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## Employer Training and Skill Shortages: A Review of the State of Knowledge With Recommendations for Future Research by the Department of Labor

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## Employer Training and Skill Shortages: A Review of the State of Knowledge With Recommendations for Future Research by the Department of Labor

### Abstract

"This report proposes that the Department of Labor undertake a program of research designed to inform the policy debate related to skill shortages and the role of employer training in ameliorating them. The paper reviews the currently available evidence and then proposes new research on seven questions."

### Keywords

CAHRS, ILR, center, human resource, worker, advanced, labor market, satisfaction, employee, work, manage, management, training, employ, model, industrial relations, employ, vocational, education, United States, youth, risk, work, job, training, skill shortage, occupation, college

### Comments

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**EMPLOYER TRAINING and SKILL SHORTAGES:  
A REVIEW OF THE STATE OF KNOWLEDGE  
with  
RECOMMENDATIONS FOR FUTURE RESEARCH  
by the DEPARTMENT OF LABOR**

**John H. Bishop  
Cornell University**

Working Paper # 91-32

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Cornell Institute for Youth and Work  
and  
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**EMPLOYER TRAINING and SKILL SHORTAGES:  
A REVIEW OF THE STATE OF KNOWLEDGE**  
with  
**RECOMMENDATIONS FOR FUTURE RESEARCH by the DEPARTMENT OF LABOR**

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

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

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

A growing number of commentators are pointing to employer sponsored training (OJT) as a critical determinant of competitiveness and standards of living. American employers and workers, it is charged, are failing to invest sufficient time and resources in training on the job (Commission of the Skills of the American Workforce 1990). The Office of Technology Assessment (1990), for example, concluded:

When measured by international standards, most American workers are *not* well trained. Many in smaller firms receive no formal training. Larger firms provide more formal training, but most of it is for professionals, technicians, managers, and executives. Our major foreign competitors place much greater emphasis on developing workforce skills at *all* levels....Our major trading competitors provide more and better worker training (p. 3,4).

Training is an extremely important issue, but very hard to study. Government statistical agencies have only recently begun asking questions about it and there is, at present, no standardization of data collection procedures across countries. Most training is informal in character and therefore hard to measure. Its effects on productivity are also difficult to quantify. Consequently, there have been almost no studies of the central issue of the impact of employer training on worker productivity. Research has, consequently, focused on issues such as who gets formal training and the impact of formal training (or tenure interpreted as a proxy for informal training) on tangential outcomes such as wage rates and turnover. The findings of this research are reviewed in sections 1.1 and 1.3.

An elegant theory has been developed that attempts to explain how the quantity of training is determined and who pays for and benefits from it. 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 on wage growth and turnover. Definitive tests of the OJT theory have not been forthcoming because the large number of unobservables means that any given phenomena has many alternative explanations (Garen, 1987).

Consequently, a good deal is known about the incidence of formal training and about the effect of tenure and formal training on wages and turnover, but little is known about its impact on productivity. Employers arrange for and pay for training because it raises productivity; not because it raises wages. Policy maker's interest in training derives from its effect on productivity; not its effect on wages. The two effects are generally not the same. Highest priority should be given to research on the productivity effects of training. Studies of wage effects alone have lesser priority.

This report proposes that the Department of Labor undertake a program of research designed to inform the policy debate related to skill shortages and the role of employer training in ameliorating them. The paper reviews the currently available evidence and then proposes new research on seven questions.

1. **HOW DO TRAINING AND SKILL DIFFERENTIALS ACROSS COUNTRIES AND ACROSS FIRMS WITHIN A COUNTRY EFFECT THE PRODUCTION PROCESS AND FIRM PRODUCTIVITY? HOW DO SKILL DIFFERENTIALS INFLUENCE THE IMPLEMENTATION OF FLEXIBLE DECENTRALIZATION, TOTAL QUALITY MANAGEMENT AND OTHER EFFORTS TO ACHIEVE A HIGH PERFORMANCE WORK ORGANIZATION?**
2. **HOW IS THE AMOUNT AND CHARACTER OF THE EMPLOYER TRAINING CHANGING OVER TIME?**
3. **DO AMERICANS RECEIVE LESS TRAINING FROM EMPLOYERS THAN THEIR COUNTERPARTS OVERSEAS?**
4. **ARE THEY LESS SKILLED?**

Assuming an affirmative answer to the third and fourth questions:

5. **WHY ARE AMERICAN WORKERS LESS WELL TRAINED AND LESS SKILLED?**
6. **IS THERE MARKET FAILURE IN THE PROVISION OF EMPLOYER TRAINING?**
7. **IS SCHOOL PROVIDED OCCUPATIONAL TRAINING A SUBSTITUTE OR A COMPLEMENT FOR TRAINING ON THE JOB?**

Most of these questions cannot be answered in currently available data sets. I, therefore, propose that the Department of Labor concentrate on funding studies which collect and analyze new data. The most important issue for research is # 1, the effect of training on production processes and productivity. Studies that look at training without evaluating its outcomes should receive lower priority.

For most kinds of training, outcomes are as much organizational as individual. Consequently, a good deal of effort needs to be devoted to studies conducted at the organizational level which examine how training fits into the organization's overall competitive strategy and effects its profitability. Examples of the kinds of studies that need to be replicated are the work of John Krafcik (1990) and John Paul MacDuffie on auto assembly plants around the world, the study of computerized machine tools by Hartman and colleagues (1983), Ramchandran Jaikumar's (1986) study of flexible manufacturing in Japan and the United States, Maurice and Sellier and Silvestre's (1986) comparison of French, German and British plants and the intensive case studies of specific industries conducted by S. J. Prais, Hillary Steedman, Karin Wagner and collaborators at the National Institute of Economic and Social Research in London.

The paper is organized as follows. The first section of the paper presents a quick review of what is known about Questions # 1 to 4. Some unique data on the magnitude and effects of the new hire training and how it varies by occupation are presented in section 1.1. Estimates of training's impact on productivity growth of new hires are presented in section 1.2. Other research on the incidence and effects of formal training is reviewed in section 1.3. In section 1.4 the limitations of currently available data on training and its effects are discussed and new data collection is recommended. In section 1.5 I propose a new approach to asking questions about on-the-job learning and training.

Section 2 of the paper presents a preliminary examination of Question # 5--why American employers and workers appear to invest less in training than the Germans and Japanese. Section 3 presents a preliminary examination of Question # 6. It examines what is known about the extent of market failure in the provision of employer training. Studies of apprenticeship programs in Germany, Great Britain and the United States suggest that employers are financing part of the cost of apprenticeship training. Econometric analysis of wage levels and rates of wage and productivity growth due to tenure also suggest that employers are contributing to the costs of non-apprenticeship training that develops skills which are useful at many firms. If this is indeed the case, the training market is probably generating less training than would be socially optimal. More research is required on this topic. Section 4 examines the advantages and disadvantages of locating occupational training in enterprises rather than schools. *Priorities for future research are discussed at many different places in the text, generally immediately following a discussion of the past research which informs and guides my proposals. These sections are highlighted by appearing in large print bold italics.* The final section of the paper recapitulates the recommendations for new research.

## I. WHAT IS KNOWN ABOUT THE INCIDENCE AND IMPACTS OF TRAINING?

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

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

### How Training Varies with Occupation

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

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

*It also implies that international comparisons of training cannot focus on the training that is managed by corporate training departments. Training departments are typically larger in big American corporations than in Japanese corporations. In Japan corporate budgets for formal training 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*

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

	Profes- sional	Mana- geral	Sales Not Retail	Retail Sales	Clerical	Blue Collar	Service
<u>Hours Spent in Training in First 3 Months</u>							
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
<u>Investment in Training Time</u>	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
<u>Increase in Reported Productivity (%)</u>							
Betw. first 2 wks. & next 10 wks.	28%	32%	50%	30%	40%	32%	28%
Betw. first 3 mo. & end of year 2	38%	33%	56%	25%	32%	23%	17%
<u>Increase in Real Wage in First 2 Yrs. (%)</u>	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: Sample is limited to jobs for which all the necessary questions on wage rates, training time, and productivity were answered.



*investments that Japanese firms make in cross training and employee rotation do not appear in these budgets.*

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

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

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 sales representatives outside of retail and service industries--also seem to have larger than average increases in reported productivity as the worker gains in tenure. Clerical workers, for instance, are reported to be improving their productivity by 40 percent in the first month or so and by a further 32 percent by the end of the second year on the job.

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

## 1.2 The Payoff to New Hire Training

The analysis of EOPP data presented in Bishop (1990) and Appendix A generated tentative estimates of both the opportunity costs and the productivity effects of training (general and specific, worker and firm financed combined). It would appear, therefore, feasible to calculate 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.<sup>2</sup> Consequently, the estimates of marginal gross rates of return for each form of training that are reported in Table 2 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 (GROR) for informal OJT by co-workers drops from 43-45 percent to 25-32 percent in the two linear models for typical new hires presented in Appendix Table 1. 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 11-15 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

Table 2  
Sensitivity of Marginal Gross Rates of Return Estimates to Specification

	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
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 3 of (Bishop 91)

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 A1 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 A1 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.

presented in Appendix Table 2. 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. Lillard and Tan (1986) have estimated that the wage effects of formal training depreciate (either due to obsolescence or changing jobs) at 15 to 20 percent per year. This also would imply that equilibrium in the training market would likely yield marginal GRORs of 30 percent or more. Tan et. al. (1991), however, estimates a much lower depreciation rate for wage rate effects of company training--6 to 7 percent per year. 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, it is my view that robust estimates of net rates of return to general on-the-job training comparable to rates of return on financial assets and physical capital are not now feasible and will not be feasible until better data sets become available.

### 1.3 Summary of Empirical Findings

The major findings derived from Bishop's analysis of employer data on new hire training presented in the first part of the paper may be summarized as follows:

- \* Formal training provided by specialized training personnel accounts for only a small portion of the training received by new hires.
- \* When informal training is included in the total, training investments in new hires are substantial even for jobs that are generally considered unskilled.
- \* Productivity rises substantially during the first year on the job.
- \* Large establishments invest more in the training of their new hires than small and medium sized establishments apparently because (1) they have lower turnover, (2) they have better access to capital markets, (3) the marginal product of an hour of training time is higher at large establishments and (4) training lowers turnover more substantially at large establishments.
- \* Informal training by coworkers and training by watching others do the job appear to have a higher benefit cost ratio than informal training by management.
- \* Estimates of rates of return to training derived from this data should be treated with a great deal of caution. Nevertheless, marginal rates of return to training appear to be quite high.
- \* The estimated benefit cost ratio for formal training depends on how the model is specified. The productivity growth effects of formal training are bigger at large establishments. Formal

training has significantly larger effects on wage growth than informal training. Formal training's tendency to have larger effects on wage growth and quit rates than informal training probably results from the fact that formal training is better signaled to the labor market.

