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Many individuals are grappling with the issue of whether to provide workers with training that upgrades the workers' basic academic skills. The corollary questions that flow from this issue are how to provide the training, how much training should be provided, and who should pay for the training. Workers are interested in this issue because they want to sustain productive, well-paying careers that will support adequate standards of living. Not receiving training may jeopardize their careers and earning power. Employers are interested in this issue because their economic role is to maximize corporate profits for stockholders. In most companies, worker productivity is the most important factor in determining output levels and profitability. Public policy makers are interested in the issue because if productive workers lose their jobs, the public may end up supporting them through income maintenance payments and financing job searches through the employment service. On the other hand, if basic skills-deficient workers get training and keep their jobs, they will continue to pay taxes that support government activities. Educators are interested in the issue because they want to improve the educational system to reduce future basic skill deficiencies and because they may be involved in the upgrading of current workers.

The question that is at the core of this issue is easy to state. What should an employer do about a factor of production, be it physical capital such as a plant or machine or be it human capital, that has become unprofitable? For human capital, that is, skills and knowledge, the lack of profitability may stem from the fact that the worker's basic skills were never adequate or it may be the case that technology or workplace demands have surpassed the worker's skill levels. The choices that employers face are limited. They can invest in upgrading the factor of production;

they can continue to employ the factor and bear the losses;[1] or they can replace the factor. From an economic and business management theoretical point of view, the answer is easy. Employers should choose the option that maximizes their rate of return. That is, they should choose the option where the difference between the (discounted) future benefits and the costs is the greatest. From a practical point of view, estimating the benefits and costs may be extremely difficult. Furthermore, it is undoubtedly the case that the best option will differ for different situations. There may be cases in which employers would reap large returns from modest investments in workplace literacy training. On the other hand, there may be cases in which employers would be better off by accepting the turnover and hiring costs of replacing workers. In short, it is impossible *a priori* to prove that it is to a firm's advantage to provide workplace literacy training. It, too, is impossible to prove *a priori* that it is to a firm's advantage to shed workers with basic skills deficiencies.

From a public policy point of view, it should be recognized that society may benefit or bear costs from employers' decisions about inefficient or outmoded factors of production. Thus it may be the case that from a firm's profit-maximizing perspective, it is not advantageous to provide workplace literacy training. But from the rest of society's perspective, provision of the training, is beneficial. In such cases, public policy should facilitate financial subsidies to firms.

The purpose of this paper is to present these arguments theoretically to identify the key factors that influence the employer's and society's choices; to discuss some empirical evidence

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[1]I am using the economic cost concept of opportunity costs. A basic skills deficient worker may be paid $8.00 an hour and be productive enough to produce $8.50 worth of product per hour. However, a trained employee or a younger employee may be willing to work for $8.00 an hour and be able to produce $10.00 worth of product. The opportunity cost of not training the worker would be $1.50 per hour even though the firm would not be losing money on the worker.

from earlier studies about the payoff to individuals and firms; and to provide policy recommendations.

A Benefit-Cost Framework for Workplace Literacy Training

The essential task of a benefit-cost analysis (BCA) is to measure the benefits and costs of an action, place weights on each, and arrive at a conclusion as to the net benefits of the action. To conduct a BCA, it is necessary to measure most, if not all, of the effects of the action in a common unit, usually money. Note that the benefits and costs differ depending on the decision making groups whose interests are affected by the action. In considering whether or not an employer should promote remedial training to upgrade general basic skills, four groups might be affected: the workers who are trained, the employer, the rest of society, and the education sector.

Table 1 displays the components of a BCA for general workplace training for these four decision making groups. Each of the expected, hypothesized, or measured effects of the training are listed.[2] For any potential benefit or cost, a plus is entered in each column if the effect would be (is) positive (an increased benefit or a decreased cost), and a minus is entered if the effect would be (is) negative (a reduced benefit or an increased cost) for that particular group. If the benefits and costs are appropriately monetized and discounted to the present, they may be summed to arrive at total net benefits (or costs).[3] The rate of return on investment (ROI) will equal the ratio of total net benefits (or costs) to the total investment cost. This ratio is usually expressed in

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[2]Note that the parties that are affected by the training can conduct an *ex ante* BCA, wherein the benefits and costs are predicted, or an *ex post* BCA, in which the benefits and costs have been measured (or estimated).

