Thaddeus Stevens College of Technology
TAACCCT Final Evaluation Report

PA Manufacturing Workforce Training Center
TC-25180-13-60-A-42

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I. TAACCCT Program/Intervention Description and Activities

A. Briefly Describe your TAACCCT project and purpose

Thaddeus Stevens College of Technology (TSCT) in Lancaster, Pennsylvania, is a two-year co-educational technical college that offers associate degrees in twenty-three programs for about 1100 students. Founded by bequest in the will of US Congressman Thaddeus Stevens, a nineteenth-century abolitionist, the College originally served only indigent orphan boys. Today, the College admits both males and females and maintains its founder's mission by enrolling a majority of students who are economically disadvantaged. During this evaluation, Thaddeus Stevens College of Technology also completed their Middle States Evaluation. That process began with a comprehensive self-study and report that recognized the role and value of the PA Manufacturing Center TAACCCT grant.

TSCT has consistently been recognized by the Aspen Institute as one of the top 150 two-year colleges in the United States, and as the top two-year technical college in Pennsylvania. TSCT is Pennsylvania's only state-owned two-year college of technology. The TAACCCT project was key to the college's efforts to double enrollment to 2,000 by 2020 and expand the campus to better serve the community, the region and the Commonwealth of Pennsylvania's technical workforce needs. The PA Manufacturing Workforce Training Center grant was the first large grant of this type received by the College.

The TAACCCT grant serves as a key and essential purpose of expanding three Associate Degree (AAS) programs (Heating, Ventilation and Air Conditioning/Refrigeration, Machine Tool and Computer-Aided Manufacturing, and Metals Fabrication and Welding), establishing a new Association Degree program (Electro-Mechanical Technology) and two new short-term programs (Production Welding and Metalcasting Credential).

B. Describe each program/intervention that was evaluated and how it was supposed to effect change for the target population.

For the three expanded Associate Degree programs, the program/intervention evaluated was the impact of the new/updated curriculum and equipment and the additional skills provided and whether that increased the employment and wage outcomes of the students. For the new and short-term programs, the evaluation was the employment and wage outcomes.

1. Describe each component of the program/intervention including components such as instructional design, prior learning assessments, college and career coaching/navigation, job placement assistance and tutoring.

The key components centered on increased skills obtained by use of new equipment, curriculum review by active Industry Advisory Councils that meet at least every semester and access to a robust Career Services office providing job/internship placement, career

development workshops, graduate employment data, and college transfer programs. Annual Career Fair attracts 140+ employers with most hiring from at least one of TAACCCT funded programs. Equipment was institutionalized through curriculum revisions.

2. Discuss the population served

The primary mission of the Thaddeus Stevens College of Technology is to serve the underserved population in Pennsylvania with over 50% qualifying for the Stevens Grant of full tuition, room, board and tools (including textbooks). TAACCCT served students in the following four AAS degree programs, HVAC/Refrigeration, Machine Tool and Computerized Manufacturing, Metals Fabrication and Welding, and ElectroMechanical. Plus all students in the following two short-term workforce development classes of Metalcasting (80 hr.) and Production Welding (100 Hr.)

3. **Summarize the evidence-based or promising model the funded program/ intervention used for its design, citing appropriate literature (if relevant).**

The program evaluation design is a comparison cohort model that compared the outcomes of TAACCCT impacted classes to other comparable classes. The treatment groups were identified as HVAC/R, Machine Tool & Computerized Manufacturing, Metals Fabrication and Welding ElectroMechanical, Metalcasting and Production Welding. The control groups were identified as Plumbing, Electrical Technology, Carpentry, Electronics Technology. Outcomes analyses included comparing employment and available wage information, NOCTI and ETS scores.

The Interim Evaluation Report focused on the process or qualitative evaluation that included interviews with employers, focus groups with students, discussions with instructors, and attending employer advisory council meetings for treatment group programs. This report previously submitted demonstrates strong employer commitment and engagement, high student employment (while attending TSCT, especially the second-year students) and strong community engagement. The project also increased participating employers and numbers of paid available internships. This report also noted challenges with short-term training programs and the impact of working with the public workforce system (that is the local Workforce Investment Board) at the time.

II. Evaluation Design Summary

A. Describe the goals of the evaluation

The specific research goals of the program included:

- Goal 1: Assess the expansion of existing capacity
    - Objective 1.1: Determine whether the proposed expansion of existing courses of study were accomplished.
    - Objective 1.2: Measure whether targets have been reached
    - Objective 1.3: How well did the expansion of capacity address the region's skill needs?

    - Objective 1.4: Measure the impact of training on outcomes
- Goal 2: Assess the creation of new courses in the new fields to study and train additional workers
    - Objective 2.1: Determine whether proposed new courses of study were created
    - Objective 2.2: Measure whether targets have been reached
    - Objective 2.3: Measure impact of training on outcomes
- Goal 3: Determine whether greater employer involvement was achieved
    - Objective 3.1: Employer involvement for the grant funded courses exceeded employer involvement for the non-grant funded courses of study
    - Objective 3.2: Measure the impact of employer participation and other innovations and outcomes

These goals were both qualitative and quantitative goals as the evaluators measured the qualitative impact and implementation of the grant and its impact on the development of the PA Manufacturing Center and the quantitative impact to determine the impact of the intervention (new/additional equipment and curricula) to the specific programs, TSCT and the community.

Key to grant requirements were the enrollment goals for the program. These nine outcome areas required by the US Department of Labor include:

1. Total Unique Participants Served
2. Total Who Have Completed a Grant-Funded Program of Study
3. Total Number Still Retained in Their Programs of Study (or Other Grant Funded Program)
4. Total Number of Students Completing Credit Hours
5. Total Number of Students Earning Credentials
6. Total Number Pursuing Further Education After Program of Study Completion
7. Total Number Employed After Program of Study Completion
8. Total Number Retained in Employment After Program of Study Completion
9. Total Number of Those Participants Employed at Enrollment (incumbent workers) Who Receive a Wage Increase Post-Enrollment

TSCT greatly exceeded all the requirements of these performance measures. Further review of these enrollments and discussions with staff and interviews with employers noted some challenges. The four expanded/new AAS programs assimilated easily to the culture of TSCT and enrollments and expectations were comparatively easily addressed. Significant changes were made to the Admissions Department processes and staff to meet increased enrollment targets for 23 AAS degree programs, including 4 TAACCCT programs. The introduction of two continuing education, short-term programs were challenges to the culture of TSCT classes and the capacity to meet the enrollment requirements, supportive services and community engagement (particularly from the public workforce system) needs. Recruitment for short-term class enrollments were from a mix of eight community based organizations including the American Job Center (PA CareerLink® Lancaster County), Tec Centro (a local Hispanic Community Based Organization), Re-Entry, Refugees and general public.

Due to financial needs of the students, twenty-eight students were employed at the time of enrollment and TSCT at not being able to count them as employed in the outcomes.

