research in Vocational Education.

Firms hiring low wage workers were over sampled. The Gallup Organization conducted the phone interviews between February and June 1982. The employers were asked to select "the last new employee your company hired prior to August 1981 regardless of whether that person is still employed by your company." The study examined 2594 employers who had hired someone in the time frame requested. Seventy percent of the establishments had fewer than 50 employees, and only 12 percent had more than 200 employees. Most respondents were, thus, owners or managers of small firms who were quite familiar with the performance of each of the firm's employees. If the primary respondent was unable to answer questions about the training received by a specific newly hired worker, that part of the interview was completed by talking to a supervisor or someone else with line responsibility.

For that new hire, the employer was asked to estimate how much time was "spent" in the first three months on four different kinds of training activities: (1) "formal training such as self-paced learning programs or training done by specialized training personnel, (2) "training activities in which he or she is watching others do the job rather than doing it himself', (3) "total number of hours management and line supervisors spent away from other activities giving informal individualized training or extra supervision", and (4) total number of hours co-workers who are not supervisors spent away from their normal work giving informal individualized training or extra supervision." For this sample of firms and jobs, the means for the typical worker during the first three months on the job were: 10.7 hours for formal training programs, 47.3 hours watching others do the job, 51 hours for informal training by management and 24.2 hours for informal training by co-workers. Of the 520 hours available during the first three months on the job, 133 hours was spent in some form of training (Bishop 1991).

In 1992 the Small Business Administration funded the University of Kentucky's Survey Research Center to replicate the EOPP survey on a national stratified random sample of employers. Similarly worded questions were asked about the time devoted to training during the first three months on the job of the last worker hired prior to May 1992. The means for the training questions were 18.6 hours for formal training, 58.8 hours for informal training by managers, 33.9 hours for informal training by coworkers and 41.1 hours for informal training by watching others. The SBA results imply that, of the 520 hours available in the first three months on the job, 152 hours were devoted to some form of training (Black, Berger and Barron 1993).

Estimates of the incidence and the time devoted to skill upgrading training derived from the EOPP and SBA surveys are, as expected, much higher than those generated by surveys asking workers about training "taken." In part this is because, employers report about 22 percent more time devoted to training than employees asked the same question (Barron, Berger

and Black 1997). The primary reason for the higher estimate of training is the greater care in defining the activities that are to be counted as training. Estimates of time devoted to formal training from the NLS and CPS surveys are consistent with estimates coming from the EOPP and SBA employer surveys. The difference is in the estimates of time devoted to informal training. According to EOPP and SBA surveys, new hires spend most of their training time either watching others do the job or being shown the job by supervisors and coworkers. Formal training provided by specialized training personnel accounts for somewhere between 8 and 12 percent of the time new hires are engaged in training activities.

These results also cast doubt on the usefulness of surveys of training directors. 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 on-the-job training that occurs continuously on the shop floor. It also implies that international comparisons of training cannot focus on the training that is managed by corporate training departments. Probabilities of responding are no doubt related to the resources allocated to the training department, so one gets a biased picture of the extent of formal training in the full population of firms. Training departments are typically larger in big American corporations than in Japanese corporations. In Japan corporate training budgets are quite small-- 0.5 percent of the wage bill in firms with more than 5000 employees and 0.1 percent in firms with 30-99 employees (Dore and Sato 1989). The massive investments that Japanese firms make in cross training and employee rotation do not appear in these budgets.

## 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. The distribution of training activities is similar across occupations. The amount of training rises with job complexity.

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 training that costs about 45 percent of the new worker's potential output. Professional, managerial and sales representatives outside the retail and service sectors required training costing 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.[4]

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.

## Establishment Size

It is well established that workers at very large firms receive substantially more formal training than the employees of smaller firms (Barron, Black and Lowenstein 1987, Lynch 1992, Bartel and Sicherman 1993). Theory predicts a positive relationship between firm size and training. The discounted value of future payoffs to training should be higher at large firms due to

lower turnover, lower required rates of return (resulting from better access to capital markets) and lower marginal costs for formal training due to economies of scale (one trainer can teach many workers simultaneously and the development costs of training programs are spread across a larger number of users).

Establishment size also effects **who** does the training. Large establishments tend to invest more heavily in formal training and informal training by coworkers. At small establishments managers and supervisors do a great deal of the training. New hires at very small companies received more informal training by managers and supervisors than workers at larger establishments. Time spent watching others was little affected by establishment size. When other factors are controlled, the relationship between establishment size and training is curvilinear with the minimum level of training during the first three months occurring at 25 employees (Bishop 1991, Table 6).

In the SBA data set, establishment size had a significant positive effect on the incidence of formal training, the incidence and amount of informal training by coworkers and the incidence of training by watching others. Establishment size did not have a positive effect on informal training by management (Barron, Berger and Black 1993b). Holding establishment size constant, establishments that are part of multi-establishment firms do more training than single establishment firms (Bishop 1991, Barron, Berger and Black 1993b).

Reported increases in productivity during training were substantially bigger at large establishments in both EOPP and SBA data. In EOPP data the very smallest establishments reported 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 reported a 49 percent increase in the first few months and a 34 percent increase during the next 21 months. In SBA data, the productivity increase during the first three months was 23.5 percent at firms with 1-24 employees and 35 percent at firms with more than 500 employees.

The ratio of the proportionate increase in productivity to time devoted to training is lower at very small firms. The cause of this pattern is probably a lower opportunity cost of the time devoted to informal training at small establishments. Small establishments typically operate with a higher ratio of capacity (staff on hand) to demand (staff interacting with a customer or engaged in production) because they are unable to spread the risk of stochastic demand as well as larger establishments.[5] Scheduling of training is also probably more flexible, so training can be done during periods of slack work when opportunity costs of trainer and trainee time are low. This lower opportunity cost of training time is one of the reasons why small firms are often the first employer of young unskilled workers (Bishop 1991; Black, Berger and Barron 1993).

## Schooling: Type and Amount

The relationship between type and amount of schooling of the new hire and the on-the-job training typically received by the typical occupant of the job is explored in Table 2. One would expect schooling to be positively related to the rate at which a new hire can learn new skills. When the job being filled requires a great deal of training if applicants have no experience, we would expect employers to attempt to reduce training costs by giving preference to applicants with more than average schooling and to graduates of relevant vocational training programs.

Both of these hypotheses are supported by the data. People with more schooling and with relevant vocational training in school took jobs that have longer training periods for inexperienced workers and that offered more intensive training during the first three months on the job. High school drop-outs with no vocational training typically received only $494 (in 1982 dollars) of training in the first 3 months of their job. For high school graduates those with relevant vocational training got $1397 worth of training, those without received $1027 of training. For workers with 1-3 years of college, training was $1665 for those with relevant vocational schooling and $1212 for those without relevant training (Bishop 1991). Multi-variate analysis of longitudinal data on High School and Beyond seniors who did not go to college produces similar results. Those who had taken vocational courses in high school were significantly more likely to get formal training from their employers (Bishop 1995).

When one looks across jobs and across individuals, we find that schooling, school-based training and employer training are complements not substitutes. Those with stronger educational backgrounds, higher test scores and relevant occupational training tend to get jobs which offer more company training (Bishop 1991, 1995).

## Variations in Training When the Job is Fixed

When one fixes the job, however, employers react to high initial skills levels by providing less OJT. Analysis of EOPP data indicates that new hires with 5 years of relevant work experience got one-third less training than new hires for the same job with no relevant work experience. In the NFIB survey of small and medium size firms, relevant formal onsite training at a previous job reduced initial training requirements by 17 percent. Years of schooling, however, had no effect on training time. Relevant vocational training had inconsistent effects on time devoted to training (Bishop 1994).

## 2.0 THE EFFEC17 OF EMPLOYER TRAINING ON WAGES

### 2.1 Effects of Formal Employer Provided Training on Wage Levels

It is well established that past receipt of employer provided training is associated with higher earnings and wage rates (Hollenbeck and Wilkie 1985, Liflard and Tan 1986, Mincer 1988, Brown 1988, Barron, Black and Lowenstein 1989, Lynch 1992, Flynn 1990). Mincer's review of the literature concluded:

> In sum, estimated effects in terms of earnings received of an additional year with training appear to range from 4.4 percent in the Panel Study of Income Dynamics (PSID) for all new hires, 9 percent for young workers in the PSID, 7 percent for the new youth cohort in the NLS, and 11 percent in the previous youth cohort in the NIS (1989, p. 8).

**Type of Training**: Even participation in workplace literacy programs is sometimes positively associated with earnings. Analysis of 1991 data from the National Household Education Survey found that, holding occupation, industry and schooling constant, the less than one percent of workers who participated in such programs during 1991 earned 12.8 percent more than those who did not (Hollenbeck 1993). When other types of training are controlled for Bowers and Swaim (1992) found, however, that, when the effects of four different types of training were estimated simultaneously, that reading/writing/mathematics training was associated with 5 percent lower wage rates while wages were 4.2 percent higher when computer training had been received, 5.9 percent higher when other occupational skill training had been received and 13 percent higher when supervisory training had been received.

All of the studies examining the effect of current and past training on wage levels, however, are biased by the tendency of more talented workers to obtain jobs which offer occupational skill training. This bias can be reduced and possibly eliminated by analyzing longitudinal data and measuring the effect of training on wage growth, not wage levels.

### 2.2 Effects of Formal Training on Wage Growth of Young Adults

Lynch's (1992) study of the wage growth experienced by NLSY youth in their late teens and early 20s found that, controlling for job changes and changes in unionization, tenure and experience, that wage rates were increased 12 percent by apprenticeship training and increased 6 percent by off-the-job-training, but were unaffected by formal company training program lasting 4 weeks or more. Krueger and Rouse's (1994) study of training at a manufacturing company found that participants in training were more likely to bid for new jobs and to be upgraded but wage effects if any were very small and limited to those who obtained occupational training.

Other analyses of NLSY data on workers have obtained different results. Blanchflower and Lynch's (1994) study of wage growth of non-college graduates from age 20 to 25 found company training raised wages by 12 percent (t = 1.94), off-job training raised wages by 5 percent (t = 1.02) and apprenticeship raised wages by 38 percent (t = 3.38). Veum's (1995) study of 1986-90 wage growth found that the 18 percent who received company training during the four years obtained 9 percent larger wage increases (t statistic = 2.3). Lowenstein and Spletzer's (1996, Table 4) study of newly hired workers in the NLSY found that a completed spell of company training during the previous year raised wage rates by 2.6 percent (t = 1.82).

**How long lasting are the wage impacts of formal training?** Paul Lengermann's (1996b) analysis of 15 years of NLSY data is the first study to carefully measure the time pattern of the wage response to formal training. He found that school-based training of less than 4 weeks duration had no impact on wage rates. For company training of less than 4 weeks duration, wage benefits depreciate rapidly. However, for school-based and company training lasting more than 4 weeks, most of the wage gains are during the year training is obtained and wage gains do not diminish even after 9 years have passed. In some cases they appear to grow. The absence of declining returns does not prove that skills do not depreciate. The probable explanation of growing returns to formal training is that it is followed immediately by unmeasured increases in informal training that initially depress wages but eventually lead to even larger wage increases. Becker and Mincer explained the tendency of the return to schooling to rise with age in the same way.

**Whose Formal Training Yields the Highest Returns?** Two studies have examined how training impacts on wage growth vary by skill level. Analyzing 1980-83 wage changes, Lynch (1992) found that the impact of school-based training on wages was greater for workers with less schooling. The differences were not large enough to be statistically significant, however. Analyzing a longer time period, Lengermann (1996b) found that school-based training of at least 4 weeks duration had significantly larger effects on high school drop outs and blue collar workers and non-significantly larger effects on those with low Armed Forces Vocational Aptitude Battery (ASVAB) test scores.

For company training of at least 4 weeks duration, wage impacts did not vary systematically with ASVAB test scores. However, long-term wage responses were non-significantly greater for high school drop outs and for blue collar workers. Thus, the groups that are least likely to receive training from their employer--blue collar workers and high school dropouts--experience very high wage payoffs when they do get training. This suggests that employer rationing of training opportunities is most severe at the bottom of the skill distribution,

possibly because of the higher turnover probabilities or the greater availability of already trained workers on the external labor market.

**Impact of Who Pays for Formal Training:** Most of school-based training received by young adults is paid for by the worker. A quarter, however, is financed (at least in part) by an employer.

The impact of school-based training on wages appears to depend on who pays for it. Lowenstein and Spletzer (1996, Table 4) found that such training did not raise wage rates when financed by the worker, but did raise wage rates when the employer financed it. Lengermann's (1996a) analysis of 1988-92 NLSY data found that school-based training financed by one's employer raised wage rates by 8.4 percent (t=2.15) and government financed training raised wage rates by a non-significant 12 percent (t = 1.49). When, however, the individual paid all of its costs, it had no impact on wage rates. It would appear that, at least in the short run, **School-based training pays off in higher wages only when employers or government sponsors it, not when the worker pays for it.** This suggests that employers are more effective trainers than schools and better able to pick effective school based training programs than individual workers.[6] Apparently the productivity benefits of the general training selected by the employer are so large that employers can afford to both pay much of its costs (see section 6) and to offer wage increases as well.

### 2.3 Impact of Training on Changes in Employment

There is, at present, only one study of the impact of training on hours of employment using a fixed effects methodology. Lengermann (1996a) study of hours growth between 1988 and 1992 found that training's effects on hours were comparable to its effects on wage rates. Indeed for school-based training, the proportionate response of hours was twice as large as the wage rate response. Lengermann's findings suggest that studies that focus solely on impact of training on wage rates give an incomplete picture of the benefits of training. More research on the effects of training on probabilities of employment and hours worked is desperately needed. This research should take advantage of the longitudinal character of data sets by employing one or another variant of the fixed effects methodology pioneered by Lengermann (1996b).

### 2.4 Impacts of School Attendance by Adults

Young adults are much more likely to be attending schools and colleges than participating in school-based training. From 1988 to 1993, only 1.1 percent of the 24 to 36 year olds in the NLSY sample were engaged in school-based training in a typical year. The annual

rate of attendance at a school or college was 9.3 percent, 8.5 times greater. Very few--.12 percent per year--enrolled in both types during the same year. Schooling is distinguished from school-based training not by an absence of vocationalism but by the fact that it occurs at a "regular school such as a high school or college." School based training by contrast takes place at either a "vocational-technical institute" or a "business school" and is generally not degree credit course work.

It is well established that schooling obtained during one's youth substantially increases earnings. A number of studies have found, however, that the return to schooling is smaller for adults and for those who interrupt their schooling. Grubb's (1993) cross section analysis of the NILS72 data suggests that post-secondary education obtained after age 25 had much smaller, often negative effects on wage rates and earnings of 32-33 year olds. Grubb's results may be biased, however, by measurement error and heterogeneity.[7] People who delay their college attendance may be less able than those who enter college directly after high school graduation and who remain continuously enrolled until a degree is obtained. Audrey Light (1995), using an IV/GLS method suggested by Hausman and Taylor (1981) to correct for heterogeneity, found that interrupted post-secondary schooling raises wages (about 4.5 percent per year of schooling) but not by as much as an equivalent amount of continuous schooling. Correcting for heterogeneity by modeling wage growth rather than wage levels, Lengermann (1996b) found that a year of school attendance has no immediate effect on wage rates but after 6 years wages are 4.8 percent higher. The wage impacts of schooling obtained as an adult are slightly but non-significantly higher for those with low test scores.

**2.5 Government Subsidized Occupational Training**

Second Chance Training Programs: The best evidence on the impacts of government training programs is from studies employing strong randomized designs. The latest findings from the Abt Associates evaluation of the Job Training Partnership Act are presented in Table 3. The per enrollee costs of JT`PA classroom training are $1457 for adults and $1863 for youth. For classroom training the earnings gains during the 2.5 year follow up period were $630 for adult women and $1287 for adult men. If the earnings differential between experimentals and controls for the final year of the study continues into the 4th and 5th years after enrollment in JTPA, the costs of the services are recouped in higher earnings within five years for adult women and within 3 years for adult men. On-the-job training had larger effects than classroom training on the earnings of adults. Payback periods were 18 months for adult women and 22 months for adult men. Adult women who received the other services treatment stream--mainly

basic education, job search assistance, job readiness training, vocational exploration and tryout employment earned 39 percent more than their control group. Payback was achieved in 7 months for adult women and 19 months for adult men.

Disadvantaged youth (under age 22), however, do not appear to be helped by JT`PA services. For example, young men with arrest records prior to entering JT`PA earned $6800 less during the 30 month follow up period than similar young men denied JT`PA services. Young men without an arrest record who were enrolled in the on-the-job training stream earned $3012 less during the 30 month follow up period than those who were denied JT`PA services. Those assigned to the other services treatment--mainly basic education, job search assistance, job readiness training, vocational exploration and tryout employment--also earned less than the control group. For young women, classroom training appears to have raised earnings somewhat, but the payback period is 5 years (Orr, Bloom, Bell, Lin, Cave and Doolittle, 1994). Evaluations of Job Start came to similar conclusions (Cave, Bos, Doolittle and Toussaint, 1993). Of the various programs designed to serve disadvantaged youth, only the Job Corps, a considerably more costly program, appears to have significant positive impacts (Maller, Kerachsky and Thornton 1982).

One possible explanation of the negative impacts of JTPA on youth earnings is stigma. Analysis of a recent survey of small and medium sized firms summarized in column 8 of Table 4 found that new hires with JTPA training were 15 percent more productive [after 6 months (P=.089) and at the time of the interview (P=.165)] than other new hires and had lower rates of turnover. Nevertheless, the JTPA trainees were paid 11 percent less than other workers hired for that job (P =. 129) (Bishop 1994). Apparently, in this data set, JTPA training simultaneously raises productivity and lowers wage rates. Since JTPA training is given only to disadvantaged individuals, advertising oneself as a JTPA trainee may hurt the individual's marketability more than it helps. Studies have also found that the Targeted Jobs Tax Credit stigmatizes its participants (Burtless 1985) and that, consequently, they are paid less than other new hires for the same job even though they typically produce more than average (Bishop 1989). These findings suggest that evaluations of JTPA programs which focus solely on wage and earnings outcomes are biased by the stigma generated by signaling the trainee's disadvantaged status and thus may substantially understate the social benefits of such training.

Military Training:

Military training appears to have substantial effects on the wages and productivity of those exiting the armed forces. Mangum and Ball (1986) estimate that about 48 percent of those trained by the military get civilian jobs in that same field. The analysis reported in column 7 of

Table 4 indicates that, when the training is relevant to the job obtained, workers with that background receive extra training in the first six months and become 10 percent more productive than other employees in the job once that training is completed. Their success on the job appears to surprise their employer and, consequently, they are not paid the higher wage rates their high productivity would seem to justify. Thus, military training benefits the future employers as well as the trainee.