[3]Analysts may want to weight different components of the benefits or costs differently.

Table 1
A Benefit-Cost Analysis Framework for Workplace Literacy Training

Benefit or Cost	Perspective			
	Workers	Employers	Rest of Society	Education/ Training Establishment
1. Training costs	0/-	-	0/-	+
2. (Higher) Productivity	0	+	+	0
3. (Higher) Wages	+	-	0	0
4. Nonwage compensation (pensions, health insurance, etc.)	+	-	+	0
5. (Less) Worker turnover	+	+/-	+	0
6. Safer workplace	+	+	+	0
7. (Higher) Taxes	-	0/-	+	0/+
8. (Improved) Self-esteem	+	0	0/+	0
Net Benefits	+	-/+	+	+

percentage terms. Rates of return are most meaningful for employers because the employers tend to bear most of the investment costs.

The first row of the table presents the training costs. For workers and for the rest of society, these costs will be negative only to the extent that workers pay for the training[4] and only if the firms or workers receive public subsidies for the training. A common practice for firms that engage in workplace literacy programs is to give release time for half of the training time. (See

[4]These payments would be direct costs of training, such as unreimbursed tuition, books, transportation costs, or value of nonwork time. Some theories suggest that workers pay for (general) training through reduced wages also.

Hollenbeck 1993). Then workers invest their nonwork time in the training. The employee's half of the training time would show up in table 1 as a cost (negative entry).

There is a negative entry in the employer column of the table for training costs because employers bear direct investment costs. These costs include instructors' compensation (whether or not the instructor is an internal employee), materials, lost productivity and wages during release time, facilities, and lost productivity and wages of human resource or other management staff for time spent in organizing the training. The positive entry in the educator/trainer column represents compensation that may be paid for offering the training (for external organizations).

The second row of the table represents the higher levels of productivity that follow the training. After all, the motivation for the training activities is to increase the worker's productivity. In most cases, the productivity effect emanates from an ability to use higher levels of technology. However, it may be the case that the productivity comes in the form of better/more courteous service. The productivity, which is defined as physical output per hour of labor, does not directly benefit the worker. It does benefit the employer and it may benefit society, which now derives (marginally) more goods and services per unit of labor.

Workers do not benefit directly from increased productivity, but they may earn higher wage compensation because of their productivity enhancements. Wage increases are represented in the third row of the table. These increases in earnings may take the form of higher wages per hour, or they may take the form of higher lifetime earnings because of greater job security. Higher wage compensation is a cost to employers.

The fourth row of the table provides hypotheses about the nonwage compensation effects that may result from general training. For example, receiving training and increasing wage

earnings may impact workers' retirement incomes or employer-paid health insurance premium payments. For workers, these nonwage compensation items are a benefit; for employers, they are a cost. The rest of society may end up with a benefit from nonwage compensation because of higher levels of health insurance and retirement income security.

Besides higher worker productivity, a second major benefit to training is reducing the costs of turnover. Lower worker turnover is the fifth row of the table. Employers who opt to replace workers will incur search and hiring costs, training costs, and separation costs. I've noted the possibility of a negative benefit for employers. This might occur if the general training leads to voluntary quits as workers find higher paying jobs. Most empirical studies have found this does not occur, however. (See Bassi, 1994.) Upgrading basic skills through training may allow an employer to avoid these costs. Furthermore, from the worker's perspective, less turnover will mean less search cost for new employment, less financial uncertainty, and less mobility costs incurred if the worker were to have to relocate. Society also benefits from lower turnover because there will be lower levels of frictional unemployment and fewer resources devoted to nonproductive turnover costs.

Anecdotal evidence has suggested that workplace literacy training can reduce accidents in the workplace and enhance safety, which is represented in the sixth row of table 1. Workers who have higher levels of technical literacy are going to be able to comprehend better and to follow more closely product and equipment safety instructions, for example. Workers benefit because they will have lower injury and health-related costs. Employers benefit from lower insurance rates, workers compensation claims, and lost productivity from accidents or injuries. Society also

benefits because of lower resources being spent on accidents and personal injuries that could have been avoided.

