ABSTRACT
                This paper presents new evidence regarding the benefits of
retraining prime-aged adults by analyzing the impacts of community college
schooling on displaced workers in Washington State during the 1990s. The
authors also conducted a similar analysis of a small program that provided
community college courses to workers displaced from their jobs during the
mid-1980s in Alleghany County, (Pittsburgh) Pennsylvania. The samples were
constructed by matching displaced workers' state unemployment insurance
earnings records to their community college transcripts. The samples included
only workers who had three or more years of job tenure when they were
permanently displaced from their jobs. The Washington State sample consists
of 21,000 workers displaced between 1990 and 1994 who enrolled in at least
one community college course, and 64,000 displaced workers who did not take
courses. The Pittsburgh sample consists of 3,200 displaced workers who took
part in a county training program, and 3,500 displaced workers who did not
enroll in the program. Both samples include dropouts in the samples of
workers who enrolled in retraining programs. Findings of this study indicate
that one year of community college training raised the hourly wage of both
male and female workers by less than 2%. But earnings increased 5-6% because
of increased hours worked due to training. (Contains 8 tables and 25
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The Returns to Community College Schooling for Displaced Workers

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Abstract

Studies have shown that displaced workers' can experience substantial long-term earnings losses. As these losses have become increasingly apparent, and the incidence of displacement has become more widely spread among industrial sectors, policy makers have significantly expanded resources for retraining programs. Much of this retraining takes place in community or junior colleges. This paper adds to the relatively sparse literature on the impacts of such retraining efforts by analyzing the impact of community college schooling on displaced workers' earnings. Using administrative data from two states, we find that the equivalent of a year of schooling raised long-term earnings of displaced male and female workers by about 5 percent. Although these gains are significant, they also are somewhat smaller than conventional estimates of the returns to schooling and insufficient to offset the lower earnings associated with workers' job losses. Further, we show that more than one-half of this gain results from the impact of schooling on hours worked. On average a year of community college schooling received by prime-aged workers was associated with less than a 2 percent increase in hourly wages. However, these average returns mask substantial variation in the returns associated with different types of courses. Skills acquired from more technically oriented vocational and academic math and science courses have very large returns, whereas most other types of courses are associated with zero or sometimes negative returns.

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I. Introduction

Despite the long economic expansion in the United States during the 1990s, employers continued to layoff a significant numbers of experienced workers from their jobs (Farber, 1993; Farber, 1996; Aaronson and Sullivan, 1998). Studies using longitudinal data indicate that these displaced workers tend to incur substantial long-term earnings losses even after they return to work (Ruhm, 1991; Jacobson, LaLonde, and Sullivan, 1993a; Fallick, 1996). These losses are large for both males and females employed in a variety of industries. As the costs of worker displacement became more apparent, and the incidence of displacement became more wide spread among industrial sectors, policy makers devoted more attention and resources toward these workers (Farber, 1993).[1] During the Clinton Administration, policy makers substantially expanded expenditures on employment and training services for displaced workers, even at the same time that they scaled back expenditures on similar services for youths.

Policy makers' heightened support for worker retraining has occurred even though there is relatively little evidence about its likely impacts. By contrast to the many studies of public sector-sponsored training for disadvantaged persons, there have been relatively few evaluations of its impacts on dislocated workers, which tends to an older and more employable population with substantial prior attachment to the labor force. Many displaced workers are in their 30s or are older and have accumulated substantial employment histories prior to entering training.

Much of our knowledge of how training affects displaced workers comes from research on

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[1] Under the Workforce Investment Act (WIA), local authorities have even more flexibility in providing training services to such workers.

several demonstration programs implemented during the 1980s (Leigh, 1990). A more recent study examines the impact of training on a relatively small subset of displaced workers who lost their jobs as a result of increased import competition (Corson, Decker Gleason, and Nicholson, 1993). These studies indicate that displaced workers benefit from job search assistance; that access to classroom vocational instruction or on-the-job training usually has little effect on subsequent earnings; and that female displaced workers likely benefit more from employment and training services than do their male counterparts (LaLonde, 1995).

This paper presents new evidence on the benefits from retraining prime-aged adults by analyzing the impacts of community college schooling on displaced workers in Washington State during the 1990s. In addition, we conducted a similar analysis of a small program that provided community college courses to workers displaced from their jobs during the mid-1980s in Allegheny County, (Pittsburgh) Pennsylvania. To estimate the impact of community college schooling on the earnings of these two groups of displaced workers, we constructed a large longitudinal database in which we merged individuals' administrative earnings records with their community college transcript records. The administrative earnings records data provide long panels that cover substantial periods of time both before workers' displacements and during the period following schooling. The transcript records provide unusually detailed information about the type, intensity, and duration of classroom training.

We find that community college schooling for displaced workers is associated with modestly higher earnings. We report these gains using two different econometric strategies. Moreover, because we are able to observe individuals' earnings for several years prior to their post-

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displacement schooling, we can estimate the gains from schooling using a fixed effect estimator (Angrist and Newey, 1991). Thus, unlike most studies on the returns to schooling, the estimates generated from both econometric strategies control for fixed unobserved characteristics that might influence both earnings and individuals' decisions to acquire training following the loss of a job.

The modest earnings gains that we report for community college courses mask substantially different returns associated with different types of courses. We find that credits completed in courses teaching quantitative or more technically oriented vocational subject matter generate positive and sometimes large earnings gains. By contrast, courses teaching non-quantitative or non-technical vocational skills are associated with little or possibly negative earnings gains. This result indicates that displaced workers who chose to enroll in programs teaching relatively non-technical subject matter on average would have been better off simply returning to the work force full-time.

The remainder of the paper is outlined as follows: Section II provides some institutional background on public sector-sponsored retraining programs for displaced workers, as well as describes the data, and the types of community college schooling analyzed in this paper. Section III presents our econometric model for estimating the effects of community college. In section IV, we present our estimates and some concluding remarks follow in Section V.

II. Schooling and Training for Displaced Workers

A. The Role of Community Colleges

Community or ``junior'' colleges have played an increasingly prominent role in worker retraining policy during the last 30 years. This change coincides with the greater emphasis that these institutions have given to vocational training. Although community colleges continue to offer

academically inclined students traditional college-level courses, they also offer vocationally oriented courses that in the past have been offered in proprietary schools and vocational institutes (Freeman, 1974; Grubb, 1993; Kane and Rouse, 1999. Typical course offerings cover areas as diverse as computer information systems, food preparation and management, real estate, word processing, respiratory therapy, the construction trades, and automobile repair. Moreover students who complete these kinds of courses can obtain certification in a particular trade or take state licensing exams.

Community colleges are natural providers of public sector-sponsored retraining, because they already have vocational programs in place. Several federal programs have provided funding to support community college services for displaced workers. These programs include those funded under the Trade Adjustment Assistance Act (TAA), the Economically Displaced Worker Adjustment Act (EDWAA), and the 1972 Higher Education Amendments (Pell Grants).[2] In 1998,

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[2] Established by Congress in 1962 and amended several times since then, the TAA program provides extended unemployment insurance benefits to unemployed workers who participate in retraining and who the Secretary of Labor determines have lost their former jobs as a result of foreign trade. Recent statistics indicate that approximately 40 percent of those enrolled in TAA sponsored programs providing job-skill training, and 73 percent of those enrolled in TAA sponsored programs providing general education, received these services at community or four year colleges (Corson, Decker, Gleason, and Nicholson, 1993).

In 1988, Congress established EDWAA as an amendment to Title III of the Job Training Partnership Act. EDWAA provides retaining services without extended unemployment benefits to permanently unemployed workers. One important change from the preexisting legislation was to require that at least one-half of its funds be spent on retraining services, instead of job search and other related employment services. Eligibility for EDWAA services extends to all permanently unemployed. Until recently, funding levels have limited annual participation in EDWAA programs to about 120,000 workers, at a cost of approximately $200 million. However, since, fiscal year 1994 expenditures have exceeded $1 billion annually.