Publicly Funded Vocational Schooling

About 56 percent of those trained at vocational-technical institutes get jobs in the field they studied and about 46 percent of those studying at business colleges get training related jobs (Mangum and Ball 1986). Controlling on ability, family socio-economic status and other demographic characteristics (but not work experience), Kane and Rouse's (1993b) analysis of the NLS72 found that one year of study at a community college raised earnings of 32-33 year old males by about a $1000 and an associates degree raised them by $1500. In NLSY data the effects were even larger (Kane and Rouse 1993a). Vocational schools had non-significantly negative effects on earnings. For women the credits and degrees awarded by community colleges and vocational schools all had large effects. Certificates and associates degrees in vocational fields from community colleges both added about $2800 to earnings. An academic associates degree added about $2260. to earnings. When those with exactly 12 years of schooling are compared, those who took vocational courses in high school are more likely to be employed and are paid more than those who pursued a purely academic course of study (Campbell et al 1986, 1987b; Kang and Bishop 1989).

School based vocational training is well signaled to the labor market by diplomas and school reputations, so one would expect productivity benefits of training to accrue to the trainee in the form of less unemployment, better jobs and higher earnings. One would not expect employers to be able to recruit significantly more productive workers from such sources and not pay them for their greater productivity. This appears to be the case for the training provided by public institutions (see column 5 of Table 4). Such training helps the student get a better job, but given the job obtained it does not appear to be associated with workers being more productive than others hired for that job.

Private vocational-technical institutions, on the other hand, place their graduates at jobs where they turn out to be decidedly better than other new hires and, as a result, they receive somewhat higher initial wages and are less likely to be discharged (see column 6 of Table 4). While samples are too small for a powerful test, private 2 year colleges had larger effects on wages than public 2 year colleges (Kane and Rouse 1995; Grubb 1995, Freeman 1973).

## 2.6 Trends in the Return to Occupational Training

Some argue that rates of turnover and skill obsolescence have risen so much that occupationally specific skills are no longer good investments for young people. The Economist (March 12 1994), for "ample, recently asserted that:

> Economists have long argued that the returns on general education are higher than those on specific training, because education is transferable whereas many skills tend to be job-specific. Today this case is becoming more compelling still as jobs become less secure, the service sector expands and the life-cycle of vocational skills diminishes and the market puts an even greater premium on the ability to deal with people and process information.

Let us examine the three parts of this argument.

- Has turnover increased? What effect has changes in turnover had on the social payoff to occupation specific training and employer willingness to invest in training?
- Has skill obsolescence increased? What effect does high rates of skill obsolescence have on the social payoff to occupation specific training?
- Has the payoff to investments in occupation specific skills declined in recent years?

Turnover: Job turnover has indeed increased over the last 25 years. The proportion of the workforce with fewer than 25 months of tenure at their company rose from 28 percent in 1968 to 40 percent in 1978 and has remained high since then (see row 1 of Table 5).

Table 5

Trends in Job and Occupational Turnover

| | 1951 | 1963 | 1966 | 1968 | 1973 | 1978 | 1981 | 1983 | 1987 | 1991 |
|---|---|---|---|---|---|---|---|---|---|---|
| % with Tenure LT 25 mo | 38.1% | 33.2 | 25.4 | 28.2 | 37.8 | 39.9 | 39.3 | 38.5* | 40.1* | 40.4* |
| Occupational Turnover (annual) | | | | | | | | | | |
| Men 20-65 + | --- | --- | 10.2% | --- | 8.6% | 10.1% | 8.9% | 8.2% | 8.2% | --- |
| Women 20-65+ | --- | --- | 63% | --- | 7.2% | 9.6% | 9.3% | 8.3% | 8.4% | --- |

* The wording of the question changed in 1983, so there is a break in the series at that point.

The first row is the share of all workers over age 16 with fewer than 25 months of tenure (OECD 1993 Table 4.1; Hamel 1963, 1967; Hayghe 1974; Horvath 1981; O'Boyle 1969; Sekscenski 1979; BLS Jan 1983, Jan 1987). The second and third rows are unweighted averages of BLS occupational mobility rates for six age groups: 20-24, 25-34, 35-44, 45-54, 55-64 and 65 and over. These rates are the number of workers who were in a different occupation the prior year as a proportion of those employed in both years--January of the year indicated and the previous January (Markey and Parks, 1989 Table 1). They are based on the following sequence of questions. "Was ... working in January [one year previously]? .... If yes..."You told me that ... is now working as a ... [occupation reported for January 16, 19..]? Was ... doing the same kind of work a year ago, in January 19..?" As a result, occupational turnover estimates are not inflated by errors in measuring occupation.

While job turnover has increased, **occupational turnover of males has decreased.** When age and gender are held constant, rates of occupational mobility for men fell 20 percent between 1966 and 1987 (see row 2 and 3 of Table 5). The occupational mobility of women increased from 1966 to 1978 and then declined from 1978 to 1987. During 1986 over 90 percent of occupational changes by women (and 84.4 percent of the changes by men) were self initiated and not made necessary by a layoff, dismissal or plant closing (Markey and Parks 1989 Table 2). Thus the rise in occupational mobility of women is not bad news; it is the result of improved opportunities for advancement. The number of women with professional and managerial jobs has doubled since 1979. Current levels of occupational turnover are considerably lower that those experienced by the generation that lived through the depression, the mobilization for World War H and the rapid demobilization after the war. Occupational turnover is high in the United States, but it has always been high.

These two facts do not imply that schools should scale back occupational training, leaving this function to employers. Rather they imply the reverse. Social returns to occupational training (and the worker's private returns) are influenced by occupational turnover, not job turnover. The decline in occupational turnover for men and more recently for women means the social returns to occupational skills training have increased. At the same time, the rise in job turnover has eroded incentives for employers to invest in this kind of training.

**Skill Obsolescence:** Rates of skill obsolescence have increased. There is no reason to expect higher skill obsolescence rates to be associated with lower rates of return to skill investment. Skill obsolescence is greatest in fast changing fields close to the frontier of knowledge. The labor market responds to high rates of skill obsolescence by paying a higher premium for the skill. The high starting salaries of engineers derive in part from the high rate of skill obsolescence in their profession.

Occupational knowledge is cumulative and hierarchical in much the same way that mathematics and science is cumulative and hierarchical. Everyone must start at the bottom of the ladder of occupational knowledge and work their way up. The spread of information technology and of high performance work systems is making some old skills obsolete, but the new skills that must be learned are often additions to, not replacements for, old skills. While learning a new skill is easier when the worker has good basic skills, a foundation of job knowledge and occupational skills is generally even more essential.

**Direct Evidence of Rising Returns to Skill:** Other types of evidence also contradict the Economist's contention that returns to occupation specific skills have fallen. The wage premiums paid for technical and occupational skills developed in non-baccalaureate programs

have been rising for the last decade. Male craft workers are now paid 27.8 percent more than operatives; in 1983 they were paid only 21.3 percent extra. Secretaries are now paid 66 percent more than maids, a substantial increase from the 48 percent premium that prevailed in 1983.

The payoffs to occupationally specific education and training of youth have increased. The wage and earnings effects of high school vocational programs (relative to non-college bound high school graduates who studied academic courses only) grew over the course of the 1980s (Bishop, Blakemore and Low 1985; Campbell 1986, 1987b; Bishop 1995). The return to vocationally oriented associates degree programs increased.

Table 6 presents Bowers and Swaim's (1992) analysis of CPS data on the return to training in 1983 and 1991. They found that the wage payoff increased for qualifying training from formal company training programs, military training, high school vocational education, 4 year colleges and public and private junior/community colleges and technical institutes. Payoffs declined only for qualifying training from informal OJT and for qualifying training from other post-secondary vocational training programs.

The return to formal company training from one's current employer rose from 11.6 percent to 14.4 percent. School based skill-improvement training paid for by the worker did not raise the individual's wage. The wage differential associated with self-initiated school based skill-improvement training fell from 1.2 percent in 1983 to -2.8 percent ($t = 1.5$) in 1991. The wage differential for school-provided training paid for by one's employer was a statistically significant 8.4 percent in 1983 and 5 percent in 1991. Hollenbeck and Willke's (1985) analysis of the 1983 CPS data obtained similar results.

## 3. THE EFFECIPS OF EMPLOYER TRAINING ON WORKER PRODUCTIVITY

### 3.1 Studies by Industrial Psychologists

Industrial psychologists have conducted many studies of the effects of formal training on job knowledge and job performance. A recent meta-analysis of the literature on management training by Burke and Day (1986) found 22 studies of the effects of training on objective learning criteria (generally scores on paper and pencil tests), 39 studies of the effects of training on subjective behavior criteria (generally performance appraisals) and 11 studies of effects on objective results criteria. Table 7 provides a summary of Burke and Day's findings. Burke and Day calculated a standardized effect size for each training program and for each criterion by dividing the difference between trainees and an untrained comparison group by the within-group standard deviation of the criterion. This result was then adjusted for criterion unreliability by dividing by the square root of criterion reliability. Mean effect sizes varied with the criterion and

the type and method of training, but in each of the categories examined mean effect sizes were positive and significantly greater than zero. A number of studies compared the efficacy of lecture presentations, lecture plus discussion and lecture/discussion plus role playing or practice. The mean 'true' effect sizes were respectively .37, .23 and .93 for objective learning criteria and .46, .11 and .34 for subjective behavior criteria. These findings provide some support for the conventional wisdom that learning is enhanced when trainees get to practice the skills they are being taught.

On the other hand, a number of studies obtained point estimates of training effects that were negative. Sample sizes are typically small, so sampling error could be the cause of these results. When, however, artifacts like sampling error and criterion unreliability were corrected for by Burke and Day (1986), 90 percent "credibility' values (the effect size which 90 percent of true effect sizes should lie above) sometimes fell below zero. This finding suggests that, while most formal training programs achieve their objectives of significantly improving job knowledge and job performance, a significant minority do not.

While cumulative reviews of the training literature by Burke and Day and others provide suggestive evidence about which training methods are more effective, the generalizations that can confidently be drawn from this literature are few. Any one issue is addressed by only a few studies, sample sizes are small (most studies compare treatment groups that contain fewer than 40 people), criterions are often of doubtful relevance to establishment profitability and designs are often flawed (random assignment is often absent). The great variability across studies in the estimates of the magnitude of training effects is further evidence of our ignorance. When one considers that probably more than $20 billion dollars is spent annually on the formal training of managers and supervisors, it is quite remarkable that Burke and Day were able to find only 70 studies (with a cumulative sample size of only 7178 individuals) that met their acceptance criteria. Clearly, a great deal more systematic field research is required.

### 3.2 Productivity Effects of Occupational Skills

Direct measures of worker skill levels also have strong relationships with job performance. When paper and pencil tests of occupational knowledge appropriate for the job compete with reading and mathematics tests to predict supervisor ratings of job performance, the job knowledge tests carry all of the explanatory power, the reading and mathematics tests none. When judged performance on a sample of critical job tasks is the measure of job performance, the beta coefficient on the job knowledge test is 2 to 4 times larger than the beta coefficient on a basic skills composite (Hunter, 1983). Thus, **basic academic skills make little**

**direct contribution to a worker's productivity.** Their contribution is to help the individual learn the occupation and job specific skills that are directly productive. Since large improvements in job knowledge are easier to achieve than equivalent (in proportions of a standard deviation) improvements in verbal and mathematical skills, occupationally specific training would appear to be desirable **if the student is likely to put the knowledge to use by working in the occupation or a closely related one.**

### 3.3 Productivity Effects of Prior Training

Most training is informal not formal. What are the productivity effects of informal training? One way to address this question is to hold the job constant and then compare the productivity of incumbents who have different amounts of tenure and prior relevant work experience.

Findings from Analysis of NFIB data: A survey of a stratified random sample of the 700,000 member National Federation of Independent Business (NFIB) during the first half of 1987 provides data on the productivity payoffs to training. About 1400 firms provided information on the training received and the productivity of two recently hired workers occupying the same job. By analyzing the determinants of the differences in productivity and wage outcomes for these two workers, one can assess the impacts of training received on previous jobs and in schools on productivity and wage rates (Bishop 1994).

An examination of column 2 of Table 5 reveals that relevant work experience significantly increased the productivity of new hires and significantly reduced the time required to train them. Holding total experience constant, new hires with ten years of relevant experience required less training, higher productivity (20 percent at the end of six months and 13 percent at the time of the interview), made more suggestions for improving productivity and were paid 22 to 25 percent more.

Total work experience was defined as the total number of years since completing school or reaching age 16 whichever is smaller. In the NFIB data, experience that was not relevant to the job did not have positive effects on productivity and retention. Ten years of irrelevant experience, in fact, reduced productivity at 6 months of tenure by a statistically significant 7 percent. Even though it is associated with lower productivity, irrelevant experience is associated with higher wage rates relative to coworkers. The effect of irrelevant experience on the wage is about one-third of the size of the effect of relevant experience on wage rates. Employers were pleasantly surprised by the productivity of workers with relevant work experience and unpleasantly surprised by the productivity of those with irrelevant work experience. These

findings suggest that many employers were not aware of the relevance of the new hire's previous work experience until long after the hiring decision.

Formal training received on-the-job from a previous employer increased initial productivity by 9.5 percent of the wage and reduced training requirements by 17 percent. It had no effect, however, at the time of the interview. Formal training received off-the-job, on the other hand, had no effects during the first few months at the firm, but it increased the index of suggestions by 37 percent and productivity at the time of the interview by 15.9 percent. Formal off-the-job training does not increase current wage rates, however, so profitability increased by 13.8 percent of the wage at six months of tenure and by 18.6 percent of the wage at the time of the interview.

These results suggest that on-the-job training sponsored by firm A not only benefits the employee and employer (as implied by Becker's theory of OJT), but also sometimes benefits other employers in the industry who hire workers who quit or are laid off by firm A. Formal off-the-job training generates substantial long lasting externalities (benefits received by the worker's future employers and by consumers). The informal training proxied by the relevant experience variable appears to generate externalities only in the first year or so of a worker's tenure at a firm.

**3.4 The Impact of Training on the Productivity of New Hires at the Training Firm**

The big improvements in productivity during the first year on a job reported in Tables 1-2 suggest that the total rates of return (combining both worker and employer benefits and costs) are likely to be very high during the first months of employment. For clerical workers, for example, the total costs of training during the first 3 months were 235 hours or .113 of a year's output by a worker whose skill level was 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 have been 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 (i.e. 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 than average rates of return and some of the gain in productivity results from learning by doing, not training. Multivariate cross section models of productivity growth are necessary to tackle the issue of the marginal productivity of on-the-job training. Multivariate analyses of the effects of training on rates of improvement in productivity of new hires (Bishop 1991) have found that:

- Hours devoted to each type of training had very similar effects on productivity growth during the first year or so on the job. This implies that lower cost forms of training--informal training by coworkers and training by watching others do the job--had higher benefit cost ratios than informal training by management and formal training.

- Formal training had significantly larger effects on wage growth and quit rates than informal training. This probably results from the fact that formal training is better signaled to the labor market.

- The productivity growth effects of formal training were bigger at large establishments.

- The reported generality of on-the-job training had no significant effects on its marginal productivity.

- When training was reported to be highly general, training had a larger effect on wage growth than when training was reported to be specific. Nevertheless, training that was reported to be entirely general had much larger effects on productivity growth than wage growth implying that the labor market treat this training as if it were at least partly specific to the firm.

The multivariate analysis of EOPP data presented in Bishop (1991) generated tentative estimates of both the opportunity costs and the productivity effects of training (general and specific, worker and firm financed combined). These estimates allow a calculation of the marginal gross rates of return (for general and specific training combined) necessary to cover the cost of capital, losses due to turnover and obsolescence. The data were not collected for this purpose, however, so there were gaps that could only be filled by some judicious assumptions.[8] Consequently, the estimates of marginal gross rates of return (Marginal GROR) for each form of training that are reported in Table 8 must be viewed as very tentative results which will hopefully be displaced when better data sets become available. Marginal GRORs are the ratio of the increment to yearly productivity generated by a small increase in training divided by the cost of increased training (A detailed description is in the notes of the table).

The estimated marginal gross 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 gross rate of return for informal OJT by coworkers drops from 43-45 percent to 25-32 percent in the two linear models for typical new hires presented in Table 7 of Bishop 1991. The linear model's GROR drops from 38-43 percent to 25 percent for watching others and from 17-23 percent to -1 to 10 percent for training by supervisors. The marginal GROR of formal OJT is estimated to drop from 1115 percent at 100 hours to -3 percent at 300 hours. Estimated gross rates of return calculated from models based on

logarithmic specifications are considerably higher than those based on linear specifications of productivity growth. Gross rates of return are also typically higher for the models using the logarithm of training intensity and the square of this logarithm presented in Bishop (1991 Table 8). At the training intensities that typically prevail during the first quarter, marginal gross rates of return are often above 40 percent.

It must be remembered, however, that these marginal GRORs include cash flows necessary to compensate for turnover and 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 workers leave and rates of turnover are high, first year GRORs of 30 percent or more will be required to induce the firm to invest in specific training. If Tan et. al. (1991), however, estimate the wage rate effects of company training depreciate at 6 to 7 percent per year and Lengermann (1996b) found that training programs lasting more than four weeks did not depreciate at all. With all the uncertainties regarding the best specification of the productivity growth model, measurement error in the training variables, the specificity of the training, turnover rates, and the obsolescence rates, robust estimates of net rates of return to on-the-job training comparable to rates of return on financial assets and physical capital are not now feasible and will not become feasible until better data sets become available.

### 3.5 Organizational Effects of On-the-Job Training

For most kinds of training, outcomes are as much organizational as individual. After reviewing studies of the effect of OJT on organizational productivity, Kochan and Osterman (1991) concluded that:

> These studies provide consistent and convincing evidence that (1) education and training are associated with significant productivity increases when their impact is examined in a production function context; and (2) training and associated flexible human resource systems are associated with higher levels of productivity and quality in matched comparisons. (pp. 16-17).

