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## Conducting Return on Investment Analyses for Secondary and Postsecondary CTE: A Framework

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## **Conducting Return on Investment Analyses for Secondary and Postsecondary CTE: A Framework**

In recent work, I have estimated the rate of return for several workforce development programs in the State of Washington, including secondary and postsecondary career and technical education (CTE; Hollenbeck, 2008). The returns are based on estimates of the net impact of CTE on individuals' labor market experiences and government income supports after encountering programs. In particular, these net impacts were estimated using a nonexperimental approach that relies on administrative data sources. The purpose of this paper is to discuss the estimation approach and to present estimates for postsecondary and secondary CTE from a recent study. The next section of the paper discusses net impact estimation, which is the basis for the rates of return estimates.

### ***Net Impact Evaluation***

In recent years, performance monitoring has become an integral part of program administration as public resources have become tighter and tighter, forcing administrators to be held more and more accountable to measurable performance standards. A fortunate by-product of performance monitoring is the considerable individual-level data that have become available, which may be used for evaluation purposes.

Evaluation is intended to go beyond performance monitoring. Stufflebeam (1999) suggested that its purpose is to make judgments about worth and value. In particular, evaluation draws conclusions about whether programs are achieving their purposes or objectives. Obviously, this means that evaluators need to identify the purposes or objectives of program(s), which may or may not be straightforward. In the world of workforce development programs, for example, there are at times tensions between employment and skill development (training) goals. Moreover, once the goal(s) have been decided, evaluation studies must find outcomes that are measurable and indicative of the outcomes. Finally, perhaps the most difficult aspect of an evaluation is the establishment of attribution (i.e., determining the extent to which outcomes result from programmatic interventions).

The purpose of a net impact evaluation is to evaluate the outcomes of the program for participants relative to what would have occurred if the program did not exist. In other words, it answers the question of how the program has changed the lives of individuals who participated in it relative to their next best alternative. The data that are used to address this question are quantitative, and the evaluation should attempt to disaggregate the results because there may be systematic relationships between program outcomes and participant characteristics. The audiences for a net impact evaluation are the funding agency(ies) and program administrators.

The attribution of the net impacts to the program intervention is confounded by at least four factors. The first factor is definition of the treatment. CTE programs vary considerably across individual students. Thus, in general, each student will receive a different set of courses from different instructors at different points in time. Furthermore, students control their effort. So, even if they experience the same "treatment," students may exert more or less effort in learning or applying the skills or knowledge that has been delivered to them. Furthermore, some

individuals may not complete the treatment at all; they may drop out. Second, in order to estimate the *net* impacts of a program, it is necessary to compare program participants to another group of individuals who represent the “counterfactual” (i.e., what would have happened to the participants absent the program). Designation of that comparison group, and concomitantly, having adequate data concerning members of the group are crucial for estimating net impacts. Having data may be difficult because the comparison group members did not receive the “treatment.”

The third factor that may confound attribution is the definition and measurement of the outcomes. Performance measurement is aimed at inflows into and outflows from a program, whereas evaluation is likely to focus on outcomes after clients have received the treatment. The performance measurement system may not be designed to collect such information. Fourth, the dynamics of program interventions and outcomes may make attribution difficult. In particular, receiving the treatment may require a significant amount of time. So the question becomes whether outcomes should be measured after program entrance or after the treatment ends. (Furthermore, individuals who receive the treatment may not complete the program.) Observations that are well-matched at the time of program entrance may differ considerably if the reference point is program exit simply because of the business cycle or other changes that may occur over time.

The four conditions, then, that must be met in order to use administrative, performance monitoring data for evaluation purposes are as follows:

- o The treatment is defined in a general enough fashion to be meaningful for a sizable group of program participants. However, the more general the definition of the treatment, the less useful it might be for program improvement purposes.
- o Data must be available for a group of individuals that arguably make a reasonable source of cases for a comparison group.
- o Outcome data must be available for both the treatment and comparison groups.
- o The time periods of observation and treatment for program participants and the comparison group must be reasonably close to each other, so that the comparison group can yield observations for which outcomes can be compared.