Please see Attachment 1 for the Performance Measures Worksheet.

B. Discuss implementation study design

1. Identify the research the study will address

The evaluative study will measure the transformative impact of the Pennsylvania Manufacturing Workforce Training Center by examining the outcome of individuals receiving training through grant resources compared to those that are receiving as comparable services as possible from resources outside of and separate from the grant.

2. Describe the conceptual framework for the implementation study (e.g., theory of change, logic model)

The conceptual framework for the implementation study is a comparison cohort model comparing treatment classes as noted in the chart below:

	TAACCCT Cohort	Comparison Cohort	Comments	Comparison Cohort 2
Long-Term Programs (AAS)	Machine Tool and Computerized Manufacturing AAS	Electrical Technology AAS	Similar Academic Requirements	Nearest matched pairs from dislocated workers in WIASRD (CWDS) receiving minimal services from One-Stop Career Center but not receiving formal training
	Metals Fabrication and Welding AAS	Carpentry AAS	Similar Academic Requirements	
	Heating Ventilation, Air Conditioning and Refrigeration AAS	Plumbing AAS	Similar Academic Requirements	
	Electro-Mechanical (Mechatronics) AAS	Electronics Technology AAS	Similar Academic Requirements	
Short-Term	Metal Casting (Foundry) Competency Credential	Construction 101 Credential	Classes are 100% WIB Dependent	
	Welding Competency Credential	Construction 101 Credential	Classes are 100% WIB Dependent	

The logic model referenced in the interim report represented the dynamics and flow of the program and the unique design of Thaddeus Stevens College of Technology. TSCT relies on close relations with industry and specific employers to enhance their programs and employment outcomes.

The comparison cohort for the short-term programs, the Construction 101 funded wholly by the Lancaster County Workforce Development Board was terminated shortly after the PA Manufacturing Workforce Training Project started, resulting in no comparable comparison cohort available. Comparison cohort for these groups resulted in the comparison to the general dislocated worker population.

3. **Describe how the conceptual framework was used to guide the implementation analysis**

The initial design of the quasi-experimental framework was suggested to be a Regression Discontinuity model. Among the many design choices, upon further review, it was decided to use a Treatment-Effect model. Also the enrollment numbers were too low to successfully complete a random selection model.

Originally the consideration was that the evaluators would have a high degree of ability to draw matched comparisons from a large set of potential control group participants including the national WIASRD database, but upon further review the comparison included TSCT students from treatment and control groups and comparable dislocated workers from a similar geographic area. This made the Treatment-Effect model the appropriate choice.

4. **Implementation data and methods**

The implementation data is based on the attached report that reviews statistical analysis in evaluating the employment and earnings outcomes students experienced as a result of their participation in six selected training programs at TSCT. The final reported results are based on enrollment and follow-up survey data (self-reported through Career Services Department) collected on participants between the 2014/2015 and 2015/2016 academic years.

The evaluators also reviewed National Occupational Competency Testing Institute (NOCTI) data as part of the Interim Evaluation Report. The observations were based upon review of 284 students (with 41 student observations excluded for various reasons).

Data was based upon information provided by the Thaddeus Stevens College of Technology for TSCT students and the Commonwealth of Pennsylvania Commonwealth Workforce Development System (CWDS) for general dislocated worker population. The CWDS comparison was drawn from the counties of Chester, Lancaster and York in Pennsylvania since 85% of the students in TSCT are from these three counties.

Please see Attachment 2 for the TAACCCT Program Evaluation Summary of Statistical Analysis for Training Program Outcomes.

5. **Describe how capacity building was measured, include a description of the indicators that were used**

Capacity building was measured based upon the pre- and post-wages and earnings of the individuals in the three programs. This is based upon student self-reporting as provided by TSCT staff for both the treatment and control groups through extensive follow by Career Services and TAACCCT Grant Coordinator. There were two control groups in the measure, the first control group consisted of students who enrolled in a core set of unsubsidized program of study—Carpentry (CARP), Electrical Engineering Technology (ELEC), Electronics Technology (EET) and Plumbing (PLBG). The second is a statistical control group that consists of a cohort of workers from Chester, Lancaster and York counties in Pennsylvania who experience dislocation and eventually returned to the labor force but received no formal training.

Capacity building was measured based upon current capacity of students in respective treatment and control programs at TSCT and also reviewing data on dislocated workers in the counties in or contiguous to TSCT (based upon review of student residency) where 85% of students were from Chester, Lancaster and York counties in Pennsylvania.

The indicators included entry and program completion wage and employment data. Additional indicators included age, gender, employment status and geographic location.

C. Discuss outcomes/impact study design

1. Identify the research questions the study will address

The study addressed the following key questions in the evaluation:

- Did the college expand its existing capacity?
- Did the college create new courses in fields of study and train new workers?
- Was greater employer involvement achieved?

Additional questions within these research questions were developed specifically around levels of employment, wages paid and training related employment. Specific statistical analysis was completed regarding increase in wages as an impact of the additional education received and skills acquired. This will be further described in the sections below.

2. For the outcomes analysis (quantitative descriptive) and impact analysis (causal analysis)

a. State the overall methodology used (e.g., randomized control trial, propensity score matching, regression discontinuity, pre-post testing) and whether or not causal inferences (internal validity) can be made from the analysis conducted

CWA used a Treatment Effect model framework to evaluate the impact of the treatment program participation on wages, the key factor in the quantitative analysis. The wage treatment models test the hypothesis that treatment group students will have higher wages than students enrolled in control programs of study. Students are pre-tested upon enrollment and post-tested

prior to graduation with the National Occupational Competency Testing Institute (NOCTI). These competencies are a significant institutional assessment tool.

b. Briefly describe the data and used their reliability

The data used consisted of information provided by the TSCT based on their official enrollment records for the TAACCCT identified classes and the comparison cohort classes. These records were from their official attendance and documentation records. The data utilized for the general dislocated worker comparison were from the Commonwealth of Pennsylvania, Department of Labor and Industry Commonwealth Workforce Development System (CWDS). This is the official data and recordkeeping source for the reporting of Workforce Investment Act (WIA)/Workforce Innovation Opportunity Act (WIOA) to the United States Department of Labor.

NOCTI data was also used in the Interim Evaluation and noted below in the Final Evaluation. NOCTI data was based upon pre- and post-test data performance review as provided by the TSCT staff.

Specific data on wage records for the TSCT students was based upon student reported data and other data acceptable to the TSCT records. For the wage data on dislocated workers, this data was based upon acceptable USDOL wage requirements, usually Unemployment Insurance records.

c. Describe the outcomes and impacts measured

Increasing employment outcomes and earning potential is a key objective of this pilot funding program. The grant funding was expected to achieve these three defined outcomes:

1. Workers receiving grant funded training are expected to have higher outcomes (employment) than workers receiving no formal training;
2. Workers receiving grant funding are expected to acquire new skills that are more closely aligned to employer needs; and
3. Workers receiving grant funding are expected to increase their wage earnings as compared to workers receiving no formal training.