The number of studies is limited, however. Summarizing his study of flexible manufacturing in Japan and the United States, Ramchandran Jaikumar's (1986) concluded that:

> The heart of this new [flexible] manufacturing landscape is the management of manufacturing projects: selecting them, creating teams to work on them, and **managing workers' intellectual development.** (p. 75)

Marcie Tyre's (1990) examination of several plants in a single multi-national corporation found that the American plants took longer to start up and had flatter learning curves than plants

in Italy and Germany. She attributed this in part to less development and cross-training of workers. A study of hot-roll steel facilities by Ichniowski, Shaw and Prennushi (1993) found that plants using high performance work systems had less down time and produced higher quality output. Higher levels of training were one of the components of the high performance work systems that generated these positive outcomes. Studies of the auto industry by MacDuffie, Krafcik and their colleagues (Krafcik 1990, Krafcik and MacDuffie 1989, Shimada and MacDuffie 1986; MacDuffie and Krafcik 1989, forthcoming; MacDuffie and Kochan 1988, 1993) came to similar conclusions. Case studies of plant level productivity in five industries--clothing, kitchen cabinet making, biscuit manufacturing, tool making and hotels--conducted by researchers associated with the National Institute of Economic and Social Research found that the British companies were less productive than their German and Dutch counterparts and concluded that the quantity and quality of occupational training received by young workers entering the industry were one of the causes of the differentials (Daly et al 1985 ; Prais et al 1989; Steedman and Wagner 1987, 1989; Mason et al 1990; Mason and Feingold 1995). **In none of these studies, however, were the data sets large enough to allow econometric estimation of the unique causal effects of training holding other elements of the human resource system constant.**

The studies cited above establish an association between training, high performance work systems and greater productivity. They **are consistent** with the proposition that modernization and training are complementary-ie. training is often critical to the implementation of new technology or a reorganization and, therefore, companies that are modernizing are more likely to be investing heavily in training. This research does not imply that modernization is the only occasion where training is worthwhile. Nevertheless, these studies are sometimes over interpreted as implying that: "Firms that are unwilling to upgrade production technologies and management methods are not ready to train." (EQW Issues 1993). This statement is not justified by the evidence. Surely, old style construction contractors still need to train the inexperienced carpenters they employ? Surely, firms with a sexual harassment problem need to train supervisors about company policies in this area?

Summary: The studies reviewed above have established that traditional employer provided training raises individual productivity and wage rates. Most of the training incidents in these studies were not occasioned by modernization or a TQM reorganization. Taken altogether the economic literature on training suggests that, as long as the company is initiating and paying for training, one can be pretty confident that most of these investments are profitable both for the worker and the firm.

On-the-job training subsidized by government has a spotty record. Programs which arrange and subsidize OJT for disadvantaged workers raise the wages of adults, but appear to lower the wages of youth (under age 22) who participate. On the other hand, analysis of a very small sample of JTPA trainees in the NFIB data suggests that stigma may be biasing these evaluations and that firms that hire JTPA trainees may be getting better employees than expected and paying them lower wages than is typical for the job.

Occupational training of youth in high schools and community colleges and vocational-technical institutes does raise earnings particularly of women. Adults and incumbent workers benefit from taking courses for degree credit but not from taking non-degree credit courses not financed by their employer.

## 4. WHY DO GERMAN AND JAPANESE WORKERS RECEIVE MORE TRAINING THAN AMERICAN WORKERS?

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 (Mincer and Higuchi 1988, Koike 1984, Noll et al 1984, Wiederhold-Fritz 1985). In the automobile industry, for example, newly hired assembly workers receive 310 hours of training in Japan and 280 hours of training in Japanese managed plants located in the US, but only 48 hours of training at US owned plants in the US (Krafcik 1990). Averaged over all auto assembly workers, annual training time is nearly three times greater in plants located in Japan and about 80 percent greater at Japanese plants located in the US. These differentials in training are one of the reasons why Japanese plants are more productive than American plants and Japanese built cars have such a reputation for quality. German employers train their youthful apprentices much more thoroughly than American employers train their teenage workers. One visible manifestation of this is the sales personnel one encounters in Germany. They are generally much more knowledgeable about the products they are selling than American sales clerks.

The Japanese and German economies apparently generate a significantly larger number of jobs which offer substantial training on-the-job. Why does this occur? This section of the report reviews the evidence on the culpability of six prime suspects: high turnover, high costs of capital, loose labor markets, lower trainability of American workers, lower rates of technological progress, and the absence of government sponsored signals of skills obtained from training on-the-job.

### 4.1 Turnover

If American employers were asked why they do not provide more intensive training to young workers, they would probably point to the high turnover rates of youth as the primary reason. And indeed, while some American workers stay at their employer for many years, most workers change employers very frequently. Table 10 presents data on how the distribution of job tenure varies across nations. In the 1980s and early 1990s, only 38.3 to 40.5 percent of American workers had been on their current job for more than 5 years. With the exception of Australia and the Netherlands, no other nation had such a low proportion of long tenure employees. The comparable proportions were 63-67 percent for Japan, 59-63 percent for Germany, 58 percent for France, 45 percent for Canada and 45-50 percent for the United Kingdom. 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 32 percent in France, 20 percent in Germany 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, 1993).

Turnover effects the stock of trained workers in three ways. First, high turnover necessarily implies that a given rate of investment in firm specific skills yields a smaller stock of workers with firm specific skills. Many of those trained have moved on to other firms where the firm specific components of training yield no benefits.

Second, turnover has a powerful effect on employer decisions to provide training to employees. Employers, not workers, finance most of the training that is undertaken in U.S. firms (see section 4.6). Employers will not invest in training unless they believe it will generate a monthly return that exceeds the sum of the monthly turnover rate (generally above 2% per month in the US and sometimes greater than 8%/mo.) and the cost of capital (which is about 1.5 percent per month or 18% per year). Monthly turnover rates are typically much larger than the cost of capital and are also more variable. If turnover is 5% per month and the cost of capital is 1.5% per month, the cash flow yield of the training investment rate of return must exceed 78 percent per year if the investment is to make economic sense. Even when turnover is a very low 2 percent per month, the required cash flow yield is still quite high: 42 percent per year. Training, thus becomes a sensible investment for an American employer only when it yields very rapid and very large returns. The amount of training employers are willing to finance is negatively related to the projected turnover rate of the trainees.

The third reason why turnover is so critical is its impact on the process of teaching and learning. Turnover disrupts learning regardless of whether the skills being learned are generic or

firm specific. Schools teach general skills and follow a common curriculum, yet have great difficulty when students transfer from one school to another during the school year. Teaching must be adjusted to the special needs of the learner, and it takes time for the teacher to learn of those special needs. Learning occurs best when instructor and learner have a close personal relationship and it takes time to build such relationships. Turnover is thus one of the determinants of the efficiency of the learning production function.

The high rates of turnover in America, then, help explain why investments in on-the-job training are lower in this country than in Japan and Germany.

**Why Is Turnover so High in the United States?:** One important reason why turnover is high in the U.S. youth labor market is job shopping and tryout hiring. When the match is first arranged, both the employer and the job seeker are poorly informed about each other, so they spend the first months learning about each other and, if they do not like what they discover, they terminate the relationship. If they knew more about each other prior to the hiring and acceptance decision, there would be fewer surprises, fewer quits and fewer dismissals. There are good reasons why try out hiring is so prevalent in the U.S. There are major institutional barriers to the free flow of information about job applicants--such as EEO testing guidelines, the failure of high schools to send out transcripts and the threat of law suits if bad recommendations are given--that do not exist in other countries. German and Japanese employers are much more careful in their selection of blue collar and clerical employees than American employers (Rosenbaum and Kariya 1987; Koenig 1987).

A second reason why turnover is higher in the U.S. is that there are fewer legal and contractual obstacles to layoffs and dismissals in the US (Sengenberger 1985; Flanagan 1986; OECD 1993, 105-115). Thirdly, turnover appears to be less costly for young American workers than for young German and young Japanese workers. Spells of unemployment are shorter in the United States. Specific training is more extensive in Japan, and the loss of these investments is a disincentive to turnover. Transition costs also discourage turnover (Bishop and Kang 1988, 1990, 1996) and there is reason to believe that there may be differences across countries in the magnitude of these transition costs. In some countries, quitting or being laid off does serious damage to the worker's reputation and the likelihood of finding another good job. The best Japanese employers hire straight out of high school and are reported to discriminate against those with work experience. The reverse appears to prevail in the US. Quitting appears to be much less stigmatizing in the US than in Japan particularly for young workers.

In Germany, apprenticeships have a three-month probationary period during which either party may opt out of the contract without serious consequences. Nevertheless, only 5

percent of apprentices change employers during this period. An apprentice who quits after the probationary period finds it difficult to get another apprenticeship. As a result, nearly 90 percent of those who start an apprenticeship stick with it for the full three years. Those trained at large firms tend to stay with the training firm for many years. Fifty-two percent of those trained by industrial firms with more than 1000 employees are still at the firm five years after completing their apprenticeship. The small (under 50 employees) craft oriented firms which provide a disproportionate share of apprenticeship training retain about 28 percent of their trainees five years after the apprenticeship is completed (Haroff and Kane 1993).

When economic conditions force a firm to contract, selection of who to lay off is often based on job performance. This makes a lay off more stigmatizing in Germany than in the US. To protect themselves from this stigma, German workers bargain for employment contracts which reduce the probability of layoffs by front loading compensation and mandating severance pay. This raises the payoff to employer investments in specific and general training, and the result is greater training investment and higher productivity (Buechtemann et al. 1993).

### 4.2 Cost of Capital

The benefits of training often take a while to be realized. Companies are less willing to make long term investments of all kinds when the cost of capital is high. Because of the large budget deficit and low savings rate, costs of capital are particularly high in the US, so long term training investments are discouraged. German and Japanese corporations face lower costs of capital (OTA 1990a), and this is one of the reasons why they invest so heavily in training. When they move production abroad they take this practice with them. Japanese corporations operating in the US spend a good deal more on training than American companies in the same industry (Mincer and Higuchi 1988).

### 4.3 Loose Labor Markets

High wage American employers have historically found it easy to recruit workers who have already been trained elsewhere. They have not been forced to train their own skilled workers as employers in Germany and Japan have. The greater availability of skilled and semi-skilled workers on the outside labor market has five causes:

- Higher average unemployment rates during the postwar period than in Germany and Japan.
- Higher turnover rates and the short term character of unemployment in the U.S. means that at any given unemployment rate an American firm will receive more applications from trained and qualified workers during a month than a comparable German or

Japanese firm. These applicants are not lemons as they tend to be in Japan and Germany. Since layoffs are common and are generally based on seniority in the U.S., there is less stigma to being laid off or being unemployed than there is in Japan and Germany (Buechtemann 1993).

- Large wage differentials between firms in the same or closely related industries allow high wage firms to raid the work force of their lower wage competitors. This strategy is available because most industrial unions have not organized their entire industry and because contract provisions are not extended to non-union firms by government edict as occurs in Germany (Soskice 1991). Wage differentials between different industries and between employers of different size are, consequently, larger in the U.S. than in Germany or Japan (OECD 1985).

- American secondary schools, community colleges and universities began providing occupation specific training to youth and adults many decades before German and Japanese schools and colleges entered this market. The early availability of school based occupational training in the U.S. helped cause the decline of apprenticeship training.

- Licensing restrictions on who can do particular jobs are less prevalent in the U.S., so there are fewer artificial restrictions on who can be hired for a particular job. If already trained workers are not available, American employers can engage in **just-in-time training.** The result is a bias toward an undertrained workforce rather than an overtrained one.

German and Japanese training practices evolved in an era of tight labor markets. Older workers who had been laid off by other employers were too few and were viewed as lemons, so firms sought talented trainees in graduating classes of local schools. American training institutions developed in a very different environment--relatively high unemployment, high turnover, large immigration flows, large numbers of graduates from school based occupational training programs and a free and highly flexible labor market.

### 4.4 Trainability of Workers

According to the National Assessment of Education (1988b) 93 percent of American 17 year olds do not have "the capacity to apply mathematical operations in a variety of problem settings (p. 42)." Young school leavers in Germany and Japan have a considerably better general education than their American counterparts. This means that they do not require remedial instruction in reading and mathematics, learn new skills more rapidly, and require less instruction to achieve a given level of competence. They are more likely to be able to learn by doing or by reading. With a less capable work force, employers feel they are less able to introduce technologies and methods of operation (eg. small-lot production, flexible manufacturing systems and high performance work systems) which require that workers be both

highly trained and cross trained in a variety of skills (Weiss 1984, Jaikumar 1986). While basic skills have stagnated in the U.S. since 1965, they have been improving in Europe and East Asia. As the learning ability and technical and mathematical background of a workforce increases, technological progress becomes more rapid and optimal level of investment in equipment and training increase as well.

### 4.5 Lower Rates of Technological Progress

Studies by Mincer and Higuchi (1988), Bartel and Sicherman (1993) and Tan et al (1991) have found that workers in industries experiencing high rates of technological progress receive more training than workers in industries with low rates of technological progress. This finding is consistent with a view that heavy investments in training cause increases in productivity, but it is also consistent with a view that causation also runs in the opposite direction--high rates of investment and technological progress increase the demand for and the profitability of training. Because the U.S. had such a large productivity lead at the end of the Second World War, American productivity growth in the postwar period has necessarily been below that of Germany and Japan. This has no doubt contributed to the lower level of training investment in the US.

### 4.6 Transmitting Information about a Worker's General Skills

In the U.S. labor market, hiring decision makers have a very difficult time assessing the quality of the general human capital obtained from on-the-job training at previous jobs. This fact increases turnover, lowers wages, and lowers productivity. Since part of the reason for getting general training is to improve the worker's marketability with other employers, not recognizing the benefits of this training reduces the incentive to invest in general on-the-job training.[9] Doing an especially good job of training employees will benefit the trained workers when they leave the firm only if the firm develops a reputation for being a good trainer. Past experience with the former employees of a firm is probably the primary determinant of a firm's reputation as a trainer. Urge firms that turn over a reasonable share of their trainees are likely to develop a reputation (good or bad) for the training that they provide. A positive reputation for providing good training helps their separating employees find better jobs, and this in turn helps the firm recruit the best possible candidates when it is hiring. The armed forces are aware of this, and consequently spend millions of dollars advertising the quality and civilian usefulness of their training.

Most young workers, however, do not obtain jobs at the large firms with established training reputations. The smaller less well-known firms where they find their first job are typically unknown quantities when it comes to the quality and general usefulness of their training.

The lack of full reward for improvements in general skills if one leaves one's current employer affects the incentives for the trainer and trainee to devote time and energy to learning general skills. The higher the worker's likelihood of leaving the firm, the lower is that worker's incentive to devote himself or herself to learning general (or specific) skills that are not immediately visible to other employers. This means that the under investment in general OJT is greatest for temporary and seasonal employees and for young people as a group (Bishop and Kang 1988, 1996).

The poor quality of the information about a job candidate's general skills and the resulting under investment in general training (both on the job and in schools) is a major institutional flaw of U.S. labor markets. Some formal systems for certifying the competencies gained through on-the-job training exist in the United States, but they have not achieved widespread usage (Wills 1993). The apprenticeship systems of Switzerland, Austria, and Germany are probably the best examples in the world of widespread and effective systems of on-the-job training and competency certification. One of the most important features of these apprenticeship systems is the requirement that the apprentice pass written and practical examinations covering the occupation's curriculum. If an employer cannot provide training in all the skills included in the curriculum, it must arrange for their apprentices to receive instruction at another firm or at a special employer-run school. The examinations are set and scored by a local committee of masters (skilled workers) and employers so the quality of the training provided by the master and the firm is put to a public test. Passing this apprenticeship exam is of benefit not only to the trainee, it is important to the masters as well, for both their reputation amongst their peers and their ability to recruit high-quality apprentices depends upon it. As a result, 90 percent of German apprentices remain at one employer for the full 3-year apprenticeship period, and 90 percent of these pass their test (on the first or second try). The apprenticeship systems of the English-speaking nations are based on time served rather than competencies achieved and are considerably less successful in standardizing and upgrading the training that occurs.

The examination at the end of training is the key to maintaining quality control. In the late 19th century, the Swiss educational/training system went through a period of crises and self-examination not unlike what is now happening in the United States and the United Kingdom. The nation had to export to survive but the quality of workmanship was low and

deteriorating. The Swiss assigned blame to their apprenticeship system and proceeded to reform it by ending apprenticeship based on time served, establishing a standardized curriculum, and instituting written and practical examinations set by local committees of employers and workers. The high standards of workmanship for which Swiss workers are renowned are not an inherent trait of national character but rather are the consequence of the institutions that teach, test, certify, and publicize this workmanship.

The standardized curriculums and the proficiency exam at the end of the apprenticeship mean that the quality and nature of the training is well signaled to employers in Germany, Switzerland and Austria. The result is that the worker can count on benefiting from doing a good job in their apprenticeship even if the training employer does not keep them on. Since the future payoff is certain, German apprentices are willing to start out at a wage that is only about one-quarter of the wage they will be able to command at the end of the apprenticeship. If the apprentices were adults, they could not afford to accept so low a wage. Beginning apprentices, however, are generally teenagers who can save on living costs by live at home. Consequently, the liquidity constraints which are such a barrier to heavy investments in general training in the US are much less of a problem in Germany.

In summary, there are a number of very good reasons why American employers invest less in training than employers in Japan and Germany. This does not necessarily imply, however, that the differential is caused by some failure of the American training market that requires remedy. It could be argued that the American just-in-time approach to on-the-job training is more efficient than the German broad apprenticeship strategy. The lower levels of training investment might be a necessary adaptation to the higher rates of turnover that result from the relative absence of government imposed barriers to dismissals and layoffs. Whether or not the American training market is failing to provide the socially optimal level of training is a different issue; one to which we will now turn.

## 5. FROM SOCIE1YS POINT OF VIEW "DO MOST EMPLOYERS AND WORKERS UNDER INVEST IN ON-THE-JOB TRAINING?"

This section of the paper reviews what is known about whether the training market in the United States provides a socially optimal quantity and quality of employer training. Six potential sources of market failure--wages and hours regulations, real externalities, network externalities, tax induced distortions, liquidity constraints and barriers to the flow of information about job applicants--are examined. Each of them are found to operate to some degree in some training

markets. Empirical evidence on the market failure issue is examined in section 6. There appears to be a good deal of evidence that employers are sharing the costs and benefits of general training with employees and are thereby effectively determining how much on-the-job training occurs. If so, the socially optimal level of training is likely to be greater than the level chosen by profit maximizing firms.

### 5.1 Wages and Hours Regulations

Labor Department regulations implementing the Fair Labor Standards Act make it very difficult for firms to ask workers to contribute towards the cost of their training by taking training classes during unpaid time. They specify that:

> Sec. 785.27 --- Attendance at ... training programs ... need not be counted as working hours if the following four conditions are met:
> a) Attendance is outside the employee's regular working hours;
> b) Attendance is in fact voluntary;
> c) The course, lecture or meeting is not directly related to the employee's job; and
> d) The employee does not perform any productive work during such attendance....
>
> Sec. 785.29 --- The training is directly related to the employee's job if it is designed to make the employee handle his job more effectively as distinguished from training him for another job, or to a new or additional skill.
>
> Sec. 785.30--...if an employee on his own initiative attends an independent school, college or trade school after hours, the time is not hours worked for his employers even if the courses are related to his job. (Bureau of National Affairs, Wages and Hours, p. 97:3208).