The next section of the paper lays out the net impact evaluation in rigorous mathematical terms and identifies the key assumptions that must be made in order to use administrative data for estimation purposes.

### ***The Net Impact Evaluation Problem and Key Assumptions***

To estimate the net impact of a treatment, the desired information (which cannot be observed) is the difference between the outcome that occurs to a student if they participate in a CTE program minus the outcome that would occur if the individual did not participate. Obviously, individuals cannot simultaneously be in two states of the world, so we must *estimate* the net impacts.

The net impact evaluation problem may be stated as follows: Individual  $i$ , who has characteristics  $X_{it}$ , will be observed to have outcome(s)  $Y_{it}(1)$  if he or she receives a “treatment”

(i.e. takes a CTE program) at time  $t$  and will be observed to have outcome(s)  $Y_{it}(0)$  if he or she doesn't participate. The net impact of the treatment for individual  $i$  is  $Y_{it}(1) - Y_{it}(0)$ . Of course, this difference is never observed because an individual cannot simultaneously receive and not receive the treatment.

To simplify the notation without loss of generality, I will omit the time subscript in the following discussion. Let  $W_i = 1$  if individual  $i$  receives the treatment, and  $W_i = 0$  if  $i$  does not receive the treatment. Receiving the treatment is assumed to be a random event—individuals happened to be in the right educational institution at the right time to learn about the program, or the individuals may have experienced random parental or guidance counselor advice to enroll in the program—so  $W_i$  is a stochastic outcome that can be represented as follows:

$$(1) \quad W_i = g(X_i, e_{pi}), \quad \text{where}$$

$e_{pi}$  is a random variable that includes unobserved or unobservable characteristics about individual  $i$  as well as a purely random component.

An assumption that we make about  $g(\cdot)$  is that  $0 < \text{prob}(W_i = 1|X_i) < 1$ . This is referred to as the “support” or “overlap” condition that is necessary so that the outcome functions described below are defined for all  $X$ .<sup>1</sup>

In general, outcomes are also assumed to be stochastically generated. As individuals in the treatment group participate in the training, they gain certain skills and knowledge and encounter certain networks of individuals. I assume their outcomes are generated by the following mapping:

$$(2) \quad Y_i(1) = f_1(X_i) + e_{1i}$$

Individuals not in the treatment group progress through time and also achieve certain outcomes according to another stochastic process, as follows:

$$(3) \quad Y_i(0) = f_0(X_i) + e_{0i}$$

Let  $f_k(X_i) = E(Y_i(k)|X_i)$ , for  $k = 0, 1$ , so  $e_{ki}$  are deviations from expected values that reflect unobserved or unobservable characteristics.

As mentioned, the problem is that  $Y_i(1)$  and  $Y_i(0)$  are never observed simultaneously. What is observed is the following:

$$(4) \quad Y_i = (1 - W_i)Y_i(0) + W_iY_i(1)$$

The expected value for the net impact of the treatment on the sample of individuals treated is as follows:

$$(5) \quad E[Y_i(1) - Y_i(0)|X, W_i = 1] = E(\Delta Y | X, W = 1)$$

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<sup>1</sup> Note that Imbens (2004) showed that this condition can be slightly weakened to  $\text{Pr}(W_i = 1|X_i) < 1$ .

$$\begin{aligned}
&= E[Y(1)|X, W = 1] - E[Y(0)|X, W = 0] \\
&\quad + E[Y(0)|X, W = 0] - E[Y(0)|X, W = 1] \\
&= \hat{f}_1(X) - \hat{f}_0(X) + \text{BIAS}, \quad \text{where}
\end{aligned}$$

$\hat{f}_k(X)$ ,  $k = 1, 0$ , are the outcome means for the treatment and comparison group samples, respectively, and BIAS represents the expected difference in the  $Y(0)$  outcome between the comparison group (actually observed) and the treatment group (the counterfactual).

The BIAS term may be called selection bias.