- \* The reported generality of training has no significant effects on its marginal productivity.
- \* When training is reported to be highly general, training has a larger effect on wage growth than when training is reported to be specific. Nevertheless, training that is reported to be entirely general has much larger effects on productivity growth than wage growth implying that the labor market treats this training as if it were at least partly specific to the firm.

Studies using individual data typically tackle different issues. Lisa Lynch's recent review of the literature on the incidence and impact of formal employer sponsored training concluded that:

- \* Formal on-the-job training significantly raises wages for workers
- \* Formal off-the-job training improves earnings but not as much as on-the-job training
- \* While there is not a significant difference in the probability of males and females receiving any type of training, males are more likely to receive OJT and females off-the-job training
- \* Nonwhites are less likely to receive on-the-job training than whites, holding all other characteristics constant
- \* The likelihood of receiving company provided training drops when the local labor market has high unemployment
- \* Company provided training for young workers is not very general, i.e. not portable from employer to employer
- \* While there is a link between schooling and company training it is not so much in the number of years of school but rather in whether or not the individual has finished high school or college
- \* Rapid technological change in the industry of employment increases the probability of receiving managerial training and in-house company programs
- \* Being in a union significantly raises the probability of receiving on-the-job training or being an apprentice
- \* Managers, professional and technical employees are most likely to receive company training. (Lynch, 1991, p. 124)

One of the most serious problems with research on training is the lack of careful analysis of the quality of the available data on training. This gap has recently been remedied in part by Zemsky and Shapiro's (1991) comparison of training incidence in different surveys. Comparing CPS and SIPP answers to almost identical questions about formal training necessary to get and keep one's job, they 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. That is why future data collection regarding this issue should ask about "learning how to do one's job better" and not about training.*

#### 1.4 What Do We Need to Know about How Employer Training Differs Across Nations ?

American employers appear to devote less time and resources to the training of entry level blue collar, clerical and service employees than employers in Germany and Japan (Limprecht and Hayes 1982, Mincer and Higuchi 1988, Koike 1984, Noll et al 1984, Wiederhold-Fritz 1985). In the 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 deals with in Germany. They are generally much more knowledgeable about the products they are selling than American sales clerks.

Most of what we know about comparative levels of skill and training investment comes from just a few case studies and a host of anecdotes. Clearly there is a need for systematic data collection. This need has also been perceived by the National Educational Goals Panel. The Technical Panel responsible for preparing methods of monitoring progress toward the goal of a literate workforce proposed the following:

*The Technical Panel recommends that any cross-national comparison include the cross-occupational skills required in the workplace: the foundation skills and SCANS skills. Worker performances involve four types of skills and knowledge:*

- o the foundation skills, knowledge, and orientations (these include the basic skills of reading, writing, mathematics, listening, and speaking; the higher order cognitive skills, such as metacognitive skills and learning strategies; and attitudes or orientations, such as taking responsibility);
- o the SCANS generic functional skills, which appear in many different occupations and industries;
- o occupationally-specific knowledge and skills; and
- o company-specific knowledge and skills.

The panel felt that K-12 should have responsibility for developing the foundation and SCANS skills. These skills therefore properly fall within the purview of the National Goals Panel. The educative responsibility for occupationally-specific skills is shared between K-12, post-secondary schools, and employers, but the very specificity of these skills make them unlikely candidates for a cross-national assessment. Company-specific skills are proprietary, entirely the training responsibility of employers, and therefore outside the scope of the National Goals Panel.

*A cross-national assessment of the foundation and SCANS skills requires a measurement battery that extends substantially beyond even a "strengthened" NALS....*

*To develop an adequate cross-national assessment of cross-occupational workplace skills, the Technical Panel recommends a staged development process....*

*The Technical Panel recommends that even the R&D for the cross-national assessment be done cross-nationally, preferably through a cross-national R&D team drawn from research institutes in the different countries....*

*The Technical Panel recommends that the levels of each of the skills measured in the cross-national assessment be benchmarked against the levels required for expert performance in broadly different occupational categories....*

*The Technical Panel recommends obtaining a descriptive distribution by country of those workplace characteristics that affect skill and skill level requirements....*

*The details of sampling and data collection strategies should be left to the R&D teams....*

This data collection program is desirable but the cost and complexity of the project insures that it will be many years before data of this type becomes available. A more serious objection to this proposal is its lack of attention to occupational and firm specific skills. In my judgement, occupational and firm specific skills are many times more important than generic skills in accounting for productivity differences between individuals and enterprises.<sup>3</sup> Basic and generic skills are useful not so much because they directly contribute to productivity but because they help workers learn the occupational and firm specific skills that determine productivity. A further difficulty of this approach is the constraints on data collection that result from attempting to study representative samples of workers. This makes meaningful measurement of occupation specific skills and the productivity outcomes of training just about impossible.

*If employer training rather than schooling outcomes is to be the focus, a very different data collection strategy is implied. Case studies are needed which focus on a specific sub-industry or a specific production process. Only by narrowing the focus in this way is it possible to get good measures of the context, character, cost, and consequences of training. Hard data is essential, so data collection strategies must be adapted to the technology and skill development institutions of the subindustry. International comparisons are also more useful and valid when sub-industry is held constant. Causal effects of a nation's training institutions on skills and*

*productivity can only be identified if sub-industry is held constant. The models for the studies that need to be done are the work of John Krafcik, John Paul MacDuffie and their colleagues on auto assembly plants around the world (Krafcik 1990, Krafcik and Macduffie 1989, Shimada and MacDuffie 1986, Macduffie and Kochan 1988), the study of computerized machine tools by Hartman and colleagues (1983), Ramchandran Jaikumar's (1986) study of flexible manufacturing in Japan and the United States and Marurice, Sellier and Silvestre (1986) comparison of French, German and British plants. Another excellent group of models for the research program are the intensive case studies of 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 (NIESR) in London. These five case studies 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 was one of the primary causes of the differentials. These studies have had an enormous effect on the policy debate in the United Kingdom.*

*I propose three low cost ways of stimulating this kind of research. The most economical way for the Department of Labor to stimulate this kind of research is to fund PhD dissertations. A typical funding package might involve travel costs, 18 months of funding for the PhD student and one month of funding for a faculty member overseeing the project. Faculty time is a necessary part of the package because faculty can help gain access to companies and because their close guidance is needed. Since faculty guidance is so essential, the faculty sponsor's track record in this style of research becomes one of the criteria in making awards. Another criteria for awards should be letters of support from industry executives making commitments to give the researcher access. The RFP should provide a partial list of industries in which there is special interest but should also announce that other industries would be fine if the researcher has the necessary access and expertise. At the very top of the priority list should be flexible manufacturing (FMS). There would be very substantial benefits from returning to the FMS installations that Jaikumar visited in the early 1980s, collecting comparable data on the performance of these systems and analyzing the reasons for change. I have asked Jaikumar how difficult such a project would be, and he feels that, with his help, a graduate student could do*



*the job in a year and a summer. Because technology and management are held constant, multinational companies are a particularly interesting environment within which to do comparative studies. The RFP should therefore suggest that proposals for comparisons of plants located in different countries that are part of the same corporation would be particularly likely to receive favorable consideration.*

*The second economical approach to stimulating this kind of research is to offer to fund the American end of studies which have European or Japanese collaborators. At minimum an RFP should be issued proposing an American replication of the five NIESR studies--hotels, and manufacturers of clothing, kitchen cabinets, machinery and biscuits--that have had such an enormous effect on the policy debate in the United Kingdom.*

*TOOL MAKING--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.*

*KITCHEN CABINETS--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.*

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

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

*BISCUITS--....*

*For skilled occupations which require formal training in schools, a third economical way of making international comparisons of worker skills is to study the competency standards that are represented by the certification exams (Hollenstein 1983; Dore and Sako 1989). Researchers at NIESR have done a number of such studies comparing France, Germany and the United Kingdom and it would not be too difficult to add the United States to the sample (Prais 1981,1986, Prais and Wagner 1983, Prais and Steedman 1987, Steedman 1987,1989, Jarvis and Prais 1989). The approach I would recommend would be to compare NOCTI Student Occupational Competency Achievement Tests (SOCATs, both written and practical tests) and the Teacher Occupational Competency Exams (TOCATs) to the British City and Guilds exams and comparable French exams. Because the SOCATs have separate scores for up to 15 different aspects of the job, it should be possible to identify sections of the exam that are similar*

*to certain sections of the European exams to which they are being compared. Data exists at NOCTI on the SOCAT subtest scores obtained by Job Corps completers, high school vocational program graduates and completers of postsecondary vocational technical programs and on TOCAT test scores of experienced workers in the occupation who sought certification as vocational teachers.<sup>4</sup> This means that rough comparisons between US performance levels and British, German and French standards should be possible without having to arrange for NOCTI tests to be administered to random samples of US workers. In addition, some industries sponsor their own examination/certification systems (for more information contact Joan Wills at the Center for Workforce Development, 202-822-8405). Comparisons should also be made between these industry exams and their European counterparts.*

*An alternative approach would be to take the British City and Guild exams and derive from it an assessment that could be administered in the US and then administer it to small samples of US workers (City and Guilds of London Institute 1987). Either way, these studies could be expected to gain a great deal of attention to the issue of the quality occupational training in the U.S. This problem has not received the attention it deserves primarily because of the lack of good data on how our vocational students (both in high school and voc/tech colleges) compare to similar students abroad. It would be desirable to involve trade associations and unions in these studies by asking their members to participate as experts on the panels that make the comparisons. Once the studies are completed an effort should be made to involve them in the dissemination of the findings and in developing programs for responding to the findings.*