These regulations present employers with the following dilemma: either (a) don't provide training in general skills like reading or word processing that will improve a worker's productivity in their current job or (b) provide such training and pay all of its costs-instructional costs and trainee time costs. Thus, no matter how general the skill nor how voluntary the decision to take training, if it raises productivity in one's current job and is provided by the employer, the worker must be paid while engaged in training. Workers and employers are prohibited from cutting the following deal--the company will provide instructors, classrooms and certification, while the worker will commit uncompensated time to learning general skills that enhance productivity (Bureau of National Affairs 1993, 97:3208). Schools can offer such a deal, employers cannot. These regulations have three pernicious effects: they discourage employers from organizing formal training in general skills, they induce them to ration the training programs that they do offer and they force workers who seek such training to get it at a school. Since school based training of adults not paid for by their employer has no effect on wage rates, the regulations

effectively push many workers into a type of training that does not appear to raise their wages. **This constraint on how workers and employers share the costs of general training provided at the workplace is probably a very important source of market failure in the training market.**

The other way workers can share the costs of general training is by accepting lower wage rates during the training period. Under current regulations this is not really possible for short intermittent spells of training voluntarily undertaken by individual workers. For new hires, however, flexibility is greater because wages customarily rise with tenure on the job. In some low wage jobs, however, the minimum wage constraint is binding. Young inexperienced workers are, in effect prevented from bidding for training opportunities by offering to work for a low wage.

Lacking the ability to get employees to pay a major share of the costs of general training (by accepting a low wage during the training period or doing the training on one's own time), employers will adopt production technologies that minimize the skill requirements of the job. The evolution of the diner and the small, family-operated restaurant into franchised fast food operations using specially designed machines and prepackaged food is an example of how this is accomplished. By reducing the skills required to do the job, the employer shortens the time it takes for new employees to reach maximum productivity. The same people may have the job but they are taught less, and what is taught is useful primarily at that firm--not elsewhere. Opportunities for promotion are minimal and wage increases are small.

A second impact of the minimum wage legislation is that the forced increase in the wage during training is partially compensated for by a fall in wage rates during the post-training period. This increases the quit rate, which in turn reduces the payoffs that employers receive from training and, therefore, their willingness to make such investments or to hire individuals who require substantial training investments. Empirical studies by Hashimoto (1982) and Leighton and Mincer (1981) provide support for this view. Maximum hours legislation is probably an even more significant barrier to general training, but there are no empirical studies of this issue.

### 5.2 Real Externalities

The primary justification for public control and subsidy of schooling and public involvement in other forms of education and training is the fact that the individual who gets the education and training receives only part of its benefits. When deciding on the type and amount of education and training to undertake and how hard to study while at school, most individuals are taking only private benefits into account. The private benefits of an educational experience

are many: the enjoyment derived from being a student or pleasing mom and dad, the higher after-tax income, the prestige and consumption benefits of having an education (or a job that requires heavy on-the-job training), the private benefits of improved health, and so forth. These private benefits account for only part of the total benefits to society of education and training, however. People who have received more or better education and training or who achieved more during the experience benefit others in society by paying higher taxes, by making discoveries or artistic contributions that benefit others in the society, by being more likely to give time and money to charity, by being less likely to experience long periods of hospitalization that are paid for by insurance or government, and in many other ways (Haveman and Wolfe 1983). Economists call social benefits such as these "spillovers" or "externalities." Private decisions will lead to an insufficient quantity and insufficient quality of education and training and insufficient achievement by students, unless public agencies intervene and partially subsidize the cost or add to the rewards. The appropriate amount of public subsidy is closely related to the size of the spillover or externality benefits of education and training. Training produces two kinds of real externalities:

**Poor Signaling of General Skills to Other Employers:** The training provided by one employer benefits other employers and consumers, not just the trainee and his/her employer (Bishop 1994). The worker is more productive in future jobs, but these employers do not perceive accurately the quality of the general OJT received by the worker and, as a result, do not fully compensate the trained worker for their higher productivity (Bishop and Kang 1984 1988, 1996; Katz and Ziderman 1990; Chang and Wang 1996).[10] Bishop's (1994) study of the relative productivity and the profitability of new hires obtained results that are consistent with this hypothesis. New hires who had received formal off-job training sponsored by a previous employer made significantly more suggestions designed to improve productivity were more productive and profitable and were less likely to be fired. If one accepts these findings as valid, the implication is a market failure which reduces the payoff to worker investments in OJT. The ultimate cause of this problem is the lack of effective signals of the quantity and quality of training.

**Discoveries and Disasters Attributable to Training:** High quality training benefits customers and the public as well as the trainer and the trainee. When, for example, the dancers of the New York City Ballet receive excellent training, the company benefits through greater ticket revenue but the audience benefits as well because they derive a larger consumer surplus from the performance. The COMSAT employee who figured out how to double the lifetime of communication satellites by judicious use of the rocket fuel remaining on board, benefited

customers and competitors at least as much as he benefited COMSAT. The Aloha airlines pilot who landed his plane after an explosive decompression and the loss of a major section of his plane, certainly raised the lifetime earnings of his passengers. On-the-job training and experience were critical to the COMSAT discovery and the safe landing of the Aloha plane.

When a worker screws up because of poor training, the customers and the general public often lose just as much as the worker and the company. Examples of disasters caused or contributed to by poor training are legion: Chernoble, Three Mile Island, Exxon Valdez, the shoot down of the Korean Airlines 747 (pilot error caused the plane to be off course), and Greyhound bus crashes in New York State. Tort law internalizes some but not all of these costs. Damage awards are typically paid by insurance funds that are imperfectly experience rated. Where the public interest in insuring top quality training is manifest to all, training is often regulated or subsidized by government. The Federal Aviation Administration, the Department of Transportation and the Nuclear Regulatory Commission, for example, engage in such regulation.

However, for every big discovery or disaster that gets media attention and generates a political response, there are millions of little discoveries, unrewarded services, or unanticipated product failures that directly effect consumers that do not generate political responses. Since customers lack low cost access to accurate information on the quality of what they are buying, the prices paid do not fully reflect quality differentials between different providers. As a consequence, training which enhances quality and reliability often generates benefits for customers which are not recognized or rewarded by the market.

### 5.3 Information Asymmetries and Network Externalities

A third reason why workers and firms under invest in general training is network externalities. Many of the skills taught in company training programs are new methods of communication or become the basis of new ways of interacting with customers, suppliers or other workers. Examples of the first are E-mail, Internet protocols, programming languages and group problem solving strategies. Generic applications software used in many different companies--eg. spread sheet, data base, project scheduling, and CAD-CAM software--are examples of the second phenomenon. E-mail is a convenient way of scheduling meetings and communicating with suppliers if they are all regular E-mail users. If, however, many recipients of an E-mail message do not get it in a timely manner, E-mail becomes an impediment to communication not a facilitator. Similarly, communication among engineers designing an automobile is facilitated by the use of the same CAD-CAM software.

Consequently, firms must standardize their software programs. To keep up with the periodic upgrades of the program, training must be continuous. Employers will be better informed about the technological uncertainties and, therefore, better able to select which skills need to be learned and be more willing to bear the risk of the investment.

Furthermore, the marginal benefit of an additional worker learning an applications program increases as the share of employees at firm A who know and use the program approaches 100 percent. If the firm were to expect workers to pay some of the costs of learning the software application, it would not be able to demand that all workers learn it and the network benefits would not be realized. Since federal wage and hours regulations mandate that workers be paid during require training programs, a firm that wants everyone in a job category to develop a particular general skill must pay the full costs of the training.

An additional reason incumbent workers are reluctant to pay for training in these fast changing applications programs is their fear that they may be left stranded by a company decision to switch to another only partially compatible applications program. The way the firm assures its workers that it will be conservative about such switches is for it to offer to pay any training costs that result from a switch.

Since some trainees end up working elsewhere, other companies benefit from the training provided by firm A. Their cost of teaching the new applications software is reduced because some of their recent hires already know it and can help the novices learn it. Workers who learn generic applications software are more attractive on the outside labor market and, as a result, receive higher wage rates if they leave. Indeed the firm that provided the training may have to raise their wage to forestall such quits. Despite the fact that the worker benefits substantially from learning the skill, the employer pays the full costs of the training (both instruction and time costs) because the network benefits of facilitating communication within the company are so large. While some of the firm's employees would have been willing to share the costs of the training, the firm is not able to offer different cost sharing deals to different employees.

Now lets look at how decisions to introduce E-mail or standardize on a new applications software are made. The employer will decide to innovate and train if he expects the productivity increases at his firm will be larger than the sum of the training costs and the higher wages he will have to pay to retain his newly trained workers. Even though they count as social benefits, the higher wages he must pay to retain workers, the higher wages that departing employees receive, and the savings in training costs at other firms are not a plus in the employer's eyes. Furthermore, a delay is likely to lower the cost of the investment because new employees who

already have the skills needed for the innovation can be hired in the interim. Thus social benefits of innovation and its associated training are substantially larger than the private benefits, and particularly so when turnover rates are high. Under investment in this type of training is the result.

### 5.4 Tax Induced Distortions of the Training Market

The Non-Deductibility of Some Training Expenses--The benefits of training are taxed, but not all of the costs are deductible.[11] Some of the time that trainees devote to employer sponsored training comes from reducing leisure time. Employees taking job related college courses typically attend classes on their own time and always do their homework on their own time. Japanese workers frequently take correspondence courses related to their job and, when rotated to a new job, they take home and study the meticulous description of how the job is done written by previous occupants. Japanese supervisors are expected to fill up slack time with training. When Ronald Dore presented his passport at an out of the way port of entry that seldom sees British passports, the supervisor called his younger colleagues over and taught them about its intricacies while Dore looked on. This little training session delayed passengers somewhat and necessitated a sacrifice of on-the-job leisure but output--the number of passengers processed--did not change (Dore and Sako 1989). Incentives to undertake training are distorted if government does not share in the costs of training to the same degree it shares in its rewards. When training time displaces leisure time, that is what happens.

**The Progressive Income Tax:** The second tax induced distortion arises from the fact that investments in OJT are often made at a time when the individual has a zero or low marginal tax rate and the benefits are received when earnings and marginal tax rates are higher. This reduces the after-tax benefits of OJT by more than the after-tax costs and this discourages worker financed OJT. Firms, on the other hand, train continuously, so the marginal tax rates faced when the costs of training are incurred and deductible are no different from those faced during the payoff period.

### 5.5 High Borrowing Costs and Liquidity Constraints

The fifth reason why society subsidizes schooling is the failure of the free market (in the absence of publicly funded loan guarantee program) to offer loans to young persons seeking to invest in their education. The government recognized long ago that people going to school needed access to low-interest, government-guaranteed loans. Workers investing in general on-the-job training have a similar need but are not eligible for such loans unless they happen to

be part of a training program run by an accredited educational institution. Because of the fear of turnover, employers are reluctant to pay for general training that is visible and useful in other firms. If the employer is not willing to pay for general training, it will be offered only to those workers who pay for it by accepting a lower wage during the training period than could be obtained elsewhere. The more intensive the training, the greater the required reduction in wages will have to be. Many workers are unwilling to accept a large reduction in their current standard of living, and, since they are unable to borrow at reasonable interest rates, they forego the investments in general on-the-job training.[12] If they do fund such investments, they do so only when rates of return are extremely high.

Most young workers 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 access to credit at reasonable terms nor liquid assets that can be depleted. In the early 1980s, half of households headed by someone under the age of 25 had less than $746 in financial assets and 19 percent had no financial assets at all. Half of households headed by someone between 25 and 34 had less than $1514 in financial assets and 13 percent had 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 general training and which, therefore, have a flat wage profile. Where significant general training is occurring, however, it comes into play and may result in an employment contract in which the employer shares the costs of general training (Glick and Feuer 1984; Feuer, Glick and Desai 1987).

Firms are thus 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. Firms, however, undertake to finance some of the costs of general OJT only when their investment yields a return that is sufficient to pay for both the cost of capital and the risk of turnover. This reduces employer investments in general on-the-job training below the level that would have prevailed if workers were able to borrow at the same interest rates as employers.

### 5.6 Barriers to Careful Selection of New Hires

Governmental institutions and regulations are an important reason why American employers do a poor job of selecting entry level workers and experience very high rates of turnover. American employers are not able to obtain good information on the skills and competencies of young job applicants largely because of barriers to the free flow of information about job applicants-such as EEO testing guidelines, the failure of some high schools to send out transcripts, large variations in grading standards across schools and across courses within a school, and the threat of law suits if bad recommendations are given.

The worker trait that best predicts turnover is dependability and work habits (Bishop 1993). Reference checks (at both schools and former employers) are one way to assess this trait. However, the threat of lawsuits by former employees who have had difficulty finding a new job because of unfavorable references has made many employers reluctant to give honest references. Personnel offices are particularly sensitive to the legal dangers of giving references, so the information content of their references has deteriorated the most. Bishop (1993) found that most of the references given by personnel offices were misleading. New hires who were vouched for by the personnel office at a previous job and for whom no reference was obtained from a previous supervisor were 11 percent less productive than expected, 12 percent less productive at the time of the interview and considerably less profitable than other new hires.

Employers believe that school performance is a good predictor of job performance and turnover[13], but they have great difficulty getting such information. If a student or graduate has given written permission for a transcript to be sent to an employer, the Federal Education Rights and Privacy Act obligates the school to respond. Many high schools are not, however, responding to such requests. In Columbus Ohio, for example, Nationwide Insurance sent over

1,200 requests for transcript information signed by job applicants to high schools in 1982 and received only 93 responses. Delays in obtaining transcripts also make transcripts less useful. In 1987 only 14 percent of small and medium sized employers obtained transcripts prior to hiring high school graduates and only 15 percent asked about GPAs on job applications. The absence of questions about grades from most job applications reflects the low reliability of self reported data, the difficulties of verifying it, and the fear of EEO challenges to such questions.

Hiring on the basis of recommendations by high school teachers is also uncommon. In the NFIB survey, when a high school graduate was hired, the new hire had been referred or recommended by vocational teachers in only 5.2 percent of the cases and referred by someone else in the high school only 2.7 percent of the time.

Tests are available for measuring competency in reading, writing, mathematics, science, and problem solving, but, after the 1971 Griggs decision, most firms stopped employment testing because EEOC guidelines made it very costly to demonstrate the validity of tests assessing competence in English and mathematics. Before such a test could be used, the firm had to conduct an expensive validity study of the proposed test and alternative tests at their own work sites (Friedman and William 1982). In 1987 only 3 percent of small and medium sized firms gave applicants a test of basic skills.

Other countries handle the signaling of high school accomplishments to prospective employers much more effectively and have lower turnover rates as a result.

### 5.7 Evidence of Under Investment from the High Rates of Return to OJT

If there is under investment in general OJT, we would expect to find private rates of return to OJT to be very high. The studies that have estimated the wage return to OJT suggest that private rates of return are considerably higher than the real rates of return of about 4 percent on corporate bonds and of about 5-10 percent for schooling (Mincer 1974, 1989). These efforts are fraught with difficulties, however, because it is very difficult (a) to measure what employees [as opposed to employers] invest in training and (b) to distinguish wage increases caused by training from wage increases caused by selective turnover or the need to discourage shirking by back-loading compensation packages.[14] Since, however, workers experienced no reductions in wage rates or hours worked while they received company training, Lengermann (1996a) calculated that the worker's private rate of return for training was essentially infinite. Not surprisingly, large numbers of American, Canadian, Dutch and Swedish workers report that they are unable to get all the training they would like (Leuven and Oosterbeek 1996).

## 6. DO EMPLOYERS SHARE THE COSTS OF GENERAL TRAINING?

An easier way to empirically examine the issue of the under provision of training is to study whether the training market indeed behaves in the way predicted by standard OJT theory. The theory of on-the-job training says that the worker pays the full costs of general training by accepting a lower wage rate while training is underway and then reaps the full benefits in the form of a higher wage rate regardless of whether there is subsequent turnover. Is this correct: Do workers pay all the costs of and receive all the benefits of training in skills that are useful at other firms? Do workers and employers share the costs and benefits of specific training? If these propositions are false and employers are being induced to share the costs of general training by the prospect of sharing its benefits, under provision of general training is probable. It probably means (a) that federal regulations which require employers to pay workers when they engage in training that improves productivity in one's current job have indeed prevented the cost sharing arrangements predicted by theory, (b) that network externalities are important, (c) that workers are liquidity constrained and/or (d) that general skills are poorly signaled to the labor market. **If employers are paying some of the costs of general training, they are not doing it for altruistic reasons. They are comparing the training costs incurred to the expected productivity benefits the firm will receive from the workers who stay at the firm. Benefits received by other employers and by the trainee will have zero weight in their calculation. Turnover, thus, causes the firm to take only a portion of the true social benefits of general training into account and under provision results.** Therefore, it is important to determine whether employers are sharing the costs of general training. What do we now know about this issue? Eight different types of evidence will be examined.

### 6.1 Cross-section Studies of Starting Wage Rates

Standard theory predicts that workers who find jobs that offer extensive general OJT will receive substantially lower initial wages than workers who take jobs which do not offer general training. 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 (Parsons 1990).

Bishop and Kang (1988, 1996) have conducted another test of this hypothesis in the 1984 follow up of the High School and Beyond (HSB) 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.

Lynch's (1992) analysis of 1983 NLSY data on workers with less than a bachelors degree found that, controlling on occupation, industry, tenure, experience, schooling and background characteristics, workers who were in the 20th week of an incomplete spell of on-the-job training were paid a significant 5.2 percent extra on average. Dissaggregating by worker education revealed that it was workers with 12 to 15 years of schooling who were paid more when they were being trained. Workers with less than a high school degree, on the other hand, were paid less (though non-significantly so) when they were receiving training.

Patrice Flynn's (1990) analysis of monthly earnings data in the Survey of Income and Program Participation found, that controlling for size of establishment, tenure, experience, schooling, previous training and demographic background (but not occupation), those currently receiving employer provided training earned a statistically significant 5.7 percent less on average. Ullard and Tan's (1986, Table 4.3-4.5) analysis of NLS Young Mens data and Barron, Black and Loewenstein (1989, Table 2) analysis of EOPP data found no significant tendency for wages to be lower while training is underway. Point estimates were negative but so small they might as well be zero from a substantive point of view. Barron, Berger and Black's (1993a, Table 1) cross section analysis of the SBA financed survey found that doubling on-the-job training intensity lowered the starting wage rate by a significant 2 to 4 percent. Doubling the off-site training intensity, however, was associated with a 4 percent higher wage. Even where training is associated with lower wage rates, the magnitude of the effect appears to be much too small to be consistent with standard theory.

It can 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 and share the costs of specific training. Maybe the anomalous findings are caused by unobserved heterogeneity. The argument is that hiring decision makers are better at assessing the ability of job candidates than econometricians with access to NLS or HSB data file and the positive association between wages and training arises because workers who are highly able (in ways not observed by the econometrician) are both paid more and also recruited for jobs that are more complex and that consequently require large amounts of training.