An indirect consequence of the higher wages and nonwage compensation earned after training is higher tax payments. For workers, these tax payments, which are displayed in row seven, include payroll taxes and personal income taxes. For employers, the taxes include payroll taxes, unemployment insurance payments, and corporate income taxes. Society benefits from these additional revenue sources into the public sector. Education may also benefit, if the marginal government revenues get allocated to education.

The final benefit that is in the table, in row eight, is improved self-esteem. As pointed out in Hollenbeck (1993), one of the most pervasive outcomes of workplace literacy training is improvements in self-esteem. Workers feel better about themselves and their positions. Obviously, these benefits can get included in the table only to the extent that they could be monetized. The improvements in self-esteem may have positive impacts on family members or acquaintances, so the impact on the rest of society is hypothesized to be (weakly) positive.

Note that some of the benefits, such as higher productivity and higher wages, accrue to workers, employers, or the rest of society in the future. In these cases, the future benefits must be discounted to their present value before entering them into the table. The discount rates that are used need to reflect the appropriate rate of time preference for each of the stakeholders. For society, the future benefits or costs affect government tax receipts or expenditures, so the discount rate should be a government long term borrowing rate such as the federal funds rate. For employers, the discount rate should reflect the private sector's borrowing cost, such as the prime

rate. Most studies suggest that individuals have fairly high rates of time preference, so discount rates should reflect high interest rates, perhaps in the 15- 25 percent range.

The table includes a net benefits aggregate for each of the four groups. This row of the table is derived by adding together the entries in each column after the entries have been appropriately discounted. The "bottom lines" clearly show that workplace literacy training provides positive net benefits to workers, the rest of society, and the educational/training sector.[5] The table also shows that the crucial bottom line for employers depends upon whether or not the positive discounted values of the productivity, reduced turnover, and safety outcomes outweigh the training costs that employers bear plus the future wage and nonwage compensation increases that they must pay.

Helping to flesh out the general framework that is provided in the table, the next section of the paper reviews previous work that I have done to estimate the wage impacts of workplace literacy training and reviews literature on the employer productivity impacts.

The Wage Impacts of Workplace Literacy Training for Workers

In Hollenbeck (1994), I used two national data sources to estimate the wage impacts of workplace literacy training. Essentially, I quantified the wage impact (row 3) in table 1 for workers. This section of the paper summarizes the findings from that earlier work.

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[5]There are negative entries in the workers and rest of society columns. However the positive wage impacts will be greater than the tax payments for workers, and I assume that the net compensation impacts for workers will exceed the time and out-of-pocket costs of training. For the rest of society, I assume that any training subsidies will be less than the positive impacts.

Model. The empirical work is based on a model developed by Mincer (1974). This model has been used extensively in empirical economics to estimate the impact of human capital investments on the wage rate. Equation (1) presents that model.

(1) $\log W_i = a + B'X_i + c\ WLP_i + e_i$

where W_i = annual wage of worker i

X_i = characteristics describing worker i thought to be related to i's wages

WLP_i = dummy variable equal to 1, if person i participated in a workplace literacy program and 0, if not

e_i = error term

a, B, c = parameters to be estimated

The coefficient c is an estimate of the impact of workplace education on wages. If workplace literacy program participation enhances productivity, then workers will receive higher wages, and c will be positive. On the other hand, if participation does not influence productivity (or diminishes it) then c will equal 0 (be less than 0).

Data. The data used to estimate the wage equation came from two large nationally representative surveys of individuals. The National Household Education Survey (NHES), a one-time survey, was conducted in 1991 by the U.S. Department of Education to estimate participation in early childhood education and adult education. The Current Population Survey (CPS) is conducted monthly by the Census Bureau for the U.S. Department of Labor to estimate the unemployment rate. The January 1991 CPS contained a supplemental survey on adult education and training.

The NHES collected data from a random sample of the U.S. population. It represents one of the first efforts of the U.S. Department of Education to collect education data through a random sample of households rather than from students, teachers, or administrators. The purpose of the adult education component of the NHES was "to measure participation in adult education activities, to describe those activities, to provide data on the characteristics of participants and nonparticipants, and to determine why some adults participate while other do not." (Brick et al., 1992, p.3).