*My final recommendation is for the Department of Labor to assign an economist to the task of working with OECD and the World Bank (contact Hong Tan) on development of an instrument for surveying firms and enterprises about training. This survey should not focus solely on formal training. Informal training and learning-by-doing must receive equal attention. If one tried to collect information on the learning experiences and training activities of all workers in a medium sized establishment, the respondent burden would be incredible. The solution to this problem is to ask about the OJT and learning by doing experiences of just a few workers. If estimates of aggregate investment in training are desired, these workers must be selected*

*randomly. Information on the subject of training and the reason why it has been undertaken is highly desirable (see next section for a draft of possible questions on the subject of and reason for the learning activity). A full range of data on the background and previous training of the sampled workers is also necessary. It will generally be desirable to ask about a pair of workers so that comparisons which hold firm and job constant are possible. An example of such a survey which was recently conducted with members of the National Federation of Independent Business can be found in Appendix B.*

#### 1.5 What We Need to Know about Trends in Learning On-The-Job ?

*Even though less than 10 percent of the time that workers spend learning how to do the job better is spent in formal training programs, questions are seldom asked about the informal ways workers learn their job. As a result, the research conducted in the past has focused on just one species of tree not the forest. The way to study the entire forest--on-the-job learning--is to ask questions about "learning" rather than about "taking training". We also need to know much more about what is being taught/learned and why firms/workers are engaging in the learning activity. For surveys of individuals (such as the CPS, SIPP, NLSY, HSB and PSID), I propose questions that are structured like the following:*

- (1) "Workers can improve their skills and productivity in a variety of ways: [GIVE CARD]  
 AT A SCHOOL,  
 FORMAL TRAINING PROVIDED BY MY EMPLOYER,  
 A SUPERVISOR EXPLAINS/SHOWS HOW CERTAIN TASKS SHOULD BE DONE,  
 COWORKERS EXPLAIN/SHOW HOW CERTAIN TASKS SHOULD BE DONE,  
 WATCHING OTHERS AND ASKING FOR INFORMATION,  
 LEARNING ON MY OWN FROM A MANUAL OR SELF TEACHING DEVICE  
 LEARNING BY TRIAL AND ERROR OR EXPERIENCE."

During the last year, did you participate in any of these forms of learning?

NO [Skip to Question 4]                      YES [Do Question 1a, 1b, 1c and 2]

[For each method of learning ask ]

- 1a) About how many hours did you spend AT WORK OR ON COMPANY TIME in this learning activity during the last year? \_\_\_\_\_
- 1b) About how many hours did you spend NOT ON COMPANY TIME in this learning activity during the last year? \_\_\_\_\_
- 1c) What did you learn about ? Please take a look at this card and indicate which if any of these things you learned about. Check all that apply.
- \_\_\_ a) about a new product or service of the company
- \_\_\_ b) how to operate new equipment (or old equipment better)
- \_\_\_ c) how to repair new equipment (or old equipment better)

- d) a new computer program or upgraded skill at using computer program
- e) about statistical process control or total quality
- f) about working as a team or group problem solving
- g) about the competitive environment, the company's financial situation or long term strategy.
- h) about a new company information system (eg. for tracking inventory or scheduling)
- i) about blueprint reading, geometric tolerancing, etc.
- j) how to be a more effective sales person
- k) about my company's pensions/benefits or financial planning
- l) to read better
- m) how to make better oral presentations
- n) mathematics (what type of math \_\_\_\_\_)
- o) how to be a better supervisor
- p) safety procedures
- q) Courses in your profession or discipline (describe \_\_\_\_\_)
- r) how to do my job better (activity not listed above)(describe \_\_\_\_\_)
- s) other (explain \_\_\_\_\_)

**(2) What event stimulated the company to provide the training or you to learn the skills on your own?**

**(Check all that apply)**

- a) I started work at a new employer in a new occupation
- b) I started work at a new employer without changing my occupation
- c) I was promoted (or preparing for a promotion)
- d) I was transferred to a new work group (or seeking transfer)
- e) The company introduced a new product or service
- f) New equipment or computer program was introduced at the company
- g) I am part of a team where we are supposed to cross train each other
- h) Management or work site was reorganized
- i) Necessary to comply with new governmental regulations (eg EEO, safety, environmental)
- j) General need to upgrade my skills
- k) Desire to become better informed about company and the industry
- l) Desire to become better informed about my rights
- m) Negotiated outcome of our union contract
- n) OTHER (please explain) \_\_\_\_\_
- o) Don't Know

**(3) What share of the skills you learned in the last year are useful at other employers in your local labor market and would help you get a good job if you were to leave your current employer?**

- a) Over 90 percent
- b) Between 70 and 89 percent
- c) Between 50 and 69 percent
- d) Between 30 and 49 percent
- e) Between 10 and 29 percent
- f) Less than 10 percent

**(4) Do you work by yourself or as part of a work group or team?**

- a) work entirely on my own [skip to question 5]
- b) I am always part of a work group [Please answer questions 4a and 4b]
- c) I am sometimes a part of a work group [Please answer questions 4a and 4b]

(4a) How many people are in the work group? \_\_\_\_\_

(4b) What is your role in the group? [check all that apply]

- Its supervisor
- senior member

- a leader or facilitator
- member

\_\_\_ specialized function (describe) \_\_\_\_\_

(5) By approximately how much has your individual productivity increased (declined) since this date last year?  
a) no change \_\_\_% increase \_\_\_% decrease \_\_\_ Don't Know

(6) By approximately how much has your work group's productivity increased (declined) since this date last year?  
a) no change \_\_\_% increase \_\_\_% decrease \_\_\_ Don't Know

(7) Was the learning/training you experienced during the year responsible for some or all of these changes in productivity?

\_\_\_ NO [Skip to Question 8] \_\_\_ YES [Answer Questions 7a or 7b and 6c and 6d]

By approximately how much did the learning/training you experienced during the last year change productivity? 7a) The effect on individual productivity was:

no change \_\_\_% increase \_\_\_% decrease \_\_\_ Don't Know

7b) The effect on work group productivity was:

no change \_\_\_% increase \_\_\_% decrease \_\_\_ Don't Know

(7c) Which of the learning experiences described in answer to question 1 was primarily responsible for this productivity change? \_\_\_\_\_

(7d) What event (or events) listed in answer to question 2 stimulated the training/learning response which was primarily responsible for this productivity change? \_\_\_\_\_

(8) By how much has your hourly wage or monthly salary (unadjusted for inflation and taxes) increased (declined) since this date last year?

a) no change \_\_\_% increase \_\_\_% decrease \_\_\_ Don't know

(9) During the last year did you make any suggestions for improving productivity, quality or sales at your current employer.

\_\_\_ NO [skip to Question 10] \_\_\_ YES [Answer Question 9a to 9d]

9a) How many suggestions did you make? \_\_\_\_\_

9b) How many were implemented? \_\_\_\_\_

9c) For the best idea that was implemented, How much did sales increase, productivity rise or quality improve as a result of implementing your idea? [select the appropriate format and answer only one of the lines below]

The establishment's sales went up by \$\_\_\_\_\_/year

My individual productivity rose \_\_\_ percent.

My work group's productivity rose \_\_\_ percent.

The enterprise reduced costs by \$\_\_\_\_ per year (holding output constant).

The enterprise's value added (output net of materials and labor costs) rose \$\_\_\_\_/yr.

Defects in my output fell from \_\_\_percent to \_\_\_percent.

Defects in my work group's output fell from \_\_\_percent to \_\_\_percent.

[OTHER] \_\_\_\_\_

9d) Which of the following events contributed to (or were necessary for) your coming up with this best idea? [check all that apply]

\_\_\_ Informal conversation with other member(s) of my work group

\_\_\_ Informal conversation with a supplier

\_\_\_ Informal conversation with a customer

- Informal conversation with an employee of one of our competitors.
- Informal conversation with some one else. WHO? \_\_\_\_\_
- Formal problem solving meeting or quality circle at work
- Informal training I received on this job
- Experience on this job
- Formal training I received on this job
- Formal off job training arranged and paid for by my employer
- Formal Training received on a previous job
- Experience from my previous jobs
- Courses I took on my own time at a school or college while employed here (if yes did your employer pay the tuition costs of these courses \_\_\_ Yes \_\_\_ No.)
- Courses I took in school or college prior to obtaining this job
- Reading, thinking and experimenting I did while at work
- Reading and thinking I did while away from work
- Other describe \_\_\_\_\_

*The responses to these training/learning questions should be part of a survey that also gets information on: occupation, industry, tenure, wage rate, weekly hours, establishment size, educational attainment, college major, and past formal occupational training. A set of questions like the above should be repeated with no change in wording every 4 years or so in the CPS. This would provide the nation with a means of tracking changes over time in the quantity, content, character, and consequences of on-the-job learning. If the list of training topics were refined and expanded, the periodic surveys might be able to provide trend data on the introduction of specific organizational innovations like Statistical Process Control and Total Quality Management for the economy as a whole. It would be highly desirable for this survey instrument to be administered in other countries as well as in the U.S. Someone should be assigned the responsibility of working with other countries to develop a standardized way of asking representative samples of workers about on-the-job learning and training.*

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

In the United States, only 33 percent of workers with 1 to 5 years of tenure report having received skill improvement training from their current employer (Hollenbeck and Wilkie 1985). Analyzing 1982 NLS-Youth data, Parsons (1985) reports that only 34 to 40 percent of the young workers in clerical, operative, service and laborer jobs reported that it was "very true" that "the skills [I am] learning would be valuable in getting a better job." The payoffs to getting jobs which offer training appear to be very high, however. In Parson's study, having a high learning job rather than a no learning job in 1979 increased a male youth's 1982 wage rate by 13.7 percent.

While the 1980 job had no such effect, the 1981 job raised wages by 7.2 percent when it was a high learning job rather than a no learning job. If the payoffs to such jobs are so substantial, why aren't such jobs more common?

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 five prime suspects: high turnover, high costs of capital, 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.