A key assumption that allows estimation of equation (5) is that  $Y(0) \perp W|X$ . This orthogonality assumption states that given  $X$ , the outcome  $Y(0)$  is a random variable whether the individual is a participant or not. In other words, participation in the treatment can be explained by  $X$  up to a random error term. The assumption is called “unconfoundedness,” “conditional independence” or “selection on observables.”<sup>2</sup> If the assumption holds, then the net impact is identified because the BIAS goes to 0, or

$$(6) \quad E[\Delta Y|X, W = 1] = \hat{f}_1(X) - \hat{f}_0(X)$$

In random assignment, the  $X$  and  $W$  are uncorrelated by design, so the conditional independence assumption holds by design. In any other design, the conditional independence is an empirical question. Whether or not the data come from a random assignment experiment, however, because the orthogonality assumption holds asymptotically (or for very large samples), in practice, it may make sense to regression adjust (6).

### ***Net Impact Estimation in Practice***

This section of the paper describes how net impacts were estimated in a study done for the state of Washington in 2006 (Hollenbeck & Huang, 2006). In particular, the section discusses the estimates for job preparation programs conducted at community and technical colleges and secondary vocational education (i.e., postsecondary and secondary CTE). Estimates were developed for individuals who exited from these programs in program years 2001-2002 and 2003-2004. The outcome variables (i.e. the  $Y$  variables) included quarterly earnings, quarterly employment (defined as having earnings greater than \$100), quarterly hours of employment, wage rates, receipt of TANF benefits, receipt of Food Stamps benefits, receipt of unemployment insurance benefits, and eligibility for Medicaid. These outcomes were measured at two points in time: three full quarters after program (school) exit and 9 - 12 quarters after exit. The hypotheses that were being tested were that the labor market outcomes would be positive and the public assistance outcomes would be negative.

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<sup>2</sup> Imbens (2004) refers to this as the “unconfoundedness for controls” assumption.



Absent a random assignment experiment and relying on administrative data, the approach used was to try to find a group of individuals who resemble the participants, but who did not participate in a CTE program. This was done by a technique called statistical matching. Let  $T$  represent the data set with observations about individuals who receive the treatment for whom we have data, and let  $n_T$  represent the number of individuals with data in  $T$ .  $T$  is the treatment sample. Let  $U$  represent a data set with observations about individuals who may be similar to individuals who received the treatment for whom we have data, and let  $n_U$  be its sample size.  $U$  is called the comparison group pool. It may be convenient to find a subset of  $U$  that contains observations that “match” those in  $T$ . Call this subset  $C$ , and let  $n_C$  be its sample size.  $C$  is the comparison group.

Various techniques have been suggested in the literature for constructing the comparison, but they may be boiled down to two possibilities: (1) use all of the  $U$  set or (2) try to find observations in  $U$  that closely match observations in  $T$ . Note that identification of the treatment effect requires that none of the covariates  $X$  in the data sets are perfectly correlated with being in  $T$  or  $U$ . That is, given any observation  $X_i$ , the probability of being in  $T$  or in  $U$  is between 0 and 1. Techniques that use all of  $U$  are called full sample techniques.<sup>3</sup> Techniques that try to find matching observations will be called matching techniques. The study reported here used the latter, although Hollenbeck (2004) tested the robustness of net impact estimates to a number of matching techniques.

In particular, the study discussed here used a nearest-neighbor algorithm using propensity scores as the distance metric (see Dehejia & Wahba, 1995). Treatment observations were matched to observations in the comparison sample universe with the closest propensity scores. The matching was done with replacement and on a one-to-one basis. Matching with replacement reduces the “distance” between the treatment and comparison group cases, but it may result in the use of multiple repetitions of observations, which may artificially dampen the standard error of the net impact estimator. Finally, a caliper is employed to ensure that the distance between the observations that are paired be less than some criterion distance.

Postsecondary job preparation programs represent the applied (non-transfer) training mission of community and technical colleges. For the most part, they provide training for individuals to enter a variety of technical occupations that usually don’t require a baccalaureate degree. These programs are open to all high school graduates or persons over the age of 18. (Persons under 18 who have not completed high school may be admitted with the permission of their local school district.) The comparison group pool consisted of individuals aged 16 to 60 who registered for the Labor Exchange. Individuals who had participated in postsecondary CTE were excluded from the comparison sample pool.