Unobserved heterogeneity no doubt has the effect of contributing to the positive association between training and starting wage rates, but to transform a large negative structural relationship into either zero impacts or statistically significant positive relationships, 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 predicting training participation shortly after leaving school estimated by Parsons (1985) and by Bishop and Kang (1988, 1996) failed to find large effects of ability proxies such as test scores, grades, and being a disciplined student on the probability of receiving training. On the other hand, Bartel and Sicherman (1993) and Veum's (1995) analysis of 1986 to 1990 NLSY data found that, once the youth had been out of school for many years, workers with high 1980 test scores were considerably more likely to receive company training and to be sent to seminars. Unfortunately, these analyses do not control for occupation and industry, so some of the positive relationship uncovered may be due to occupational selection.

Another way to control for heterogeneity is to follow workers over time and assess whether entering a training program lowers wage growth. Lowenstein and Spletzer's (1996 Table 4) study provides separate estimates of the effect of complete and incomplete training spells on wage growth. They found that those in the midst of incomplete spells of training did not suffer wage declines relative to those who received no training during the previous year. Paul Lengermann's (1996a, 1996b) studies of NISY data also found no statistically significant reductions in wage rates for those receiving training.

Another possible explanation of these anomalous findings is that almost all training is specific and employers finance 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 revisionist theories [eg. Salop and Salop's (1976) adverse selection theory] predict that employers pay none of the costs of specific training. A specific training explanation of these findings is particularly perplexing when to all outward appearances the training is largely general.

Further evidence that unobserved heterogeneity and highly specific training can not explain these anomalous findings comes from five types of studies which avoid the unobserved heterogeneity problem by holding the job or the individual being trained constant: (a) comparisons of new hires who require large and small amounts of training (b) evidence that some employers pay for training in completely general skills such as mathematics and problem solving, (c) detailed studies of the costs of apprenticeship training and who pays these costs, (d) comparisons of the productivity growth and wage growth of new hires, and (e) econometric

analyses which compare the productivity growth and wage growth impacts of general training received by the individual.

### 6.2 Impact of Training Requirement Differentials on Relative Wage Rates

One way to deal with the unobserved heterogeneity problem, is to pick a particular job and compare individuals hired for that job while holding job performance realizations constant. Workers hired for the same job often have different amounts of relevant work experience and so require different amounts of training. Who pays for the additional costs of training an inexperienced worker? Are workers who require extra training forced to accept much reduced starting wage rates? Or does the employer bear most of the additional costs, hoping to recoup these costs by limiting the wage increase after the completion of training? Bishop (1987) presents an empirical analysis of EOPP data which addresses this question. He regressed the difference between the starting wage rates of two new hires for the same job on differences in their productivity and training time requirements. Workers who required extra training time were offered lower starting wage rates, but the effect was small. Holding productivity outcomes constant, workers who received 100 extra hours of training during the first 3 months on the job were paid 3.3 percent less both at the start and after one year or so on the job. Barron, Berger and Black (1993a Table 4) analysis of SBA data obtained similar results. Even though about a third of the new hires received more or less training than was typical for the job, wage rates differed from the typical level only 6 percent of the time.

### 6.3 Employer Sponsored Workplace Literacy Programs

While the number is currently small, a growing number of firms are training their workers in completely general skills such as mathematics, reading, writing, problem solving and interpersonal skills. Based on a telephone survey that achieved a remarkably good 66 percent response rate, Laurie Bassi (1992) has estimated that 10 percent of manufacturing firms with fewer than 500 employees and 8 percent of similarly sized non-manufacturing firms offered such training at the work site and provided at least partial release time for participation. Hollenbeck and Anderson's (1992) survey of Michigan firms with workplace literacy programs also found that most (81 percent) gave their workers released time when they participated in the training. The National Household Education Survey found that less than one percent of all workers had participated in a workplace literacy program in 1991, but those that did spent an average of 80 hours in the program. One-third of participants said it was required by their

employer, 54 percent said they were given time off to attend and 49 percent said the costs of the training were paid by their company (Hollenbeck 1993b).

The fact that many companies required worker participation indicates that literacy training is not a new form of untaxed compensation. Indeed one of the reasons why some companies do not offer such training is a concern that workers will feel demeaned by a suggestion that they need to improve their reading and arithmetic skills. To avoid such a reaction, the basic skills training is often integrated with workplace technical training. The word literacy is never used (Mikulecky 1989). Companies with such programs believe the training has raised morale, company loyalty, communication on the job, teamwork, quality of output, productivity and customer satisfaction (Bassi 1992 Table 1 1A). Clearly, some companies feel strongly enough about the need for their workers to improve these general skills, they were willing to pick up most of the costs of developing skills which are highly useful at other companies and in everyday life.

### 6.4 Employer Sponsored Computer Training at Temporary Help Agencies

Even temporary help agencies provide general training to their workers. Alan Krueger's (1993) survey of 83 temporary employment agencies found that 59 percent of them provided free up-front computer training for the workers they place. Training costs were shared: the worker committed her time and the agency provided an instructor and training facilities. The agencies were willing to share general training costs because secretaries proficient in word processing generated substantially higher weekly fees when placed and the worker received only half of the increment.

### 6.5 Studies of the Sharing of Apprenticeship Costs

Studies of who pays the costs of apprenticeship training have been conducted in Germany, Great Britain, and the United States (Noll et al 1984; Ryan 1980; Jones 1985; Weiderhold-Fritz 1985). Despite the transferable character of the training and significant turnover, these studies concluded that employers made large investments in general training 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 worker's output. Despite the fact that the local economy was in deep recession, separation rates were extremely high: 10.8 percent per month for beginners and 6.3 percent per month 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.

### 6.6 Comparisons of Wage Growth and Productivity Growth

In EOPP data, newly hired workers in jobs which provide training in skills which were useful at other firms received real wage increases of only 5 to 6 percent in the first year and 2 to 6 percent in the second year on the job. 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 was significantly greater than the 8 to 12 percent increase in the worker's real hourly compensation during the first two years at these jobs (Bishop and Kang 1990). 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.

### 6.7 Econometric Studies of the Productivity and Wage Growth Effects of Training

Becker's theory predicts that **when training is general, its impact on wage growth should equal or exceed its impact on productivity growth.** Bishop's (1991) cross section analysis of EOPP data discussed in section 3.3 contradicts this prediction. When proportionate rates of wage and productivity growth during the first year or two of tenure on a job were regressed on time spent training the individual, productivity effects are many multiples larger that wage effects. Barron, Berger and Black (1996, 1993a) came to a similar conclusion: "Using both the EOPP and SBA data, however, we find little evidence that workers bear a substantial portion of the costs and benefits of training." How can these puzzling results be explained?

One explanation that doesn't fit is that the training is specific to the employer and the employer is financing all of its costs. There is direct evidence that most of the training is general. Employers in the EOPP survey were asked, "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." Only 7.5 percent answered "almost none." When firms provided training in almost completely general skills, doubling training intensity raised productivity by 6.7 percent but wages by only 0.8 percent in a logarithmic model and raised productivity by 3 percent while increasing wage growth by only 0.96 percent in a linear model (Bishop 1991).

### 6.8 Impacts of Company Training on Wage Growth when Workers leave the Training Firm

Employers who share the costs of general training because liquidity constrained employees are unable or unwilling to finance general training will naturally expect to share the benefits during the post training period. Consequently, the wage increase they offer their trainees should be smaller than is available if the worker takes the new skills to another firm. If, however, trained workers are less productive at other firms because some of their skills are technically or behaviorally specific to the training firm, the wage effects of training will be larger for those who stay at the firm. Only the training firm is willing to offer a wage premium for skills developed in training that are technically or behaviorally specific to the firm.

Therefore, the impact of turnover on the wage growth effects of training provide evidence on how important the liquidity constraint explanation of employer sharing of general training costs and benefits is relative to the imperfect sign1ling and skills are specific explanation. Two separate analyses of N"LSY data have found evidence supporting the liquidity constraint motive for sharing training investments. Lowenstein and Spletzer (1996) found that wage effects of training were larger when workers switched employers after training. Paul

Lengermann's (1996b) analysis of 1979 to 1993 NLSY data found that company training programs lasting more than 4 weeks had long lasting effects on wage rates that were larger when workers switched employers (12.1 percent after 6 years, F = 6.38) than when they stayed at the training firm (4.6 percent after 6 years, F=4.98).

## 7. WHY DO EMPLOYERS SHARE THE COSTS OF GENERAL TRAINING?

Why might it be rational for employers to partially finance training in skills which they describe as useful at other firms?

Probably the most important reason why firms share general training costs is federal regulations that require firms to pay their workers while they receive employer sponsored training that increases productivity on their current job (even when the training is voluntary and the skill is useful at other firms). Given this regulation, the only way workers can pay for general training (as predicted by theory) is for them to receive a reduced wage rate during the training period. This is feasible for entry level training, if the minimum wage constraint is not binding. However, for more senior workers, a wage reduction during voluntary training in new computer applications programs or other general skills would probably be forbidden by federal wage and hours regulations. Wage structures reflect a host of efficiency and equity considerations. Even in non-union settings, changing them is very costly--particularly if compensation is being lowered. Hence when technological change makes a new general skill valuable, the firm must decide whether to provide the training in that skill under the constraint of its predetermined wage structure. By prohibiting the firm from asking workers to take training during uncompensated time, federal wage and hours regulations effectively prevent the firm from inducing its workers to share the costs of training in this general skill.

Federal regulations are not the only reason why employers share the costs of general training? A second reason is that skills that are clearly useful at other firms may nevertheless be treated as if they are specific to the firm. Different firms require different mixes of general skills. The firm that does the training concentrates on those skills it needs the most, some of which may not be as highly valued by alternative employers. Skills that would be highly valued by an alternative employer may not be taught because others on the staff already fulfill that function. A particular employer may expect its employees to use Word Perfect for word processing, Lotus 1-2-3 for spreadsheets and Harvard Graphics for presentations. Other firms in the area may have selected a different mix of software packages for their firm, so while familiarity with each of these packages is a general skill, there may be no (or only a few) other firms which use exactly the same mix of software applications. As a result, the package of general skills workers

develop are almost always more valuable at the training firm than at other firms even when each individual skill is correctly perceived to be useful elsewhere.

A third reason why the market behaves as if general skills are effectively specific to the firm is that other employers will generally be ignorant of the character of a new hire's general skills and, consequently, may not assign the worker to a job that puts the skills to work. Indeed when an employer has been forced by federal regulations to pay for all the costs of training in technically general skills, it will not want to advertise these skills to other firms for fear of losing the now skilled worker to a higher paying employer. Even when a worker's next job makes use of the general skills learned, there is no guarantee that new hires with better than average skills will be offered comparably higher starting wage rates. **These phenomena have the effect of transforming some skills that are technically general into skills which when it comes to wage setting are effectively specific to the firm.** To the extent training is effectively specific, wages will rise more slowly than productivity net of training cost and wage offers from other employers will not reflect the general skills learned at the initial job (Bishop and Kang 1984, 1988, 1996; Barron, Berger and Black 1996).

Support for this signaling/visibility explanation of the gap between productivity and wage rate effects of training comes from comparing the gaps between wage growth and productivity growth effects of training for specific types of training. In Bishop's analysis of EOPP data (1991 Table 7), all forms of training had roughly equal effects on productivity growth. For wage growth, however, formal training had much larger effects than other forms of training and OJT by co-workers had no effect. Apparently, formal training is either less specific to the job or more visible to the employee and other employers, and thus has a larger impact on wage growth. Analyses of household data sets take this signaling point one step further. Lynch's (1992) fixed effect estimation found that apprenticeship and off-job-training had more positive wage effects than the less visible formal company on-the-job training programs. Lowenstein and Spletzer (1996 Table 4) also found that off-site training paid for by the employer had bigger effects on wages than on-the-job company training.

The fourth reason why employers might voluntarily pay for general training is the inability/unwillingness of most young workers (those with the greatest need for general training) to finance large amounts of general training. As discussed earlier, when workers face liquidity constraints, firms will often find that it is optimal to induce workers to undertake general training by offering to share the costs and benefits of the training.

A fifth reason why employers may be willing to pay for general training is network externalities. Many of the skills taught in company training programs are modes of internal

communication--eg. software application programs--that everyone must adopt if they are to be fully effective. If the firm were to expect workers to pay the full cost of learning such software applications, it would not be able to demand that all workers learn it and the network benefits would not be realized. Consequently, it tries to get as close as possible to 100 percent usage by requiring and paying for training in a skill that is useful at other firms.

A sixth reason why employers may voluntarily provide and partially finance general training is their greater access to information on the likely payoffs to different types of general training. Worker uncertainty about whether the particular skill taught at their company is also useful in other jobs may make them unwilling to pay for the training even when the skill is in fact general. Employers will be better informed about the technological uncertainties and, therefore, better able to decide which particular skills should be taught and be more willing to bear the risk of the investment. In many cases, the employer controls how useful general training is on the job over the long term. Having invested in learning a skill at the behest of their employer, workers quite sensibly want to be assured that the company will not shortly be switching to a different E-mail system or applications program which is difficult to learn. Firm assure their workers that they will be conservative about such switches by offering to pay any training costs that result.

A seventh reason is worker risk aversion and the resulting implicit contracts in which many of the risks of the employment relationship are born by the firm not the worker. Worker risk aversion results in labor contracts in which worker compensation does not rise and fall proportionately with actual productivity on-the-job (Stiglitz; 1974). Bishop (1987) showed that, holding the job constant, that less than 20 percent of the differences in realized productivity between workers were reflected in their relative wages. Firms are held liable when a mistake by one of their employees damages or kills others. Such implicit contracts weaken worker rewards for better performance, so workers have a much reduced incentive to engage in on-the-job training. To avoid this problem, labor contracts can be written which reward workers for participation in well signaled (eg. formal) general training. When, however, the success of that training is not measured, there will only be limited rewards for doing well in the training.
If, as argued above, employers are sharing the costs and benefits of training that develops skills that are useful at other firms, under provision of such training is going to result if turnover rates are non trivial.

## 8. Conclusions

Occupational training is provided by both schools and employers. What does the literature review tell us about how American employers and local schools should divide responsibility for occupation specific training? The literature offers different prescriptions for occupational training of youth, retraining of dislocated workers and unemployed adults and upgrading training of incumbent workers.

**Occupation Specific Education of Youth:** Studies have found that the occupation specific education delivered by high schools and community colleges stimulates OJT and raises earnings and productivity (Kane and Rouse 1995, Grubb 1995, Campbell et al 1985, Kang and Bishop 1989, Bishop 1995, Lengermann 1996b). School-based training and employer training appear to be complementary. Therefore, public subsidy of school-based occupation specific education **for youth** should continue.

Employers should be encouraged to offer cooperative education and apprenticeship opportunities, but we must recognize that, without a subsidy of some kind, most American employers outside the retail sector will be uninterested in taking on large numbers of teenage apprentices. More involvement of employers in the occupational preparation of youth is feasible; but a German style apprenticeship system is not. Turnover rates are too high and the cultural and governmental institutions that support German apprenticeship do not exist here and cannot be created. Schools will inevitably be the primary locus of the occupational training obtained by youth and by adults seeking to switch occupations.

Evaluations of training programs targeted on disadvantaged youth have generally found that they do not benefit young people under the age of 22 and sometimes hurt them (Off, et al 1994). JTPA programs for those under 22 should, therefore, be cut back and limited to experiments with randomized controls so that we can discover how to train this population. In the meantime, the focus should be preventing disadvantaged youth from dropping out and encouraging participation in mainstream vocational education programs.

**Training of Unemployed Adults:** A number of high quality studies have been conducted of the impact of JTFA training on the earnings of unemployed disadvantaged adult workers. JT`PA is cheap, costing only $1500 per adult enrollee. Commensurate with its costs, its benefits are modest as well. Nevertheless, the earnings increases generated by training are sufficient to recoup the investment in 2 to 5 years (Orr et al 1994). Schooling investments by adults also raise wages but not immediately (Lengermann 1996b). Pay back periods are, therefore, considerably longer than for JTPA.

Despite JTPA's success with adults, proposals have been put forward to utterly transform it by turning it into a training voucher. If it ain't broke, why fix it? Studies of training vouchers for the disadvantaged using strong randomized designs have found that vouchers increase school enrollment but wages are not improved (West and Dickinson 1980, Barnow 1995). The research finding reviewed in section 2 that school-based training initiated by workers without employer subsidy does not pay off also suggests that turning JTPA into a voucher program would reduce its effectiveness. Instead, program innovation should focus on improving linkages with employers and the quality and occupational relevance of JTPA training.

**Incumbent Worker Training:** Non-degree credit school-based training that is paid for by one's employer has large effects on wage rates. When, however, a worker undertakes non-degree credit school-based training on his own, it does not appear to have any effect on wage rates. The finding that school-based occupational training paid for by adults has no effect on wages is based on five studies analyzing three independent data sets.[15] (The productivity effects of school-based training paid for by adult workers has not been studied). Additional studies of the wage growth effects of school provided training not subsidized by an employer using **NLS, PSID, HSB** and NLS72 data are needed before we can be really certain that school-based training not paid for by employers fails to raise the wages of the adults who undertake it. Nevertheless, these findings suggest that a number of the non-degree credit training vendors/institutions fail to add much value. The federal policy of ending institutional eligibility for guaranteed loan subsidies when loan default rates are extremely high is probably forcing some of the most ineffective training institutions out of business. It is a step in the right direction, but further steps are probably desirable.

Regular degree-credit schooling obtained by adults raises earnings, but effects appear to be smaller when schooling is obtained after reaching adulthood. Earnings impacts depend on college major and are larger for business and mathematically oriented fields.

Incumbent worker training that is provided by employers raises worker productivity and wages. Formal and informal training appear to have roughly equal effects on productivity. Probably because it is better signaled, formal training has significantly larger impacts on wages than informal training. Rates of return (both private and social) are very high and substantially higher than for regular schooling and non-degree credit school-based training. From society's point of view, employers and workers under invest in employer provided training. These findings suggests that incumbent worker training should be stimulated by inducing employers to provide or sponsor more of it.

The finding that gross private rates of return are highest for poorly educated workers in blue collar jobs requires confirmatory research before one can be certain. If replicated by other studies, these findings suggest that public efforts to subsidize or stimulate employer sponsored training should focus on lower paid blue-collar workers.