Although it was not designed specifically for displaced workers, the Pell Grant program has provided relatively low-income displaced workers with grants to cover the cost of retraining and schooling. Until recently, the program included a provision in its rules that allowed administrators to waive the normal limit on an applicant's assets and base their eligibility on current instead of the

policy makers replaced the EDWAA program with Adult Activities program under Title I of the Workforce Investment Act (WIA). Today, most displaced workers who receive public sector-sponsored retraining services participate in programs authorized under WIA. These programs provide clients with a diverse set of services that may include job search assistance, on-the-job training, or classroom instruction in vocational, remedial, or college level skills. To provide for these training services, the federal government allocates funds to state and local authorities, who in turn, generally subcontract training services from a mixture of nonprofit, public, and private organizations. In practice two-year community colleges constitute one of the most common providers of government-sponsored training services.

Although community colleges that receive WIA funds sometimes place displaced workers into specially design noncredit courses that are tailored to their needs, they also enroll WIA participants into regular community college programs. In these mainstream programs, displaced workers take classes with younger non-displaced workers and full-time students.[3] Because community colleges play an important role in retraining displaced workers, this paper's objective is to examine whether these workers benefit from completing regular community college courses. Further, since these workers are older than most students, the evidence presented here also sheds

previous years income. As a result of this provision, displaced workers were eligible to receive grants to cover the tuition costs of retaining and schooling. Many displaced workers have taken advantage of this provision. During the 1990-91 academic year over 75,000 displaced workers received Pell Grants. Approximately 30 percent of displaced Pell grantees attended proprietary schools, another 10 percent attended four-year colleges, and the remaining 60 percent enrolled in community colleges.

[3] About one-third of community college students in the United States are over 30, and the vast majority work at least part-time (Kane and Rouse, 1999).

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new light on the returns to schooling received by prime-aged adults.

B. Data Sources

Our analysis is based on two different samples that we constructed by matching displaced workers' state unemployment insurance earnings records to their community college transcripts. One sample consists of workers who had three or more years of job tenure when they were permanently laid off from their jobs between 1990 and 1994 in Washington State. The second sample consists of similar workers who were permanently displaced from their jobs between 1978 and 1985 in Allegheny County, Pennsylvania. We excluded "low-tenure" displaced workers from both samples because public policy has been most concerned about the long-term consequences of job loss by experienced workers.

In each sample, the unemployment insurance earnings records provide information about individuals' quarterly earnings records, their birth year and gender, their quarter of separation, job tenure at separation, and for each calendar year their primary employer's 4-digit SIC code, geographic location, and number of employees. The machine-readable community college records provide information on students' demographic characteristics, listings of the credit and noncredit courses that they enrolled were in, and the grades that they received in courses taken for credit.

As a result of using state administrative earnings records, we have an unusually long earnings panel for a majority of community college participants both prior to and following displacement. We can follow some participants for up to five years following their schooling in our Washington State sample, and for up to eight years following their schooling in our Pittsburgh sample. In addition, each sample contains a large number of displaced workers who did not enroll

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in any community college courses. These individuals constitute a comparison group in our analysis below. (The Appendix provides further details about the construction of the sample.)

1. The Washington State Sample

Most of the analyses presented in this paper are based on our sample of displaced workers from Washington State. In keeping with the national economy, the state's economy worsened in 1990. The unemployment rate rose with several sectors especially hard hit, including the aerospace and wood products industries. In 1993, the state legislature established a program that would provide community colleges with additional funding if they enrolled displaced workers in their programs. But because the substantial increase in federal subsidies for retraining displaced workers had not yet taken effect, most of the state's unemployed workers attended community college at their own expense.

Our sample of consists of about 21,000 workers who were displaced between 1990 and 1994 and who enrolled in at least one community college course around the time of their job losses. This group includes approximately 9,000 ``dropouts'' who enrolled in but never completed any community college courses. This sample also includes 64,000 workers who were displaced during the same period, but never enrolled in any community college courses. We ensured that our sample consisted only of workers who had a history of strong attachment to Washington state's workforce, by excluding workers (i) who were not consistently attached to Washington State's wage and salary work force.[4]

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[4] See Appendix for discussion of how we limited our samples to individuals who remained attached to the state's workforce.

2. The Pittsburgh Sample

To see whether our results based on the Washington Sample might apply to other displaced workers we also analyzed a second sample of individuals from Allegheny County, Pennsylvania. This county is located in the western part of the state, and includes the city of Pittsburgh, which was known at one-time as the "capital" of the U.S. steel industry. Its population is approximately 2.5 million persons. Beginning in the late 1970s the local economy declined and by the 1982-83 recession, the county's unemployment rate stood at 16.2 percent. At that time, federal and state authorities provided few direct resources for retraining displaced workers. In response to the worsening economic conditions, the county government established the Displaced Workers Educational Training Program (DWETP). Local authorities in turn subcontracted with Community College of Allegheny County (CCAC) to operate the program. CCAC provided recruiting and counseling services, developed relevant curricula, and encouraged participants to enroll and complete regular community college courses. The program paid for all tuition, fees, and supplies under the condition that participants remained enrolled at CCAC and worked no more than 30 hours per week.

Our Pittsburgh sample consists of more than 3,200 DWETP participants who were permanently displaced between 1978 and 1985 from a job that had lasted 3 or more years. Approximately 1,000 persons among this group sample were "dropouts," i.e. they enrolled in but did not complete at least one community college course. In addition, sample includes more than 3,500 displaced workers who never enrolled in DWETP. As with the Washington State sample, we limited our analysis of the Pittsburgh sample to those individuals who had a history of strong

attachment to Pennsylvania's workforce.

C. Characteristics of Displaced Workers.

Displaced workers who enroll in community college classes are prime-aged adults, many of who have attended college before, and who have been displaced from jobs from a wide array of industries. As shown by Table 1, the average age of displaced workers in the Washington State who enrolled and completed community college courses was approximately 35 for males and 37 for females. The sample also includes a substantial number of individuals who already had acquired education beyond high school. Approximately one-half of both the male and female community college participants had attended college some point during their lives. Finally, the table also indicates that a substantial fraction of both males and females were displaced from outside the durable goods industries (Farber, 1996). About two-thirds of the female displaced workers had lost jobs in the non-goods producing sector of the economy.

The are of course differences between the community college participants and non-trainees in the Washington State sample. Participants tend to be younger, have less prior job tenure, and are more likely to be female. They also are somewhat more likely to attend a community college in one the state's rural counties. Most striking, however, is that those displaced workers who completed community college courses are more likely to have already attended college than their counterparts who never completed any community college courses following their job losses.

As shown by Panel B of Table 1, participants completed on average 20 to 30 credits. In Washington State colleges a full-time academic year consists of 45 credits. So community college participants completed approximately one-half of a year of schooling. The table also indicates that

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female displaced workers completed a larger share of their total credits in less technically oriented subjects. Approximately one-third of the credits completed by female displaced workers were in courses teaching more technically oriented vocational skills or science and math. In the text below, we refer to these courses as " Group 1 courses." Male displaced workers completed more than one-half of their credits in Group 1 courses. This difference between the content of courses completed by males and females suggests that community college schooling may have different impacts for these two groups.

Before discussing our econometric model of earnings and schooling, we examine from our Washington State sample the quarterly earnings of the community college participants-those displaced workers who completed at least one course, the dropouts-those who enrolled but never completed any classes, and non-trainees-those displaced workers who never enrolled in any of the state's community colleges. Among the participants we distinguish between the earnings of those who primarily took Group 1 courses from those who primarily took Group 2 classes. As shown by Figure 1, in participants' real quarterly earnings (1995 dollars) declined during the three-year period before their displacements. This evidence of pre-displacement earnings declines has been reported elsewhere. Their earnings fall sharply after their displacements. Further, displaced workers' quarterly earnings remain $1,000 - $2,000 below their peak pre-displacement levels. In addition, we observe that while the earnings of Group 1 participants are similar to the non-trainees and dropouts, the earnings of the Group 2 participants are consistently lower than the other groups, even prior to their job losses.

Simple comparisons between earnings of these groups do not necessarily indicate the

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effectiveness of community college schooling. Although the earnings of both participants and non-participants were similar prior to their displacements, participants may have lost more job-specific skills. Alternatively, participants may have been less likely to receive a job offer following their displacements than were the non-trainees. The econometric model we have developed and the empirical work presented below attempts to account for these and other possibilities.