Secondary CTE (vocational education) provides general workplace and, to some extent, specific occupational skills instruction to high school students. In the postsecondary analyses, the participating population included completers as well as “non-completers.” However, with the high school CTE students, the “treatment” is full-time equivalent vocational completers only, defined as completing 360 hours of sequenced vocational classes. The reason for this decision

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<sup>3</sup> Some of these techniques trim or delete a few outlier observations from  $U$  but will still be referred to as full sample techniques.

was that virtually all high school students in the state take at least one CTE class, so in this case, treatment was defined as having completed a concentration. The Office of the Superintendent of Public Instruction (OSPI) in Washington provided individual-level data from general administrative information provided by all public high schools in the state about their student enrollment. The intent of the data collection was to have universal coverage, but some high schools did not provide the data. So the representativeness and generalizability of the data may be at question. A significant advantage, however, was the ability to use the same data set for the comparison group pool as the treatment. That is, the observations in the high school data who were not classified as vocational completers (by the high school) comprised the comparison group pool.

Table 1 provides the estimated short-term net impacts of the postsecondary and secondary CTE programs. The elements reported in the table show the increase in employment defined as having at least \$100 in earnings in the third quarter after exiting from the program, the increase in the average hourly wage rate, increase in hours of employment, the increase in quarterly earnings, and the reduction (or increase) in the percentage of individuals receiving unemployment insurance benefits, TANF, Food Stamps, or Medicaid, on average, for that quarter.<sup>4</sup> Note that for postsecondary CTE, these results include all participants—those individuals who completed their education or training and those who left without completing. Separate net impact estimates for subgroups of participants, including completers only, are reported in Hollenbeck and Huang (2006).

Table 1  
*Short-Term<sup>a</sup> Net Impacts of Postsecondary and Secondary CTE in Washington*

Outcome	Secondary CTE	Postsecondary CTE
Employment (in percentage points)	4.1	9.2
Average hourly wage	\$0.38	\$3.24
Average quarterly hours	12.0	71.3
Average quarterly earnings	\$141	\$1,564
Receiving unemployment insurance benefits (in percentage points)	0.1 <sup>‡</sup>	-1.2
Receiving TANF benefits (in percentage points)	-0.0 <sup>‡</sup>	-0.5
Receiving Food Stamp benefits (in percentage points)	-0.2 <sup>‡</sup>	-4.1
Enrolled in Medicaid (in percentage points)	0.7	-3.0

*Note.* Specific estimation techniques are described in later chapters. Dollar figures adjusted for inflation to 2005:Q1. All entries statistically significant at the .01 level (two-tailed test) unless otherwise denoted. <sup>a</sup>Defined as three quarters after exit. <sup>‡</sup>Table entry not statistically significant.

The estimates in Table 1 suggest that both postsecondary and secondary CTE have positive employment and earnings outcomes in the short-term. The impacts for postsecondary are much larger, however, with average wage rates over \$3.00 per hour higher than the appropriate comparison group and quarterly earnings greater by more than \$1,500. The secondary CTE impacts are positive and statistically significant, but much smaller in magnitude. In terms of receiving government benefits, the postsecondary CTE participants conform to the hypothesis of having negative impacts. On the other hand, the secondary CTE participants have statistically

<sup>4</sup> The earnings and hours impacts are not conditional on individuals having earnings or hours, i.e., the means include observations with values of zero.

insignificant net impacts for unemployment insurance benefits, TANF, and Food Stamps, and a positive net impact for Medicaid enrollment.

Table 2 provides estimates of the longer-term payoffs to postsecondary and secondary CTE programs. Again, the employment and earnings impacts are positive and significant, although the impacts for postsecondary CTE have been attenuated somewhat. This may be explained by the comparison group “catching up” somewhat between the short-term and longer-term. In the longer-term, the secondary CTE participants have an increase in the percentage of individuals receiving unemployment insurance benefits, but this is likely an artifact of the increased employment and earnings. They exhibit reductions in public assistance receipt, although the TANF reduction is not significant.