For each individual who participated in higher or postsecondary technical education on a part-time basis or who participated in adult education, the NHES collected detailed information on up to four courses. The data set contains information on 12,568 individuals and 17,612 courses. Because the survey first screened households to identify adult education participants and then oversampled such households, it is important to adjust statistical analyses by the sampling weights that have been provided on the file.

To identify participants in adult education, the survey asked individuals whether they had participated in any of the following activities during the previous 12 months:[6]

- Continuing education courses or noncredit courses
- Courses by mail, television, radio or newspaper
- Private instruction or tutoring
- Educational or training activities given by an employer, labor organization, neighborhood center, church, or community group
- Instruction in basic skills such as math, or reading and writing English
- Instruction in English as a Second Language
- Any other organized educational activity

[6]The survey was conducted between January and May 1991, so the adult education took place between January 1990 and May 1991.

Respondents were asked for their main reason for taking up to four courses. The choices they were given were as follows:

- A personal, family, or social reason
- To improve, advance, or keep up to date on your current job
- To train for a new job or a new career
- To improve your basic reading, writing, or math skills
- To meet a requirement for a diploma, degree, or certificate of completion
- Other reason

In addition, if their main reason for taking a course was not job or career-related, respondents were asked whether they also had employment- or career-related reasons for taking it.

For purposes of analysis, I defined an individual to have participated in a workplace literacy program if they engaged in "Instruction in basic skills such as math, or reading and writing English" or "Instruction in English as a Second Language" and they took at least one course either "to improve, advance, or keep up on your current job" or "to improve your basic reading, writing, or math skills" and they had employment- or career-related reasons for taking the course.[7]

The NHES gives considerable information about each course that respondents indicated they had taken including course name, provider, tuition and fees, and party (or parties) who paid for the course. When I examined the detailed data for those individuals who had participated in workplace literacy as defined above, I found a number of courses that were managerial or supervisory training, that were advanced academic courses such as "physical chemistry" or "foreign language," or that were based on specific computer software. I went through the data

[7]A rigorous parsing of the workplace literacy program definition is ((instruction in basic skills such as math, or reading and writing English) or (instruction in English as a Second Language)) and ((main reason for taking course is to improve, advance, or keep up to date on your current job) or (main reason for taking course is to improve your basic reading, writing, or math skills and you also had employment- or career-related reasons for taking course)).

systematically and deleted from consideration any observation whose workplace literacy "course" involved management or supervisory training, particular computer software, advanced academics, or company-specific training in its title. These deletions eliminated about 40 percent of the observations, but left me with a sense that I had a better definition of workplace literacy participants. One last condition that I imposed on the definition of workplace literacy participation was that the individual must not have earned a bachelor's degree or higher.[8]

The CPS is the source of the official government statistics on employment and unemployment.[9] The current sample size for this monthly survey is approximately 57,000 households containing approximately 148,000 people. Each household is interviewed once a month for four consecutive months one year, and again for the corresponding time period a year later. Although the main purpose of the survey is to collect information on individuals' employment situation, an important secondary purpose is to collect information on the demographic status of the population, information such as age, sex, race, marital status, educational attainment, and family structure. From time to time, supplemental questions are added to the CPS on topics such as health, education, income, and previous work experience.

The January 1991 Job Training Survey was conducted as a supplement to that month's CPS. The job training questions were asked of all persons 15 years of age or older, who were members of the experienced labor force. A number of items recorded information about the skills and training workers needed to obtain their current or last job and about training received to improve their skills once on that job. One item determined the frequency that workers used

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[8]This eliminated about 13 percent of the participants as defined by all of the preceding conditions.

[9]The material describing the CPS is taken from U.S. Census Bureau (1992).

reading, writing, arithmetic, and computer skills on their job. Finally, workers were asked for their opinions about the adequacy of their skills in these four areas.

Question 38 of the Job Training Survey asked experienced workers the following question:

- Since you obtained your present job did you take any training to improve your skills?

If the response was affirmative, then the following question was asked:

- What kind of training did you take? (Mark all that apply).