For a complete review of the entire statistical analysis, please refer to Attachment 2, TAACCCT Program Evaluation Summary of Statistical Analysis for Training Program Outcomes.

III. Implementation Findings

1. Describe how the grant was used to build institutional capacity

The grant was used to build institutional capacity in several ways. Specific new programs were established (Electro-Mechanical AAS, Metalcasting Short Term, and Production Welding Short Term). Three already existing programs (Machine Tool and Computerized Manufacturing AAS, Metals Fabrication and Welding AAS, and Heating Ventilation Air Conditioning and Refrigeration

AAS) were enhanced and expanded with new curriculum, faculty and additional program offerings.

Overall employer and company engagement was increased to assist in community engagement and student placement in the various programs including paid internships.

2. **Provide a summary or the key steps taken by the institution (or institutions if part of a consortium) to create and run the training program**

TSCT took several key steps to create and run the training programs including establishing new short-term programs (Metals Casting and Production Welding), a new AAS program (Electro-Mechanical) and enhancement of three AAS Degree programs (Machine Tool and Computerized Manufacturing, Metals Fabrication and Welding, and Heating, Ventilation, Air Conditioning, &Refrigeration). These steps included but not limited to:

- Specific employer advisory councils were charged with helping ~~that helped~~ establish or enhance the curricula, assist in equipment selection, and student work based engagement.
- Integration with the public workforce system and community based organizations to better recruit and place students with appropriate employers.
- Establish new short-term training programs to assist the immediate needs of employers.

3. **Highlight any important partnerships**

TSCT developed several important partnerships related to this project. Initial partnerships were formed with the local Workforce Investment/Development Board (Lancaster Workforce Investment/Development Board) to seek assistance in referrals, tracking and technical assistance. TSCT also developed strong relations with the local American Job Center (PA CareerLink® Lancaster County), Tec Centro (the Spanish American Civic Association) and the Lancaster Re-entry Management Organizations (serving ex-offenders) and other community based organizations to assist in recruitment of potential students for classes.

4. **Discuss whether the grantee was able to implement the program/intervention fidelity to the original design model and, if not, why**

For the majority of programs provided, the TSCT was able to implement the program design model as originally envisioned. One of the reasons for this is because of the already strong industry advisory culture. The exceptions were in the short-term training programs where recruitment and enrollment in classes were a problem due to lack of referrals from the American Job Center (For various reasons including staff turnover, a strong economy, and others).

The collection of Management Information System (MIS) placement and job information originally promised for all TAACCCT participants was not provided by the Workforce Board as

originally planned. The Workforce Investment Board simply could not provide what was promised during the initial grant document.

5. Describe the operational strengths and weaknesses of the program

The requirements of this part suggest that the evaluator must address the required four research questions as articulated in the Solicitation for Grant Application. These questions are explained in CWA's evaluation plan and summarized here:

1. Analyze the steps taken by the institution to create and run the training program.

During the Interim and Final Evaluations, CWA observed and analyzed the steps taken by TSCT to create and run the training program. Research Goals 1 and 2 specifically address this issue.

2. Assess the operational strengths and weaknesses of the project after implementation.

The Interim Evaluation addressed this in the General Observations of the program, while the Final Evaluation addresses this in several locations including Sections IV and V.

3. Suggest how program might be strengthened within appropriate timing as not to interfere with the impact/outcomes analysis.

The Interim Evaluation provides significant detail on the technical assistance provided to maintain enrollments and integration with the public workforce system. in Section V of the Final Evaluation, steps to ensure ongoing success of the program are suggested.

4. What contributions did each of the partners (employers, workforce system, other training providers and educators, philanthropic organizations make in terms of 1) program design 2) curriculum development 3) recruitment 4) training 5) placement 6) program management 7) leveraging of resources and 8) commitment to program sustainability.

Research Goal 3 specifically discusses employer roles and engagement in assisting in the areas listed above. Section V also speaks of the involvement of other community based organizations and the public workforce system.

IV. Participant Impact & Outcomes

A summary of the outcome and impacts measured included:

- The evaluators noted that the enrollment cohort is comprised largely of non-Hispanic white male students, noting the comparative under enrollment of minority and female students when compared to the general labor market population. The age distribution is also skewed toward the more traditional student age (average age 25.6 years)

compared to the general population. The shorter term more workforce development oriented classes tended to have a wider age range and diversity.
    - When this was presented to TSCT, it must be noted that based on IPEDS Data Feedback Report 2016 that TSCT compared to IPEDS comparable institutions, TSCT is more diverse and minority populated than the comparative group median. TSCT also noted that the classes evaluated (both comparison and treatment) are less diverse than other classes and the overall college. The overall college 2017 freshman class exhibited a 29.8% minority.
- The TSCT treatment group reports strong employment outcomes relative to their pre-training employment status. Within this data, a small share of previously employed students reported being unemployed at the close of the review period with over 60% of this small group of students concentrated in the short-term training programs.
    - TSCT has had difficulty addressing the recruitment, enrollment and placement requirements of the short-term training programs. In discussing with TSCT, the evaluators noted, additional review needs to address identification of community partnerships, student supports, and placement opportunities necessary for higher student volume/shorter-term continuing education/non-credit type programs.
    - Also noted, the return of students to long-term Associate Degree programs for those who had enrolled and completed the short-term programs.
- For students who were employed upon entry, 70% of the students responded and reported a wage gain. Of those responders, 90% were enrolled in three programs: HVAC, MACH, and MFWT.
- Control group students have higher wages than students enrolled in the treatment group and continue to have higher wages when the short-term programs are removed. However, disaggregating the wage distribution by programs of study reveal a distinct cluster pattern. By clustering the programs based upon their similar sectoral labor markets (See page 14 of the attachment 2), the average hourly wage for control students is $17.63 compared to an average hourly wage of $21.59 for treatment group students.
- When comparing treatment effect students to those workers not exposed to formal training, the wage differential is significant and positive at $3.31 per hour. The average hourly wage for control students is $15.42 compared to a higher average hourly wage of $18.72 for treatment group samples.
- CWA also obtained additional data on dislocated workers to measure the impact of foregoing formal skills upgrading on average re-employment wage earning for a full sample statistical control. The analyses show that on average workers who do not participate in training programs after a job loss experience an average wage loss when they eventually return to the workforce.
- CWA also compared dislocated worker job search times with those of students enrolled in the TSCT treatment programs of study. Dislocated Workers spent an average of 9.7 months searching for new employment (some spent 27.4 months) with the median time being 6.7 months. In contrast, the TSCT treatment group spend considerable less time

finding jobs upon completion of training with the average 2.4 months and the median being 1.1 months.

