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ABSTRACT

A study examined the role of employer training in ameliorating skill shortages and enhancing productivity and competitiveness. The study established that formal training by specialized personnel accounts for only 5-10% of the time newly hired workers are engaged in training activities and that existing labor market research instruments fail to measure much of the informal training and on-the-job training (OJT) received by new employees. U.S. employers were found to devote less time and fewer resources to training entry-level blue-collar, clerical, and service employees than do employers in Germany and Japan. The lower U.S. training rate was attributed to the following: higher employee turnover and higher cost of capital in the United States, lower trainability of U.S. youth, lower rates of technological progress, and lack of information about the quality of the general human capital obtained from OJT. Clear evidence that most U.S. employers and workers underinvest in OJT was found. The study further confirmed that, although high-quality occupational training offered by schools ameliorates the problem of underprovision of skill training, school-based training cannot replace some kinds of employer training and is generally less effective than employer-provided training in providing the same skills. (Contains 126 references.) (MN)

EQW WORKING PAPERS

A Program of Research on the Role of Employer Training in Ameliorating Skill Shortages and Enhancing Productivity and Competitiveness

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Contents

Introduction

> 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, 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.** (Jaikumar 1986, 75)

A growing number of commentators are pointing to employer-sponsored training on-the-job (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 (OTA 1990b), 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 (3, 4).

Training is an extremely important issue, but one which is 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 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 1988).

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. Similarly, policymakers' interest in training derives primarily from its effect on productivity and not from 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 paper outlines a program of research designed to inform the policy debate on skill shortages and proposals to encourage increases in employer training. The paper also 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 affect 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 employer training changing over time?**
3. **Do Americans receive less training from employers than their counterparts overseas?**
4. **Are they less skilled?**

Assuming affirmative answers to both the third and fourth questions, the following should be asked:

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 for or a complement to training on the job?**

Most of these questions cannot be answered by analyzing currently available data sets. I, therefore, propose that emphasis should be placed on studies that collect and analyze new data. The most important issue for research is the issue raised in Question 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 affects its profitability. Examples of the kinds of studies that need to be replicated are the work of John Krafcik (1990) and Krafcik and MacDuffie (1989) on auto assembly plants around the world; Shimada and MacDuffie (1986); MacDuffie and Krafcik (1989); MacDuffie and Kochan (1988); the study of computerized machine tools by Hartmann and collegues (1983); Ramchandran Jaikumar's (1986) study of flexible manufacturing in Japan and the United States; and the intensive case studies of specific industries conducted by S. J. Prais, Hillary Steedman, Geoff Mason, 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 through 4. Some unique data on the magnitude and effects of 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, which asks 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, usually immediately following a discussion of the past research which informs and guides my proposals. These sections are highlighted by appearing in ***bold italics***. The final section of the paper recapitulates the recommendations for new research.

1. 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 owners/managers 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 three months after being hired. Even jobs that are thought to require little skill—for example, service jobs—seem to involve a considerable amount of training during the first three 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 co-workers is the 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 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

Table 1
Training and Productivity Growth of Typical New Employees by Occupation

	Profes-sional	Mana-gerial	Sales Not Retail	Retail Sales	Clerical	Blue Collar	Service
Hours Spent in Training in First 3 Months							
Watching others do the job	60.0	65.0	82.8	39.2	50.4	48.1	32.7
Formal training programs	9.1	12.1	23.9	8.2	13.5	9.1	5.7
Informal training by management	76.6	80.4	71.8	48.5	54.6	49.3	35.1
Informal training by co-workers	31.8	23.0	33.9	23.9	26.2	26.8	16.7
Investment in Training Time	293	295	350	185	235	200	130
Weeks to become fully trained if no previous experience	11.1	13.4	9.2	6.5	6.7	9.0	3.4
Increase in Reported Productivity (%)							
Between first 2 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%
Increase in Real Wage in First 2 Yrs. (%)	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.