  A. Reading, writing, or math skills
  B. Computer-related skills
  C. Other technical skills specific to your occupation
  D. Managerial or supervisory skills
  E. Other

Unfortunately, no additional questions were asked that named or specified with more detail the nature of the training. My first-cut at a definition of workplace literacy program participation was to include anyone who had taken training to improve their job skills and that training was in reading, writing, or math skills. Upon further analysis, that definition appeared to be too inclusive and so I omitted from consideration respondents who had marked "computer-related skills," "managerial or supervisory skills," or "other" in addition to "reading, writing, or math skills." I did not exclude observations who had marked both "other technical skills specific to your occupation" and "reading, writing, and math skills" because of the frequency with which workplace literacy programs are offered in conjunction with other company training in specific job skills. I did exclude individuals who indicated that they had earned a bachelor's degree or higher as I did with the NHES data.[10]

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[10]This deleted about 38 percent of the sample who met the other conditions of the definition.

The January 1991 CPS has wage and earnings data for only about one-quarter of the sample (the outgoing rotation groups), which limits the sample size for my analyses of the wage payoffs. Nevertheless, there were an adequate number of observations to perform the model estimation as can be seen below.

Table 2 presents the estimates. The upper panel of the table comes from the NHES data set and the lower panel from the CPS. On both data sets, the model was estimated for the total population and separately, by sex. All models were estimated with and without a set of industry and occupation dummy variables. By examining coefficients across the models with and without industry and occupation, we can see the extent to which industry or occupation choice mediates the payoff to workplace literacy program participation and the payoff to other characteristics as well. For example, suppose there is a positive effect of program participation without the industry and occupation variables, but no program effect when these variables are included. This means that the program effect is spurious. In this case, we would conclude that industry and occupation determine peoples' wages at the margin, and it is the way that workplace literacy program participants are distributed across industries and occupations that makes it <u>appear</u> as if program participation pays off.[11]

The demographic variables of sex and ethnicity are included in the model to capture any wage or earnings discrimination. Because the dependent variable is the logarithm of earnings, the

[11]In addition to the models reported in the text, models that would control for self-selection of program participants were estimated. In these models, participation in workplace literacy programs is first estimated by probit analysis and then the Mills ratio from that first stage is added as a regressor in the earnings models. Alternatively, the predicted probability of participation was used as a regressor in a 2SLS procedure. These estimates are not reported because the coefficients were extremely volatile to specification and estimation technique. Furthermore, the coefficients on workplace literacy program participation (or predicted participation) were implausible.

Table 2
Estimates from a Model of the Economic Payoffs
from Participation in Workplace Literacy Programs

Characteristic	Population/Model: Total Population 1	Total Population 2	Males 1	Males 2	Females 1	Females 2
Panel a: NHES, Dependent Variable is log(annual earnings)						
Female	-.450*** (.013)	-.424*** (.014)	--	--	--	--
Minority	-.070*** (.017)	-.016 (.017)	-.194*** (.025)	-.150*** (.024)	.015 (.024)	.065*** (.023)
Married	.044*** (.016)	.028* (.015)	.213*** (.025)	.189*** (.024)	-.057*** (.020)	-.073*** (.020)
Children < 16	-.045*** (.017)	-.045*** (.016)	-.008 (.024)	-.013 (.023)	-.165*** (.023)	-.142*** (.022)
South	.007 (.014)	-.008 (.013)	-.036* (.019)	-.044** (.018)	.029° (.019)	.006 (.018)
Homeowner	.047*** (.015)	.042*** (.014)	.105*** (.022)	.094*** (.021)	.017 (.020)	.033* (.019)
Age[a]	.014*** (na)	.014*** (na)	.013 (na)	.027 (na)	.028*** (na)	.025*** (na)
Urban	.153*** (.015)	.118*** (.015)	.226*** (.021)	.183*** (.021)	.129*** (.021)	.079*** (.020)
Years of education	.071*** (.003)	.049*** (.003)	.056*** (.004)	.033*** (.004)	.079*** (.004)	.054*** (.004)
Current FT student	-.390*** (.025)	-.352*** (.024)	-.440*** (.036)	-.397*** (.035)	-.363*** (.034)	-.320*** (.033)
Current PT student	.090*** (.032)	.069** (.030)	.091* (.047)	.075* (.044)	.098** (.042)	.064° (.040)
Workplace literacy program participant	.169* (.085)	.128° (.081)	.208** (.102)	.191** (.096)	.100 (.140)	.018 (.133)
Industry and occupation dummies	No	Yes	No	Yes	No	Yes
$\bar{R}^2$	.2590	.3273	.2664	.3460	.1629	.2470
Dep. variable mean	9.66	9.66	9.92	9.92	9.44	9.44
n	11,483	11,483	5,111	5,111	6,372	6,372