For a complete review of the entire statistical analysis, please refer to Attachment 2, TAACCCT Program Evaluation Summary of Statistical Analysis for Training Program Outcomes.

Issue to consider in this section:

1. **Highlight key outcomes impacts estimated, including the nine (9) outcomes articulated in the Solicitation for Grant Applications**

Grant students in the six programs were impacted in one of two ways: 1) use of TAACCCT funded equipment and/or 2) taught by TAACCCT funded faculty (4 instructors, maintained by college upon completion). Total number of students served (Performance measure #1) was 176% higher than projected because of new program development, program expansions, such as evening offerings, and short-term trainings.

Please reference Attachment 1 for the Performance Measures Worksheet.

2. **Include any additional outcome and impact findings, expanding on or refining what was discussed in your evaluation plan**

The National Occupational Competency Testing Institute (NOCTI) outcomes examined in the Interim Evaluation Report were not updated in the final report, since this information was unchanged from the previous report.

As noted in the Interim Report, the NOCTI dataset used in this program evaluation consists of pre- and post-test scores proficiency test scores across a number of sub-competency areas. The focus of this evaluation report is to assess the overall impact of treatment group assignment on overall technical and vocational performance because of exposure to an enhanced applied curriculum setting; therefore, the statistical analysis focuses on the reported comprehensive score rather than the sub-competency scores.

The NOCTI analytical sample comprises pre- and post-test observations for 284 students; the distribution of group membership is relatively balanced with 54% of the participants belonging to the treatment group. Student membership in the NOCTI data is skewed for the control group. Control group students are predominantly from the ELEC major, accounting for almost half of the students in the group. This singular over-representation will have a distorting impact on control group results; the exact nature of the distortion is unclear. Enrollment distribution in the treatment group is more representative of the pipeline programs of interest, with HVAC and MACH each contributing roughly 1/3rd of the student observed in the analytical sample, followed by MFWT, which contributed 20% of enrollment in the sample

Average NOCTI Scores by Treatment Group*

	Pre-Test Score (2013)	Post-Test Score (2016)
Control Group	42.2	69.8
Treatment Group	49.3	72.4
Combined Group	45.6	71.0

* Sample was adjusted for invalid observations

NOCTI data and information was valuable in helping analyze and identify the competency gains of the treatment versus control group. For more information on this analysis, please refer to the Interim Evaluation Report.

3. Note any important limitations to interpreting the findings (e.g., internal and external validity)

Several key limitations to interpreting the findings based on the data received. Specifically, the initial tracking and wage outcomes envisioned in the grant were not delivered by the Workforce Investment Board. With some technical assistance, TSCT developed some workaround to obtain viable wage data. With the USDOL allowing self-reported data, this did enhance the potential wage and employment information.

Short-term training, something new to TSCT, was a challenge in identifying adequate student numbers to justify the class offerings. Several classes had to be cancelled or postponed due to under enrollment. As of the date of this report, TSCT plans to continue and expand short-term/ continuing education offerings to meet high employer demand. The long-term programs, more in the culture of TSCT, were not as much of a challenge.

V. Conclusions

A. Highlight any key lessons from your evaluation that would help others who want to replicate your TAACCCT project—helping them to understand what worked well and where challenges may lie

For items working well, TSCT has a very strong and close relationship with employers and businesses in the community resulting an incredibly high demand for the graduates of their programs. Of particular strength are the Associate Degree programs (AAS) that provide a more in-depth education and training for the students with specific curricula dedicated to the subject area.

A key part of this is the general program design of work-integrated education for TSCT students. This design provides for sophomore (second-year) students to be available for laboratory/hands on/ work during the morning block, whereas freshmen (first-year) students have laboratory/hands on work in the afternoon block. This allows students as they increase their skills to engage in work while continuing in the class. Through this project, paid internships were expanded as part of the ongoing growth of employer engagement and involvement.

Challenges include engaging and working with the public workforce system. In this project, the WIB did not meet its promises and assurances. Another challenge is adjusting to the short-term training needs with the right capacity and resources to ensure adequate student numbers to populate and support the programs.

B. Consider the main implications for future workforce and education research—what are the next steps to rigorously studying the types of approaches and strategies tested under your current TAACCCT project?

The main implications for future workforce and education research, as noted in the Interim Evaluation Report, is how to best prepare for the collection of data necessary to complete the research and evaluation. As you review CWA's TAACCCT Program Evaluation Summary of Statistical Analysis for Training Program Outcomes (Attachment 2 to this report), it is noted that there are limitations to the data collected.

The data originally promised by the Local Workforce Investment Board/Workforce Development Board as part of this grant also never materialized and was promised with little chance of delivery. In short, the data collected had significant limitations, therefore, is difficult to take a broader comparison. TSCT has taken steps recently to better engage the public workforce system by establishing a part-time recruiter at the American Job Center (PA CareerLink® Lancaster) and increasing the role of the industry advisory councils.

On the other hand, the data provided by the public workforce system for the general dislocated worker compared to the treatment group does provide significant information on the value of obtaining skills and their potential impact on immediate employment and higher income.

A preferred next step would be to identify and conduct studies of TAACCCT grantees that had excellent completer and employment percentages, however, the support and staffing for this is not currently in place.

Thaddeus Stevens College of Technology should be commended for the quality of their programs and their impact on the community. For their first large federal grant of this type, they performed well, exceeding performance measures is impressive and their impact of wages and employment (especially when compared to dislocated workers with no additional training) is very compelling.

Attachments:

Attachment 1: Performance Measures Worksheet

Attachment 2: TAACCCT Program Evaluation Summary of Statistical Analysis for Training Program Outcomes

Pennsylvania Manufacturing Workforce Training Center
Thaddeus Stevens College of Technology - Performance Measures Worksheet

Outcome Number	Outcome Measure: Students use equipment and/or are taught by TAACCCT-funded faculty	Year	Projection 3.18.14	Actual 9.7.17	Program Breakdown
1	Total Unique Participants Served	Year 1 10/1/13 - 9/30/14	60	105	ELME 21 HVAC 64 MACH 20 MFWT 0 WELD 0 MCAST 0
		Year 2 10/1/14 - 9/30/15	133	205	ELME 25 HVAC 45 MACH 63 MFWT 52 WELD 0 MCAST 20
		Year 3 10/1/15 - 9/30/16	120	232	ELME 21 HVAC 31 MACH 35 MFWT 63 PWELD 40 MCAST 21 WELD 21
		Year 4 10/1/16 - 3/31/17	0	22	ELME 0 HVAC 0 MACH 0 MFWT 0 PWELD 9 MCAST 13 WELD 0
		Total	313	564	
2	Total Who Have Completed a Grant-Funded Program of Study	Year 1 10/1/13 - 9/30/14	0	0	ELME 0 HVAC 0 MACH 0 MFWT 0 WELD 0 MCAST 0
		Year 2 10/1/14 - 9/30/15	10	64	ELME 0 HVAC 18 MACH 17 MFWT 13 WELD 0 MCAST 16