floor. Surveys of workers about their training experiences have been handicapped by the way questions were posed. For example, the January 1983 Current Population Survey (CPS) 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 co-worker or supervisor. As one might anticipate, this question results in a significant underestimate 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 National Longitudinal Survey (NLS) and High School and Beyond (HSB) fail to pick up much of the informal OJT that workers receive. Consequently, studies using these data are looking at only one species of tree, not the whole forest. If we are really to 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 Sako 1989). The massive 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 three months on the job. The index values the time that managers, coworkers, and the trainee devote to training and expresses 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 three 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 three to four weeks of training, retail sales and clerical jobs slightly under seven weeks, and professional and managerial over ten weeks.[1]

The reported productivity of new employees increases quite rapidly (by roughly a third) during the first few months at the firm (see row 7). Despite the 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 twenty-fourth month than in the first two 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 three months—professionals, clerical workers, managers and sale representatives outside of retail and service industries—also seem to have larger than average increases in reported productivity as the worker gains in tenure. Clerical workers, for instance, are reported to improve 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). Furthermore, 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 percent 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 Employment Opportunity Pilot Projects (EOPP) data presented in Bishop (1990) and Appendix A of this paper 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 the marginal gross rates of return (for general and specific training combined) necessary to cover the cost of capital, 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.[2] Consequently, the estimates of marginal gross rates of return for each form of training that is reported in Table 2 must be viewed as very tentative results that will hopefully be displaced when better data sets become available. Marginal gross rates of return 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 located 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 three months, expressed in units of the time of trained workers is 148 hours. As intensity during the first three months rises from 100 hours to 300 hours (double the mean), the marginal gross rate of return (GROR) for informal OJT by coworkers drops from 43-45 percent to 25-32 percent in the two linear models for typical new hires—presented in Appendix Table A1. The linear model's GROR

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

Hours	Formal Training 100	300	Training by Supervisors 100	300	Training by Co-Workers 100	300	Watching Others 100	300
			Table A					
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 B					
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, a 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 Appendix Table 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 A for training intensity (T) equal to 300 hours was as follows: [(.00046 - .00000049*T*2*1.8)*2000] / [3*1.8] = -.0256.

The co-worker 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 the following equation) 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 $(b_2 + b_{5i} + b_3*ln T*2)*2000/(T*\text{duration factor})$ 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.

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 presented in Appendix Table A1. 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 the 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, which 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, estimate 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;
- Non-whites 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 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 and professional and technical employees are most likely to receive company training (Lynch 1991, 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 colleague's (Forthcoming) comparison of training incidence in different surveys. Comparing Current Population Survey (CPS) and Survey of Income and Program Participation (SIPP) answers to almost identical questions about the formal training necessary to get and keep one's job, they found large discrepancies in the number of people reporting that they received such training between 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 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 fewer 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 United States, but only 48 hours of training at American-owned plants in the United States (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 United States. 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 teenaged 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 (NEGP 1991). 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 (Secretary's Commission on Achieving Necessary Skills) skills. Worker performances involve four types of skills and knowledge:
>
> - 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);
> - the SCANS generic functional skills, which appear in many different occupations and industries;
> - occupation-specific knowledge and skills; and
> - company-specific knowledge and skills.
>
> K-12 should have responsibility for developing the foundation and SCANS skills. These skills therefore properly fall within the purview of the National Education Goals Panel. The educative responsibility for occupation-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. . . . (NEGP 1991, 90-93)