Table 2
(Continued)

Characteristic	Population/Model: Total Population 1	Total Population 2	Males 1	Males 2	Females 1	Females 2
Panel b: CPS[b], Dependent variable is log(weekly earnings)						
Female	-.382***	-.320***	--	--	--	--
	(.010)	(.011)				
Minority	-.063***	-.022*	-.156***	-.107***	.033°	.065***
	(.014)	(.013)	(.019)	(.018)	(.021)	(.019)
Married	.099***	.064***	.164***	.111***	.007	-.003
	(.012)	(.011)	(.018)	(.017)	(.017)	(.015)
Children < 16	-.113***	-.096***	-.043***	-.032**	-.229***	-.197***
	(.012)	(.011)	(.016)	(.015)	(.017)	(.016)
Homeowner	.025**	-.011	.062***	.029**	.001	-.042***
	(.011)	(.010)	(.015)	(.014)	(.017)	(.015)
Work experience[a]	.027***	.022***	.032***	.028***	.021***	.019***
	(na)	(na)	(na)	(na)	(na)	(na)
Years of education[a]	.116***	.084	.112***	.082	.118	.082
	(na)	(na)	(na)	(na)	(na)	(na)
Workplace literacy program participant	.113**	.080°	.014	-.042	.171**	.142**
	(.054)	(.050)	(.075)	(.071)	(.076)	(.070)
Industry and occupation dummies	No	Yes	No	Yes	No	Yes
$\bar{R}^2$	.4121	.4977	.4447	.5163	.3245	.4360
Dep. variable mean	5.84	5.84	6.04	6.04	5.62	5.62
n	15,096	15,096	7,744	7,744	7,351	7,351

Note: Entries are coefficient estimates from weighted OLS regressions. Standard errors are in parentheses.
[a] These variables were entered as quartics in the models. Table entries represent marginal effects evaluated at sample means. Statistical significance is shown if all four coefficients were significant.
[b] Sample comes from outgoing rotation groups only—approximately one-quarter of the total CPS sample.

*** Significant at the .01 level.
** Significant at the .05 level.
* Significant at the .10 level.
° Significant at the .15 level.

coefficients can be interpreted as percentage impacts. Women have earnings that are 30-40 percent lower than men and black males have earnings that are 15-20 percent lower than white males. Interestingly, other things equal, minority women earn about 6.5 percent more than white women.

The family status variables—marital status and presence of children—are in the model for reasons that are similar to their inclusion in the participation equation. For women, particularly, marriage and presence of young children are expected to be negatively correlated with earnings. This is because married women and women with young children have less workforce experience and labor force attachment than comparable unmarried women or women without young children. For men, marriage is expected to be positively related to earnings. The coefficients in the table bear out these predictions.

Residing in the South and in urban areas are in the model to pick up geographic effects on wages and earnings. The estimates suggest that earnings in the South are lower than the rest of the country by about 3-4 percent and that urban earnings levels are 11-20 percent higher than non-urban earnings. Being a homeowner should indicate a higher attachment to the labor force and higher earnings, and indeed, this is what is shown in the table.

Age is a proxy for work experience in the NHES data set, whereas experience (age-education-6) is entered directly in the CPS. In both data sets, an additional year of experience results in 2-3 percent higher earnings. Years of education are also highly related to earnings. In the NHES results, an additional year of education results in 6-8 percent higher earnings, whereas an additional year of education results in 8-11 percent higher earnings on the CPS.

Finally, we get to workplace literacy program participation. Table 3 extracts the coefficients on program participation from the previous table and presents them in percentage

Table 3
Estimates of the Marginal Economic Effects
from Workplace Literacy Program Participation

Dependent Variable	Population/Model					
	Total Population		Males		Females	
	1	2	1	2	1	2
Percentage increase in annual earnings (from NHES)	16.9*	12.8°	20.8**	19.1**	10.0	1.8
Percentage increase in weekly earnings (from CPS)	11.3**	8.0°	1.4	-4.2	17.1**	14.2**

Note: Entries are coefficient estimates from weighted OLS regressions, expressed as percentages. Full models are reported in table 5. The models in column 1 exclude industry and occupation, whereas industry and occupation dummy variables are included in 2.