		Year 3 10/1/15 - 9/30/16	**50**	**158**	ELME 14 HVAC 35 MACH 34 MFWT 16 WELD 0 MCAST 24 PWELD 35
		Year 4 10/1/16 - 3/31/17	**0**	**19**	ELME 0 HVAC 1 MACH 0 MFWT 0 WELD 0 MCAST 12 PWELD 6
		Total	**60**	**241**	
3**	**Total Number Still Retained in Their Programs of Study (or Other Grant-Funded Programs)**	**Year 1 10/1/13 - 9/30/14**	**42**	**105**	ELME 0 HVAC 0 MACH 0 MFWT 0 WELD 0 MCAST 0
		Year 2 10/1/14 - 9/30/15	**118**	**223**	ELME 43 HVAC 83 MACH 57 MFWT 37 WELD 0 MCAST 3
		Year 3 10/1/15 - 9/30/16	**98**	**269**	ELME 42 HVAC 73 MACH 56 MFWT 77 PWELD 0 MCAST 0 WELD 21
		Year 4 10/1/16 - 3/31/17	**0**	**248**	ELME 41 HVAC 67 MACH 51 MFWT 70 WELD 16 MCAST 0 PWELD 3
		Total	**258**	**845**	
4	**Total Number of Students Completing Credit Hours**	**Year 1 10/1/13 - 9/30/14**	**10**	**105**	ELME 0 HVAC 0 MACH 0 MFWT 0 WELD 0 MCAST 0

		Year 2 10/1/14 - 9/30/15	**30**	**196**	ELME 25 HVAC 74 MACH 62 MFWT 35 WELD 0 MCAST 0
		Year 3 10/1/15 - 9/30/16	**70**	**229**	ELME 41 HVAC 81 MACH 55 MFWT 52 WELD 0 MCAST 0 PWELD 0
		Year 4 10/1/16 - 3/31/17	**0**	**1**	ELME 0 HVAC 1 MACH 0 MFWT 0 WELD 0 MCAST 0 PWELD 0
		Total	**110**	**531**	
5	Total Number of Students Earning Credentials	**Year 1 10/1/13 - 9/30/14**	**0**	**0**	ELME 0 HVAC 0 MACH 0 MFWT 0 WELD 0 MCAST 0
		Year 2 10/1/14 - 9/30/15	**10**	**64**	ELME HVAC 18 MACH 17 MFWT 13 WELD 0 MCAST 16
		Year 3 10/1/15 - 9/30/16	**40**	**158**	ELME 14 HVAC 35 MACH 34 MFWT 16 WELD 0 MCAST 24 PWELD 35
		Year 4 10/1/16 - 3/31/17	**0**	**19**	ELME 0 HVAC 1 MACH 0 MFWT 0 PWELD 6 MCAST 12 WELD 0
		Total	**50**	**241**	

6	**Total Number Pursuing Further Education After Program of Study Completion**	**Year 1 10/1/13 - 9/30/14**	**0**	**0**	ELME 0 HVAC 0 MACH 0 MFWT 0 WELD 0 MCAST 0
		Year 2 10/1/14 - 9/30/15	**0**	**0**	ELME 0 HVAC 0 MACH 0 MFWT 0 WELD 0 MCAST 0
		Year 3 10/1/15 - 9/30/16	**0**	**3**	ELME 0 HVAC 0 MACH 2 MFWT 1 WELD 0 MCAST 0
		Year 4 10/1/16 - 9/30/17	**0**	**0**	ELME 0 HVAC 0 MACH 0 MFWT 0 WELD 0 MCAST 0
		Total	**0**	**3**	
7	**Total Number Employed After Program of Study Completion**	**Year 1 10/1/13 - 9/30/14**	**0**	**0**	ELME 0 HVAC 0 MACH 0 MFWT 0 WELD 0 MCAST 0
		Year 2 10/1/14 - 9/30/15	**3**	**25**	ELME 0 HVAC 7 MACH 5 MFWT 1 WELD 0 MCAST 12
		Year 3 10/1/15 - 9/30/16	**10**	**62**	ELME 6 HVAC 13 MACH 11 MFWT 11 WELD 0 MCAST 8 PWELD 13
		Year 4 10/1/16 - 9/30/17	**27**	**17**	ELME 0 HVAC 3 MACH 0 MFWT 1 WELD 0 MCAST 12 PWELD 1
		Total	**40**	**104**	

8	Total Number Retained in Employment After Program of Study Completion	**Year 1 10/1/13 - 9/30/14**	**0**	**0**	ELME 0 HVAC 0 MACH 0 MFWT 0 WELD 0 MCAST 0
		Year 2 10/1/14 - 9/30/15	**2**	**0**	ELME 0 HVAC 0 MACH 0 MFWT 0 WELD 0 MCAST 0
		Year 3 10/1/15 - 9/30/16	**7**	**26**	ELME HVAC 5 MACH 4 MFWT 1 WELD 0 MCAST 8 PWELD 8
		Year 4 10/1/16 - 9/30/17	**13**	**58**	ELME 6 HVAC 14 MACH 11 MFWT 12 WELD 0 MCAST 8 PWELD 7
		Total	**22**	**84**	
9	Total Number of Those Participants Employed at Enrollment (incumbent workers) Who Receive a Wage Increase Post-Enrollment	**Year 1 10/1/13 - 9/30/14**	**0**	**0**	ELME 0 HVAC 0 MACH 0 MFWT 0 WELD 0 MCAST 0
		Year 2 10/1/14 - 9/30/15	**2**	**6**	ELME 0 HVAC 2 MACH 4 MFWT 0 WELD 0 MCAST 0
		Year 3 10/1/15 - 9/30/16	**15**	**28**	ELME 0 HVAC 8 MACH 7 MFWT 11 WELD 0 MCAST 2 PWELD 0
		Year 4 10/1/16 - 9/30/17	**26**	**28**	ELME 5 HVAC 6 MACH 15 MFWT 0 WELD 0 MCAST 1 PWELD 1
		Total	**43**	**62**	

** The total for this outcome can exceed the total for all other outcomes, because, unlike in the other outcomes, students may be counted in multiple years if they are enrolled in programs in multiple years.