This data collection program is desirable but the cost and complexity of the project ensures that it will be many years before data of this type become 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.[3] 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 practically 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 that 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 are essential, so data collection strategies must be adapted to the technology and skill-development institutions of the sub-industry. International comparisons are also more useful and valid when the sub-industry is held constant. Causal effects of a nation's training institutions on skills and productivity can only be identified if the 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 Krafcik 1989; MacDuffie and Kochan 1988); the study of computerized machine tools by Hartman and colleagues (1983); and Ramchandran Jaikumar's (1986) study of flexible manufacturing in Japan and the United States. Other excellent 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 a funding agency to stimulate this kind of research is to fund Ph.D. dissertations. A typical funding package might involve travel costs, 18 months of funding for the doctoral 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 criterion for awards should be letters of support from industry executives making commitments to give the researcher access. The Request For Proposal (RFP) should provide a partial list of industries in which there is special interest but should also announce that other industries would be acceptable if the researcher has the necessary access and expertise. At the very top of the priority list should be flexible manufacturing systems (FMS). There would be 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 and 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 that 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., D.M.W.N. Hitchens, and K. Wagner, "Productivity, Machinery and Skills in a Sample of British and German Manufacturing Plants," National Institute Economic Review, February 1985, pp. 48-60.

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

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

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

BISCUITS—Mason, G., S.J. Prais, and Bart Van Ark. "Vocational Education and Productivity in the Netherlands and Britain," National Institute of Economic and Social Research, November 1990, pp. 1-34.

For skilled occupations that 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 1986; Steedman 1987, 1990; Jarvis and Prais 1989). The approach I would recommend would be to compare the National Occupational Competency Testing Institute's (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. Data also exist on TOCAT test scores of experienced workers in the occupation who sought certification as vocational teachers.[4] This means that rough comparisons between American 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 U.S. 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 derive from the German apprenticeship exams an assessment that could be administered in the U.S. and then administer it to small samples of U.S. workers. Either way, these studies could be expected to attract a great deal of attention to the issue of the quality of 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 the Organization of Economic Cooperation and Development (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 reasons 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 that 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 Do 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, and the National Longitudinal Survey of Youth [NLSY]), 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) 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) statistical process control or total quality

__f) working as a team or group problem solving

__g) the competitive environment, or the company's financial situation or long-term strategy

__h) a new company information system (e.g., for tracking inventory or scheduling)

__i) blueprint reading, geometric tolerencing, etc.

__j) how to be a more effective sales person

__k) my company's pensions/benefits or financial planning

__l) how to read better

__m) how to make better oral presentations

__n) mathematics (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 led the company to provide the training or stimulated you to learn the skills on your own? (Check all that apply)

__a) I started work with a new employer in a new occupation

__b) I started work with 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 (e.g., 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, 4b, and 4c]**

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

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

__ its supervisor

__ a leader or facilitator

__ member

__ specialized function (describe) _____

(4c) Did other members of your work group receive similar training?

__ all of them did

__ most of them did

__ half of them did

__ a few of them did

__ none did

(5) By approximately how much has your individual productivity increased (declined) since this date last year?

__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?

__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 7c and 7d]**

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 weekly salary for a standard work week (unadjusted for inflation and taxes) increased (declined) since this date last year?

____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 enterprise'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: _____

__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 gathers 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 four 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 that 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 that 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.

Table 3
Distribution of Job Tenure

		Under One Yr	Under Two Yrs	Over 5 Yrs	Over 10Yrs
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
	(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; Buechtemann and Standing 1993; Hamel 1963, 1967; Hayghe 1974; Horvath 1982; O'Boyle 1968; Sekscenski 1979; Bureau of Labor Statistics Jan 1987.

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 with their employer for many years, most workers change employers very frequently. Table 3 presents data on how the distribution of job tenure varies across nations. In the early 1980s, only 40 percent of American workers had been on their current job for more than five 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 (OECD 1984, Tables 33 and 34), national differences in turnover could be a major reason for the low levels of training investment in the United States, if the employer's explanation is right. Turnover effects the stock of trained workers in three ways. First, high turnover necessarily implies that a given rate of investment in firm-specific skills yields a smaller stock of workers with firm-specific skills. Many of those trained have moved on to other firms where the firm-specific components of training yield no benefits.