III. The Econometric Model

We use two different econometric approaches to measure the returns from community college schooling for displaced workers. Our first approach identifies the impact of schooling using the method common in the program evaluation literature on training programs (Heckman, LaLonde, and Smith, 1999). In this setting, we compare regression adjusted post-program earnings of the displaced workers who completed community college schooling with the earnings of displaced workers who did not receive such schooling. As indicated above, information on individuals' earnings over several years prior to their schooling allows us to account for fixed unobserved characteristics in our analysis.

Our second approach identifies the impact of community college schooling on earnings by using the variation in credits completed among displaced workers who finished at least one community college course. If schooling benefits displaced workers, those who completed more schooling should earn more than their counterparts who completed less schooling (Rosenbaum, 1988). Under this second method, we use the "trainees" as their own comparison group. Unlike the first approach, in this method bias associated with non-random selection into schooling based on time-varying unobserved characteristics does not affect our estimates. However, estimates based on

our second approach may be biased because of non-random selection into more community college courses. We consider these possibilities below.

We estimated several statistical models of the following general form to implement these two approaches:

(1) $y_{it} = X_{it}\beta + \delta_{it}(s_i, z_i) + \tau_{it}(c_{i,.}, f_i, l_i, z_i) + \alpha_i + \gamma_t + \varepsilon_{it}$.

According to (1), workers' earnings, y_{it}, depend on observed characteristics that vary with time; characteristics of their displacement $\delta_{it}(s_i, z_i)$; the community college schooling that they obtained, $\tau_{it}(c_{i,.}, f_i, l_i, z_i)$; unobserved individual fixed-effects; time effects; and time varying unobserved characteristics characterized by an independent and identically distributed disturbance. In this study, the observed characteristics are a fourth order polynomial in age. We also interacted each of the terms in the polynomial with a dummy variable indicating a worker's gender. It is important to adjust for age because community college participants are younger than other displaced workers.

Previous research has documented the temporal pattern of the impact of displacement on workers' earnings (Jacobson, LaLonde, and Sullivan, 1993). Displaced workers' earnings tend to decline during the period prior to displacement; drop sharply following the quarter of their job loss; and then rise relatively rapidly during the next few quarters before increasing at a slower rate in subsequent periods. The evidence in Figure 1 indicates that this pattern also holds in the Washington State sample. It may be important to account for the effects of displacement in our analysis, because this pattern may be associated with individuals' decisions to participate in community college schooling. Accordingly, we let earnings' depend on the time since (or until) the

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date of displacement, s_i , and on worker characteristics, z_i. We define the impact of being displaced in period s on earnings during quarter t as follows:

$$\delta_{it} (s_i , z_i) = \delta_{t-s} = \delta_k ,$$

where $k = t - s_i$. Letting $D^k_{it} = 1$ if worker i was displaced at time t - k, we write the displacement effect as

$$\delta_{it} (s_i , z_i) = \Sigma \, \delta_k \, D^k_{it}$$

In our empirical work, we allow k to range from -12, the twelfth quarter prior to job loss, to the end of the sample period, which is more than 40 quarters after displacement for some individuals in the Pittsburgh sample.

We allow displacement effects to vary by workers' characteristics to account for the possibility that the impact of displacement is correlated with whether a worker receives community college schooling. Instead of interacting these characteristics with the full vector of displacement indicators, D^k_{it} , we found that a more parsimonious specification adequately accounts for differences between the average pattern of displacement effects, δ_k, and the pattern for workers with characteristics, z_i. We summarize this departure using four variables defined as follows:

$F^1_{it} = t - (s - 12)$, if $s - 12 \leq t \leq s$ and is equal to 0 otherwise;

$F^2_{it} = (F^1_{it})^2$;

$F^3_{it} = 1$ if $s < t$, and is equal to 0 otherwise;

$F^4_{it} = 1/(t - s)$, if $s < t$, and is equal to 0 otherwise.

This specification allows the displacement effects for workers with characteristics z_i to differ from the average effect. This occurs according to a quadratic function during the twelve quarters prior to

displacement, and according to the inverse of the time since displacement during the post-displacement period. The coefficient associated with the F^3_{it} term indicates the departure from the average long-term impact of displacement for workers with characteristics z_i. Therefore, the displacement effect in our econometric model becomes:

(2) $\delta_{it}(s_i, z_i) = \Sigma \delta_k D^k_{it} + F^1_{it}z_i\phi_1 + F^2_{it}z_i\phi_2 + F^3_{it}z_i\phi_3 + F^4_{it}z_i\phi_4$.

The most important part of the model is our specification of the ``schooling effect,'' $\tau_{it}(c_{i,\cdot}, f_i, l_i, z_l)$.. We model this effect as a function of the amount of schooling completed measured in credit hours, $c_{i,\cdot}$; the first and last quarters that worker i was enrolled in school, f_i and l_i; and the workers' characteristics. We expect that schooling may cause workers to forego earnings during the period when they are enrolled in school, and that their earnings losses to be proportional to number of credits taken. However, it is reasonable to allow for economies of scale in classes taken. Therefore, we specify the impact of schooling on earnings during the schooling period as follows:

(3a) $\tau_{it}(c_{i,\cdot}, f_i, l_i, z_i) = \psi + \kappa c_{it}$, if $f_i \le t \le l_i$,

where c_{it} is the number of credits during the current quarter. In the empirical work below, we also allow these parameters to vary according to workers' characteristics.

We find during the quarters after workers' leave their community college programs that there is a transition phase associated with their schooling in which the schooling impacts are usually substantially lower in the short-term than they are in the long-term. This finding underscores the importance of using long follow-up periods when evaluating education and training programs for adults. To capture this temporal pattern in schooling effects we specify the post-schooling effects as follows:

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(3b) $\tau_{it}(c_{i,\cdot}, f_i, l_i, z_i) = \tau_0 + \tau_1 c_{i,\cdot} + \tau_2 [1/(t - l_i)] + \tau_3 [1/(t - l_i)] c_{i,\cdot}$ if $l_i < t$.

The parameters τ_0 and τ_2, control for systematic earnings differences between displaced workers who complete at least one community college credit and their counterparts who either do not enroll or enroll but do not complete any courses. Intuitively, if we were to plot the long-term relationship between credits completed and earnings at a point in time, this specification does not require the intercept of that relation to be at zero. We find that when we restrict the parameters τ_0 and τ_2 to zero, the positive relation reported below between credits completed and earnings becomes stronger.

In the foregoing specification, we identify the impact of community college schooling by using the variation in credits completed among those displaced workers who completed at least one course. The impact of completing additional community college credits in the short-term is given by $\{\tau_1 + \tau_3 [1/(t - l_i)]\} c_{i,\cdot}$. Because the term $[1/(t - l_i)]$ gets smaller with the passage of time, we measure the long-term impact of schooling by the parameter, τ_1. As shown by Figure 2, this specification allows for the possibility that the impact of community college credits on earnings is negative during the first few quarters after leaving school. Then these impacts grow (or decline) with time before leveling off in the long-term. We examined other specifications of the relationship between credits and earnings and found the one described above to be the most parsimonious one that fit the data. In the empirical work presented below, we also allow each of the schooling parameters to vary according to workers' characteristics. Such interactions permit us to assess the heterogeneity in the impacts of community college schooling.

The schooling effects generated from our econometric framework differ from those

generated from the conventional framework in the program evaluation literature. Instead of relying on differences between participants' and non-trainees' earnings, our framework relies on differences in the number of credits completed among participants. Adopting this approach enables us to estimate the impacts of training using the sub-sample of displaced workers who self-selected into community college schooling. In effect, the training participants serve as their own comparison group in the same way that they do in the literature on the returns to schooling. In those studies individuals with fewer years of schooling serve as the comparison group for individuals with more schooling. Using our econometric model we are able to identify the effect of schooling even without a conventional comparison group such as a sample of displaced workers who did not enroll in community college courses or who enrolled but dropped out early. When we implement this approach below, we use the information on the non-participants-the non-trainees and the dropouts-to more precisely estimate the other parameters of the model.

In order to compare the estimates based on our specification to those generated from a more conventional specification in the program evaluation literature, we also consider a version of (3b) in which we restrict the parameters τ_1 and τ_3 to equal zero. Under this restriction, we identify the impacts of schooling from the differences in earnings between displaced workers who complete some community college schooling and those who do not. This alternative specification is simply a variation of the standard model in the program evaluation literature in which the (constant) treatment effect is the parameter associated with a dummy variable indicating whether or not the individual participated in training. This standard model is commonly implemented because often no information is available on the quantity or intensity of training or schooling.