** Significant at the .05 level.
* Significant at the .10 level.
° Significant at the .15 level.

terms. When the models are estimated over the entire population, workplace literacy program participation is estimated to increase earnings by about 17 percent (NHES) or 11 percent (CPS). These are substantial impacts. Part of the impacts come from the industries and occupations of participants, however they remain substantial even when industry and occupation are controlled in the model: the payoffs drop to 13 percent (NHES) and 8 percent (CPS).

However, because the coefficients on the control variables in the models differ across sexes, we have less confidence in the total population estimates and should pay closer attention to those in the final four columns of the table. Unfortunately, the two data sets present quite different results. The estimates from the NHES data set show that males receive a 20 percent higher earnings payoff from participation in literacy programs than otherwise identical males who do not participate. The return is hardly eroded when industry and occupation controls are added to the model. In the CPS estimates, males are shown to receive no payoff (i.e., the payoffs are not statistically different from zero).

On the other hand, from the CPS estimates, women receive a 14-17 percent earnings payoff that again hardly changes when industry and occupation are added to the model. But from the NHES, the payoffs for women, while positive, are not statistically significant.

How can the discrepancies in the estimates from the separate data sets be resolved? First of all, part of the differences may be explained by differences in the outcome variables. The NHES uses annual earnings, whereas the CPS uses weekly earnings. If men who participate in literacy programs work more weeks per year than nonparticipants, but women who participate work fewer weeks per year, then the coefficients would be more consistent than they appear. However, we cannot put much confidence in this explanation of the discrepancies because

participants are such a small percentage of the overall labor force and there is no obvious explanation as to why male participants would work more weeks per year than nonparticipants, whereas women wouldn't.

A second explanation that seems more plausible is that economic payoffs to programs are not automatic, but rather depend on program characteristics and employer/firm characteristics. If this explanation is correct, it must be the case that the NHES happened to sample males in the programs/firms that have successful attributes and the CPS happened to sample females in successful programs.

A final explanation is that the sample designs or implementation of the two surveys resulted in discrepant data by chance. After all, the event of interest, workplace literacy program participation, is only observed in a small number of cases and the differences in demographic characteristics and participation behavior may be well within sampling error. The models that were estimated may be "correct" and if they were estimated on different data, they would yield results that are consistent across gender.

The Productivity Impacts of Workplace Literacy Training for Employers

Perhaps the most important outcome of workplace literacy training is the extent to which it enhances the productivity of workers. As the BCA framework shows, employers are unlikely to invest in such training unless the productivity impacts are substantial. Unfortunately, very little work has been done on measuring these impacts. Bassi (1994) asserts the following:

> The impact of workplace education programs is known to be extraordinarily difficult (if not impossible) to quantify rigorously.

Phillips (1996) also emphasizes the difficulty of measuring the effects of training on performance, but he does suggest several approaches that might be employed to isolate effects:

- Control groups
- Trend-line analysis
- Forecasting
- Participant estimation
- Supervisor estimation
- Management estimation
- Customer input
- Expert estimation
- Subordinate estimation

Bassi (1994) reports on case studies of firms that had offered workplace literacy training where participants, supervisors, and management were asked to assess the outcomes on the firm of the training. Unfortunately, these case studies used a qualitative scale of "No impact," "Moderate impact," or "Significant impact." She notes that management respondents reported the following moderate or significant productivity impacts:

Impact	Percentage of respondents who reported a "moderate" or "significant" impact
Quality of output	51%
Ability to use new technology	51
Error rates	41
Customer satisfaction	35
Time savings	33
Safety	33

Anecdotes given by McVey (1996) provide more quantitative assessments about employer productivity impacts, but unfortunately the article does not describe the type or amount of training. Some quotes from this article follow:

> ' ...and productivity, defined as sales per employee, has doubled since the company adopted an aggressive education and training program,' says Richard

Plumley, Vice-Chairman of the Board of Plumley Companies, a fabricated rubber products maker.