A low cost way of promoting general employer-provided training is to remove government imposed barriers to training. Four possibilities, together with counter arguments, are listed below:

- Allow jobs that offer considerable general training to pay wage rates below the legal minimum. *Counter. Minimum wage is not binding for most jobs and employers fail to take advantage of the exemptions already available.*

- Allow firms to provide general training that improves productivity on one's current job during uncompensated time. *Counter. There is no way of anticipating how big an effect removing legal constraints on sharing training costs would have. Workers are used to being paid while being trained, so they might be reluctant to work at companies that ask workers to undertake training on their own time (Acemoglu and Pischke 1996b).*

- Lower turnover by improving matching of workers to jobs by removing barriers that prevent them from signaling their competencies to employers. *Counter. May conflict with affirmative action goals*

- Improve systems of certifying skill development. *Counter: It is intrusive. Government may do a poor job of designing it or structure it to serve multiple but incompatible objectives. If so, few employers will use the system and it will not stimulate training.*

The other way government can try to stimulate training is to either mandate it or subsidize it. This, however, requires practical administrative mechanisms for measuring expenditures on training. Informal training cannot be distinguished reliably from work and normal supervision, so subsidies and mandates would focus solely on formal training. This would induce substitution of formal training for informal training. Formalizing training has the benefit of making it more portable, but the overall efficiency of the firm's training might be reduced. Three options are listed below:

- Mandate that firms invest at least X percent of their wage bill on training if they are to avoid paying a tax. *Counter. Needs for training vary across firms. There is no presumption that all firms should spend the same share of their wage bill on formal training.*

- State run subsidies of customized training. *Counter: High administrative costs and fear of government intrusion discourage small firms from participating. Sometimes these schemes are ways of bribing plants to move to your state.*

- Tax credit for firm training expenditures above a certain percentage of the wage bill. *Counter. The primary response might not be to increase total training, but to substitute formal for informal training.* (Westergaard-Nielsen, 1996)

# REFERENCES

Acemoglu, Daron and Pischke, Jorn-Steffen. (1996b) "The Structure of Wages and Investment in General Training." Massachusetts Institute of Technology Department of Economics, November, 1-29.

Acemoglu, Daron and Pischke, Jorn-Steffen. (1996a) "Why do Firms Train? Theory and Evidence." National Bureau of Economic Research Working Paper 5605, 1-29.

Barron, John M., Black, Dan A. and Loewenstein, Mark A. "Employer size: The Implications for Search, Training, Capital Investment, Starting Wages and Wage Growth," Journal of Labor Economics, (January 1987), Vol 7, No. 1, 76-89.

Barron, John M., Black, Dan A. and Loewenstein, Mark A. "Job Matching and On-the-Job Training," Journal of Labor Economics, (January 1989), 1-19.

Barron, John M., Black, Dan A. and Loewenstein, Mark A. (1993d) "Gender Differences in Training, Capital and Wages," Journal of Human Resources, 28(2), Spring 1993, 343-364.

Barron, John M.; Berger, Mark C. and Black, Dan A. (1993a) "Do workers pay for On-The-Job Training?" Center for Business and Economic Research Working Paper #E-16993, University of Kentucky, June, 1-28.

Barron, John M.; Berger, Mark C. and Black, Dan A. (1993b) "Access to On-the-Job Training: The Role of Education, Gender, Race and Affirmative Action" Center for Business and Economic Research, University of Kentucky, July, 1-25.

Barron, John M.; Berger, Mark C. and Black, Dan A. (1993c) "Employer Search, Belated Information, and Training" Center for Business and Economic Research Discussion Paper #E-171-93, University of Kentucky, June, 1-28.

Barron, John M.; Berger, Mark C. and Black, Dan A. (1997) "How Well Do We Measure Training." forthcoming Journal of Labor Economics, 1-28.

Barron, John M.; Berger, Mark C. and Black Dan A. (1996) "General Training made Specific: Reasons and Consequences." Paper presented at the New Empirical Research on Employer Training: Who Pays? Who Benefits? Nov. 15-17, 1996, Cornell University, Ithaca NY.

Bartel, Ann P. and Frank R. Lichtenberg. "The Comparative Advantage of Educated Workers in Implementing New Technology." The Review of Economics and Statistics, February 1987, 1-11.

Bartel, Ann P. and Sicherman, Nachum (1993) "Technological change and the on-the-job training of young workers." Paper presented at the NBER Summer Institute in Labor Studies, July 26-30, 1993, Columbia University, 1-50.

Bassi, Laurie. (1992) Smart Workers. Smart Work. Washington, D.C.: The Southport Institute for Policy Analysis, 1-58.

Becker, Gary. "Investment in Human Capital: A Theoretical Analysis." Journal of Political Economy, Vol. 70, No. 5 pt.2, October 1962, 9-50.

Bishop, John. "The Recognition and Reward of Employee Performance." Journal of Labor Economics, Vol. 5, No. 4, pt 2, October 1987a, pp. S36-S56.

Bishop, John. (1995) "Expertise and Excellence." Center for Advanced Human Resources Research Discussion Paper 95-13.

Bishop, John. 'Toward More Valid Evaluations of Training Programs Serving the Disadvantaged" Journal of Policy Analysis and Management, Vol. 8, No. 2, Spring 1989a, pp. 209-229.

Bishop, John. (1991) "On-the-Job Training of New Hires," Market Failure in Training edited by David Stem and Josef Ritzen, New York, Springer Verlag, 61-96.

Bishop, John. (1993a) "Improving Job-Worker Matching in the Labor Market: What is the Role of the Employment Service?" Brookings Papers on Economic Activity: Microeconomics. 1993, Washington, DC: The Brookings Institution, 335-400.

Bishop, John. (1994) 'The Impact of Previous Training in Schools and on Jobs on Productivity, Required OJT, and Turnover of New Hires," Private Sector and Skill Formation: International Comparisons, edited by Lisa Lynch, National Bureau of Economic Research, Chicago: Univ. of Chicago Press, 161-200.

Bishop, John; Blakemore, Arthur; Low, Stuart. "High School Graduates in the Labor Market: A Comparison of the Class of 1972 and 1980." Columbus, Ohio: National Center for Research in Vocational Education, 1985.

Bishop, John and Kang, Suk. "On-the-Job Training/ Sorting: Theory and Evidence" National Center for Research in Vocational Education, Ohio State University, 1984.

Bishop, John and Kang, Suk. "A Signaling/Bonding Model of Employer Finance of General Training." Center for Advanced Human Resource Studies, Cornell University, Ithaca, New York, 1988.

Bishop, John and Kang, Suk. (1990) "Why are Wage Profiles so Flat During the First Year on the Job?" Center for Advanced Human Resource Studies Working Paper 89-18,Cornell University, Ithaca, New York.

Bishop, John and Kang, Suk. (1996) "Do Some Firms Share the Costs and Benefits of General Training?" Center for Advanced Human Resource Studies Working Paper 96-19, Paper presented at the New Empirical Research on Employer Training: Who Pays? Who Benefits? Nov. 15-17, 1996, Cornell University, Ithaca NY.

Black Dan, Berger, Mark and Barron, John. (1993) Job Training Approaches and Costs in Small and Large Firms. Report to the Small Business Administration, Department of Economics, University of Kentucky.

Blanchflower, David and Lynch, Lisa, (1994) "Training at Work: A Comparison of U.S. and British Youths." Private Sector and Skill Formation: International Comparisons, edited by

Lisa Lynch, National Bureau of Economic Research, Chicago: Univ. of Chicago Press, 233-260.

Bowers, Norman and Swaim, Paul. (1992) "Probing (Some of) the Issues of employment related Training: Evidence from the CPS." Washington D.C.: Economic Research Service, U.S. Department of Agriculture, 1-36.

Brown, Charles. "Empirical Evidence on Private Training," Background Papers for Investing in People, pp. 331-387.

Buechtemann, Christopher, Schupp, Jurgen and Soloff, Dana. (1993) "Roads to Work: school-to-work transition patterns in Germany and the United States." Industrial Relations Journal, Vol. 24, no 2, 97-111.

Buechtemann, Christopher. "Introduction: Employment Security and Labor Markets." ed. C. Buechtemann, Employment Security and Labor Market Behavior: Interdisciplinary Approaches and International Evidence. Ithaca, N.Y.: I.L.R. Press, 1993, 3-68.

Bureau of National Affairs, (1993) "Text of Rules and Regulations", Wages and Hours. New York, Bureau of National Affairs.

Burke, M.J. and Day, R.R. (1986) "A Cumulative Study of the Effectiveness of Managerial Training." Journal of Applied Psychology, Vol 71, 232-245.

Burtless, Gary. "Are Targeted Wage Subsidies Harmful? Evidence from a Wage Voucher Experiment." Industrial and Labor Relations Review, October 1985, Vol. 39, No. 1, 105-114.

Campbell, Paul B.; Elliot, Jack; Laughlin, Suzanne and Seusy, Ellen. "'The Dynamics of Vocational Education Effects on Labor Market Outcomes." Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1987b.

Campbell, Paul B.; Basinger, Karen S.; Dauner, Mary Beth; and Parks, Marie A. "Outcomes of Vocational Education for Women, Minorities, the Handicapped, and the Poor." Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1986.

Castles, Ian. (1994) Employer Training Expenditure--Australia: July-September 1993. Canberra: Australian Bureau of Statistics.

Cave, George; Bos, Hans; Doolittle, Fred and Toussaint, Cyril. (1993) Job Start: Final Report on a Program for School Dropouts. New York: Manpower Development Research Corporation, 1-319.

Chang, Chun and Yiijang Wang. (1996) "Human Capital Investment under Asymmetric Information: The Pigovian Conjecture Revisited." Journal of Labor Economics, Vol. 14, No. 3, July, 500-25.

Daly, A., Hitchens, D.M.W.N., and Wagner, K, "Productivity, Machinery and Skills in a Sample of British and German Manufacturing Plants", National Institute Economic Review, February 1985, pgs. 48-60.

Dore, Ronald and Sako, Mari. How Japanese Learn to Work. New York, Routledge, 1989. 1-150.

Economist, March 12, 1994.

Feuer, M., Glick, H., and Desai, A. "Is Firm-Sponsored Education Viable?" Journal of Economic Behavior and Organization, March 1987, Vol. 8, No. 1.

Flanagan, Robert. "Labor Market Behavior and European Economic Growth." paper prepared for conference on Impediments to European Economic Growth, The Brookings Institution, 1986

Flynn, Patrice. (1990) "Does Employer-Provided Training Pay Off?" Department of Economics, University of Texas Austin, November, 1-34.

Freeman, Richard. Occupational Training in Proprietary School and Technical Institutes. Cambridge, Mass.: Harvard University, November 1973.

Friend, Irwin and Blume, Marshal. "The Demand for Risky Assets." American Economic Review, Vol 65, December 1975, pp. 900-922.

Friedman, Toby and Williams, E. Belvin. "Current Use of Tests for Employment." Ability Testing: Uses, Consequences. and Controversies, Part H: Documentation Section, edited by Alexandra K Wigdor and Wendell R. Gardner. Washington, DC: National Academy Press, 1982, pg. 999-169.

Garen, John. "Empirical Studies of the Job Matching Hypothesis," in Ron Ehrenberg ed., Research in Labor Economics, Vol. 9, Greenwich, Conn.: JAI Press, 1988.

Glick, Henry A. and Feuer, Michael J. "Employer-Sponsored Training and the Governance of Specific Human Capital Investments." Quarterly Review of Economics and Business, Vol. 24, No. 2, Summer 1984.

Griggs vs. Duke Power Company, 3 FEP 175 (1971).

Grubb, Norton. "The Varied Economic Returns to Postsecondary Education: New Evidence from the National Longitudinal Study of the Class of 1972." Journal of Human Resources, Vol. 28, No. 2, Spring 1993, 365-382.

Grubb, Norton. "Response to Comment." Journal of Human Resources, Vol. 30, No. 1, Winter 1995, 222-228.

Haber, S., J. Cordes. and J. Barth. "Employment and Training Opportunities in Small and Large Firms." U.S. Small Business Administration, June 1988.

Hall, Robert. "Intertemporal Substitution in Consumption." Journal of Political Economy, Vol. 96, No. 2, April 1988, pp. 339-357.

Hamel, Harvey R., "Job Tenure of American Workers, January 1963", Monthly Labor Review, October 1963, Reprint No. 2426, pgs. 1145-1163.

Hamel, Harvey R., "Job Tenure of Workers, January 1966", Monthly Labor Review, January 1967, pgs. 31-45.

Harhoff, Dietmar and Kane, Thomas J. (1993) "Financing Apprenticeship Training: Evidence From Germany." Working Paper No. 4557, National Bureau of Economic Research, Cambridge Mass. 1-44.

Hashimoto, M. "Firm-Specific Human Capital as a Shared-Investment." American Economic Review, 71, no. 3, March 1981, pp. 475-482.

Hashimoto, M., and Yu, B. "Specific Capital, Employment and Wage Rigidity." Bell Journal of Economics, 11, no. 2, 1980: 536-549.

Hashimoto, M. "Minimum Wage Effects on Training on the Job." American Economic Review, Vol 72, No. 5, December 1982, pp. 1070-1087.

Hausman, Jerry and Taylor, William E. (1981) "Panel Data and unobservable Individual Effects." Econometrica, Vol 49, No. 6, 1377-98.

Haveman, Robert and Wolfe, Barbara. (1984) "Education and Economic Well-Being: The Role of Non-Market Effects." in Dean, Edward (ed.) Education and Economic Productivity, Cambridge, Mass: Ballinger.

Hayghe, Howard, "Job Tenure of Workers January 1973", Monthly Labor Review, December 1974, Vol. 97, pgs. 53-73.

Hollenbeck, Kevin. (1993) "The Economic Payoffs to Workplace Literacy." Staff Working Paper # 93-21, Kalamazoo, Mich.: W.E. Upjohn Institute, 1-32.

Hollenbeck, Kevin and Anderson, William. (1992) "Workplace Education Programs in Small and Medium-Sized Michigan Firms." Staff Working Paper # 92-13, Kalamazoo, Mich.: W.E. Upjohn Institute, 1-32.

Hollenbeck, Kevin. Classrooms in the Workplace. Kalamazoo, Mich: W.E. Upjohn Institute for Employment Research, 1993, 1-137

Hollenbeck, K, and Smith B. The Influence of Applicants' Education and Skills on Employability Assessments by Employers. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1984.

Hollenbeck, Kevin and Wilkie, Richard. "The Nature and Impact of Training: Evidence From The Current Population Survey." In Training and Human Capital Formation, edited by John Bishop et al., The National Center for Research in Vocational Education, The Ohio State University, July 1985.

Horvath, Francis W., "Job Tenure of Workers in January 1981", Monthly Labor Review September 1982, pgs. 34-36.

Hubbard, R. Glenn and Judd, Kenneth L. "Liquidity Constraints, Fiscal Policy and Consumption" Brookings Papers on Economic Activity, 1986, #1, 1-60.

Hunter, J.E. "Causal Analysis, Cognitive Ability, Job Knowledge, Job Performance, and Supervisor Ratings." In Performance Measure and Theory, edited by S. Lundy, F. Zedeck, and S. Cleveland. Hillsdale, NJ: Lawrence Erlbaun-4 1983.

Ichniowski, Casey; Shaw, Kathryn and Prennushi, Giovanna. (1993) "The Effects of Human Resource Management Practices on Productivity." Carnegie Mellon Univ, July, 1-62.

Idson, Tom and Holtman, A. G. "Employer Size, Training and Wage Growth." Working paper, August 1993.

Jaikumar, Ramchandran. "Postindustrial Manufacturing." Harvard Business Review, Nov/Dec, 1986, pp. 69-76.

Jaikumar, Ranchandran, "Flexible Manufacturing Systems: A Managerial Perspective", Harvard Business School, January 1984, pgs. 1-54.

Jones, Ian. "Trainee Pay and the Costs of Vocational Training in Britain and West Germany." Social Forces: Supplement on Youth Pay and Employers' Recruitment Practices for Young People. Commission of the European Communities, Directorate Generale for Employment, Social Affairs and Education, 1985.

Kane, Thomas and Rouse, Cecilia. (1993a) "Labor Market Returns to Two- and Four-Year Colleges: Is a Credit a Credit, and Do Degrees Matter." NBER Working Paper # 4268, Cambridge Mass: National Bureau of Economic Research.

Kane, Thomas J. and Rouse, Cecilia Elena. (1995) "Comment on W. Norton Grubb, "The Varied Economic Returns to Postsecondary Education: New Evidence from the Class of 1972." The Journal of Human Resources, Vol. 30, No. 1, 205-221.

Kang, Suk and Bishop, John. "Vocational and Academic Education in High School: Complements or Substitutes." Economics of Education Review. Vol. 8, No. 2, 1989, pp. 133-148.

Katz, Eliakim and Ziderman, Adrian. "Investment in General Training: The Role of Information and Labor Mobility." The Economic Journal, Vol 100, Dec. 1990, 11471158.

Katz, Harry and Keefe, Jeffrey. (1993) 'Training and Restructuring of Work in Large Unionized Settings." Cornell Univ., Ithaca, N.Y.: Center for Advanced Human Resource Studies Working Paper 93-19, 1-32.

Kochan, Thomas and Osterman, Paul. "Human Resource Development and Utilization: Is there too Little in the U.S." Cambridge, Ma: Sloan School of Management, Massachusetts Institute of Technology, 1991.

Koenig, Richard. "Toyota takes Pains and Time, Filling Jobs at its Kentucky Plant." Wall Street Journal, December 1 1987, p. 1.

Koike, Kazuo. "Skill Formation Systems in the U.S. and Japan: A Comparative Study." The Economic Analysis of the Japanese Firm, edited by M. Aoki, New York: Elsevier Science Publishers B. V., 1984, pp. 47-75.

Krafcik, John F. Training and the Automobile Industry: International Comparisons. Contractor Report prepared for the Office of Technology Assessment under contract N3-1910, Feb. 1990.

Krafcik, John F. and MacDuffie, John Paul "Flexible Production Systems and Manufacturing Performance: The Role of Human Resources and Technology." Presented at the Academy of Management Meetings August 16, 1989, Sloan School of Management, Massachusetts Institute of Technology, 1-32.

Krueger, Alan. "How Computers Have Changed the Wage Structure: Evidence from Micro Data, 1984-1989." Quarterly Journal of Economics, Feb. 1993, 33-60.

Krueger, Alan and Rouse, Cecilia. (1994) "New Evidence on Workplace Education." Working Paper # 329, Industrial Relations Section, Princeton University, May, 1-30.

Leighton, Linda and Mincer, Jacob. "Effects of Minimum Wages on Human Capital Formation." in The Economics of Legal Minimum Wages, edited by Simon Rottenberg, Washington DC: American Enterprise Institute, 1981.

Lengermann, Paul. (1996a) "Training's Impact on Wages and Hours Worked: A Comparison of the Benefits and costs of Training." forthcoming Economics of Education Review,

Lengermann, Paul. (1996b) "Training and Wage Growth: Depreciation, Portability and Varying Returns for Different Demographic Groups." Masters Thesis, New York State School of Industrial and Labor Relations, Cornell University.

Leuven, Edwin and Oosterbeek, Hessel. "Demand and Supply Factors in Formal Work-Related Training." Paper presented at the New Empirical Research on Employer Training: Who Pays? Who Benefits? Nov. 15-17,1996, Cornell University, Ithaca NY.

Light, Audrey. (1995) "The Effects of Interrupted Schooling on Wages." Journal of Human Resources, Vol. 30, No. 3, 472-502.