Finally, our analysis of the data also reveals another important extension of our model. In equation (3b), we treat each credit without regard to the type of course completed. We can measure how the impacts of schooling depend on the subject matter of the classes, because our data contains information about these classes' content. Accordingly, we extend our model and treat c_i, as a vector denoting different types of completed credits. In the most parsimonious extension of the model, we divided the completed courses into two groups. The first group consisted of academic science and math courses or courses teaching more technically oriented vocational subject matter (Group 1 courses). The second group consisted of all other vocational and academic classes including those in the social sciences and humanities (Group 2 courses). We also estimated models that further disaggregated these categories of courses.

IV. The Impact of Community College Schooling

A. Alternative Estimates For Washington State

To contrast the differences between our two approaches to estimating the impact of community college schooling, we present estimates based on both methods together for both men and women. Table 2 presents three sets of estimates for displaced workers from Washington State. In the first panel of the table, we present estimates of the impact of community college schooling based on the conventional program evaluation specification. In columns (1) and (3), we present estimates of the average impact of community college schooling on displaced workers' subsequent quarterly earnings. In columns (2) and (4), we present the long-term impact of such schooling along with the difference between the long-term impact and the impact during the first quarter after leaving school. Negative estimates indicate that the impact of community college during the first

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quarter after leaving school is lower than the long-term impact.

In the second panel of Table 2, we present estimates based on our specification (3b). The figures in the first row of the second panel measure the impact of completing an additional credit on quarterly earnings. As in the first panel, the figures in columns (1) and (3) are estimates of the average impact of completing a community college credit on displaced workers' subsequent quarterly earnings. In columns (2) and (4) we estimate separately the long-term and short-term impacts of schooling.

In the second panel of the table, we present estimates of the impact of community college schooling based on the assumption of a linear relationship between credits and earnings. By contrast, in third panel of the table, we allow this relation to be nonlinear. We divided the number of credits completed into six groupings of credits based roughly on the number of people in the sample within each category. The idea underlying this semi-parametric specification is that individuals who complete for instance 11 to 20 credits should earn more than their counterparts who complete only 6 to 10 credits, who in turn should earn more than those who complete only 1 to 5 credits. The figures reported in columns (1) and (3) are the average impact of credits on quarterly earnings. The figures in reported columns (2) and (4) are the long-run impact of credits on quarterly earnings.

As shown by the first panel of Table 2, estimates based on the conventional training specification indicate that those who completed at least one community college course subsequently earn more than displaced workers who either do not enroll in community college course or who enroll but never complete a course. We obtain these estimates after controlling for individual fixed-

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effects and for the temporal pattern of the impact of displacement on workers' earnings both prior to and following their job losses. During the quarters following job loss, males who completed at least one community college course earn on average $63 more than other displaced workers.

As shown by the second column, this average impact results from short-term impacts being substantially negative, whereas the long-term impact of having participated in community college schooling is $261 per quarter. The negative short-term impacts of training are shared by the two sets of estimates that distinguish between short and long-term effects. In fact, even estimates based on (3b) consistently indicated that the impact of community college schooling was negative during the first few post-schooling quarters. According to our specification, the impact of training during the kth quarter after workers complete their last course is measured as the sum of the ``Long-term effect" plus 1/k times the ``First quarter Difference." For example, as shown by column (2) in the first panel, the predicted training effect during the first quarter after leaving school is -$443 (or 261 + (1*-704)); four quarters after leaving school the predicted training effect is $85 (or 261 + (0.25*-704)). This result inidcates that there is an adjustment period following the completion of community college courses that is associated with modest earnings losses. But over time trainees' earnings approach and apparently surpass the earnings of comparable non-trainees. This result underscores the importance have having several years of post-schooling earnings data when evaluating the impacts of retraining on prime-aged workers.

As shown by column 2, the long-term impact of community college schooling is $261 or 4.7 percent of males post displacement earnings. (See Table 1.) However, on average males who complete at least one community college credit complete only one-half an academic year of

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schooling. If we were to scale this percentage impact up to the equivalent of a year of schooling, this estimate would suggest that a year of community college schooling raise male earnings by about 9.5 percent. This figure is comparable to recent estimates reported in the returns to schooling literature.

As shown in the last columns of Table 2, when we use the conventional specification from the program evaluation literature, we found that the impact of community college schooling on displaced females' earnings was smaller than it was for males. Over the long-term, the quarterly earnings of female participants were $147 dollars higher than other displaced females. However, because women's post-displacement earnings are smaller than those of men, the percentage impact of schooling is about the same. This impact based on about a one-half of an academic year of community college schooling constitutes 4.2 percent of earnings. Once again this impact suggests that displaced workers gain as much from community college schooling as does the population from all forms of formal schooling.

Next, we examine in the middle panel of Table 2 the impacts of community college schooling based on variation in completed credits among those who completed at least one credit. As shown by columns (1) and (3), during the post schooling period the earnings of male and female displaced workers do not depend on the number of credits that they completed. These findings suggest that the results of our prior analysis, which were based on the conventional program evaluation specification, may be biased upward because of differences between participants and non-participants time varying unobserved characteristics.

However, as shown by columns (2) and (4) in Table 2, in the long-term completing more

community college credits is associated with higher earnings. During the period immediately after leaving school, displaced workers who complete more credits have higher earnings than participants who complete fewer credits. In the long-term a community college credit is associated with a $6 increase in the quarterly earnings of males, and a $5 increase in the quarterly earnings of females. Given that on average both males and females completed about one-half an academic year of community college schooling, these estimates imply an impact of $144 (i.e. $6.2*23.2, from Table 1) for males and $112 (i.e. $5.1*22.4, from Table 1) for females. In percentage terms, these impacts are 2.6 percent of quarterly earnings for males, and 3.2 percent of quarterly earnings for females.

Our estimates of the impact of community college schooling are smaller when they are based on the specification that uses variation in completed credits to identify the impact of schooling. For displaced males our estimates are about one-half as large. Scaling these impacts up to the equivalent of a year of schooling implies that completing one year of community college schooling raised male displaced workers' earnings by about 5 percent and those of females by about 6.5 percent. Although these results represent the low side of the range recent estimates of the return to formal schooling, our findings nevertheless suggest that community college schooling does raise the earnings of prime-age students. Recall from Table 1 that the average age of male students in our sample is 35, and the females are even older.

In order to examine sensitivity of our estimates to our linear specification of the relationship between credits and earnings, we also estimated (3b) by using the semi-parametric specification described above. As shown by column (2) of Table 2, males' earnings rise monotonically with the

number of credits completed, except among males who completed more than 75 credits. If we examine the difference between the earnings of males who completed 21 to 40 credits and their counterparts who completed 6 to 10 credits, we observe nearly a $300 difference in quarterly earnings. Given that on average the difference between these two groups' completed schooling is about one-half a year, this impact is quite substantial in terms of percentages. In fact, the results of this panel of the table suggest that the average impact of a community college credit in the long term is a consequence of the strong positive effects schooling has during its early stages and moreover a subsequent negative effect of schooling in its later stages. These results are consistent with earlier research on younger community college students that finds that males receive little additional benefit from obtaining a degree, although our results indicate that for older students it may be counterproductive to stay in school too long (Kane and Rouse, 1995)..

The semi-parametric estimates of the relationship between credits and earnings among female displaced workers differ in two important respects from those of their male counterparts. First, the relation between credits and earnings females is not as uniformly monotonic during the first year and one-half years of schooling as it was for males. Column 4 shows that women who completed 21 to 40 credits earn more than $200 less per quarter than their counterparts who completed only 11 to 20 credits. Second, the completion of enough credits to obtain an Associate of Arts degree does appear to raise the earnings of female displaced workers. This finding also is similar to those reported in earlier studies that indicate there is a significant "degree" or "sheepskin" effect for female community college students (Kane and Rouse, 1995; 1998). As in that earlier research, our analysis of these data also indicates these results are a consequence of the greater

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tendency for women to enroll in courses in the health occupations.