## 2.1 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 1 presents data on how the distribution of job tenure varies across nations. In the early 1980s, only 40 percent

TABLE 3  
DISTRIBUTION OF JOB TENURE

		Under One Yr	Under Two Yrs	Over 5 Yrs	Over 10 Yrs
United States	(1951)	29.0%	38.1%	35.6%	19.8%
	(1963)	24.5	33.2	46.1	34.5
	(1966)	15.9	25.4	43.0	28.9
	(1968)	16.9	28.2	43.8	28.7
	(1978)	18.2	29.9	39.9	23.2
	(1981)	27.7	39.3	39.5	23.6
United States	(1983)	27.3	38.5	39.6	27.2
	(1987)	28.8	40.1	40.5	26.7
Australia	(1981)	25.0	38.8	37.2	19.4
Belgium	(1972)	--	24.8	51.1	31.4
Canada	(1983)	22.7	33.1	45.3	26.6
France	(1978)	--	17.8	62.5	35.1
	(1984)	--	--	57.5	36.0
Germany	(1972)	--	25.0	51.0	34.5
	(1985)	--	18.6	63.0	42.1
Italy	(1972)	--	20.0	49.7	28.0
Japan	(1982)	9.8	21.2	66.8	48.0
Luxembourg	(1972)	--	22.6	58.1	41.6
Netherlands	(1972)	--	25.2	50.3	32.1
United Kingdom	(1979)	13.8	24.4	52.4	30.5
	(1984)	--	--	51.8	29.8

Source: OECD 1984, Table 32; Bnechveman and Standridge 1991; Hamel 1963, 1967; Hayghe 1974; Horvath 1982; O'Boyle 1968; Sekscenski 1979; BLS Jan 1987)

of American workers had been on their current job for more than 5 years. With the exception of Australia, no other nation had such a low proportion of long tenure employees. The comparable proportions were 66.8 percent for Japan, 63 percent for Germany, 57.5 percent for France, 45.3 percent for Canada, and 50 to 52 percent for Belgium, Holland and 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 20 percent in the United Kingdom and 24 percent in Japan, national differences in turnover could be a major reason for the low levels of training investment in the US, if the employer's explanation is right (OECD, 1984, Table 33 and 34).

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 US firms (see section 3.5). 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 much 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 very low, 2 percent per month, 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. *More research is needed on the impact of expected turnover rates on investments in employer training and on the effect of turnover on the efficiency of the learning production function.*



Why Is Turnover so High in the United States? : One important reason why turnover is so high in the US 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 US. 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 US is that there are fewer legal and contractual obstacles to layoffs in the US (Sengenberger 1985; Flanagan 1986). Thirdly, turnover appears to be less costly for young American workers than for young German and young Japanese workers. It has already been noted that 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) 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 his apprenticeship after the probationary period will find it very difficult to get another one. As a result, about 95 percent of those who finish the first 3 months of their apprenticeship stick with it for the full three years and pass the performance exam that comes at the end. While, apprentices are not subject to layoff when there is slack work, journeymen are. Who is laid off is often based on job performance not seniority, so being laid off is more stigmatizing than it is 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.

The result is lower turnover, a higher payoff to employer investments in specific and general training, greater training investment and, as a result, strong productivity growth.

## 2.2 Cost of Capital

Turnover is not the only reason for the low levels of training investment in the United States. 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 provide (Mincer and Higuchi 1988).

### 2.3 Trainability of Workers

Levels: 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.<sup>5</sup> With a less capable work force, employers feel they are less able to introduce technologies and methods of operation (eg. small-lot production and flexible manufacturing systems) which require that workers be both highly trained and cross trained in a variety of skills (Weiss 1984, Prais 1989).

Rates of Change: Not only are levels of basic skills achievement low in the US; achievement levels of entering workers actually declined between 1967 and 1980. While basic skills have stagnated in the U.S., they have been dramatically improving in Europe and East Asia. As the learning ability and academic background of a workforce increases, technological progress becomes more rapid and optimal level of investment in equipment and training increase as well. *More research is needed on the impact of worker trainability on the productivity of investments in training and on incentives to invest in training.*

### 2.4 Lower Rates of Technological Progress

Studies by Mincer and Higuchi (1988), Bartel and Lichtenberg (1987) 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. However, not all of the growth rate gap is due to this catch up phenomenon.

## 2.5 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. 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.<sup>6</sup> 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.<sup>7</sup> Past experience with the former employees of a firm is probably the primary determinant of a firm's reputation as a trainer. Large 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. It is well known, for instance, that IBM and General Electric provide excellent training to their newly recruited junior executives. This positive reputation helps their separating employees find better jobs, and this in turn helps the firm recruit the best possible candidates when it is hiring. Even though a good reputation as a trainer forces them to pay higher wages in the post-training period, most firms have a strong interest in establishing such a reputation. 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 without a baccalaureate degree, 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 effects 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.

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. Formal systems for certifying the competencies gained through on-the-job training exist in the United States, but they have not achieved the widespread usage they deserve. 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 is 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 the training process 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. They are, however, teenagers who because they live at home are heavily subsidized by their parents. Consequently, the liquidity constraint that is such a barrier to heavy investments in general training in the US is much less of a problem in Germany. *More research is needed on the impact of credentialing systems on the payoff to training, on turnover, and on the willingness of workers to engage in training.*

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. 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.

### 3. FROM SOCIETY'S POINT OF VIEW "DO MOST US EMPLOYERS AND WORKERS UNDERINVEST IN ON-THE-JOB TRAINING?"

This section of the paper presents a preliminary review of what is known about whether the training market in the United States is failing to provide a socially optimal quantity and quality of employer training. Four potential sources of market failure--real externalities, tax induced distortions, liquidity constraints and government regulatory interventions which discourage training--are examined. Each of them are found to operate to some degree in some training markets. Then, empirical evidence on the market failure issue is examined in section 3.5 and 3.6. There appears to be a good deal of evidence that employers are sharing the costs and benefits of general training with employees. If so, the socially optimal level of training is likely to be greater than the level chosen by profit maximizing firms.

#### 3.1 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 Signalling 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 1989). 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's (1991) 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, benefitted customers and competitors at least as much as he benefitted 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 internalize some but not all of these costs. A study of egregious physician errors in New York State found that only one-eighth of them resulted in a malpractice claim. 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, un rewarded 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. *This is a controversial proposition. It would be desirable to fund a top theorist (eg. Nalebuff, Stigler or Akerloff) to examine the assumptions about the cost and quality of information about the quality of general training and the quality of goods are necessary to justify the standard assumption that all of the benefits of training are received by either the worker or the firm.*

### 3.2 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.<sup>6</sup> 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 they are rotated to a new job, the meticulous description of how the job is done written by its previous occupant is studied at home. 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. 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 substitutes for leisure time, that is what happens.

*It would, therefore, be very desirable to know more about the extent to which the time devoted to on-the-job learning results in a sacrifice of leisure either on or off the job. Interviews focussing on-the-job learning/training should therefore ask about what was sacrificed in order to undertake the learning activity.*

The Progressive Income Tax: The second tax induced distortion arises from the fact that investments in OJT are typically made at a time when the individual has no tax liability or a lower-than-normal marginal tax rate and the benefits are received when earnings and marginal tax rates are higher. As a result, the after-tax benefits of an OJT investment are reduced more than the after-tax costs and such investments are discouraged. 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.

### 3.3 High Borrowing Costs and Liquidity Constraints

The third reason why society subsidizes schooling is the failure of the free market (in the absence of publicly funded loan guarantee programs) 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.<sup>9</sup> If they do fund such investments, they do so only if extremely high rates of return are obtained.

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 assets which can be depleted nor access to credit at reasonable terms. Half of households headed by someone under the age of 25 have less than \$746 in financial assets and 19 percent have no financial assets at all. Half of households headed by someone between 25 and 34 have less than \$1514 in financial assets and 13 percent have none (Survey of Consumer Finances 1984). Subsidized or guaranteed student loans are not available to finance on-the-job training and banks will not lend money for this purpose without collateral. Borrowing against the equity in one's home is a possibility for some but only 34 percent of households with heads under the age of 35 own a home and many of the houses have been owned for only a short while, so the equity that can be borrowed against is small. Even with collateral, the loans available to individuals usually carry higher interest rates than those charged businesses. Studies of the willingness of consumers to substitute consumption over time have all concluded that the intertemporal elasticity of substitution is no higher than one and most studies conclude it is .5 or below (Friend and Blume 1975; Hall 1988; Hubbard and Judd 1986). A substitution elasticity of .5 implies that reducing a liquidity constrained worker's wage by one half (in order to pay for general training) roughly quadruples the worker's marginal utility of consumption. Such a worker would be willing to give up four dollars of future income in return for one dollar of current income. The liquidity constraint phenomenon has little effect on the wage profile of jobs requiring no general training and which, therefore, have a flat productivity 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.



### 3.4 Repairing Government Created Distortions

A fourth justification of public efforts to encourage greater on-the-job training is to undo the damage done by other government interventions in the labor market which discourage on-the-job training. With respect to investments in on-the-job training, the two most significant such interventions are the minimum wage and barriers to employer use of basic skills tests and high school grades as devices for selecting new workers.

Minimum Wage--The minimum wage prevents unskilled American workers from offering to pay for general training by accepting a sub-minimum wage during the training period. Providing training to a new employee is costly. The new employee is not very productive at first, and other workers must take time away from their regular activities to give instruction to the new hire. Many of the skills that the new employee learns have application in other firms as well. To avoid losing the worker to another firm, the employer that is providing the training must raise the wage as the trainee's productivity increases. Jobs that offer training and the prospect of future wage increases are more attractive than those that do not. The competition for these jobs will enable employers offering general training to obtain workers at lower wage rates.

Minimum wage legislation, however, prevents wage rates from falling below the legislated monetary figure. Lacking the ability to get new employees to pay a major share of the costs of general training (by accepting a low wage during the training period), 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 only in that firm--not elsewhere. Opportunities for promotion are minimal and wage increases are small or nonexistent.

A second impact of the minimum wage is that the forced increase in the starting wage 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. The predictions of theory have been confirmed by at least two studies (Hashimoto 1982, Leighton and Mincer 1981). *More research on the impact of the minimum wage on training on-the-job is needed.*

Barriers to Careful Selection of Entry Level Workers--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. Employers are not able to obtain good information on the skills and competencies of young job applicants. Employers believe that school performance is a good predictor of job performance<sup>10</sup>, 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 transcripts signed by job applicants to high schools in 1982 and received only 93 responses.

An additional barrier to the use of high school transcripts in selecting new employees is that when high schools do respond, it takes a great deal of time. In most high schools, the system for responding to transcript requests has been designed to meet the needs of college-bound students rather than the students who seek jobs immediately after graduating. The result is that a 1987 survey of a stratified random sample of small-and medium-sized employers who were members of the National Federation of Independent Business [NFIB] found that transcripts had been obtained prior to the selection decision for only 14.2% of the high school graduates hired.<sup>11</sup> Only 15% had asked high school graduates to report their grade point average. 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% of the cases and referred by someone else in the high school in only 2.7%.