### *From Net Impact to Rate of Return*

In order to estimate the rates of return for secondary and postsecondary CTE, we need to project the benefits into the future and to estimate the costs of participation. Furthermore, we need to look at the costs and benefits from three perspectives: the participant, the government, and society as a whole.

Table 2  
*Longer-Term<sup>a</sup> Net Impacts of Postsecondary and Secondary CTE in Washington*

Outcome	Secondary CTE	Postsecondary CTE
Employment (in percentage points)	2.0	6.7
Average hourly wage	\$0.29	\$2.06
Average quarterly hours	24.5	39.7
Average quarterly earnings	\$284	\$1,008
Receiving unemployment insurance benefits (in percentage points)	0.6	-2.7
Receiving TANF benefits (in percentage points)	-0.0 <sup>‡</sup>	0.6
Receiving Food Stamp benefits (in percentage points)	-0.5	-0.4
Enrolled in Medicaid (in percentage points)	-1.0	-0.2 <sup>‡</sup>

NOTE: Specific estimation techniques are described in later chapters. Dollar figures adjusted for inflation to 2005:Q1. All entries statistically significant at the .01 level (two-tailed test) unless otherwise denoted. <sup>a</sup>Defined as 9-12 quarters after exit.

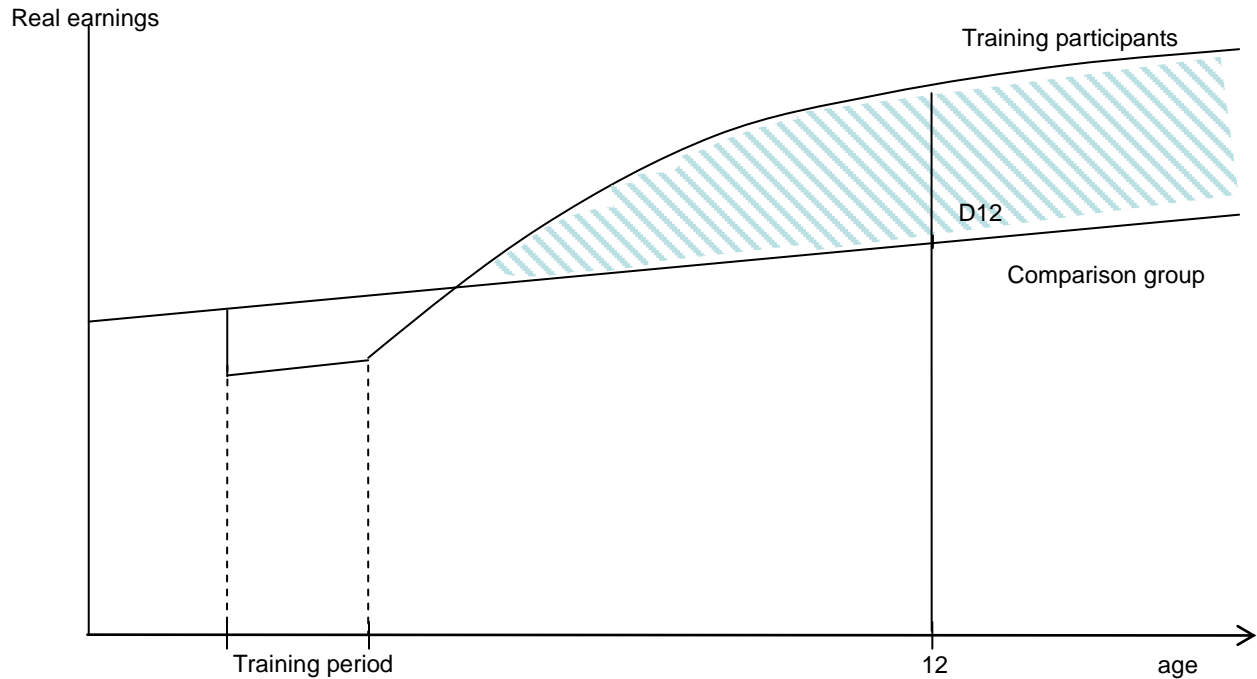
<sup>‡</sup>Table entry not statistically significant.