B. Different Impacts By Demographic and Skill Groups

Upon further analysis of our data we found two sources of heterogeneity in our estimates of the impact of community college schooling. First, as shown by Table 3, we find modest differences among the impacts of community college credits on displaced workers' earnings depending on their minority status and age, but much larger differences depending on their prior skills. As indicated above, the impacts of community college schooling were similar for men and women. Among displaced males, minority men gain less than white males. Among females, younger women gain more per credit than older women. The results by age are less clear cut for males.

The differences in the impact of community college credits are striking when looking at displaced workers' prior skills. We found that the impact of a credit is markedly different among both male and female displaced workers who had accumulated six or more years of tenure with their prior employer than they are for displaced workers who had acquired less tenure. These impacts for high-tenure displaced workers are large. The figures indicate that an academic year of school raises earnings by about $700 (i.e $16*45) per quarter. Likewise we find similar, though less marked results, when we compare the impacts of credits received by those who had acquired at least some prior college education before their job loss to the impacts received by those with a high school degree or less. This difference is particularly large among female displaced workers in our sample. Our results for both measures of prior skill are consistent with the view that "skill begets skill" and that among adults the returns to training are greater for more skilled workers (Heckman, 2000; Ashenfelter and LaLonde, 1997).

C. Impacts By Content of Courses

A second source of heterogeneity in our estimates of the impact of community college schooling results from differences in the types of courses taken by different individuals. As discussed above in section II, we measured not only how many credits individuals completed, but also how many credits he or she completes in different subject areas. To examine the differences in the impacts of different types of credits we estimated (3b) by extending the specification to account for the nine categories of credits listed in Appendix Table A (Jacobson, LaLonde, and Sullivan, 1997). After reviewing the results, we found it instructive to aggregate these categories into two groupings. As described above in Section II, the first grouping (Group 1 courses) consists of courses in the sciences and mathematics as well as courses teaching more technically oriented vocational subject matter, including courses in the health occupations. The second grouping (Group 2 courses) consists of all other community college courses.

As shown by the first panel of Table 4, we found very striking differences between the long-term impacts of Group 1 courses and Group 2 courses. Completing a Group 1 credit increased quarterly earnings of both males and females by approximately $16. Accordingly, we estimate that one academic year of Group 1 community college schooling raises earnings by about $700 per quarter or about 14 percent of post-displacement earnings. If correct, this impact would imply that this type of community college schooling generates a sizeable return. By contrast, we find no evidence that displaced workers benefit from completing Group 2 courses. Our estimated impacts are in fact negative.

It is possible that Group 2 courses could have a negative impact if such schooling had no

productive value and came at the price of lost labor market experience. But for males the estimated

impact of these types of courses seems implausibly negative, suggesting that there remains some as

yet uncontrolled for differences among males who complete few Group 2 classes and those who

complete many such classes. In order to explore this possibility further, we estimated our model

limiting the sample to individuals who completed at least three Group 1 classes. Our intent was to

see whether the unexpected impact of Group 2 classes was do to differences in the types of

displaced workers who enroll in such classes. However, even among displaced workers prone to

complete Group 1 courses, which apparently have a high return, we find that if anything completing

more Group 2 courses lowers subsequent quarterly earnings.

The two sets of results that we report on the heterogeneity of impacts of community college

courses are likely connected because high skilled individuals are more likely to enroll in and

complete Group 1 courses. This point is illustrated in Table 5. In this table we report the log

hourly wages of male displaced workers during the 4th quarter prior to their job loss by the number

of Group 1 and Group 2 courses that they subsequently completed. The individuals in the cell (0,0)

are displaced workers who did not complete at least one community college course for credit. The

displaced workers in cell (21+, 0) are displaced workers who completed 21 or more Group 1

courses, but no Group 2 courses.

As shown by the first Panel of the table, displaced workers in cell (21+, 0) had greater pre-

displacement earnings than displaced workers that never completed any community college credits.

But the pre-displacement earnings of this group of Group 1 course takers were similar to their

counterparts who also had never completed a Group 2 class, but who completed fewer Group 1 courses. This similarity suggests that when estimating the impact of Group 1 courses, Group 1 course takers may serve as a good comparison group for each other

By contrast, the first column of Table 5 provides insight into the apparent negative impacts of Group 2 courses. Notice that among displaced workers who did not complete any Group 1 courses, the pre-displacement wages of those who subsequently completed many Group 2 credits are lower than the wages of individuals who completed relatively few such credits. We intend that our fixed effect estimates will account for such systematic differences among individuals. But our estimates reported in the tables suggest that there may be important differences in time-varying characteristics among Group 2 course takers. As the table indicates, individuals who complete many Group 2 classes, regardless of how many Group 1 classes they completed, were less skilled to begin with. Thus, when analyzing the effects of Group 2 courses, it is unclear whether individuals who complete fewer such classes serve as a good comparison group for those who complete many Group 2 classes. What is clearer, however, is that we found no evidence in our data indicating that completing Group 2 courses raised the subsequent productivity of displaced workers.

With the foregoing points in mind, we now proceed to the second panel of Table 4. These figures represent estimates based on an extension of the semi-parametric specification described above in connection the discussion with Table 2. In this case we divided the number of credits into 16 groups as in Table 5 based on the numbers of Group 1 and Group 2 credits an individual completed. The figures in the table report long-term estimates of a given amount of community college schooling.

The figures in the first two rows of the table underscore our results reported in the first panel of Table 4: completing additional Group 1 credits are associated with significantly higher earnings. As shown by the last two rows of the table, however, as an individual completes more Group 2 courses, the strong positive relation between Group 1 courses and earnings begins to weaken. Indeed, among individuals who have completed more than 21 Group 1 credits, the more Group 2 credits that they have completed, the lower their earnings. With the exception of those Group 2 course takers who never completed any Group 1 courses (the first column of the table), there does not appear to be a positive relationship in these data between completing Group 2 classes and higher earnings. We believe the evidence presented suggests that displaced workers may gain from community college schooling only when they concentrate their course taking in a particular subject area. Taking a wide range of courses in several subject areas does not appear to be as productive as focusing one's energy within a narrower subject area.

D. Impacts on Wages and Hours

Until this point we have examined the relationship between displaced workers' community college schooling and their earnings. The relationship is contingent on how schooling separately affects the probability of being employed, hours worked, and hourly wages. Although most of the program evaluation literature focuses on the impact of training on earnings, most of the literature on the returns to schooling focuses the relationship between schooling and hourly or weekly wages. Thus, the results reported above are not comparable those commonly reported in the schooling literature.

The administrative records from Washington State are unusual in that they report both quarterly earnings and quarterly hours paid for. (By contrast, the administrative records in the Pittsburgh sample do not have measures of hours worked.) Thus it is possible to isolate the effects of schooling on wages from the impact of schooling on hours worked. Accordingly, we estimate (3b) using alternatively as the dependent variable, the impact of schooling on individuals' log hourly wage, quarterly hours worked, and their employment status during the quarter.

As shown by Table 6, community college schooling is associated with increases in both the wages and hours worked of male and female displaced workers. Estimates based on our parametric specification in which the impact of schooling rises (or falls) linearly with completed credits indicates a large impact on hours worked, but a relatively small impact on wages. As shown by the first column of the table, completing 100 credits or approximately 2 academic years of community college schooling is associated with only a 2.5 percent increase in wages. This increase is much smaller than the estimates reported in the literature on the returns to schooling.

By contrast in the second column we find that the same amount of schooling is associated with a 55 hour increase in quarterly hours worked. Given that a full-time worker works about 500 hours per quarter, this impact is substantial. Our results for females are similar, although in addition community college schooling also is associated with a modest increase in quarterly employment rates.

The semi-parametric estimates reported in the bottom portion of Table 6 reveal a somewhat different picture of the relationship between completed credits and wages and hours worked. As shown by the first column of the table, males' wages raise rise substantially by credit category. The

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0.097 figure associated with the row labeled "41 to 75 credits" indicates that somewhat more than a year of community college schooling is associated with nearly a 10 percent increase in wages. Such a gain is consistent with recent estimates of the return to formal schooling, and if found to generally hold would indicate that prime age males experience similar return to schooling as younger students.

However, as indicated by the last row of the table, the reason that our parametric estimates of the "returns" to community college schooling were so small is that males who complete many community college courses tend to earn lower wages than other displaced workers who attend community college. There are several possible explanations for this finding including the possibility that our estimates are biased because we fail to control for important unobserved time-varying characteristics. Further, our results suggest that if this interpretation is correct, males who complete many community college courses are inherently less productive than their observationally equivalent counterparts who attend community college, but complete fewer such courses. However, as shown by the second column of the table, despite earning lower wages these males in the long-term work more hours per quarter. This finding is somewhat surprising as usually less skilled workers both earn lower wages and work fewer hours (Juhn and Murphy, 1994).