Second, turnover has a powerful effect on employer decisions to provide training to employees. Employers, not workers, finance most of the training that is undertaken in U.S. firms (see section 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 percent per month in the U.S. and sometimes greater than 8 percent per month) and the cost of capital (which is about 1.5 percent per month or 18 percent per year). Monthly turnover rates are typically much larger than the cost of capital and are also much more variable. If turnover is 5 percent per month and the cost of capital is 1.5 percent per month, the cash flow yield of the training investment 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 U.S. youth labor market is job shopping and tryout hiring. When the match is first arranged, both the employer and the job seeker are poorly informed about each other, so they spend the first months learning about each other, and if they do not like what they discover, they terminate the relationship. If they knew more about each other prior to the hiring and acceptance decision, there would be fewer surprises, fewer quits, and fewer dismissals. There are good reasons why tryout hiring is so prevalent in the U.S. There are major institutional barriers to the free flow of information about job applicants—such as Equal Employment Opportunity Commission (EEOC) testing guidelines, the failure of high schools to send out transcripts, and the threat of lawsuits 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 1989; Koenig 1987).

A second reason why turnover is higher in U.S. firms is that there are fewer legal and contractual obstacles to layoffs in the U.S. (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 United States, where quitting appears to be much less stigmatizing 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 U.S. To protect themselves from this stigma, German workers bargain for employment contracts that reduce the probability of layoffs by 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 U.S., 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 United States spend a good deal more on training than American companies in the same industry (Mincer and Higuchi 1988).

2.3 Trainability of Workers

According to the National Assessment of Educational Progress (1988b), 93 percent of American 17-year-olds do not have "the capacity to apply mathematical operations in a variety of problem settings" (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, they learn new skills more rapidly, and they require less instruction to achieve a given level of competence. They are more likely to be able to learn by doing or by reading.[5] With a less capable workforce, employers feel they are less able to introduce technologies and methods of operation (e.g., 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; and Steedman and Wagner 1987, 1989).

Not only are levels of basic skills achievement low in the U.S., but also 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 the optimal levels 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 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 U.S. 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.[6] 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.[7] 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 jobs 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 must arrange for its 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, but to the trainer and the training firm as well, for both their reputation amongst their peers and their ability to recruit high-quality apprentices depend upon it. As a result, 90 percent of German apprentices remain with one employer for the full three-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 tend to be based on time served rather than competencies achieved, and are 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 nineteenth century, the Swiss educational/training system went through a period of crisis 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 believed to be 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 U.S. 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 U.S. 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 that discourage training—are examined. Each is found to operate to some degree in some training markets. Then, empirical evidence on the market failure issue is examined in sections 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, 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 by contributing 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. On-the-job-training generates two kinds of real externalities: (1) poor signalling of skills to other employers, which results in, (2) trained workers not receiving wage offers commensurate with their productivity.

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 such trained workers 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 that 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 makes a costly error 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 by or contributed to poor training are legion: Chernobyl, Three-Mile Island, Exxon Valdez, the shoot-down of a Korean Airlines 747 (pilot error caused the plane to be off course), and Greyhound bus crashes in New York State. Tort law internalizes some, but not all, of these costs. 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 ensuring top-quality training is manifest to all, training is often regulated or subsidized by the government. The Federal Aviation Administration, the Department of Transportation, and the Nuclear Regulatory Commission, for example, engage in such regulation.

However, for every big discovery or disaster that gets media attention and generates a political response, there are millions of little discoveries, unrewarded services, or unanticipated product failures that 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 that enhances quality and reliability often generates benefits for customers that are not recognized or rewarded by the market. ***This is a controversial proposition. It would be desirable to fund a top***

theorist (e.g., Nalebuff, Stigler, or Akerloff) to examine assumptions about the cost and quality of information on the quality of general training and the quality of goods in order 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.[8] 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 to perform the job which is 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 focusing on 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-then-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 investments in general on-the-job training.[9] 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 that 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 to 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 1.0 and most studies conclude it is 0.5 or below (Friend and Blume 1975; Hall 1988; Hubbard and Judd 1986). A substitution elasticity of 0.5 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 that discourage on-the-job training. With respect to investments in on-the-job training, the two most significant 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 1989a). ***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,[10] 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. For example, in Columbus, Ohio, 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 percent of the high school graduates hired.[11] Only 15 percent 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 percent of the cases and referred by someone else in the high school in only 2.7 percent.