Attachment 2

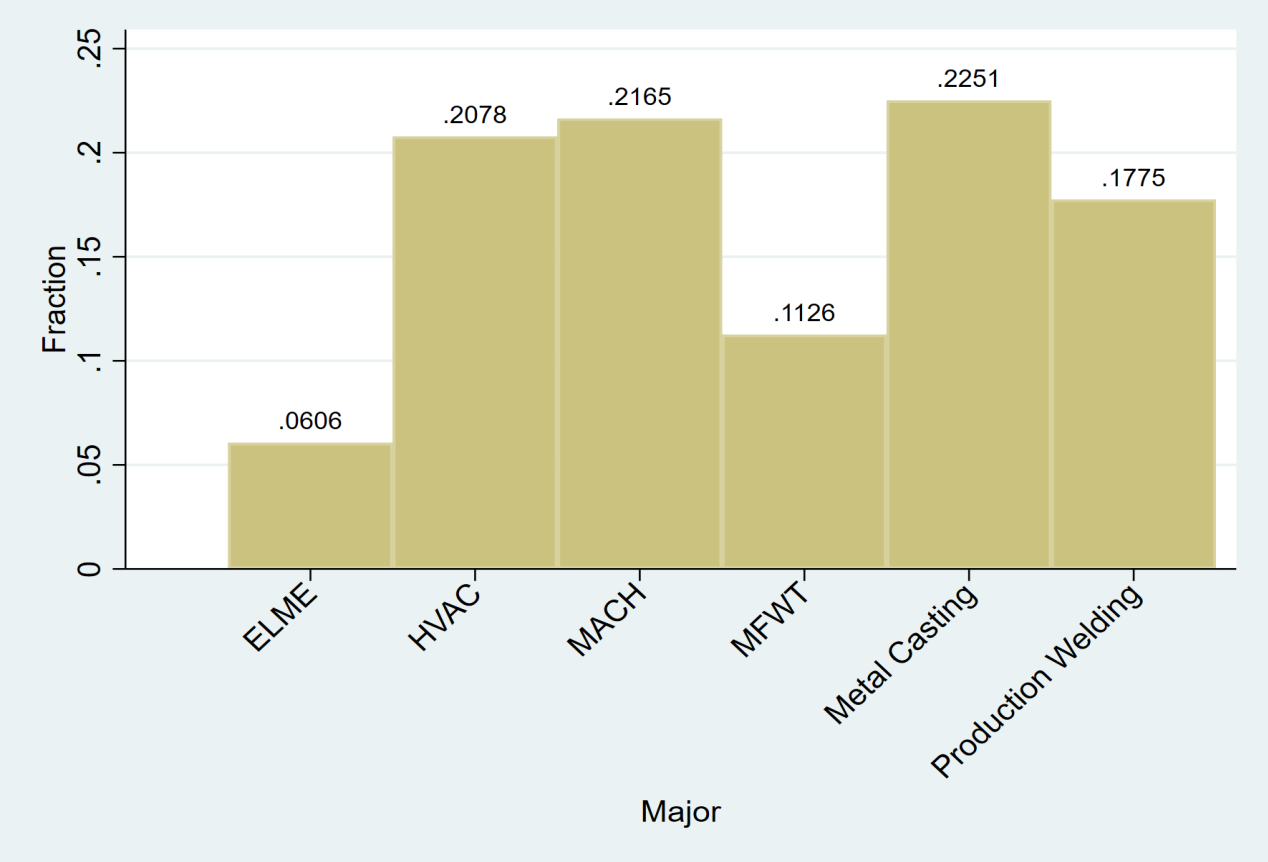
TAACCCT Program Evaluation
Summary of Statistical Analysis
for
Training Program Outcomes

Findings

This report reviews statistical analyses that are aimed at evaluating the employment and earnings outcomes students experienced as a result of their participation in six (6) selected training programs at Thaddeus Stevens College of Technology (TSCT). The final reported results are based on enrollment and follow-up survey data collected on participants between the 2015/16 and 2016/17 academic years. Total student enrollment was reported at 231; students enrolled in programs in 2016 account for the more 63% of the final enrollment analytical population.

TSCT identified six (6) programs—four (4) two-year associate degree programs of study and two (2) shorter duration certificate programs of study, which collectively comprise the treatment class groups. TSCT further identified four (4) pre-existing degree conferring courses—the control group against which employment outcomes will be evaluated.

Figure 1. Student Enrollment by Program of Study



Shorter duration certificate courses—Metal Casting and Production Welding accounted for 40.3% of total student enrollment[1]; whilst two programs—Heating Ventilation, Air

[1] Metal Casting [52 students], Production Welding [41 students].

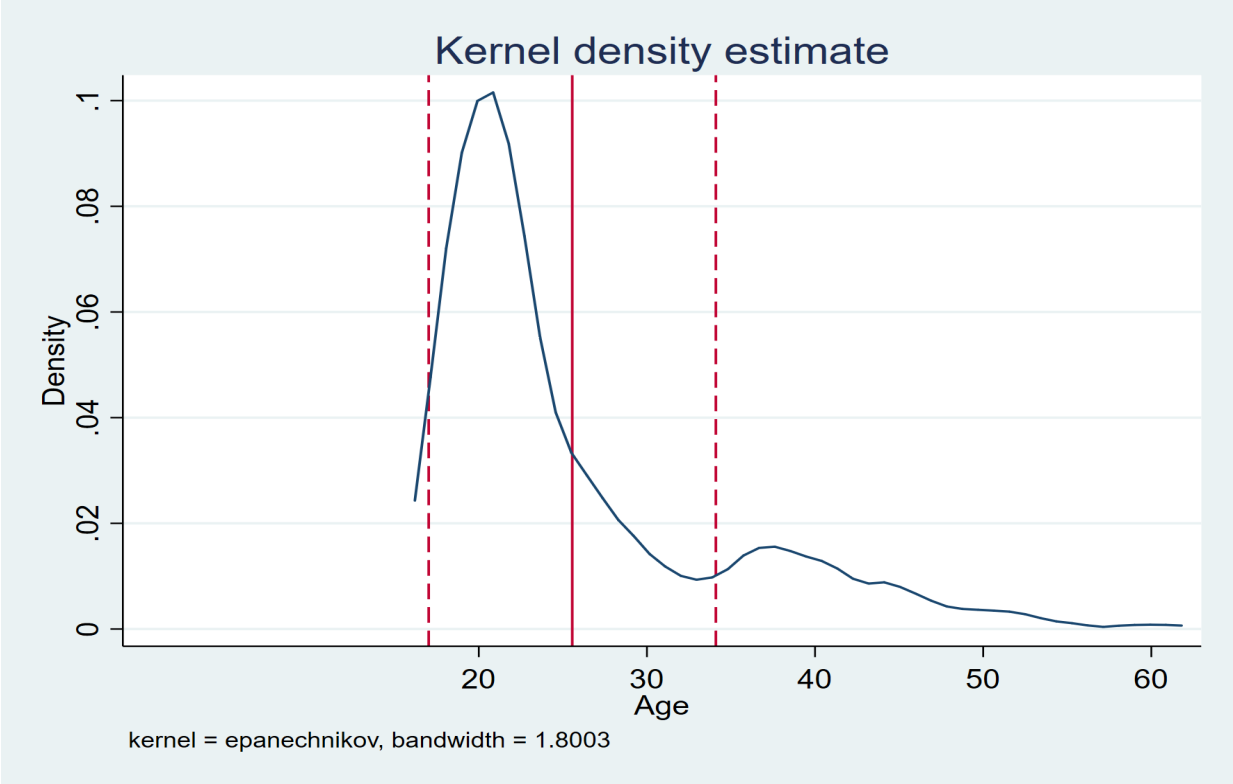
Conditioning and Refrigeration and Machine Tool & Computer Aided Manufacturing, in the associate degree program of study cohort collectively contributed the lion share of degree program enrollment, representing 71.0% of total long term program enrollment.