The relation between completed credits and wages and hours worked is somewhat different for females than it is for males. Although, as shown by column 4 of the table, the parametric estimates are similar, the semi-parametric estimates are different. Wages do not rise as systematically with completed credits as they did for males, but women who essentially complete enough credits to obtain an Associate of Arts degree earn about 5 percent higher wages than other

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displaced workers. Although statistically significant, this impact is relatively small per year of school. As shown by columns 5 and 6 of the table, community college schooling increases prime-aged women's employment rates and hours worked. In light of the earnings impacts reported in Table 2, these results suggest that more than one-half of the earnings gains that we observed earlier for women result from the impact of community college schooling on hours worked.

E. The Pittsburgh Sample

As we discussed above in section II, we also have a sample displaced workers who participated in a special program designed by the Community College of Allegheny County during the mid-1980s. In this sample, we can follow some displaced workers for up to seven years following their schooling as compared to five years for the much larger Washington State sample. We present a set of estimates in Table 7 for the Pittsburgh sample that are analogous to those presented in Table 2 for the Washington State sample.

The estimates in the first panel of the table indicate that post-schooling earnings of both male and female participants are substantially greater than their observationally equivalent counterparts who did not attend community college. These impacts constitute approximately 15 percent of post-displacement earnings for males and even larger gains for females. Given that the typical participant in the program completed nearly an academic year of schooling, these impacts are large. But turning to the second panel of the table, we see that our alternative approach for estimating the impact of schooling generates substantially different results, especially for males. The figure of −10.0 suggests that each community college credit is associated with a $10 decrease

in males' quarterly earnings.

Among females the relationship between credits and earnings is positive. But the impact generated from this alternative approach is substantially smaller than that generated by the conventional program evaluation estimator. In CCAC's semester system an academic year of courses consisted of 30 credits. Hence, the estimated coefficient of $11.1 implies that one year of academic credits raises female displaced workers' quarterly earnings by about $330. This figure is much smaller than the $812 figure in the first panel of the table, but it is about 50 percent larger than the corresponding figure reported for women in Washington State sample (once we adjust for differences between credits in the quarter and semester systems).

Turning to the last panel of Table 7, we can better understand the source of the puzzling results for males in the previous panel. Among displaced workers who complete at least some community college schooling, those with the highest earnings are those who essentially completed one class. Among the remaining participants in the CCAC program, there does not appear to be any systematic relation between credits completed and earnings. Despite our controls for unobserved fixed-effects and the temporal pattern of displacement, these findings suggest that there may still be important time-varying characteristics that remain unaccounted for in our analysis. Still there is not much evidence here that community college schooling in Pittsburgh improved the prospects of male displaced workers.

Among women it remains the case that those who completed just one class had earnings that were at least as high as many of their observationally equivalent counterparts who completed more classes. Except for this group however, there does appear to be a positive relationship

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between completing community college credits and earnings. Those who completed 5 to 14 credits earned about $500 more than displaced workers who do not attend community college; those that completed 15 – 50 credits earned about $750 more; and those who completed more than 51 credits earned about $1,200 more. As we reported for the Washington State sample and has been reported elsewhere, we find evidence in the Pittsburgh sample that prime-age women benefit from completing enough community college courses to obtain an Associate of Arts degree (Kane and Rouse, 1995). Once again when we analyzed our data by type of course, our findings indicate that we get this result because these women tend to complete programs teaching skills in the health occupations.

V. Conclusion

This paper examined how community college schooling affects the subsequent earnings of displaced workers. Because these individuals are relatively old, this study also provides an opportunity to examine whether such schooling has the same returns for prime-age adults as it does for younger students. Our analysis indicates that on average the returns to such schooling are relatively small: a year of community college schooling raised the hourly wages of both male and female displaced workers by less than two percent. We found larger impacts of such schooling on earnings—on the order of 5 to 6 percent of earnings—because of the significant impact that such schooling has on subsequent hours worked. In addition, our results are consistent with those reported by Kane and Rouse (1995) that indicated that males' earnings rise even if they complete only a few courses. Further, we found no evidence of a "sheepskin" effect for males. In fact, we

report evidence that males who take too many community college courses do worse than their counterparts who complete fewer classes.

For policy purposes these results indicate that worker retraining programs will not offset a large portion of the long-term earnings losses associated with workers' displacements. Previous studies indicate that even may years after their job losses, experienced displaced workers earn 15 to 25 percent less in their new jobs than what they would have earned on their old jobs (Rhum, 1991; Jacobson, LaLonde, and Sullivan, 1993). Thus even if a displaced worker acquires one year worth of schooling, his or her earnings will still remain below the levels that they would have anticipated had they not lost their jobs. Further, as we observed in our Washington State sample, most displaced workers did not acquire as much as a year of schooling.

At the same time, the foregoing summary of our results masks considerable heterogeneity in our results among individuals with different prior skills levels and by type of program. More skilled displaced workers were more likely to enroll in Group 1 courses. These courses taught skills that apparently have high returns. Our results indicate that one academic year of such courses should raise individuals subsequent earnings by about 14 percent for males and by even a larger amount for females. The magnitude of these gains indicate that programs offering such courses stand a chance of offsetting a substantial portion of the earnings losses associated with workers' displacements.

An implication of our results is that public subsides of community college schooling for displaced workers will not pay off unless displaced workers enroll in more technically oriented vocational courses, academic math and science classes, or courses teaching skills for the health

occupations. We found that males who completed at least one course in Washington State Community Colleges completed on average about one-half of a year of schooling. The average long-term impact of community college schooling received by males indicated that this much schooling raised quarterly earnings by $144. Even if we ignore the estimated negative short term impact of schooling on earnings, and assume that a typical student will work for 30 years following school, the present discounted value of this gain (using a 5 percent discount rate) is less than $9,000. This amount does not take into account that part of this gain results from a loss of non-market time, because schooling appears to increase subsequent hours worked. If a displaced male worker returned to school full-time for one-half of a year to acquire this schooling, it is likely that his foregone earnings would be close to this amount. Further, the calculation of the private net benefit of this schooling would also have to include expenses for tuition, fees, supplies, and transportation. The social net benefit would have to take into account the substantial subsidies that community colleges receive from state and local governments.[5]

By contrast, our findings for the impacts of Group 1 courses indicate that one-half an academic year of such courses raises long-term quarterly earnings by $360. Applying the same assumptions as above, the present discounted value of this gain is about $22,000. Even a male displaced worker capable of obtaining a job paying $15 per hour would be better off going to school full-time and acquiring these kinds of skills. Because, women's opportunity cost of working is substantially lower than it is for males, and yet the gains they experienced from taking Group 1

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[5] Kane and Rouse (1999) estimate that the average cost of tuition to U.S. community colleges is about $1,300 per year, and that the total cost of a year of community college schooling is about $8,000 per student.

courses are the same, the net benefits associated with providing training to displaced women is larger than it is for men. Interestingly in other research we find that even holding constant a wide array of personnel characteristics, displaced women are more likely to enroll in community college courses around the time of their job losses than are displaced male workers (Jacobson, LaLonde, and Sullivan, 1999).

Our analysis of the net benefits of community college schooling relied on our specification in which we identify the impact of schooling using the variation in credits completed by those displaced workers who completed at least one course. If we relied on the alternative approach that compares outcomes of community college participants to other displaced workers who never completed any community college courses around the time of their job losses, our net benefit calculations, with one exception, would be larger. For displaced female workers in Washington State, we found that both approaches yielded approximately the same impact of community college schooling.

Although these alternative sets of estimates trade off two different sources of selection bias, we believe that our preferred approach produces the more credible estimates of the impact of additional community college schooling on individuals' earnings. We can identify the impact of an additional credit using individuals that are similar in that they also decided to enroll and complete community college courses. By contrast, part of the difference between the earnings of community college participants and non-participants is likely attributed to differences between the average of the time-varying characteristics of the two groups. For example, participants tended to be better educated displaced workers, so it is plausible that the trend in their subsequent earnings growth

would be larger. Thus, even after controlling for fixed effects, estimates based on the conventional

program evaluation specification would be biased upward.