### *Cost-Benefit Analyses*

**Earnings.** Benefits and costs are projected for the “average” participant. Figure 1 shows the earnings profiles for the average individual in the treatment group and in the comparison group. The hypothesis used to construct these profiles is that encountering a CTE program enhances an individual’s skills and productivity (thus increasing wage rates) and increases the likelihood of employment. Thus, after the training period, the treatment earnings profile is above the comparison earnings profile (both hourly wage and employment net impacts are positive). During the training period, the treatment earnings will be below the comparison earnings, on average. These are the foregone costs of training in the form of wages that are given up by the participant while he or she is receiving training.

The theoretical lifetime earnings benefit is the shaded area in the graph. The average comparison group member’s real earnings grow at some fairly constant rate (increase in productivity), and

**Figure 1. Age-Earnings Profiles of Training Participants and Comparison Group.**



the average treatment group member's earnings eventually become higher after training and likely grow faster as they accumulate additional human capital in the form of work experience.

The problem that needs to be solved in estimating the benefits is how to compute the shaded area. In general, we have several quarters of outcome data, so we can get accurate estimates of the area up to line denoted D12 (treatment minus comparison difference at the 12<sup>th</sup> quarter.) Because the profiles represent the *average* individual, we use the *unconditional* net earnings impacts to calculate these benefits. (They automatically control for employment, hourly wage, and hours worked impacts.)

What is unknown (and unknowable) is the shape of the earnings profiles into the future after the D12 point. The profiles could continue to move apart from each other if the training participants continue to be more and more productive relative to the comparison group member, or the profiles eventually may converge over time if the training effect depreciates. Alternatively, the profiles may become parallel to reflect a scenario in which the training participants gain a permanent advantage, but then their productivity growth eventually matches the comparison group members. The typical approach is to extrapolate earnings into the future based on the observed time trend in the first 12 quarters after exit. Because the earnings benefits are received by the participants in future periods, they need to be discounted; a real discount rate has been used.

**Fringe benefits.** With additional earnings, workers will also accrue additional fringe benefits in the form of paid leave, paid insurances, retirement/savings plan contributions, and other non-cash benefits. Two sources of data provided estimates of the ratio of fringe benefits (defined as paid leave plus paid insurances plus retirement plan contributions plus other) to gross wages and

salaries (including supplemental pay such as overtime). The U.S. Department of Labor Bureau of Labor Statistics (2002) reported this ratio to be 23.3% for “All U.S.” and 20.4% for the “West Census Region.” The U.S. Chamber of Commerce (2001) reported a ratio of 24.3% for the Pacific region. Under the assumption that workforce development program participants are less likely to get fringe benefit coverage than the average worker, and to be conservative in our benefit estimation, we used the assumption that this ratio would be 20% (applied to the discounted annual earnings increments).

***Tax payments.*** Higher earnings will lead to payment of increased payroll, sales/excise, local, state, and federal income taxes.<sup>5</sup> The increased taxes are a cost to participants and a benefit to the public. We used average (marginal) tax rates for each of the taxes and applied these rates to the annual earnings changes. For example, we used the current rate of 7.65% to estimate the future payroll tax liabilities. We relied on IRS data for the federal income tax rates that factor in earned income tax credits, and state sources provided average rates for the other types of taxes.

***Unemployment compensation.*** Unemployment compensation benefits in the future may increase for participants if programs increase employment (and therefore the probability of receiving unemployment insurance [UI]) or increase earnings (and therefore benefits) or they may decrease if programs decrease the likelihood of unemployment or decrease duration of unemployment spells. Increased UI benefits in the future would be a discounted benefit to participants and cost to the public. We used a similar empirical strategy as we did for lifetime earnings to interpolate and extrapolate these benefits. In particular, we estimated the unconditional UI benefit net impacts for the first 12 quarters after exit and used these estimates as the average impact for the program in those quarters. Then we used the estimate for the 12th quarter after exit to extrapolate for 28 more quarters (68 quarters for secondary CTE.) In other words, we assumed that the UI benefit gain or loss would dampen to 0 after 10 years for the postsecondary CTE participants, and after 20 years for the secondary CTE students.