Lillard, L and H. Tan. Private Sector Training: Who Gets it and What are Its Effects. Monograph, R-331-COI/RC, Santa Monica, Calif. Rand Corp, 1986.

Lowenstein, Mark and Spletzer, James R. (1996) "Dividing the Cost and Returns to General Training." forthcoming Journal of Labor Economics.

Lynch, Lisa. (1992) "Private Sector Training and the Earnings of Young Workers." American Economic Review, Vol 82, March, 299-312.

MacDuffie, John Paul and Krafcik, John F. "Integrating Technology and Human Resources for High Performance Manufacturing: Evidence from the International Auto Industry." in Thomas Kochan and Michael Useem, eds. Transforming Organizations. New York: Oxford University Press, forthcoming.

MacDuffie, John Paul and Krafcik, John F. "Flexible Production Systems and Manufacturing Performance: The Role of Human Resources and Technology." Presented at the Academy of Management Meetings August 16, 1989, Sloan School of Management, Massachusetts Institute of Technology, 1-32.

MacDuffie, John Paul and Kochan, Thomas. "Human Resources, Technology, and Economic Performance: Evidence from the Automobile Industry." paper delivered at the Annual Meeting of the Industrial Relations Research Association, December 28 1988, New York.

MacDuffie, John Paul and Kochan, Thomas. (1993) "Do U.S. firms Under Invest in Human Resources? Determinants of Training in the World Auto Industry." Wharton School, University of Pennsylvania, September, 1-30.

Maller, Charles; Kerachsky, Stuart; and Thornton, Craig. Evaluation of the Economic Impact of the Job Corps Program. Third Follow-up Report. Princeton, New Jersey: Mathematical Policy Research Inc., 1982.

Mangum, Steve, and Ball, David. "Military Service, Occupational Training and Labor Market Outcomes: An Update." Columbus: Center for Human Resource Research, The Ohio State University, March, 1986.

Mangum, Steve, "Evidence on Private Sector Training," Background Papers for Investing in People, pp. 331-387.

Markey, James and Parks, William. (1989) "Occupational Change: Pursuing a different kind of work." Monthly Labor Review, September, 3-12.

Mason, Geoff and Finegold, David. "Productivity, Machinery and Skills in the United States and Western Europe: Precision Engineering", Discussion Paper no. 89, National Institute of Economic and Social Research, November 1995, pgs. 1-51.

Mason, Geoff, Prais, S.J., & Van Ark, Bart, "Vocational Education and Productivity in the Netherlands and Britain!', National Institute of Economic and Social Research, November 1990, pgs. 1-34.

Mikulecky, Larry. (1989) "Second Chance Basic Skills Programs." Investing in People; Background Papers. edited by David Crawford and Lauri Bassi, Vol. 1. 187-214.

Mincer, Jacob (1989a) "Human Capital and the Labor Market: A Review of Current Research." Educational researcher. May 1989, 27-34.

Mincer, Jacob (1989d) "Human Capital Responses to Technological Change in the Labor Market." Columbia University, Conference on Economic Growth at SUNY, Buffalo, New York, May 26-27, 1989, Aug 1989.

Mincer, Jacob. (1989c) "Labor Market Effects of Human Capital and of its Adjustment to Technological Change." Department of Economics, Columbia University, 1989.

Mincer, Jacob. (1989b) "Job Training: Costs, Returns and Wage Profiles." September 1989, Department of Economics, Columbia University, 1-23.

Mincer, Jacob and Higuchi, Yoshio. (1988) "Wage Structures and Labor Turnover in the U.S. and Japan." The Journal of the International and Japanese Economy. Kyoto and Stanford.

National Assessment of Educational Progress. The Mathematics Report Card. Princeton, New Jersey: Educational Testing Service, 1988b.

National Federation of Independent Business. [Survey of NFIB membership using a questionnaire designed by John Bishop], 1987.

Noll I., Beicht U., Boll G., Malcher W. and Wiederhold-Fritz S. Nettakosten der Betrieblichen Ber Ufsbildung Schriften Berufsbildungsforschung, Band 63. Beuth Verlag GMBH, Berlin, 1984.

O'Boyle, Edward, "Job Tenure: How it Relates to Race and Age", Monthly Labor Review, January 1968, pgs. 16-33.

Office of Technology Assessment, Making Things Better: Competing in Manufacturing, (Washington, DC: U.S. Government Printing Office), February, 1990a, pgs. 1-241.

Office of Technology Assessment. Worker Training: Competing in the New International Economy. OTA-ITE-457, (Washington, DC: U.S. Government Printing Office, September 1990b)

Organization of Economic Cooperation and Development Secretariat Working Party No. 1 of the Economic Policy Council. Labour Market Flexibility. Paris: OECD, January 1985.

Organization of Economic Cooperation and Development. Employment Outlook. Paris: OECD, September, 1984, Chapter 4.

Organization of Economic Cooperation and Development. Employment Outlook. Paris: OECD, September, 1993.

Orr, Larry; Bloom, Howard S.; Bell, Stephen; Lin, Winston; Cave, George; Doolittle, Fred. The National JTPA Study: Impacts, Benefits and Costs of Title II-A Bethesda, Md.: Abt Associates, March 1994.

Parsons, Donald. "Specific Human Capital: An Application to Quit Rates and Layoff Rates." Journal of Political Economy, Vol. 80, No. 6, Nov/Dec 1972, pp. 1120-1141.

Parsons, Donald. "Wage Determination in the Post Training Period." Pathways to the Future, Vol. 7, Chapter 7, Center for Human Resource Research, Ohio State University, 1985.

Parsons, Donald. (1990) "The Firm's Decision to Train," Research in Labor Economics, Vol 11, 53-76.

Prais, SJ., Karvis, Valerie, and Wagner, Karin, "Productivity and Vocational Skills Services in Britain and Germany: Hotels", National Institute Economic Review, November 1989, pgs. 52-74.

Rosenbaum, James E. and Kariya, Takehiko. "From High School to Work: Market and Institutional Mechanisms in Japan." American Journal of Sociology, 94:6, May 1989, pp. 1334-1365.

Ryan, Paul. "The Costs of Job Training for a Transferable Skill." The British Journal of Industrial Relations, Vol. 18, # 3, 1980, pp. 334-352.

Salop, Joanne and Salop, Steven. "Self Selection and Turnover in the Labor Market." Quarterly Journal of Economics, Vol. 91, November 1976, p. 619-627.

Sengenberger, Werner. "Job Security--Germany." unpublished paper, OECD,1985.

Sekscenski, Edward S., "Job Tenure Declines as Work Force Changes", Monthly Labor Review, December 1979, pgs. 48-69.

Shimada, Haruo & MacDuffie, John Paul. (1986) "Industrial Relations and "Humanware," Sloan School of Management, MIT, 1986, 1-90.

Soskice, David "The German Training System: Reconciling Markets and Institutions", Institute of Economic and Statistics, Oxford University, July 1991, pgs. 1-18.

Steedman, Hilary and Wagner, Karin, "Productivity, Machinery and Skills: Clothing Manufacture in Britain and Germany", National Institute Economic Review, May 1989, pgs. 40-57.

Steedman, Hilary and Wagner, Karin, "A Second Look at Productivity, Machinery and Skills in Britain and Germany", National Institute Economic Review, November 1987, Pgs. 84-94.

Stiglitz, Joseph E. "Risk Sharing and Incentives in Sharecropping." Review of Economic Studies, 61, no. 2 April 1974, 219-256.

"Survey of Consumer Finances, 1983." Federal Reserve Bulletin. Vol 70, September 1984, p. 686 and December 1984, p. 863.

Tan, Hong; Chapman, Bruce; Peterson, Christine and Booth Alison. Youth Training in the United States, Britain and Australia. (RAND, 1700 Main Street, Santa Monica, Calif. 1991), 147.

Tyre, Marcie. "Managing the Introduction of New Process Technology: International Differences in a Multi-Plant Network." Working Paper, Cambridge Mass: Massachusetts institute of Technology, 1990.

U.S. Bureau of Labor Statistics, "Job Tenure", January 1987, pgs. 1-18.

U.S. Bureau of Labor Statistics, (1993a) "Employer-Provided Training among Young Adults." Work and Family, February 1993, Report 838, 1-5.

U.S. Bureau of Labor Statistics, (1993b) "Never too Old to Learn." Work and Family, September 1993, Report 856, 1-5.

Veum, Jonathan R. (1993) "Training among Young Adults: Who, What Kind and for How Long?" Monthly Labor Review, August 1993, 27-32.

Veum, Jonathan R. (1994) "Sources of Training and their Impact on Wages." Industrial and Labor Relations Review, 48(4) July 1995, 812-26.

Weiderhold-Fritz, Susanne. "Is There a Relationship between Cost of In-Company Vocational Training and the Offer of Training Places in the Federal Republic of Germany." Social Forces: Supplement on Youth Pay and Employers' Recruitment Practices for Young People, Commission of the European Communities, Directorate Generale for Employment, Social Affairs and Education, 1985.

Weiss, Andrew. "Simple Truths of Japanese Manufacturing", Harvard Business Review, July-August, 1984, p. 119-124.

Westergarrd-Nielsen, Niels. "Apprenticeship Training in Denmark: The Impact of Subsidies." Paper presented at the New Empirical Research on Employer Training: Who Pays? Who Benefits? Nov. 15-17, 1996, Cornell University, Ithaca NY.

Wills, Joan. (1993) An Overview of Skill Standards Systems in Education and Industry. Washington, D.C.: The Institute for Educational Leadership.

Zemsky, Robert and Daniel Shapiro. (1994) "On Measuring a Mirage: Why U.S. Training Numbers Don't Add Up." EQW Working Paper-WP20, Univ of Pennsylvania.

**TABLE 1**
**TRAINING AND PRODUCTIVITY GROWTH OF TYPICAL NEW EMPLOYEES**
**BY**
**OCCUPATION**

| | Profes-sional | Mana-geral | Sales Not Retail | Retail Sales | Clerical | Blue Collar | Service |
|---|---|---|---|---|---|---|---|
| Hours Spent in Training in First 3 Months | | | | | | | |
| Watching others do the job | 60.0 | 65.0 | 82.8 | 39.2 | 50.4 | 48.1 | 32.7 |
| Formal training programs | 9.1 | 12.1 | 23.9 | 8.2 | 13.5 | 9.1 | 5.7 |
| Informal training by management | 76.6 | 80.4 | 71.8 | 48.5 | 54.6 | 49.3 | 35.1 |
| Informal training by co-workers | 31.8 | 23.0 | 33.9 | 23.9 | 26.2 | 26.8 | 16.7 |
| Investment in Training Time | 293 | 295 | 350 | 185 | 235 | 200 | 130 |
| Weeks to become fully trained if no previous experience | 11.1 | 13.4 | 9.2 | 6.5 | 6.7 | 9.0 | 3.4 |
| Increase in Reported Productivity (%) | | | | | | | |
| Between first 2 weeks & next 10 weeks | 28% | 32% | 50% | 30% | 40% | 32% | 28% |
| Between first 3 mo. & end of year 2 | 38% | 33% | 56% | 25% | 32% | 23% | 17% |
| Increase in Real Wage in First 2 Years (%) | 5.0% | 7.7% | 22.6% | 9.7% | 11.5% | 11.5% | 3.7% |
| Number of cases | 95 | 112 | 76 | 203 | 429 | 649 | 334 |

NOTE: Tabulation of the EOPP Employer Survey. The sample is limited to jobs for which all the necessary questions on wage rates, training time, and productivity were answered.

**TABLE 2**
**TRAINING AND PRODUCTIVITY GROWTH OF TYPICAL NEW EMPLOYEES**
**BY**
**SCHOOLING**

| | HS Dropout | | High School Graduate | | Some College | | College Graduate | |
|---|---|---|---|---|---|---|---|---|
| Typical New Employees | Voc Ed | No Voc Ed | Voc Ed | No Voc Ed | Voc Ed | No Voc Ed | Voc Ed | No Voc Ed |
| Hours Spent In Training In First 3 Month | | | | | | | | |
| Watching others do the job | 30.2 | 25.6 | 56.4 | 45.6 | 61.3 | 49.0 | 84 | 67.1 |
| Formal training programs | 4.5 | 5.4 | 17.3 | 7.3 | 19.3 | 15.7 | 10.7 | 8.3 |
| Informal training by management | 40.0 | 31.6 | 53.4 | 54.0 | 62.4 | 51.7 | 68.7 | 68.9 |
| Informal training by co-workers | 23.8 | 17.3 | 31.3 | 23.5 | 26.4 | 23.8 | 27.1 | 23.9 |
| Investment in Training Time | 158 | 116 | 246 | 199 | 269 | 226.5 | 293 | 279 |
| Weeks to become fully trained if no previous experience | 6.5 | 4.2 | 9.7 | 6.3 | 11.1 | 7.3 | 12.4 | 11.3 |
| Increase in Reported Productivity | | | | | | | | |
| Between first 2 weeks & next 10 weeks | 33 | 24 | 28 | 35 | 34 | 38 | 35 | 37 |
| Between first 3 months & end of year 2 | 33 | 17 | 28 | 24 | 28 | 30 | 33 | 41 |
| Wage Rate | | | | | | | | |
| Current wage | $4.20 | 4.26 | 5.68 | 5.16 | 6.19 | 5.35 | 7.65 | 5.37 |
| Increase in real wage | 17.1 | 9.2 | 11.3 | 8.7 | 10.6 | 13.6 | 8.9 | 7.9 |
| Number of cases | 46 | 154 | 284 | 823 | 134 | 205 | 47 | 105 |

Note: Tabulation of the EOPP Employer Survey. The sample is limited to jobs for which all the necessary questions on wage rates, training time, and productivity were answered.

Table 3

**Impacts of Job Training Partnership Act Training on Earnings per Enrollee**

| | Incremental Cost | | Earnings Increase for Months 1 to 30 | | | | |
|---|---|---|---|---|---|---|---|
| | Adults | Youth | Adult Women | Adult Men | Young Women | Young Male Non-arrestees | Young Male Arrestees[1] |
| Classroom Training | $1,457 | $1,863 | $630 (5.5%) | $1,287 (7.1%) | $839 ( 8.9%) | $ 251 ( 1.6%) | -6,804 (-36.0%) |
| On-Job-Training/ Job Search Assist | $1,330 | $2,908 | $2,292 (15.3%) | $2,109 (9.8%) | -$578 (-3.9%) | -$3,012 (.12.6%) | -6,804 (-36.0%) |
| Other Services | $601 | $359 | $3,949 (38.6%) | $ 941 (4.9%) | -$ 33 (-0.4%) | -$ 438 (.3.3%) | -6,804 (-36.0%) |

Source: Howard Bloom et al. The National JTPA Study-Overview, Washington D.C.: Abt Associates, Jan. 1994, Exhibits 5, 12, 13, 14 & 15. The effects of enrollment in JTPA were calculated by dividing the effects per assignee by the proportion of assignees who enrolled in at least one kind of JTPA training. Many assignees participated in more than one form of training. Job Search Assistance QSA) was often a part of the package of services given. For adults the proportion of enrollees that received JSA was 20 percent for classroom training, 51 percent for on-the-job training and 40 percent for other services. For youth the proportion of enrollees getting JSA was 41 percent for classroom training, 52 percent for on-the-job training and 18 percent for other services. Forty-three percent of youth enrollees in other services received basic education.

1. Estimated earnings impacts are based on survey data as are all other numbers in the table. In UI wage record data, JTPA had no impact on the earnings of this group. The truth probably lies in between zero and the -$6,804 from the survey. The sample of young male arrestees was too small to distinguish different types of services, so an average for all service streams is reported.

Table 4
THE IMPACT OF PREVIOUS TRAINING ON THE PRODUCTIVITY OF NEW HIRES
(in percent)

| | 10 Yrs Irrelevant Exper. | 10 Yrs Rel Exp Replaces Irrelevant Exper. | Formal Training | | Relevant School Based Training | | | |
|---|---|---|---|---|---|---|---|---|
| | | | On Job | Off Job | Vocat School | Private School | Military Training | JTPA Training |
| Productivity | | | | | | | | |
| End of First Week | -2.7 | 32.7*** | 9.5*** | .3 | 2.0 | 10.0** | -3.2 | 8.0 |
| End of 6 Months | -6.9* | 20.3*** | -.9 | 6.6 | -3.1 | 12.3*** | 10. 6** | 15.7* |
| Current | -3.5 | 13.3*** | .3 | 15.9** | 4.5 | 10. 3** | 9.8 | 15.4 |
| Ideas | -1.7 | 45.2*** | 13.6 | 37.3** | 2.7 | 2.3 | 10.1 | -6.0 |
| Required Training | 2.4 | -30.7*** | -17.3*** | 7.2 | 6.5 | -4.0 | 24.4** | 11.1 |
| Wage Rates | | | | | | | | |
| Starting | 7.6*** | 22. 1*** | 1.9 | 1 | 1.5 | 7.1*** | -0.4 | 0.0 |
| Current/Most Rec | 8.0*** | 24.6*** | -1.3 | -.2 | 1.4 | 4.8 | -6.6* | -10.6 |
| Expected Productivity | -.5 | 10.2*** | 4.2*** | 2.5 | -1.4 | 4.4** | 3.9 | 7.7* |
| Surprise | -6.6** | 7.2** | -4.6 | 4.2 | -1.1 | 8.0* | 9.6* | 8.9 |
| Profitability | | | | | | | | |
| End of First Week | -10.3* | 32.8*** | 6.7 | 15.2 | 3.2 | -0.9 | 2.6 | -12.7 |
| End of 6 Months | -15.5*** | 3.2* | -1.1 | 13.8* | 0.8 | -0.1 | -0.6 | 12.8 |
| Current/Most Rec | -6.5 | -6.6 | 2.0 | 18.6* | 5.3 | -7.6 | 11.8 | 1.7 |
| Turnover | | | | | | | | |
| Leave | -4.5 | -11.1 | -8.4 | -31.0 | -11.8 | -11.9 | 5.8 | -40.5 |
| Quit | -22.2 | -27.2 | -8.9 | -.4 | -30.6 | 17.2 | 20.0 | -8.1 |
| Discharge/Layoff | 20.0 | 11.6 | -5.9 | -68.8 | 17.5 | -54.0* | -4.3 | -90.4 |

Source: Analysis of a survey of a stratified random sample of the members of the National Federation of Independent Business (Bishop 1994). Larger firms had a significantly higher probability of being selected for the study. The response rate to the mail survey was 20 percent and the number of usable responses was 2014. The estimated models compared two workers in the same job while controlling for schooling, gender, ethnicity, marital status and whether the job was temporary.
Column 1 presents the effect of increasing total experience by ten years while holding relevant experience constant.
Column 2 presents the estimated effect of ten years of relevant experience while holding total experience constant.
Column 3 is the effect of having received on-the-job formal training from a previous employer.
Column 4 is the effect of having received off-job formal training arranged by previous employer.
Column 5 is the estimated effect of relevant vocational training obtained at a public institution.
Column 6 presents the additional effect of obtaining training at a private voc/tech institution.
Column 7 presents the additional effect of receiving relevant training from the military.
Column 8 presents the additional effect training obtained through the Job Training Partnership Act.
Percentage effects for required training and wage rates are anti logs of ten years effects calculated from logarithmic models for training and wage rates. The suggestions index ranges from 0 to 3 and has a mean of 1.027.