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Appendix

Notes on Displaced Workers, Administrative Earnings and Community College Records

There is no consensus as to the definition of a displaced worker. However, there are four common elements in most descriptions of such individuals:

(i) Displaced workers have not been discharged for cause;
(ii) Displaced workers have permanently separated from their former employer or have only a very small likelihood of being recalled to their old jobs;
(iii) Displaced workers have had strong prior attachment to the industry of their pre-displacement employer;
(iv) Displacement is often identified has having resulted from structural changes in the economy rather than from the idiosyncratic fortunes of a single firm.

As a result of the foregoing description, studies on the consequences of job loss and of programs and policies to aid the victims of displacement have sought to limit their attention to unemployed workers with some or all of these characteristics. Recognition that job loss is potentially more costly for high-tenured workers has lead to U.S. Department of Labor in some of its publications to define displaced workers as persons having at least 3 or more years of tenure when they permanently lost their jobs (Flaim and Seghal, 1985).

Our Washington State sample consists of every individual who lost a job in that state between 1990.II and 1994.IV and who filed a valid claim to receive unemployment insurance benefits. From the state, we received two types of administrative records. First, we received administrative quarterly earnings and unemployment insurance benefits records that started in 1984 and continued through 1995. Second, we received machine-readable transcripts for all of these individuals who had enrolled in one of 25 of the state's community colleges These records cover the period prior to job loss starting with the fall term of 1989. These records continue through the end of our sample period.

We excluded from our sample individuals who transferred to a four-year college or who acquired more than 135 community college credits. We also excluded from the sample all individuals displaced from jobs in the public sector.

We restricted our sample of displaced workers in several ways in order to focus on individuals for whom the effects of retraining would likely be of the greatest policy interest. First, we limited our analysis to adults between the ages of 22 - 60 years old. We make the former age restriction because of the traditional policy interest in the displaced as a group of experienced workers who require retraining assistance and also because studies of the economically disadvantaged population suggest that youths respond differently to retraining services than do adults (Heckman, LaLonde, and Smith, 1999). We impose the latter age restriction because the medium and long-term earnings impacts of retraining are likely to be small for persons close to retirement.

Another restriction that we impose on our sample is that workers must have accumulated at least 12 quarters of service with their pre-displacement employers. We exclude workers with few quarters of service (tenure) with their former employer because such individuals do not fall within common definitions of a displaced worker. In addition, because a rationale for subsidizing displaced workers' retraining is that the earnings losses associated with their displacements may be substantial, we chose not to analyze a group for whom on both theoretical and empirical grounds the adverse impacts of job loss are likely to be small.

We also limited our sample to displaced workers who remained "continuously attached" to the state's work force. We defined such a worker if he or she never had more than one calendar year without earnings, except during the period following his or her job loss and when he or she was enrolled in community college courses. In the Washington State sample, we excluded from our analysis any worker who did not have at least some positive earnings in every sample year from 1984 through 1995, except for the eight quarters following his or her job loss. This sample restriction ensures that each member of the sample was consistently attached to Washington State's employed work force throughout the sample period. This restriction meant that we excluded approximately one-half of the available observations from our analysis. Our review of these excluded individuals indicated that many never had positive wage and salary earnings in Washington State (or Pennsylvania) following their job loss or enrollment in the state's community colleges. Although many of these individuals many have moved out of state, we also found the women and older workers were more likely in this category. These individuals are generally found to have lower mobility rates or are considered "tied movers."

The Washington State sample used in our analysis contains more than 3 million person/quarter observations, or 86,001 individual observations. Of this number, 13,152 completed at least one credit in a Washington State community college around the time of their job losses. We define this period to encompass the 3 quarters prior to an individual's job loss and the 11 quarters after the quarter that they lost their job. We consider schooling prior to the quarter of job loss because of prior research that indicates that displaced workers earnings begin to decline even prior to their separations (Jacobson, LaLonde, and Sullivan, 1993).

We constructed our Pittsburgh sample similarly. The earnings records cover the period from 1974 through 1991 for all establishments in Pennsylvania. Our sample includes information only for one community college, the Community College of Allegheny County (CCAC). We matched earnings records of individuals displaced in the county between 1978 and 1985 to CCAC's machine-readable transcript records. As in the Washington State sample, we restricted the sample to individuals who remained continuously attached to the Pennsylvania workforce. The Pittsburgh sample is much smaller than the Washington State sample. It contains 2,246 community college participants and 3,500 displaced workers who did not attend CCAC.

As might be expected from a sample consisting of displaced workers from metropolitan Pittsburgh the early 1980s, the fraction of workers displaced from durable goods industries is very large compared to the Washington State sample. About 45 percent of the community college participants and nearly 20 percent of the non-participants had been displaced from the steel industry. Further, because of the large numbers of displaced steelworkers in the county, the Pittsburgh sample includes a smaller fraction of female displaced workers.

Table A

Classifications of Washington State Community College Classes

A. Quantitative or Technically Oriented Vocational courses (Group 1):

Health related courses
Technical/professional courses
Technical trades
Science/math academic courses.

B. Non-quantitative Courses (Group 2):

Sales/service courses
Vocational courses (not in A)
Social Science/humanities courses
Health/PE/consumer oriented courses
Basic skills education
Other courses.

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Table 1
Characteristics and Community College Schooling of Displaced Workers

Panel A:
Characteristics of Individuals in Sample of Washington State Displaced Workers

	Males		Females	
	Participants (1)	Comparisons (2)	Participants (3)	Comparisons (4)
Age at separation	35.4 (8.8)	39.0 (9.3)	37.1 (9.1)	40.5 (9.3)
20 - 29	.28	.16	.23	.13
40 - 59	.32	.46	.40	.53
Minority	.11	.13	.11	.14
More than H.S. degree	.49	.37	.51	.40
6+ years tenure	.20	.24	.25	.29
Aerospace/Motor Veh.	.14	.11	.10	.09
Other Manufacturing	.26	.23	.15	.15
Other Goods Producers	.19	.23	.07	.07
Non-Goods Producing	.41	.43	.69	.68
Rural	.26	.22	.24	.20
Seattle-Tacoma MSA	.53	.55	.56	.58
Other MSA	.21	.23	.20	.22
1995:III earnings	$5,300	$5,378	$3,524	$3,410
Number of Observations	6,445	44,414	6,707	28,435

Notes: The comparison groups are comprised of displaced non-trainees, those who never enrolled in a community college course, and displaced dropouts, those who enrolled but never completed a community college course. Participants in the state's ESHB88 program are excluded.

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Table 1 (continued)

Panel B
Credits Completed By Washington State Displaced Workers:

All Credits	Mean	1 - 5	6 - 10	11 - 20	21 - 40	41 - 75	76+
Males	23.2 (29.2)	.35	.17	.16	.13	.11	.08
Females	22.4 (29.1)	.38	.17	.14	.12	.11	.08

Type of Credits	Mean	0	1 - 5	6 - 20	21+
Group 1:					
Males	12.5 (21.7)	.34	.26	.22	.17
Females	7.6 (15.2)	.45	.27	.17	.11
Group 2 :					
Males	10.7 (17.5)	.35	.25	.23	.16
Females	14.8 (20.9)	.20	.30	.26	.23

Notes: Total credits accumulated in Washington State community colleges. Group 1 credits are from courses teaching more technical academic and vocational skills. Group 2 credits are from all other courses, including basic skills classes.