Student Demographics

The final enrollment cohort is comprised of predominantly non-Hispanic white male students. During the two-year review period only 5 (2.2%) female students enrolled in TSCT programs of study; of these 4 were enrolled in the short-term programs and 1 was enrolled in Machine Tool & Computer Aided Manufacturing. Minority students, like women, are underrepresented in the enrollment cohort, 21.2%[2] reported a race/ethnicity status other than non-Hispanic white.

The enrollment cohort is generally comprised of young and emerging adults, with an average age of 25.6 years. The cohort's age profile shows considerable skew in its distribution; this is primarily due to the dispersion in range.

Figure 2. Distribution of Age in Enrollment Cohort



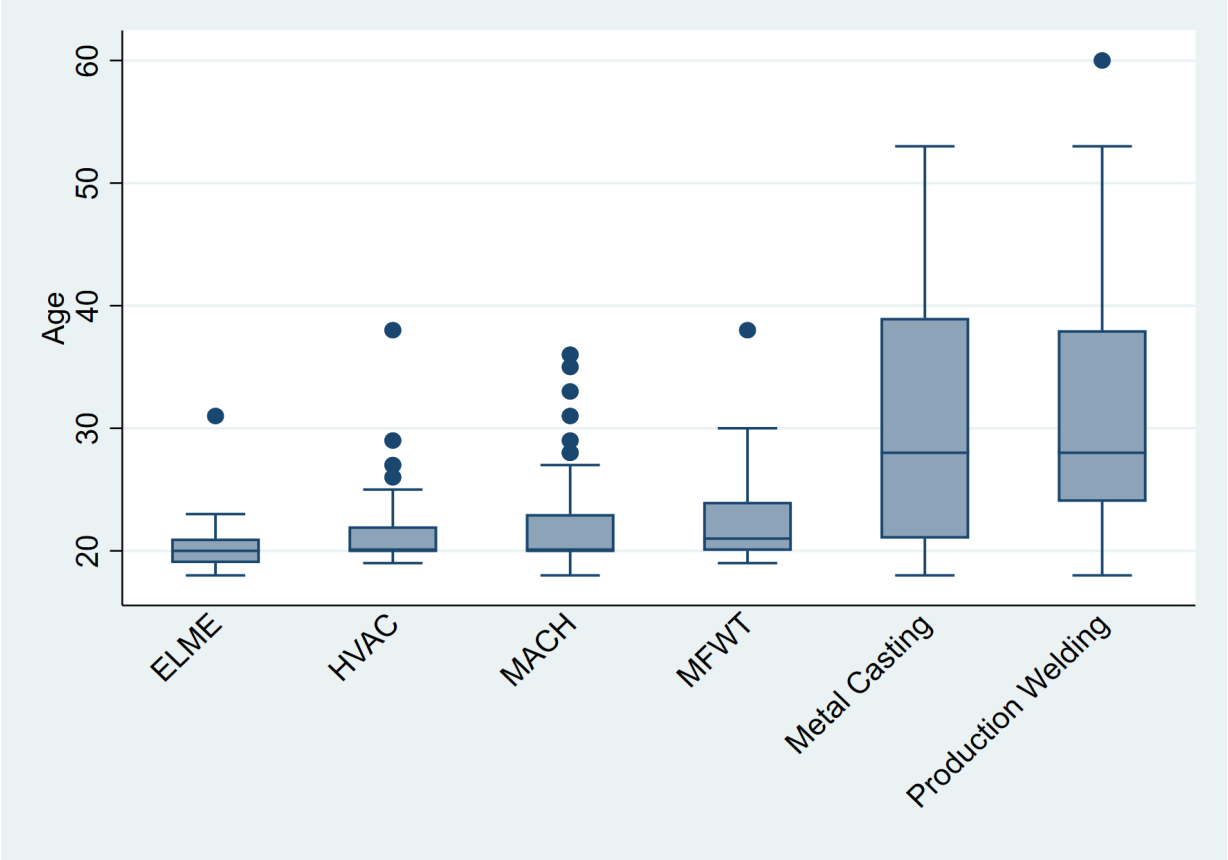
As shown in Figure 2 above, the cohort is primarily comprised of emerging adults as young as 18.0 years of age. However, there is a considerable share of the students in the right tail of the distribution who are older than 30.0 years of age; in fact the oldest student reported in the sample is 60.0years of age. The density distribution shows a

[2] This figure is based on the 217 students who reported their race-ethnicity designation.

slight bimodal shape, indicating that there are two distinct groups of students, a younger cohort whose representation dominates the presence of a smaller group of older students. Of note, is the fact that the older students are either women enrolled in short-term programs or students reporting a minority race/ethnicity status.

Older students (see Figure 3 below) are concentrated in short-term programs of study as opposed to associate degree programs.

Figure 3. Distribution of Student Age by Class



Short-term programs, which account for more than 40.0% of total enrollment appear to be very attractive to women and older students, who are on average 6-7 years older than their peers, with a significant share older than 40. Hispanic female and Asian male students are the oldest cohort with average ages of 39.0 and 40.3 respectively.

Minorities and women are underrepresented in the study sample. Low minority and female student enrollment appear to be consistent with the local area demographics from which TSCT draws its applicant pool. As previously mentioned, women, older, and minority students in the analytical cohort demonstrate slightly higher tendencies than their non-Hispanic white male peers to enroll in short-term programs and the HVAC program of study. Underrepresentation in the analytical cohort may present TSCT administrators with a growth opportunity to increase enrollment in short-term

programs by targeting recruiting programs at these special groups within the College's current footprint.

Several key benefits immediately accrue to TSCT in pursuing such a strategy. First, enrollment and tuition revenue will grow as a result. Secondly, a targeted recruiting program can help to improve educational opportunities that can improve the chances of long-run economic mobility for traditionally disadvantaged families. Finally, TSCT will add value to its institutional brand as an academic institution that serves a diverse population and delivers relevant technical training that can be immediately transferred into the labor market with positive returns to a student's earning potential.

Employment and Income Outcomes

Increasing employment outcomes and the earning potential is a key objective of this pilot funding program. Specifically, the grant funding was expected to achieve three defined outcomes:

I. Workers receiving grant funded training are expected to have higher outcomes (employment) than workers receiving no formal training;

II. Workers receiving grant funding are expected to acquire new skills that are more closely aligned to employer needs; and

III. Workers receiving grant funding are expected to increase their wage earnings as compared to workers receiving no formal training.