***Income-conditioned transfers.*** The maintained hypothesis was that participation in the workforce development programs would decrease the probability of receiving Temporary Assistance for Needy Families (TANF) and Food Stamps, and the probability of enrolling in Medicaid. In addition, increased earnings may have resulted in reductions in benefit levels for TANF and Food Stamps. Finally, if individuals no longer receive TANF or Food Stamps, they would not receive any support services such as child care or other referrals

For TANF/Food Stamps, we followed the same empirical strategy as we did for unemployment compensation. We estimated net impacts for unconditional TANF benefits and Food Stamp benefits for the 12 quarters after program exit cohort and extrapolated beyond that period using the estimate from quarter +12. We again assumed that on average, the program participants may receive these benefits (or lose these benefits) for up to 40 quarters (or 80 quarters for the high school CTE program) even though TANF is time limited to 20 quarters. The reason for going beyond 20 quarters is that these are averages for the entire program group, and the dynamics of reciprocity will be assumed to continue for up to 10 years.

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<sup>5</sup>Washington does not have local or state income taxes.

We followed a similar empirical strategy for Food Stamps as we did for TANF. We estimated net impacts for unconditional benefits for the 12 quarters after program exit and extrapolated beyond that period using the estimate from quarter +12. We again assumed that on average, the program participants may receive these benefits (or lose these benefits) for up to 40 quarters (or 80 quarters for secondary CTE youth).

The state did not make actual benefit/usage information for Medicaid available, so we estimated net impacts of actually being enrolled in Medicaid. Our hypothesis was that training participants will tend to decrease their enrollment rates as they become better attached to the labor force over time and will thus lose eligibility. We converted Medicaid enrollment into financial terms by multiplying the average state share of Medicaid expenditures per quarter times the average number of household members per case. As with TANF and Food Stamps, this is a benefit to the participant and a cost to the public. To interpolate/extrapolate the net impact of a program on Medicaid eligibility, we either averaged or fit a linear equation time series of estimated enrollment net impacts.

**Costs.** Two types of costs were estimated for the two programs. The first was foregone earnings, which would be reduced earnings while the participants were actually engaged in the training programs. The second type of cost was the actual direct costs of the training.

Foregone earnings represent the difference between what workforce development program participants would have earned if they had not participated in a program (which is unobservable) and what they earned while they did participate. The natural estimate for the former is the earnings of the matched comparison group members during the length of training. Specifically, we used (7) to estimate mechanistically the foregone earnings. Note that we did not discount foregone earnings, but did calculate them in real dollars.

$$(7) \quad \text{Foregone}_i = \left[ 0.5 \times (\hat{E}_{-1_i} + \bar{E}_{-1_i}) - \bar{E}_{0_i} \right] \times d_i \quad ,$$

where,  $\bar{E}_{-1}, \bar{E}_0$  = avg. quarterly earnings (uncond.) for treatment group in quarter -1 and during training period, respectively.

$\hat{E}_1$  = avg. quarterly earnings in 1<sup>st</sup> post-exit period for matched comparison group  
 $d$  = avg. training duration  
 $i$  = indexes program

For the most part, the costs of the programs were supplied to us by the state. Staff members of the state agencies calculated these costs from administrative data on days in the program and daily cost information.

Tables 3 and 4 provide the benefit-cost estimates for the CTE programs. Two time frames are presented: benefits and costs through the first 10 quarters (2.5 years) after the individual has taken their CTE coursework and up to when the average individual reaches age 65. The tables present the estimates of benefits and costs for the average participant, and they show the benefits and costs to the public that are associated with the average participant. For participants, the

benefits include net earnings changes (earnings plus fringe benefits minus taxes) and transfer income changes (UI benefits plus TANF plus Food Stamps plus Medicaid). These changes may be positive, indicating that the additional earnings and transfer income accrue to the participant, or they may be negative if earnings and/or transfers are projected to decrease. For the public, benefits include tax receipts plus reductions in transfer payments. Again, these may be positive (taxes are received and transfers are reduced) or, they may be negative. For participants, the costs are foregone earnings during the period of training and tuition and fees, if any. For the public, costs represent the budgetary expenditures necessary to provide training and education services.