Tests are available for measuring competency in reading, writing, mathematics, science, and problem solving, but, after the 1971 Griggs decision, almost all firms were forced to stop employment testing by EEOC guidelines which made it prohibitively costly to demonstrate the validity of tests assessing competence in English and mathematics.<sup>12</sup> Before such a test could be used, the firm had to conduct a very expensive validity study of the proposed test and alternative tests at their own work sites. Separate studies had to be done for men and women, blacks, hispanics and whites. Most firms did not have enough workers in each category to do a reliable study (Friedman and Williams 1982). Litigation costs and the potential liability are substantial. Using an event study methodology, Joni Hersch (1991) found that corporations that were the target of a class action discrimination suit that was important enough to appear in the Wall Street Journal experienced a 15 percent decline in their market value during the 61 day period surrounding the announcement of the suit. Companies became extremely cautious about testing and the result was to greatly diminish the use of tests for employee selection. A 1987 survey of the membership of the National Federation of Independent Business found that basic skills tests had been given in only 2.9 % of the hiring decisions studied.

Other countries handle the signaling of high school accomplishments to prospective employers much more effectively and have much lower turnover rates as a result. *More research is needed on the impact of governmental restrictions on the flow of information about the qualifications of young workers on turnover rates.*

### 3.5 Evidence of Underinvestment from the High Rates of Return to OJT

If there is underinvestment 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 investments by workers find that rates of return are very high. For instance, after adjusting for inflation, the real rate of return to OJT investments by the worker was 12.6 percent per year for those who went to college and 19 percent for those who did not attend college (Rosen 1982). These rates of return are considerably higher than the real rates of return of about 4 percent on corporate bonds and of about 5 percent for schooling. Some estimates of rates of return to training are even higher (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.<sup>13</sup> The total returns to employer and employee investments (both general and firm specific) have not been evaluated because data on productivity effects was lacking. *If credible and reliable estimates of rates of return to training (either the wage returns received by workers or the productivity returns shared by firms and workers) could be obtained, funding such research would be very worthwhile, even if costs were very high. The results would tell us a lot about whether training is underprovided. For the reasons cited in section 1.2, however, I am quite pessimistic that such a study is feasible.*

### 3.5 Do Employers Share the Costs of General Training?

An easier way to empirically examine the issue of the underprovision of training is to study whether the training market indeed behaves in the way predicted by standard theory. The theory of on-the-job training says that for general training, the worker pays the full costs of the 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?** If it is false and employers are being induced to share the costs of general training by the prospect of sharing its benefits, underprovision of general training is probable. It probably means that workers are liquidity constrained or 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 productivity benefits the firm will receive if the worker stays at the firm to the training costs they are incurring. 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 underprovision results. Therefore, it is important to determine whether employers are sharing the costs of general training. What do we now know about this issue?

Cross-section Studies of Starting Wage Rates: Standard theory predicts that workers who find jobs which 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. Bishop and Kang (1988) have conducted another test of this hypothesis in the 1984 follow up of the High School and Beyond seniors by regressing the log of the deflated starting wage of the current or most recent job on indicators of the receipt of employer sponsored training. Here again, the jobs offering some training rather than none or which offer greater amounts of training paid higher starting wage rates even when a whole array of human capital characteristics were controlled. For females the positive effect of receiving training on the starting wage was statistically significant. Adding dummies for occupation and industry did not change the results appreciably. Lillard 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 of 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.

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. 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 analyst) are both paid more and also recruited for jobs that 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 estimated by Parsons (1985) and by Bishop and Kang (1988) failed to find large effects of ability proxies such as test scores, grades, and being a disciplined student on the probability of receiving training.

Further evidence that unobserved heterogeneity can not explain these anomalous findings comes from two types of studies which avoid the unobserved heterogeneity problem by holding the individual being trained constant: (a) detailed studies of the costs of apprenticeship training and who pays these costs and (b) econometric analyses which compare the productivity growth and wage growth impacts of general training received by the individual. *Replications of these studies in other data sets are highly desirable.*

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 high turnover rates, 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. *Replication of these studies is highly desirable.*

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. An analysis of EOPP data on training is presented in Appendix A which contradicts this prediction. When proportionate rates of wage and productivity growth during the first year or two of tenure on a job are regressed on time spent training the individual, productivity effects are many multiples larger than wage effects (Bishop forthcoming). How can these puzzling results be explained?

One possible explanation of these anomalous findings is that the training is specific to the employer and the employer is financing all of its costs. But standard models of the sharing of the costs of specific training do

not predict that employers pay all of its costs and some of the new revisionist theories--Salop and Salop's (1976) adverse selection theory--predict that employers pay none of the costs of specific training. A specific training explanation of these findings is particularly perplexing when to all outward appearances the training is largely general, as is the case with apprenticeships. In fact in the EOPP study employers were asked how useful the skills being learned by new employees are at other firms, and most responded that they were quite useful. When training was done by managers and the skills were reported to be entirely general, doubling training intensity raised productivity by 6.7 percent but wages by only 0.8 percent in a logarithmic model and raised productivity by 3 percent while increasing wage growth by only 0.96 percent in a linear model. *Replication of this study in other data sets should receive high priority.*

Why might it be rational for employers to finance training in skills which they describe as useful at other firms? One explanation of the phenomenon is that 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. As a result, the package of general skills that workers develop are always more valuable at the training firm than at other firms even when each individual skill is correctly perceived to be useful elsewhere.

A second reason why the market may behave as if general skills are effectively specific to the firm is that other employers will generally be ignorant of the exact character of a new hire's general skills and, consequently, may not assign the worker to a job that puts the skills to work. 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 entry wages. **These phenomena have the effect of transforming some skills which are technically general into skills which are effectively specific to the firm.** To the extent training is effectively specific, wages will rise more slowly than productivity net of training cost (Bishop and Kang 1984, 1988).

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 Appendix Table 1, 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 workers are more willing to contribute to its costs.

The third reason why general training may masquerade as specific training is the inability/unwillingness of most young workers (the ones who have the greatest need for general training) to finance large amounts of general on-the-job 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.

If, as argued above, employers are sharing the costs and benefits of training that develops skills that are useful at other firms, underprovision of such training is going to result if turnover rates are non trivial.

#### 4. CAN VOCATIONAL TRAINING IN SCHOOLS SUBSTITUTE FOR EMPLOYER TRAINING ?

Many societies have tried to deal with the presumed tendency of employers and workers to underinvest in skill training by establishing school based occupational training programs. While high quality occupational training offered by schools ameliorates the problem of under provision of skill training, school based training cannot replace some kinds of employer training and is generally less effective than employer provided training in the same skills. There are a number of advantages to locating skill training at firms rather than schools.

Advantages of Locating Occupational Training at the Work Site: Often, training in a skill can only be organized by the employer. This is obviously the case when skills are specific to the firm or partially specific to the firm, but is also sometimes the case for completely general skills as well. General skills are often easier to learn when they are integrated into a training program that is specific to the context of a particular firm. The need for particular general skills is often generated by the introduction of new technology and new equipment or a reorganization of the business. The firm must select which skill is to be taught and when. Since firms quite reasonably desire to have all employees use the same word processing and financial analysis programs, the selection of such a program must be centralized. IBM first developed the FORTRAN computer language and then taught it to its employees and customers. Colleges and universities eventually offered courses in FORTRAN, but it took many years for schools to take over the bulk of the teaching of this very general skill.

Even when the same skills are to be taught, employer provided training is generally more effective than school based training? Seven reasons appear to account for this. First, most individuals who obtain occupational training from a school do not obtain jobs in the occupation they studied in school, while most of those trained by an employer stay in the occupation. For graduates of vocational training programs in the US, only 43 percent of the employed graduates out of school between one and ten years had a training related job (broadly defined) in the 1985 National Longitudinal Survey of Youth (Campbell *et al.*, 1987). Other studies of high school vocational education using the same methodology obtain similar results. Felstehausen's (1973) study of 1981 vocational graduates in Illinois found training related placement rates of 27 percent in business occupations, 17 percent in trade and industry, 52 percent in health, and 20 percent in agriculture. Conroy and Diamond's study (1976) of Massachusetts graduates obtained a training related placement rate of 29 percent for business and 37 percent for trades and industry. High school vocational education is not the only occupational skills training program with low training related placement rates. The proportion of CETA participants whose occupational field 12 months after completion of classroom training matched their field of training was only 41 percent for

clerical training, 39 percent for training in operative occupations and 29 to 32 percent for professional and craft training (Barnow 1985).

When, on the other hand, employers are heavily involved in providing occupational training, it is much more likely to be used. Mangum and Ball (1986) found in their analyses of NLS data that employer controlled training institutions have much higher training related placement rates. Using a procedure of matching training fields against jobs, they found that the proportion of male graduates who had at least one job in a related field was 85 percent for company training and 71 percent for apprenticeship but only 52 percent for vocational-technical institutes and 22 percent for proprietary business colleges. The rates for females were 82 percent for company training but only 59 percent for nursing schools, 61 percent for vocational-technical institutes and 55 percent for proprietary business colleges. Six months after passing a German apprenticeship examination, 68 percent of those with civilian jobs were employed in the occupation for which they were trained (much more narrowly defined) (Federal Institute for Vocational Training, 1986).<sup>14</sup>

The second reason why learning skills on a job is to be preferred to learning those skills in a classroom is the fact that trainees are well-motivated because skills developed are almost certain to be used, and because promotions and pay increases go to those who do well. Third, the training is generally tutorial in nature and this is known to be an effective teaching method. Fourth, training is generally done by supervisors and coworkers who are aware of the trainee's progress and can give necessary corrective instruction. Fifth, the equipment and materials necessary to the training are generally readily available at the work site and time on the machine for the trainee can generally be arranged without disrupting production. When schools provide the training, equipment must be specially purchased and keeping the equipment up-to-date is often prohibitively expensive. Sixth, the trainer (not just the trainee) is held accountable for success since the training is designed to increase productivity and supervisor/trainers are held accountable for the productivity of the work group. Finally, when employers provide training the trainee's time tends to be used much more efficiently. Because they are paying for both the trainer and the trainee's time and receive most of the benefits, employers have much stronger incentives to select cost effective training strategies than schools which neither pay the time costs of the trainee nor receive any of the direct benefits of the skills that are developed.