Collins & Aikman (a carpeting manufacturer) instituted an in-plant adult basic education class. Since the program began, productivity has risen steadily and the number of defects has been cut in half.

The most extensive quantitative evidence on the productivity impacts of workplace basic educational training that I have encountered is in a case study documented by Gordon and Owens (1996). A manufacturing firm instituted a regime of English as Second Language (ESL), statistical process control, basic math, blueprint reading, and cross-training courses and activities over a five-year period (1990-94) and tracked field returns of defective products, scrap rates, sales/employee, performance evaluation results, and number of jobs certified. The authors report substantial positive impacts in all of these areas, although they do not document their methodology. From data provided in the paper, I calculated that this firm experienced 4.67 percent annual growth in productivity (shipments ($) per employee) between 1989-1994. The authors indicate that their analysis of the data suggests that 31 percent of the improvement is due to the basic skills training regime, which would imply a productivity improvement of 1.45 percent. The average value of shipments per worker over the period appears from the data that are reported to be about $135,000, so the annual productivity improvement from training might be estimated as approximately $2000.[12]

[12]This estimate is subject to a couple of caveats. The authors do not indicate whether their shipment data are adjusted for price changes, for example. Furthermore, they do not document how they derived their estimate that 31 percent of the productivity growth should be attributed to training.

Conclusions and Recommendations

The benefit-cost analysis framework presented in this paper demonstrates the economics underlying firms' and workers' decisions to undertake training programs aimed at upgrading basic academic skills. Unless one makes very unusual assumptions about costs and benefits, it is the case that workers, trainers, and society are all net gainers from such training programs. The "bottom line" for employers is far less clear-cut. Their net benefits may be positive or they may be negative. If the value of productivity enhancements, safety improvements, and lower turnover that result from workplace education exceed the investment costs, then employers, too, will be net gainers. However, if the value of these training benefits is limited, then employers may have very low or negative rates of return.

The BCA framework points to two ways that advocates of workplace literacy training can increase its occurrence and efficacy. First, employers costs will be lessened if some of the costs can be shifted to workers or to society. The federal government and many states do have small programs that partially finance programs. Indeed, 65 percent of the firms in Bassi's (1994) case studies received some sort of public subsidy. The firm studied in Gordon and Owens (1996) received a state subsidy. However, given the number of positive externalities that society reaps from workplace literacy training, it is likely that governments are underinvesting in workplace literacy training.[13] The workers who receive workplace literacy training tend to have modest wages, so it is probably difficult to shift much of the investment burden to them, but it might be possible for employers to shift some in-class time from release time to non-work hours. My

[13]Hollenbeck (1993) provides a "back of the envelope" estimate that public support of workplace literacy training is about one-fifth of the optimal level.

estimate of the wage increases that accompany workplace literacy training indicate that workers should be willing to bear some of the costs. Another way that costs might be reduced would be through consortium programs where multiple employers participate in a joint program that is offered to all of their employees.

A second implication of the BCA framework is that it is important for workplace literacy training to lead to productivity improvements as quickly and as cheaply as possible. This argues for contextual instruction in which learning is embedded in work practices and scenarios, so that learning can be applied on the job. It implies that adult educators, who are accustomed to the "soft" rewards of seeing enhanced self-esteem and personal improvements in their students, must focus on the "hard" bottom line of improved job performance and productivity. Note that in table 1, self-esteem is of value only to workers and, to some extent, society.

Despite the "true belief" of its advocates, it is probably the case that many firms make rational decisions when they decide not to offer workplace literacy training. This implies that society needs to have programs and institutions available that will provide basic skills upgrade training to workers who are laid off rather than trained. Federal job training programs and adult education programs fill this need to some extent, but these programs are not of the appropriate scale, and furthermore, they are at risk as legislative bodies attempt to deal with reduced public budgets.

Finally, the paucity of quantitative evidence on the outcomes of workplace literacy training suggests that data collection and analysis is greatly needed to inform decisionmakers. It is particularly important to collect hard evidence about the physical productivity of workers before and after training. I suspect that firms measure such data, but that confidentiality concerns and

lack of expertise in data analyses are contributing to foregone opportunities that could make considerable headway in our attempt to learn how workplace literacy training effects workers and employers.

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