**Table 6**

**Effect of Training on Hourly Wage Levels in 1983 and 1991**

| | Training Needed to Get Job | | Training on Current Job to Upgrade Skills | |
|---|---|---|---|---|
| Source of Training | 1983 | 1991 | 1983 | 1991 |
| Formal Company Training | .127(10.1) | .132(9.5) | .116(10.1) | .144(12.4) |
| Informal OJT or Exper | .108(13.1) | .065(7.0) | .022(2.2) | .021(2.0) |
| Military | .069(2.6) | .079(2.6) | | |
| Correspondence Course | -.018(.4) | -.050(1.2) | | |
| Friend | -.049(2.1) | .037(.5) | | |
| Schools | | | .012(.8) | -.028(1.5) |
| Employer Paid for Schooling | | | .072(3.3) | .078(3.2) |
| High School Vocational Educ | .016(1.0) | .024(1.2) | | |
| Other Vocational School | .121(6.3) | .066(2.6) | | |
| Two- Year College | .092(5.5) | .130(8.6) | | |
| Four-Year College | .202(16.3) | .238(18.4) | | |
| Received Qualifying Training | | | .164(20.3) | .161(18.6) |
| R Square | .447 | .492 | .449 | .494 |

Source: Bowers and Swaim (1992) analysis of CPS data. All models contained controls for years of schooling, potential experience and its square, tenure and its square, and dummy variables for gender, married, husband, race, veteran, metropolitan resident, region, part-time job and union membership.

## Table 7
## Impacts of Formal Training on Learning and Behavior of Managers
### (Burke and Day's 1986 Meta Analysis)

| | Objective Learning Criteria | | | | Subjective Behavior Criteria | | | | Objective Results Criteria | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | True Mean Effect | 90% Lower Bound | # of Ef Sz & Studies | Total # of Obs. | True Mean Effect | 90% Lower Bound | # of Ef Sz & Studies | Total # of Obs. | True Mean Effect | 90% Lower Bound | # of Ef Sz& Studies | Total # of Obs. |
| Training Method | | | | | | | | | | | | |
| Lecture | .37 | -.03 | 20(5) | 1708 | .46 | .13 | 12 (3) | 1055 | .82 | -.04 | 15(3) | 520 |
| Lecture/Discussion | .23 | -.06 | 24(4) | 4782 | .11 | .03 | 11 (4) | 5102 | --- | --- | --- | --- |
| Lecture/Disc + Role | .93 | .46 | 8(3) | 267 | .34 | .07 | 21 (4) | 1117 | | | | |
| Play or Practice | | | | | | | | | | | | |
| Leader Match | --- | --- | --- | --- | .40 | .40 | 69 (5) | 3081 | | | | |
| Sensitivity Training | | | | | .73 | -.13 | 49 (8) | 7153 | | | | |
| Behavioral Modeling | --- | --- | --- | --- | .78 | .78 | 17 (5) | 446 | --- | --- | --- | --- |
| Multitechnique | .81 | .01 | 13(6) | 607 | .51 | -.48 | 76 (11) | 5169 | .52 | .52 | 13(5) | 634 |
| All Types of Training | .38 | -.37 | 77(22) | 8280 | .49 | -.26 | 277 (39) | 26025 | .60 | -.06 | 60(11) | 2298 |

Source: Burke and Day (1986). Objective Learning Criteria are generally paper and pencil tests assessing knowledge of what is taught by the training program. Subjective Behavior Criteria are generally supervisory ratings of trained and untrained managers' performance (sometimes a global performance rating but more commonly a behavior that was the target of the training program). Objective Results Criteria are objective measures of various output elements. Half of the data on objective results criteria come from three studies of training programs designed to reduce bias and error in the rating of subordinates. Effect sizes were calculated for each study by dividing the difference between the trained and the untrained comparison group by the within group standard deviation. The 'true' effect size was estimated by dividing by the square root of criterion reliability. Then weighted averages were calculated using the number of observations in each study as weights. Some of the variance in effect sizes across studies and criterion measures is due to sampling error and variations in criterion reliability. The effects of these two artifacts were estimated and subtracted from the observed variance of effect sizes to estimate the 'true' effect size error variance. The 90% lower bound 'credibility value is an estimate of the "true' effect size above which 90 percent of the true training impacts should lie. It is calculated by subtracting (1.285*the square root of the 'true' effect size error variance) from the estimate of the 'true' mean effect size.

Table 8
**Estimates of Marginal Gross Rates of Return Estimates**

| | Formal Training | | Training by Supervisors- | | Training by Co-Workers | | Watching Others | |
|---|---|---|---|---|---|---|---|---|
| | 100 hrs | 300 hrs | 100 hrs | 300 hrs | 100 hrs | 300 hrs | 100 hrs | 300 hrs |
| Table 4 | | | | | | | | |
| Typical Individual Linear | 11% | -3% | 23% | 10% | 45% | 32% | 38% | 25% |
| Logarithmic | 38% | 15% | 46% | 24% | 85% | 63% | 113% | 90% |
| Particular Individual Linear | 15% | -3% | 17% | 1% | 43% | 25% | 43% | 25% |
| Table 5 | | | | | | | | |
| Typical Individual Logarithmic | 118% | 54% | 99% | 48% | 112% | 53% | 128% | 58% |
| Linear | 43% | 16% | 41% | 16% | 48% | 18% | 50% | 18% |
| Particular Individual Logarithmic | 156% | 68% | 109% | 52% | 130% | 59% | 146% | 64% |
| Linear | 46% | 16% | 38% | 13% | 47% | 16% | 46% | 16% |

Estimates of the marginal gross rates of return to increases in the intensity of training at two different levels of training intensity: a 100 hour investment during the first quarter of the job and a 300 hour investment during the first quarter on the job. Hourly cost factors are assumed to be 1.8 for formal training, 1.5 for training by supervisors, 1.0 for training by coworkers, and 0.8 for watching others. When productivity growth over 2 years for the typical individual is being modeled, duration adjusted cost factor is calculated by multiplying by the hourly cost factor by 3 for the reasons given in the text. When productivity growth of a particular individual during the first 14 months is modeled, the duration adjusted cost factor is calculated by multiplying the hourly cost factor by 2.2. The results presented in the first panel are calculated by taking the derivative of the estimated regression equations reported in tables 4 with respect to hours of the specified kind of training, then multiplying by 2000, the assumed number of hours worked in a year, and then dividing by the duration adjusted cost factor. As an example of the calculation, the formula for formal OJT using the coefficients from the linear model in table 4 for training intensity (T) equal to 300 hours was as follows:

[(.00046 - .00000049*T*2*1.8)*2000 ] / [3*1.8] = -.0256 and the coworker training formula is:

[(.00077 -.00000049*T*2)*2000]/[3] = .3173. {Note that the coefficients must be divided by 100 and 10000 in order to scale them in hours of training). The GROR estimates presented in the second panel assume that the firm has 18.5 employees (this zeros out the 5th and 7th terms of equation 3) and that all of the training received is of the type indicated. For informal training by supervisors, the formula is:

$(b_2 + b_3 * ln T*2)*2000/(T*\text{duration factor})$ which is [(.003 +.0064*4.605*2)*2000] / (100*3) =.4176 at T=100 for the linear productivity growth model for typical workers. For training by watching others, the formula is $(b_2 + b_{5F} + b_3 * ln T*2)*2000/(T*\text{duration factor})$ which is [(.003 + .013*$S_w$ +.0064*4.605*2)*2000] / (100*3) =.504.

Obsolescence of skills and turnover mean that these cash flows do not have an infinite duration and should therefore be compared to the sum of the interest rate, the obsolescence rate and the turnover rate times the proportion of skills that are effectively specific to the firm.

TABLE 9
**INTERNATIONAL DIFFERENCES IN THE DISTRIBUTION OF JOB TENURE**

| | Date | Under One Yr | Under Two Yrs | Over 5 Yrs | Over 10 Yrs |
|---|---|---|---|---|---|
| **United States** | **(1983)** | **27.3** | **38.5** | **39.6** | **27.2** |
| | **(1987)** | **28.8** | **40.1** | **40.5** | **26.7** |
| | **(1991)** | **28.8** | **40.4** | **38.3** | **26.6** |
| Australia | (1981) | 25.0 | 38.8 | 37.2 | 19.4 |
| | (1991) | 21.4 | 34.6 | 39.4 | 23.3 |
| Belgium | (1972) | -- | 24.8 | 51.1 | 31.4 |
| Canada | (1983) | 22.7 | 33.1 | 45.3 | 26.6 |
| | (1991) | 23.5 | -- | 44.6 | 29.4 |
| France | (1978) | -- | 17.8 | 62.5 | 35.1 |
| | (1991) | 15.7 | 26.4 | 58.0 | 41.4 |
| Germany | (1985) | -- | 18.6 | 63.0 | 42.1 |
| | (1990) | 12.8 | 23.1 | 59.0 | 41.2 |
| Italy | (1972) | -- | 20.0 | 49.7 | 28.0 |
| **Japan** | **(1982)** | **9.8** | **21.2** | **66.8** | **48.0** |
| | **(1990)** | **9.8** | | **62.6** | **42.9** |
| Luxembourg | (1972) | -- | 22.6 | 58.1 | 41.6 |
| Netherlands | (1972) | -- | 25.2 | 50.3 | 32.1 |
| | (1990) | 24.0 | 39.5 | 37.6 | 26.2 |
| Spain | (1992) | 23.9 | 31.6 | 53.6 | 39.7 |
| Switzerland | (1991) | 17.6 | 29.3 | 50.5 | 32.6 |
| United Kingdom | (1979) | 13.8 | 24.4 | 52.4 | 30.5 |
| | (1984) | -- | -- | 51.8 | 29.8 |
| | (1991) | 18.6 | 31.0 | 45.2 | 28.9 |

Source: OECD 1984, Table 32; OECD 1993 Table 4.1; Buechtemann 1992; BLS Jan 1987).

## ENDNOTES

[1] This suggests that a government subsidy equal to 10 percent of the full marginal opportunity costs of training (or a reduction in turnover or required rates of return which had an equivalent impact on rental cost) would increase time devoted to the training of each new hire by 7 percent. An inelastic demand for training also means that holding the job constant, a decrease in learning efficiency (eg. because the workers hired are slow learners or the firm is not very effective in its training) simultaneously increases the time devoted to training and reduces value added.

[2] When Bartel and Sicherman (1993) model the amount and incidence of training as a function of industry specific total factor productivity (TFP) growth and dummies for one-digit industry category, they obtain statistically significant positive effects of TFP growth on training. A one percentage point increase in TFP increases the incidence of training by 15.3 percent in the manufacturing sector and by 11.5 percent in the economy as a whole. When controls for growth of output are added to the model the effect of TFP becomes insignificant and falls to 10 percent for manufacturing and to 6.5 percent for the full economy.

[3] Surveys focused on formal training, in part, because it was thought that it would be easier to get reliable data about formal training than other types of training. Unfortunately, the data that has been obtained has severe reliability problems. Comparing CPS and SIPP answers to almost identical questions about formal training necessary to get and keep one's job, Zemsky and Shapiro (1994) found large discrepancies between the number of people reporting that they received such training in the two surveys. It would appear that answers to questions about formal training are quite sensitive to context-nuances in the wording of questions, the format and length of the interview, where the question is placed in the interview and which the questions appear immediately before the training question. This finding implies that the effort to obtain reliable measures of training by asking only about the most salient form of training--formal training--has failed. Clearly the word "training" means different things to different people and the interpretation of the word depends upon context.

[4] If the arithmetic mean were being reported these numbers would be considerably larger. Nevertheless these numbers seem low especially for professional and managerial jobs.

[5] 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:

$$\frac{P_{2YR}-P_{1Q}}{P_{1Q}} = \%\Delta P = AGROR_j * (\theta_j) * (\text{Hours Devoted to Training})$$

where $\theta$ is the opportunity cost of time devoted to training
$AGROR_j$ is the average gross rate of return on dollars of investment in the training of stayers at the $j^{th}$ establishment.

The lower percentage productivity growth (%ΔP) to (Hours devoted to Training) ratio of tiny establishments implies that either they have a lower $AGROR_j$ or a lower $\theta_j$. It is unlikely that tiny firms have lower AGROI~ for they have higher turnover and poorer access to capital markets. The probable explanation of their small OloLP is a lower opportunity cost of time devoted to training ($\theta$).

[6] Selection effects might be contributing to the large estimated effects of employer sponsored training. If employers identify talent by observing past job performance and then select the top performers for training, promotions and wage increases, the association between training receipt (not quantity) and wage increases might not reflect a causal effect of training on productivity, so much as a decision to reward the worker's past contributions to the firm. If this is what is happening, OLS coefficients measuring the effect of training on wage growth will be biased upward. Veum included selection correction terms in his model to deal with this problem. While the coefficient on the selection correction for company training was negative as hypothesized, it was not statistically significant and the corrected estimate of the impact of company training remained quite large. Another way to examine the issue of causality in the wage growth equation is to examine productivity growth. Is it really true that top performers get more training, or do they get less because they learned the job more quickly? If less competent workers must receive more training, that might explain why it is receipt not the quantity of training that explains wage growth.

[7] The most accurate source of data on college attendance in the NLS72-transcript data-is available for post-secondary institutions that were attended prior to 1979. Only self-reported data was available to describe spells of post-secondary education that began after 1979. Grubb had two sets of schooling variables in his model--transcript derived measures and self-reports of additional schooling obtained after 1979. The coefficients on these self-reported schooling variables were almost all negative particularly for men. This could be because (1) self reports of schooling obtained as an adult are very error prone and this causes a severe bias, (2) more time is required after schooling is completed for its effects to show up, and/or (3) the returns to college attendance by adults are truly much smaller than the returns to college attendance immediately after high school.

[8] Because the period for which training intensity is measured is much shorter than the period over which productivity growth is measured, an assumption must be made about the strength of the correlation between training intensity during the first 3 months and training hours during 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. 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 further 1.2 unit increase in that training activity during the remainder of the first year on the job.

[9] Lack of information about the quality of general OJT received can increase investment in general OJT only under the very unlikely circumstances of very high retention rates and large differentials between the rates at which employers and employees trade off present before-tax income for future before-tax income. Under these circumstances the employer's desire to invest in general training may be stronger than the worker's desire. Because the wage will have to be increased by an equivalent amount, employers cannot benefit from (and therefore do not pay for) general training that is visible to other employers. Consequently, as such training becomes more visible to other employers, the calculus that determines the amount of training shifts to give greater weight to the very high discount rates faced by the worker, possibly reducing investment in general training. The condition that would have to be satisfied is that the retention rate would have to be equal to or greater than the ratio of the firm and worker discount factors. Even if the worker were to face yearly interest rates that were double the firm's rate (e.g., 30 percent rather than 15 percent), the

yearly retention rate would have to be above 85 percent. Retention rates for the first year at a job are seldom above 50 percent and average yearly retention rates for all employees new and old seldom exceed 85 percent. Yearly retention rates of employees who have been at the firm for many years may exceed 85 percent, but these more mature workers will typically have better access to capital markets than younger workers and face a tax regime that is neutral to OJT. This discussion has been based on the theoretical analysis of the training decision presented in Bishop and Kang (1984, 1988).

[10] Well-trained employees who leave the firm that provided the training may benefit if their new employer eventually learns of their greater-than-anticipated productivity and makes later adjustments to the wage or bases a promotion on it. In the model presented in Bishop and Kang (1984, 1988), high renegotiation costs prevent such adjustments from occurring at the first employer. If a third period was added to the model and retention in the second job modeled, the same assumption of high renegotiation costs would prevent the worker from benefiting from better-than-expected training in the second job. If one were to relax the assumption that post-training wage rates are prespecified and analyze a multi-period model, the size of the distortion to training investment decisions would be reduced, but it would not disappear. Productivity is measured with error so one could never expect the new employer to perceive the full value of the worker's greater-than-anticipated training. Furthermore, other employers remain ignorant of greater-than-anticipated productivity. To all intents and purposes this greater productivity is specific to the firm, so the worker will only receive a small share of this greater productivity in higher wage rates.

[11] If training an employee causes a reduction in output or necessitates an increase in hours paid, profits and thus taxes are reduced. If workers pay for training by accepting lower wage jobs, individual income tax payments are reduced. In both of these cases, training costs are effectively deductible in the year they are incurred. If all individuals pay taxes every year at the same marginal tax rate, the tax system would not distort decisions to invest in OJT.

[12] Becker clearly recognized the existence of liquidity constraints in his 1962 paper. 'Since employer specific skills are part of the intangible assets or good will of firms and can be offered as collateral along with tangible assets, capital would be more readily available for specific than for general investments (p.42)." He did not, however, explicitly analyze how such constraints might influence the tenure profile of wages and thus induce employers to share the costs of general training. Parsons (1972) points out that "The worker's ... discount rate will affect the firm's choice of wage policies.... It can be shown that firms will decrease the worker's share of specific investment as the workers discount the future more heavily (p. 1129).

[13] Policy capturing experiments have found that employers give significantly higher ratings to job applicants with high grade point averages (Hollenbeck and Smith 1984). Marshall Brenner's (1968) study of performance during the first year on the job of 100 Lockheed Corporation employees who had recently graduated from Los Angeles high schools found that GPA has a correlation of .34 -.37 with the supervisory job performance ratings.

[14] Mincer (1989), for example, attempts to calculate a rate of return to the worker's investment in training by dividing the percentage wage increase by estimates of the cost of training (generally running between .2 and .25 of a years productivity) that are based on the fraction of a years time that worker's report they spend in training. This fraction tells us something about the combined employer and employee costs of training not the costs incurred by the

trainee. In fact, in the Lillard and Tan (1986 Table 4.3 and 4.5) earnings regression which Mincer uses to estimate the depreciation rate for training, trainees experienced no earnings reduction during the year in which training was received. The worker's investment in training is probably much smaller so the wage GROR for worker investments in training is probably much higher than the numbers estimated by Mincer.

[15] The time periods over which wage growth was measured were quite short--one year in the Lowenstein & Spletzer study and 3-4 years in the Lengermann study. Grubb's (1993) cross-section study measured the effect of self-reported schooling increments from age 26 to 32 on earnings at age 32. Since wage impacts of school provided training grow with time since completion, these studies may underestimate the eventual effect of school provided training. The analyses of CPS data by Hollenbeck and Willkie and Bowers and Swaim are less subject to this criticism, but they completely lack controls for ability and family background.