Advantages of School Based Occupational Training: School based occupational training is not without its advantages. First, school based occupational training systems can be structured to allow individuals to select the occupation for which they will prepare and to offer scheduling flexibility to the learner. Firm based systems cannot be so structured. When firms provide occupational training, competition to enter an occupation occurs before training rather after. Secondly, when trainers with the necessary expertise are scarce, schools are a way to get the maximum out of a limited supply of expert trainers. Even very large enterprises often do not have a sufficient flow of trainees requiring instruction in a particular subject to warrant developing in house the expertise necessary to teach that subject.



Thirdly, many enterprises are too small to mount training by themselves and so are forced to rely on training programs organized by schools and trade associations. For skills that are teachable in a classroom environment, schools can achieve significant economies of scale by putting one teacher in front of many students and by having one teacher teach the same course to different groups of students. The teaching experience such teachers accumulate presumably improves their teaching skills. Finally, certification of skills is made easier by the centralization of the training function into a smaller number of institutions.

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### ENDNOTES

1. If the arithmetic mean were being reported these numbers would be considerably larger. Nevertheless these numbers seem low especially for professional and managerial jobs.
2. 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.
3. Indeed, some of the competencies that SCANS claims to be generic such as budgeting, technical, scheduling, and problem solving may be context or occupation specific and not generic.
4. This characterization of the NOCTI exams is based on a conversation with Bruce Broman, Coordinator of special projects at NOCTI, 616-796-4695. NOCTI retains the answer sheets for as much as 10 years so it would not be too difficult to develop data on how particular items were answered by different groups of students and how this has changed over the course of the 1980s. Many school systems administer the exam as a pretest to students beginning a vocational program so it might also be possible to study the gains made on NOCTI exams as a function of characteristics of the student and the training program.
5. Another consequence of the poor preparation that American students receive in high school is that comparisons across countries of secondary school graduation rates and college entry rates are quite misleading. We are justly proud that 60 percent of high school graduates now enter college (Bureau of Labor Statistics June 26, 1990), but most college freshmen and sophomores are studying material that Europeans study in secondary school and most college entrants never complete a bachelors degree. The poor preparation of students in high school and the absence of rigorous standards for admission to degree credit programs in college has resulted in high college drop out rates. Participation in postsecondary education is expanding rapidly in other industrialized nations. For males, the ratio of higher education graduates to the population 24 years old is 33 percent for Japan, 25 percent for the United States, 20.6 percent for Canada, and 14-16 percent for England, France and Germany (NCES 1990, Indicator 2.8). Demand for highly educated workers has grown very rapidly during the last 30 years. After a slump during the 1970s, the wage premiums for college educated workers are now higher than in other industrialized countries and significantly higher than ever before during the postwar period. The very high payoff to completing a college degree has stimulated only a modest increase in rates of college completion, however. For the high school class of 1980, only 18.8 percent had obtained a bachelors degree by February 1986 (NCES 1991). In the absence of major improvements in American secondary education, it is not unreasonable to project that by the year 2010 that Canada and much of the continental Europe will graduate a larger share of their 25 year olds from college than we do. Since highly educated workers receive substantially more training from their employers, these trends suggest that employer investments in training may well be growing more rapidly overseas than in the US.
6. 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).

7. 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.
8. 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. In fact, however, some training costs are not deductible and tax rates are generally higher when benefits are being received than when costs are being incurred, so the tax system discourages training investments.
9. 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)."
10. Policy capturing experiments have found that employers give substantially higher ratings to job applicants with high grade point averages (Hollenbeck and Smith 1984).

11. The survey was of a stratified random sample of the NFIB membership. 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.
12. The Supreme Court's decision in the Wards Cove Packing Case has made it easier for employers to defend the use of selection methods that produce adverse impact and has therefore opened the door for increased use of employment tests. It appears that employers will be able to justify the use of employment tests without having to undertake costly validity studies in their own firm by citing validity research done for similar jobs in other firms. Congress is considering legislation that would reverse Wards Cove and make it even harder to defend the use of selection procedures which have adverse impact than under the Griggs precedent. If this legislation passes, the ability of firms to make wise hiring decisions will deteriorate even more.
13. 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. Similar results have been obtained in other data sets (Parsons 1985, Bishop and Kang 1988, Barron, Black and Loewenstein 1989). While the positive association between current training and current earnings is probably due to the omission of unobserved worker quality, it strains credibility that the true earnings sacrifice is 20-25 percent of a years wages when multivariate models that include schooling, test scores, actual work experience and a host of other variables indicate a positive effect of current training on current wages. 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.
14. The U.S. rate of training related placement might have been somewhat higher if measured 6 months after high school graduation. However, the German definitions of relatedness are more rigorous and applying them to U.S. data would have lowered training related placement rates. High unemployment rates no doubt contribute to the low rates of training related placement in the U.S. However, aggregate differential between the countries in training related placement cannot be attributed to differentials in the general tightness of labor markets.

APPENDIX ON THE EOPP EMPLOYER SURVEY  
AND  
THE MEASUREMENT OF TRAINING AND PRODUCTIVITY GROWTH

The analysis is based on data from a survey of 3,412 employers sponsored by the National Institute on Education (NIE) and the National Center for Research in Vocational Education (NCRVE) conducted between February and June 1982. The survey was the second wave of a two-wave longitudinal survey of employers from selected geographic areas across the country. The first wave was funded by the U.S. Department of Labor to collect data on area labor market effects of the Employment Opportunity Pilot Projects (EOPP). The survey encompassed 10 EOPP pilot sites and 18 comparison sites selected for their similarity to the pilot sites. The ES-202 lists of companies paying unemployment insurance taxes provided the sample frame for the survey. Because of the interest in low wage labor markets, the sample design specified that establishments in industries with a relatively high proportion of low-wage workers be over sampled. The tax paying units were stratified by the estimated number of low wage employees and the number of establishments selected from each strata was roughly in proportion to the estimated number of low wage workers at the establishments in that strata. Within strata the selection was random. The survey was conducted over the phone and obtained a response rate of 75 percent.

The second wave attempted to interview all of the respondents in the first-wave survey. About 70 percent of the original respondents completed surveys for the second wave. Most of the respondents were the owner/manager of small firms who were quite familiar with the performance of each of the firm's employees. Seventy percent of the establishments had fewer than 50 employees, and only 12 percent had more than 200 employees. In large organizations the primary respondent was the person in charge of hiring, generally the personnel officer. If the primary respondent was unable to answer questions about the training received by newly hired workers in the sampled job, that part of the interview was completed by talking to a supervisor or someone else with line responsibility.

The employers who received the full questionnaire 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." Only 2594 employers had hired someone in the time frame requested and these employers constitute the sample used in the study.

The respondent was asked to report how much time typical new hires for this job spent during the first three months of employment in four different kinds of training activities: (1) watching others do the job rather than doing it themselves, (2) formal training programs, (3) informal individualized training and extra supervision by management and line supervisors, and (4) informal individualized training and extra supervision by co-workers. For the sample of firms and jobs, the means for the typical worker were 47.3 hours watching others do the job ( $T_w$ ), 10.7 hours for formal training programs ( $T_f$ ), 51 hours for informal training by management ( $T_s$ ), 24.2

hours for informal training by co-workers ( $T_C$ ). A copy of the relevant portions of the questionnaire is available from the author.

A training time index was constructed by first valuing trainer and trainee time relative to that of workers with two years of tenure in that job and then combining the time invested in training activities during the first three months on the job. The employers reported that workers with two years of tenure in the job averaged between 22 and 50 percent (depending on occupation and other worker characteristics) more productive than new hires during their first three months on the job. This ratio was calculated for each job/worker category and used to place a relative value on coworker time devoted to training.<sup>1</sup> The management staff members who provide formal and informal training were assumed to be paid 1.5 times the wage of coworkers with 2 years of tenure. Formal training involves both the trainer and trainee's time. Sometimes it is one-on-one and sometimes it is done in groups. It was assumed that the average ratio of trainees to trainers was 3 and that the value of the trainer's time (including the amortized cost of developing the training package) was three times the wage of a coworker with two years of tenure. When supervisors and coworkers are giving informal training to a new employee, the trainee is almost invariably directly involved in a production activity. Employers report that for informal training, the trainees are typically as productive while being trained as they are when working alone (Hollenbeck and Smith 1984). Consequently, informal training is assumed to involve only the investment of the trainer's time. Thus in units of coworker time the value of trainer time is:

$$(a1) \text{ Valued Trainer Time} = T_C + 1.5 * T_S + T_F$$

In units of trainee time, the time the trainee spends not producing because of training activities is:

$$(a2) \text{ Trainee Time} = T_W + T_F$$

The total investment in training in trainee time units<sup>2</sup> is:

$$(a3) \text{ Total Training Investment} = T_W + T_F + (T_C + 1.5 * T_S + T_F) / RP.$$

where

RP = the productivity of the average new hire during the first 3 months divided by the productivity of typical worker with two years' tenure

The arithmetic mean of this index is 209 hours, implying that the value of the time invested in training a typical new employee in the first three months is about 40 percent of the output that the trainee can produce working full-time during the first three months on the job.

The survey asked the employer (or in larger firms the immediate supervisor) to report on productivity of the typical individual hired in the job after two weeks, during the next 11 weeks and at the end of two years at the firm. The rating was made on a "scale of zero to 100 where 100 equals the maximum productivity rating any of your employees in (NAME'S) position can obtain and zero is absolutely no productivity by your employee." For the full data set at the mean values of these indexes of reported productivity were 49.0 for the

first two weeks, 64.6 for the next 11 weeks and 81.4 at the time of the interview. The questions asking for a rating of the productivity of particular workers had a nonresponse rate of only 4.4 percent. Comparably defined nonresponse rates for other questions were 8.2 percent for previous relevant experience, 3.2 percent for age, 6.7 percent for education, 8.6 percent for time spent in informal training by supervisor, and 5.7 percent for a three-question sequence from which starting wage rate is calculated. The low-nonresponse rate implies that our respondents felt that they were capable of making such judgments and augur well for the quality of the data that results.