Table 2
Impact of Community College Schooling on Displaced Workers' Earnings
[Impact on quarterly earnings of displaced workers from Washington State]

	Males		Females	
	(1)	(2)	(3)	(4)
Conventional Estimates:				
Long-term (Intercept)	$63	$261	$18	$147
	(18)	(23)	(18)	(23)
First. Qtr. Difference	---	-704	---	-389
		(49)		(48)
Impact of Credits (i.e. 3b in text):				
Parametric				
Long Term (Slope)	-0.6	6.2	0.2	5.1
	(0.7)	(0.9)	(0.7)	(0.9)
First. Qtr. Difference	---	-18	---	-13
		(2)		(2)
Semi-Parametric				
1 - 5 credits	12	90	67	124
	(28)	(35)	(26)	(33)
6 - 10 credits	177	372	43	141
	(40)	(50)	(41)	(51)
11 - 20 credits	317	548	261	448
	(43)	(53)	(46)	(50)
21 - 40 credits	316	661	35	216
	(50)	(65)	(52)	(68)
41 - 75 credits	326	779	138	470
	(62)	(84)	(62)	(84)
76 +	-216	494	116	621
	(75)	(106)	(78)	(110)
Controls for Change in Impacts Since School	No	Yes	No	Yes

Notes: See (3b) and accompanying text. The term "long term (slope)" refers to parameter τ_1. The term "First. Qtr. Difference" refers to the difference between the long-term impact of schooling and the impact during the first post-schooling quarter or the parameter τ_3. The estimated impact of schooling during the kth quarter after an individual completes his or her last course is given by the $1/k$ times the "First. Qtr. Difference" plus the ``Long-term" estimate.' The term "Long-term (Intercept)" refers to the parameter τ_0 when we restrict the parameters τ_1 and τ_3 to equal 0.

Table 3
Heterogeneity in the Impacts of Community College Schooling
[Impact of a community college credit on long-term quarterly earnings in Washington State]

Characteristic	Males		Female	
	Long-term	Fst. Qtr. Diff.	Long-term	Fst. Qtr. Diff.
	(1)	(2)	(3)	(4)
Minority Status:				
Non-minority	6	-18	5	-13
	(1)	(2)	(1)	(2)
Minority	2	-13	5	-11
	(3)	(7)	(4)	(7)
Age at Displacement:				
20s	8	-13	9	-15
	(2)	(3)	(2)	(4)
30s	8	-20	4	-18
	(2)	(3)	(2)	(3)
40s	-4	-16	3	-4
	(2)	(4)	(2)	(4)
50s	9	-37	0	-18
	(4)	(4)	(4)	(8)
Tenure at Displacement:				
3 to 6 years	4	-16	3	-13
	(1)	(2)	(1)	(2)
6 or more years	16	-29	16	-15
	(3)	(5)	(3)	(5)
Prior Education:				
H.S. Educ. or Less	3	-18	0	-14
	(1)	(3)	(2)	(3)
More than H.S. Educ.	7	-17	6	-11
	(1)	(3)	(1)	(3)

Notes: See (3b) and accompanying text. The term "long term" refers to parameter τ_1. The "Fst. Qtr. Diff." refers to the difference between the long-term impact of schooling and the impact during the first post-schooling quarter or the parameter τ_3.

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Table 4
Impacts Different Community College Courses
[Long-term impact of community college credits on quarterly earnings in Washington State]

Panel A: Parametric Estimates

	Males	Females
Group 1 Quantitative Academic & Vocational Courses	$16 (1)	$17 (2)
Group 2 Less Quantitative Academic & Vocational Courses	-9 (2)	-3 (1)

Panel B: Semi-parametric Estimates of Long-term Impacts (Males)

Group 2 Credits	Group 1 Credits			
	0	1-5	6 - 20	21+
0	---	421 (52)	997 (58)	1,220 (96)
1 - 5	-164 (46)	367 (118)	776 (139)	1,066 (165)
6 - 20	-77 (61)	-175 (113)	1,000 (126)	725 (136)
21+	246 (114)	95 (146)	527 (145)	275 (146)

Panel C: Semi-parametric Estimates of Long-term Impacts (Females)

Group 2 Credits	Group 1 Credits			
	0	1-5	6 - 20	21+
0	---	275 (54)	724 (92)	818 (198)
1 - 5	28 (40)	256 (98)	784 (184)	699 (248)
6 - 20	81 (53)	539 (100)	50 (128)	874 (169)
21+	-33 (104)	484 (126)	207 (100)	606 (137)

Notes: See (3b) in text. All estimates are of the parameter τ_1. Specifications that include controls for change in impacts of community college during the post- schooling period.

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Table 5
Wages of Male Displaced Workers Prior to Displacement
[Mean log hourly wages of males from Washington State during 4th quarter prior to displacement]

Group 2 Credits	Group 1 Credits			
	0	1-5	6 - 20	21+
0	2.75	2.85	2.80	2.81
	(.51)	(.46)	(.47)	(.49)
1 - 5	2.76	2.74	2.71	2.69
	(.47)	(.39)	(.46)	(.33)
6 - 20	2.67	2.67	2.61	2.64
	(.46)	(.41)	(.41)	(.49)
21+	2.56	2.56	2.57	2.59
	(.44)	(.39)	(.42)	(.49)

Notes: Figures are mean log hourly wages for male displaced workers from Washington State sample. Hourly wages during the 4th quarter prior to the quarter of separation equal quarterly earnings divided by hours paid for. Subject areas of Group 1 and Group 2 credits given in Appendix Table A. Sample standard deviations are in parentheses.

Table 6
Impact of Community College Schooling on Wages, Quarterly Hours and Employment Rates

Impact of Credits:	Males			Females		
	Log Wage (1)	Qrtly Hours (2)	Empl. Rate (3)	Log Wage (4)	Qrtly Hours (5)	Empl. (6)
Parametric						
Long-term (Credits*100)	0.025 (0.012)	55 (5.7)	0.015 (0.017)	0.026 (0.012)	42 (5.7)	0.034 (0.017)
First. Qtr. Difference.*100	-0.16 (0.0250)	-92 (11.7)	-0.036 (0.017)	-0.08 (0.026)	85 (12.0)	0.021 (0.018)
Semi-Parametric						
1 - 5 credits	0.019 (0.005)	0 (2)	0.011 (0.003)	0.011 (0.004)	12 (2)	0.013 (0.003)
6 - 10 credits	0.029 (0.007)	26 (2)	0.022 (0.004)	0.005 (0.007)	17 (3)	0.025 (0.005)
11 - 20 credits	0.071 (0.007)	14 (2)	0.011 (0.005)	0.047 (0.004)	22 (3)	0.021 (0.005)
21 - 40 credits	0.069 (0.009)	28 (2)	0.014 (0.006)	0.006 (0.004)	25 (4)	0.023 (0.006)
41 - 75 credits	0.098 (0.011)	25 (2)	0.036 (0.007)	0.014 (0.011)	43 (5)	0.022 (0.007)
76 +	0.014 (0.014)	70 (2)	0.019 (0.009)	0.055 (0.014)	47 (7)	0.058 (0.010)

Notes: Estimates based on Specification (3b) in text. "Long term" is an estimate of the parameter τ_1. The term "First. Qtr. Difference" refers to the difference between the long-term impact of schooling and the impact during the first post-schooling quarter and is an estimate of the parameter τ_3. Hourly wages equal quarterly earnings divided by hours paid for.

Table 7
Impact of Community College Schooling on Quarterly Earnings in the Pittsburgh Sample

	Males		Females	
	(1)	(2)	(3)	(4)
Conventional Estimates:				
Long-term (Intercept)	$860	$1,047	$645	$812
	(31)	(33)	(39)	(42)
First. Qtr. Difference.	---	-1,070	---	-865
		(64)		(82)
Impact of Credits (i.e. 3b in text):				
Parametric				
Long-term (Slope)		-10.0		11.1
		(0.9)		(1.1)
First. Qtr. Difference		-11		21
		(2)		(2)
Semi-Parametric:				
1 - 4 credits	900	1,072	605	746
	(36)	(40)	(43)	(47)
5 - 10 credits	575	711	470	550
	(45)	(49)	(54)	(59)
9 - 14 credits	686	818	336	481
	(45)	(49)	(57)	(63)
15 - 28 credits	337	519	585	732
	(43)	(47)	(59)	(66)
29 - 50 credits	64	196	621	760
	(48)	(54)	(69)	(78)
51 + credits	299	600	880	1,241
	(59)	(66)	(69)	(77)
Controls for Change in Impacts Since School	No	Yes	No	Yes

Notes: Sample of participants includes both subsidized DWETP participants and unsubsidized displaced workers who enrolled and completed courses at CCAC. Estimates based on (3b). See also accompanying text. The term "long term (slope)" refers to parameter τ_1. The term "First. Qtr. Difference" refers to the difference between the long-term impact of schooling and the impact during the first post-schooling quarter or the parameter τ_3. The term "Long-term (Intercept)" refers to the parameter τ_0 when we restrict the parameters τ_1 and τ_3 to equal 0.