The public costs are always positive, but the secondary CTE participant costs are negative because foregone earnings are negative (participants actually earn more during their high school training than if they had not participated). All of the benefits are expressed as net present values; they are adjusted for inflation and discounted back to 2000 at a rate of 3.0%. Costs are adjusted for inflation, but they are not discounted.

Table 3  
*Participant and Public Benefits and Costs per Participant in Postsecondary CTE Programs*

Benefit/Cost	First 2.5 years		Lifetime (until 65)	
	Participant	Public	Participant	Public
<i>Benefit</i>				
Earnings	12,411	0	82,280	0
Fringe Benefits	2,482	0	16,456	0
Taxes	-2,141	2,141	-14,193	14,193
<i>Transfers</i>				
UI	-2,137	2,137	-2,629	2,629
TANF	351	-351	933	-933
FS	107	-107	331	-331
Medicaid	45	-45	161	-161
<i>Costs</i>				
Foregone earnings	2,100	0	2,100	0
Program costs	3,519	6,877	3,519	6,877

Note. Dollar figures are in real 2000 dollars.

Table 4  
*Participant and Public Benefits and Costs per Completer in Secondary CTE Programs*

Benefit/Cost	First 2.5 years		Lifetime (until 65)	
	Participant	Public	Participant	Public
<i>Benefit</i>				
Earnings	2,753	0	34,603	0
Fringe Benefits	551	0	6,920	0
Taxes	-475	475	-5,969	5,969
<i>Transfers</i>				
UI	16	-16	168	-168
TANF	-91	91	-442	442
FS	-73	73	-380	380
Medicaid	-27	27	-169	169
<i>Costs</i>				
Foregone earnings	-28	0	-28	0
Program costs	0	704	0	704

Note. Dollar figures are in real 2000 dollars.

## ***Return on Investment***

The rate of return on investment (ROI) is simply the interest rate that equilibrates the costs to the discounted stream of benefits. Table 5 displays these rates of return for participants, the public, and society as a whole (adding participants and the public together). The costs and benefits come from Tables 3 and 4. Note that the rates of return are quarterly interest rates; they can be multiplied by 4.0 to get approximate annual rates.

Table 5  
*Benefits, Costs, and Rates of Return for Washington's Postsecondary and Secondary CTE Programs over the First 2.5 Years and Lifetime for the Average Participant*

Benefit/Cost	Secondary CTE		Postsecondary CTE	
	First 2.5 years	Lifetime (age 65)	First 2.5 years	Lifetime (age 65)
<i>Participant</i>				
Benefits	2,654	34,731	11,118	83,339
Costs	-28	-28	5,619	5,619
ROI	n/a	n/a	8.68%	15.10%
<i>Public</i>				
Benefits	650	6,792	3,775	15,397
Costs	704	704	6,877	6,877
ROI	-1.38%	9.29%	-15.38%	2.20%
<i>Society</i>				
Benefits	3,304	41,523	14,893	98,736
Costs	676	676	12,496	12,496
ROI	42.34%	43.97%	-0.04%	9.19%

*Note.* Table entries are for average participant. Benefits include earnings, fringe benefits, and income-related transfer payments. Costs include tuition and fees (if any), foregone earnings, and public program costs per participant. Dollar figures are in real 2000 dollars. n/a means that ROI could not be calculated because of 0 or negative costs.

In general, the participants in these programs reap substantial returns. The costs are virtually zero (even negative) for secondary CTE, and yet they get positive earnings, even in the short-term. For postsecondary CTE, there are tuition costs and foregone earnings, but the economic payoffs, even in the short-term, more than offset these costs. The public, on the other hand, does not have a positive return on these programs in the first 2.5 years, but it does get positive returns over the participants' lifetimes. Society gets very high returns from secondary CTE, and from postsecondary CTE in the long-run.



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