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 that made it prohibitively costly to demonstrate the validity of tests assessing competence in English and mathematics. Before such a test could be used, the firm had to conduct 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 percent of the hiring decisions studied.

Other countries handle the signalling 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 1989b). 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.[12] 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.***

3.6 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 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 signalled 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 that offer extensive general OJT will receive substantially lower initial wages than workers who take jobs that 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 those offering 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 Tables 4.3-4.5) analysis of NLS Young Mens data and the Barron, Black, and Loewenstein (1989, Table 2) analysis of EOPP data found no significant tendency for wages to be lower while training is underway. Point estimates were negative but so small they might as well be zero from a substantive point of view.

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 between hiring decision-makers who are better at assessing the ability of job candidates and hiring econometricians with access to NLS or HSB data files involves the positive association between wages and training. 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 in order 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 cannot 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 that 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 (Ryan 1980; Noll et al. 1984; 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 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' (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 that contradicts this prediction is presented in Appendix A. 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 1991). 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 that 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 that are technically general into skills that are effectively specific to the firm.*** To the extent that training is effectively specific, wages will rise more slowly than productivity net of training cost (Bishop and Kang 1984, 1988).

Support for this signalling/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 A1, 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 coworkers 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 underprovision 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.

4.1 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 U.S., 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 1971 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 Comprehensive Employment and Training Act (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 apprenticeships, 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).[13]

The second reason why learning skills on a job is preferable 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 are given 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 that neither pay the time costs of the trainee nor receive any of the direct benefits of the skills that are developed.

4.2 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 than 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 provide 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.

5. Summary

Export-oriented capitalist growth strategies are being adopted throughout the world. These countries have billions of hard working, poorly educated workers who are currently paid far less than 50 cents an hour. Manufacturing operations, which make heavy use of unskilled labor, have been moving abroad and will continue to do so. By the year 2010, unskilled manufacturing jobs will probably be scarce in the United States, and those that do exist will pay very poorly.

These results provide support for the hypothesis that workers do not pay the full costs of general training and do not receive wage increases equal to the full productivity effects of general training, and that the outcomes of training, particularly informal training, are poorly signaled to the labor market. Because other employers are unaware of its exact character and unable to assess its quality prior to making hiring decisions, training that is technically general often becomes effectively specific to the firm; employers choose to share the costs and benefits of investments in general training (see Bishop and Kang 1984, 1988 for a formal proof of this statement). The second hypothesized reason why shared financing of general training may be in the joint interest of employees and employers is the fact that young workers are typically liquidity constrained while employers are not.

If employers are paying the costs of general training, turnover becomes a more important determinant of training investments than previously thought. In the standard model, turnover propensities influence the amount of specific training supplied, but not the amount of general training undertaken. However, if employers finance some of the costs of general training (or general and specific training are joint products of the same training activity), workers with high turnover propensities are likely to find it hard to obtain jobs that offer general as well as specific training.

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 three months and training hours during the rest of the two-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 three months was assumed to be associated with a further two-unit increase in that training activity during the rest of the two-year period. When the productivity gain during the first 14 months for a particular new hire is being analyzed, a unit increase in a training activity during the first three 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. Some 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 (National Center for Educational Statistics 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 1992). 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).

Appendices for this paper can be obtained by calling the Education Line, 1-800-437-9799, or by writing to the Center:

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Philadelphia, PA 19104-4090

[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" (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" (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] Mincer (1989b), 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 Tables 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.

[13] 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 differentials between the countries in training-related placement cannot be attributed to differentials in the general tightness of labor markets.

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