The interview questions about the productivity of recently hired employees do not measure productivity in any absolute sense and therefore are not comparable across firms or across jobs in a firm. Rather, they are intended as ratio scale indicators of the relative productivity of a typical (or a particular) worker at different points in their tenure at a firm. Under an assumption that these productivity indexes are proportional transformations of true productivity plus a random error, percentage differences in cell means of the productivity index will be unbiased estimators of percentage differences in true productivity. If the variations in the productivity scores assigned by supervisors exaggerate the proportionate variations in the true productivity, our estimates of percentage differences in productivity between two workers will be biased upward. Even though it is possible for a worker's true productivity to be negative, the scale was defined as having a lower limit of zero. Floors and ceilings on a scale typically cause measurement errors to be negatively correlated with the true value. If this is the case, then our estimates of percentage differences in productivity between two workers will be biased downward. This latter type of bias appears to be more likely than the former.

Further evidence that the proportionality assumption results in an understatement of percentage differences in productivity between individual workers doing the same job comes from comparing the coefficients of variation of productivity in this and other data sets. If pairs of workers who are still at the firm are used to construct a coefficient of variation for this data set, it averages .13 for sales clerks, clerical, service and blue collar workers. This estimate of the coefficient of variation is smaller than the estimates of the coefficient of variation for yearly output derived from analysis of objective ratio scale measures of output. These estimates were .35 for sales clerks, .144 for semi-skilled blue collar workers, .28 in craft jobs, .164 for workers in routine clerical jobs and .278 in clerical jobs with decision making responsibilities (Hunter, Schmidt and Judiesch 1988). This means that the estimates of the effect of training on productivity growth reported in this paper are probably conservative. The fact that the employer is reporting on the past productivity of particular employees may also generate biases in data but it is not clear how estimates of productivity growth rates might be influenced by this problem.

## 2. Impact of Training on Worker Productivity

The learning curve is very steep during the first 2 years of employment at a firm. A part of this productivity increase is due to learning by doing and occurs even in the absence of training. Formal and informal training are responsible for a major portion of the productivity growth, however. In this section, an effort will be made to determine how much of the gain in productivity is due to training, to calculate which training methods are most effective and to assess the rate of return to training investments.

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

The measures of time spent in specific training activities in the first 3 months on the job are measures of training intensity rather than of aggregate training investment during the first 2 years on the job. Consequently, the reported required length of training--the log of the weeks before a new employee becomes fully trained and qualified--was also included in the model. A full set of controls for job, occupation, and firm characteristics was included in each model. The control variables included the characteristics of the new hire, the occupation, SVP, and GED of the job, percent of craft workers and percent of skilled workers at the firm, the cost of machinery used in the job, unionization, importance of vocational training in selection, percentage of the firm's work force under age 25, and reported difficulty in finding reliable unskilled workers. The specification used was the following:

$$(a4) \quad P_{2YR} - P_{2WK} = \underline{AX} + a_1 \ln L + a_2 T_F + a_3 T_S + a_4 T_C + a_5 T_W + a_6 T^2 + u$$

where  $\underline{X}$  = a vector of control variables listed in Table A1 ( $\underline{A}$  is a vector of coefficients on these control variables)

$\ln L$  = logarithm of the required length of training

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

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

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

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



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

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

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

The results of estimating equation a4 are reported in table A1. The regression with the logged productivity growth as dependent variable is in column 1. Regressions predicting the linear measure of productivity growth are in columns 2 and 3. In both models, the coefficient on the square term is negative and statistically significant indicating that there are diminishing returns to training intensity. When the square of total training intensity is included in the model, all four of the linear terms for particular forms of training have positive and statistically significant effects on productivity growth. The effect of training intensity on productivity is quite large. An increase in any of the training activities from 0 to 100 hours raises the worker's productivity by 13 to 15 percent in the logarithmic models and by 4 to 7.7 percent (calculated at the mean level of productivity at the end of two years) in the linear models. Clearly when training intensity is low, increases in its intensity will produce large increases in worker productivity. The length of training also has large positive effects on productivity growth.<sup>3</sup>

The total effect of training on productivity growth was calculated by multiplying the six estimated coefficients by mean values of the corresponding variables. The calculated increase in productivity was 22 percent (32 percent of the gain over the first two years) in the logarithmic model and 12 percent of final levels of productivity (28 percent of the gain) in the linear model.

An alternative approach to estimating the impacts of training is to examine the productivity growth of particular new hires. Column 3 of Table A1 presents results using productivity data on a particular new hire rather than a typical new hire. Missing data reduces sample sizes by about 100. The variance of productivity growth across firms is larger when actual individuals are the data rather than typical individuals. R squares of the models are slightly higher, however, because characteristics of the worker and the worker's tenure at the time of the interview are included in the structural model of productivity growth. In order to reduce simultaneity problems, the training variables used in these models were for a typical new hire rather than for that particular new hire. Comparisons of the coefficients in column 2 and 3 reveal that substituting data on productivity growth outcomes of particular individuals for data on typical hires and controlling for personal characteristics does not change the estimated effects of training.

The impacts of each type of training are remarkably similar. This was not anticipated because some forms of training (e.g., formal training) have higher hourly costs than others (e.g., watching others do the work),

**Table A1**  
**Impact of Training on Wage and Productivity Growth**

	Productivity Growth			Wage Growth (log)	
	Typical Worker (log 2 Yrs.)	Typical Worker (linear 2 Yrs.)	Particular Individual Linear (1.1 Yrs)	Typical (2 Yrs)	Particular Individual (1.1 Yrs)
<i>Ln</i> Length of Training	.068*** (6.43)	.032*** (6.09)	.025*** (4.36)	.010*** (2.84)	.008** (2.49)
<u>Hrs. of Training in first quarter</u>					
Formal Training (100's)	.133*** (3.06)	.046** (2.14)	.048** (2.10)	.043*** (3.13)	.027** (2.05)
Training by Supervisors (100's)	.130*** (3.85)	.067*** (4.01)	.043** (2.44)	.020* (1.83)	.017 (1.61)
Training by Co-workers (100's)	.145*** (4.92)	.077*** (5.30)	.057*** (3.70)	.001 (.15)	-.002 (.25)
Watching Others (100's)	.149*** (7.37)	.053*** (5.30)	.046*** (4.32)	.017** (2.54)	.016** (2.55)
Training Intensity Squared (10,000's)	-.0085** (2.27)	-.0049** (2.61)	-.0050* (2.53)	-.0011 (.92)	-.0011 (.97)
Standard Error of Estimate	.597	.295	.308	.187	.178
R <sup>2</sup>	.171	.129	.135	.198	.233
Number of Observations	2116	2116	2002	1986	1963
* Significant at the 10% level (two-sided)					
** Significant at the 5% level (two-sided)					
*** Significant at the 1% level (two-sided)					

and this was expected to result in the more expensive forms of training having larger marginal impacts on productivity than the cheaper forms. Measured in the units of productivity of a worker with 2 years of tenure on the job, the hourly cost of learning by watching others is approximately .8. Formal training with an assumed cost factor of 1.8 is the most expensive because it requires the time of both the trainee and the trainer. The cost factor for informal training by supervisors (1.5) and for informal training by co-workers (1.0) lie between these two extremes because the trainee is engaged in production and only the time of the supervisor and co-worker must be charged off as a cost of training. If one accepts these estimates of the relative hourly cost of different forms of training, the results imply that informal training has higher rates of return than formal training. A further implication is that within the informal training category, co-worker training and training yourself by watching others have the highest rate of return.<sup>4</sup>

### 3. Impact of Training on Wage Growth

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

These issues were addressed by estimating wage growth counterparts to the productivity growth models presented in Tables A1. The first dependent variable studied was the log of the ratio of the firm's current wage for a worker with 2 years of tenure to the actual starting wage of a person who had recently been hired for the position. Models predicting this variable control for the effects of wage inflation by including the date of hire and its square in the specification. The results are presented in column 4 of Table A1.

The second dependent variable is the log of the ratio of the current wage rate (or most recent wage if there has been a separation) and the starting wage rate for a particular new employee who was hired on average 14 months earlier. The model predicting this variable is presented in column 5 of table A1. The control variables are the same as those used in the productivity growth models.

The first conclusion that can be drawn from an examination of the wage growth results is that training does have the hypothesized positive effect on wage growth. The effect is statistically significant in almost all of the models. Comparisons of these coefficients with the estimates of the impact of training on productivity growth, however, reveal that training has a much smaller impact on wage growth than it has on productivity

growth. In table A1 an increase in informal training from 0 to 100 hours raises productivity of typical employees by 13 to 15 percent in the logarithmic model and 5.3 to 7.7 percent in the linear model, but raises wage rates by only .1 to 2.0 percent. A doubling of the length of training raises productivity by 2.2 to 4.8 percent, but wage rates rise only 0.7 percent. In Bishop 1990 it is shown that this pattern of results prevails even when the employer reports that all of the skills learned on the job are useful at other firms.

## ENDNOTES FOR APPENDIX

1. The use of the ratio to estimate the relative productivity implicitly involves an assumption that the productivity reports received from employers are a proportional transformation of true productivity plus a random error. It is assumed that the unknown factor of proportionality can be different for every job, every firm and every respondent but a single respondent always uses the same proportionality factor when answering our questions. If alternatively it were assumed that these reports exaggerate the rate of growth of productivity with tenure by a factor of 2, estimates of training investment would be 7 to 15 percent lower. Comparisons across occupations or of new hires with different qualifications would not change appreciably.
2. The index was constructed under an assumption that the four training activities were mutually exclusive. This implies that if the sum of the hours devoted to individual activities is greater than 520, that a reporting error has occurred which overstates investment of training. In the few cases where the sum of hours devoted to training exceeded 520, the training time index was adjusted downward by the ratio of 520 to the sum of the hours reported for individual activities. This procedure reduces the mean of the index by about 10 percent. The cost of the trainer and amortization of training package development costs was assumed to be two-thirds of the foregone productivity of a supervisor, since formal training often spreads fixed costs over more than one trainee. Thus  $1.8 = (2/3)1.5 + .8$ .
3. To test for possible effects of measurement error and simultaneity bias, instrumental variables estimates were obtained for a simple model containing only three training variables-- logarithm of training length, training intensity, and training intensity squared. The variable used as instruments for length and intensity of training were: the number of alternative employers, dummies for industry, the growth rate of employment, the growth rate of sales, the number of employees at the establishment, the size of firm, the wage rate, a dummy for wage at or below the minimum wage, a dummy for temporary job, dummies for no probationary period, the log of length of the probationary period, dummies for not knowing if there is a probationary period, a measure of the difficulty of firing a worker after the probationary period is ended, a measure of the importance of seniority in determining who is laid off, and characteristics of the local labor market. It appears that measurement error is a problem in the training intensity variable, for the IV estimates for this variable remain highly significant and become about three times larger. The IV estimates for length of training have a negative sign.
4. Measurement error may bias these coefficients in a way that makes these findings stronger. Our respondent (generally a boss, supervisor, or personnel manager) probably had better knowledge of time spent in formal training and informal training by supervisors than of time spent in other forms of training. This should have resulted in the coefficients on these forms of training having a smaller measurement error bias than the coefficients on informal training by co-workers and time spent watching others. Thus, correcting for measurement error in the individual indicators might raise the coefficients on these last two forms of training by more than it raises the coefficients on formal training.



8. What percentage of those hired for this job are typically **not** with the firm at the end of a year for any reason. (Mark one)
- |                |        |        |        |                |    |
|----------------|--------|--------|--------|----------------|----|
| 1. 10% or less | 3. 30% | 5. 50% | 7. 70% | 9. 90% or more |    |
| 2. 20%         | 4. 40% | 6. 60% | 8. 80% |                | 38 |
9. Are the workers in this job covered by a collective bargaining contract? (Mark one.)
- |        |    |
|--------|----|
| 1. Yes | 39 |
| 2. No  |    |
10. What share of the skills learned by new employees in this job are useful **outside** of your firm? (Mark one.)
- |                  |         |    |
|------------------|---------|----|
| 1) All .....     | 90-100% | 40 |
| 2) Most .....    | 61- 89% |    |
| 3) Half .....    | 40- 60% |    |
| 4) Some .....    | 11- 39% |    |
| 5) Minimal ..... | 0- 10%  |    |
11. How many other firms in the local labor market have jobs similar to this one? (Mark one)
- |                 |    |
|-----------------|----|
| 1) Less than 10 | 41 |
| 2) 10-24        |    |
| 3) 25-100       |    |
| 4) Over 100     |    |
12. If it were purchased today, what would be the cost of the most expensive machine (including vehicles) employees in this job work with? (Mark one.)
- |                     |    |
|---------------------|----|
| 1) Under \$2,000    | 42 |
| 2) \$2-\$10,000     |    |
| 3) \$10-\$50,000    |    |
| 4) \$50-\$200,000   |    |
| 5) \$200,000 and up |    |
13. How are people in this job paid? (Mark all that apply.)
- |  |    |
|--|----|
| 1. Hourly wages or salary  | 43 |
| 2. Individual Incentives, e.g. commissions, tips piece rates, etc. |    |
| 3. Group Incentives, e.g. profit sharing, etc.                     |    |

Please think of the last person hired for this job (job X) by your firm prior to August 1986 regardless of whether that person is still employed by your firm. Call this individual person A. The individual hired for job X immediately before person A is called person B. Do not include rehires of former employees. Please give us the following information on these individuals.

	Person A	Person B	
If no such person hired check box and do not complete column.		<input type="checkbox"/>	44
When was the individual hired?	/	/	45-4
	mo yr	mo yr	
Age at time of hire	_____ years	_____ years	51-4
Sex	1. M 2. F	1. M 2. F	55-4
Ethnicity	1. Caucasian 2. Black 3. Hispanic 4. Oriental 5. Other _____	1. Caucasian 2. Black 3. Hispanic 4. Oriental 5. Other _____	57-4
Was the new hire married?	1. Yes 2. No	1. Yes 2. No	59-4
Years of formal schooling, e.g. high school grad. = 12, college grad. = 16	_____ years	_____ years	61-4
Did A/B receive relevant occupationally specific training in a school or the military. (Check all that apply.)	1. None 2. Yes, from public inst. 3. Yes, from private inst. 4. Yes, from military 5. Yes, from JTPA, etc.	1. None 2. Yes, from public inst. 3. Yes, from private inst. 4. Yes, from military 5. Yes, from JTPA, etc.	65-4
Number of years of occupationally specific training in school.	_____ years	_____ years	67-7
Years of relevant work experience in jobs that had some application to job X. (If less than 1 year, mark 1/2 or 1/4, etc.)	_____ years	_____ years	71-7
Did A/B receive any relevant formal training from previous employers? (Mark all that apply)	1. On sight 2. Off sight 3. No	1. On sight 2. Off sight 3. No	77-7 79-8 81-8
Prior to being hired, did the individual know anyone working at the firm?	1. Yes 2. No 3. Don't know	1. Yes 2. No 3. Don't know	83-8

How did this individual hear of your job opening?  
(Check one only.)

Person A	Person B	
1. Walk in	1. Walk in	85
2. Advertisement	2. Advertisement	
3. Friend/relative	3. Friend/relative	
4. Other employee	4. Other employee	
5. Referral, e.g. school, employment agency, etc.	5. Referral, e.g. school, employment agency, etc.	
6. Other	6. Other	

Which of the following types of information were obtained about A/B prior to hiring? (Mark the appropriate types.)

a. High school or college transcript	1	2	87-8
b. Self-reported school grades	1	2	89-9
c. Performance test, e.g. typing test, drivers test, job try-out	1	2	91-9
d. Aptitude test, e.g. GATB, ASVAB	1	2	
Test Name: _____	1	2	93-9
e. Certificate of training received on prior job	1	2	95-9

Prior to hiring, did you obtain a referral or recommendation (written or oral) from: (Mark the appropriate sources)

a. Immediate supervisor or previous job(s)	1	2	1-2
b. Personnel office at previous job(s)	1	2	3-4
c. Private employment agency	1	2	5-6
d. Public employment agency	1	2	7-8
e. JTPA or community based organization	1	2	9-10
f. Vocational rehabilitation agency	1	2	11-1
g. Current (at the time of hiring) employee	1	2	13-1
h. Regular customer(s) or supplier(s)	1	2	15-1
i. Relative or personal friend of yours	1	2	17-1
j. High school vocational teacher or major professor in college	1	2	19-2
k. Other teachers, principal, school placement office, etc.	1	2	21-2
l. Other (please specify) _____	1	2	23-2

Was (were) the contact(s) a referral(s) or a recommendation(s)?  
(Mark all that apply.)

1. Referral	1. Referral	25-2
2. Written recommend	2. Written recommend	27-2
3. Oral recommend	3. Oral recommend	29-3

Had you ever hired someone on this person's recommendation before?

1. Yes	1. Yes	31-3
2. No	2. No	
3. Some of both	3. Some of both	

Was the job supposed to be temporary when you hired (him/her)?

1. Temp/Seasonal	1. Temp/Seasonal	35-3
2. Permanent	2. Permanent	

Is (he/she) still with the firm?

1. Yes	1. Yes	35-3
2. No	2. No	

If not, when did he/she leave?

____ / ____	____ / ____	37-4
mo    yr	mo    yr	

What kind of separation was it?

Person A	Person B	
1. Layoff	1. Layoff	43-4
2. Discharge	2. Discharge	
3. Induced resignation	3. Induced resignation	
4. Voluntary resignation	4. Voluntary resignation	
5. Other _____	5. Other _____	

What was his/her starting wage?  
(Please include commissions, tips and incentive pay.)

6. _____ per hr	6. _____ per hr	45-4
or	or	
6. _____ per month	6. _____ per month	51-5

What is her/his current wage?  
(Please include commissions and incentive pay.  
If left firm report wage at time of separation.)

6. _____ per hr	6. _____ per hr	59-5
or	or	
6. _____ per month	6. _____ per month	65-7

If this employee were to seek a job at another firm, about how much less (or more) would he/she probably be paid in a new job compared to what he/she is earning now?

1. 15% less	1. 15% less	73-7
2. 10% less	2. 10% less	
3. 5% less	3. 5% less	
4. Same	4. Same	
5. 5% more	5. 5% more	
6. 10% more	6. 10% more	



How many hours does did (A/B) usually work per week?

hrs wk

hrs wk

25-30

How many days has (A/B) been sick or absent during the past six months (or during the period at the firm)?

1. Zero
2. 1-3
3. 4-6
4. 7-10
5. 11+

1. Zero
2. 1-3
3. 4-6
4. 7-10
5. 11+

31-43

How many hours did you or an employee spend training or closely supervising A/B?

first week hrs  
next 6 months hrs

hrs  
hrs

45-90

How many additional hours (beyond training and close supervision) did A/B spend learning the job by watching others rather than doing it?

first week hrs  
next 6 months hrs

hrs  
hrs

91-94

95-100

How many hours did A/B spend reading manuals, etc., in order to learn the job?

first week hrs  
next 6 months hrs

hrs  
hrs

1-4

5-10

Please rate A and B on a ratio scale of zero (0) to 100 where 50 is the average productivity rating for someone who has spent on year on the job. (Zero is absolutely no productivity.) (Assume A/B are assigned to production as distinct from training activities.) How productive was each employee at the following times:

- a. On the 6th day after starting work
- b. At the end of the first 6 months
- c. Currently or 2 weeks before leaving the firm
- d. When you hired the individual, what did you think it would be after 6 months

Person A

Person B

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11-14

15-18

19-22

23-26

If work is not completed, does this employee stay late to finish it? (Mark one only)

1. No
2. Yes if paid
3. Yes w/o pay
4. Yes, "exempt" employee

1. No
2. Yes if paid
3. Yes w/o pay
4. Yes, "exempt" employee

27-28

Has (A/B) suggested any ways of improving sales or productivity?

1. No
2. Yes but not adopted
3. Adopted 1-2 Ideas
4. Adopted 3+ Ideas

1. No
2. Yes but not adopted
3. Adopted 1-2 Ideas
4. Adopted 3+ Ideas

29-30

Which of the two employees (A/B) proved better on each of the following:

"A" Much Better  
1

"A" Better  
2

No Differ  
3

"B" Better  
4

"B" Much Better  
5

- a. Occupational and job skills
- b. Ability to learn new occupational and job skills
- c. Work habits and attitude
- d. People skills (teamwork, appearance, getting along)
- e. Leadership ability (organize, teach, and motivate others)
- f. Reading, writing, math and reasoning ability

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31

32

33

34

35

36

What kind of business are you in, e.g. furniture retailer, plumbing contractor, etc.?

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