This evaluation analysis measures TSCT's success in achieving the three state outcomes through a variety of measures. First, we assess students' pre- and post-training employment status to ascertain whether students enrolled in grant funded program of study (treatment group) have statistically significant improved outcomes as compared to students enrolled in non-grant funded programs of study (control group). Secondly, we examine student job titles to evaluate the extent to which students acquired the relevant technical that aligned with potential employer demand. Finally, we compare student employment wage earnings with two distinct control groups to assess the effectiveness of the grant-funded training programs in improving wage earnings.

Employment Status

TSCT's grant funded programs of study attracted two distinct groups of students:

i. Students who are seeking to either update their skills or acquire new technical skills; and

ii. Students who are either disconnected or experienced a dislocation from the labor force and are seeking to re-skill themselves in an effort to re-enter the labor force.

Data collected on student employment status on entering a program of study show that

43.7% of students reported being currently employed on entering a program of study; likely belonging to the first group—workers are either seeking to update their existing skills or obtain new technical skills. The remaining share of students, 56.3%, represent a group of individuals who experienced a disconnection from the formal labor force and are likely seeking to re-skill themselves; no data was collected on the cause or duration of the dislocation event.

Data on student pre-employment status was only collected for treatment group students, therefore it is not possible to assess their post-employment outcome gains relative to control group students. Overall, the TSCT treatment group reported strong employment outcomes relative to their pre-training employment status.

74.7% of all treatment student reported either full-time or part-time employment as opposed to 25.3% of students who reported being unemployed[3] (see Table 1). Of the 97 students (for whom post-employment data is available) reporting prior to entering a program of study unemployed, 67% reported being employed at the close of the review period.

Table 1. Post-Training Employment Outcomes

Pre-Training Status	**Post-Training Status**				**Row Total**
	Employed		Unemployed		
	No.	%	No.	%	
Prev. Unemployed	83	66.9	41	33.1	**124**
Prev. Employed	82	84.5	15	15.5	**97**
Total	**165**	**74.66**	**56**	**25.34**	**221**

Two concerning unemployment trends emerged within the treatment group. First, a small share (15) of previously employed students reported being unemployed at the close of review employed. More than 60% of this small group of students appear to be concentrated in the short-term programs. A review of the completion dates show that these students exited their short-term between December 2015 and April, 2016, and that considerable time has elapsed since exit data and data collection, which suggests that either these students are experiencing some entry barriers or that they made another choice.

Second, 33% of previously employed students reported being unemployed at the close of the review period. This is an unexpected outcome that can be due to a number of factors including data error, a continuing education election, or some other choice on which data is not available.

CWA recommends that TSCT conduct a follow-up review on these participants to identify the cause of their unemployment. TSCT collected data on students' ability to maintain their employment 30-, 60-, and 90-days post-program completion. However,

[3] At the time of final data collection, March, 2017. TSCT continues to support student employment placements and track the associated outcomes.

these data were not sufficient to generate any reliable conclusions on post-training employment retention.

Despite these unemployment patterns, the treatment group demonstrated strong employment outcomes in both the ability of the previously unemployed cohort to find a job or the previously employed to successfully maintain their current employment during training or switch to a new job.

Additionally, the data indicate that previously unemployed workers tended to be older than workers reporting being employed on program entry; particularly for female students in the analytical cohort. However, the share of students who continue to be unemployed tend to be younger and closer to the average age of the full analytical sample (25.6 years), suggesting that older students (older than 35) and women are able to maximize on the programmatic benefits and return to the workforce without being left behind.

Earned Income Outcomes

Increasing students' income potential across the six (6) grant-funded programs of study is a critical outcome that underscores the pilot program's performance and TSCT's efficient use of the awarded grant funding. In order to evaluate whether treatment students achieved meaningful income outcomes we use a treatment model framework to assess whether a conclusive causal inference exists between participation in the treatment programs of study and wages, as opposed to participation in the non-grant funded programs of study. We use two distinct control groups to assess the causal relationship hypothesis and estimate the marginal effect of the grant funding on student wage levels.

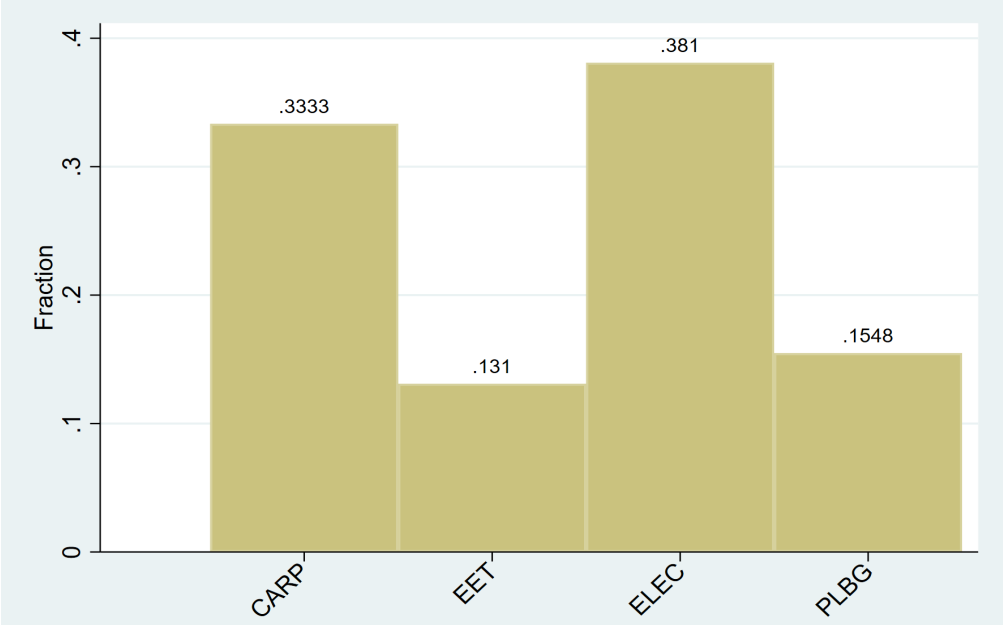
The first control group consists of a cohort of students who enrolled in a core set of unsubsidized programs of study—CARP, EET, ELEC, and PLBG. The second, is a statistical control group, which consists of a cohort of workers from Chester, Lancaster, and York counties in Pennsylvania, who experienced a dislocation event and eventually returned to the labor force, these workers received no formal training during their unemployment spell.

70% of the 42 previously employed students responding to the survey item reported a wage gain, and 90% of these responders were enrolled in three associate degree programs of study—HVAC, MACH, and MFWT. Though TSCT collected data on wage gains for students who were employed at the time of their program entry, insufficient data precludes any definitive conclusions on post-training wage gains beyond simple descriptive distributions.

Program Based Control Group Results

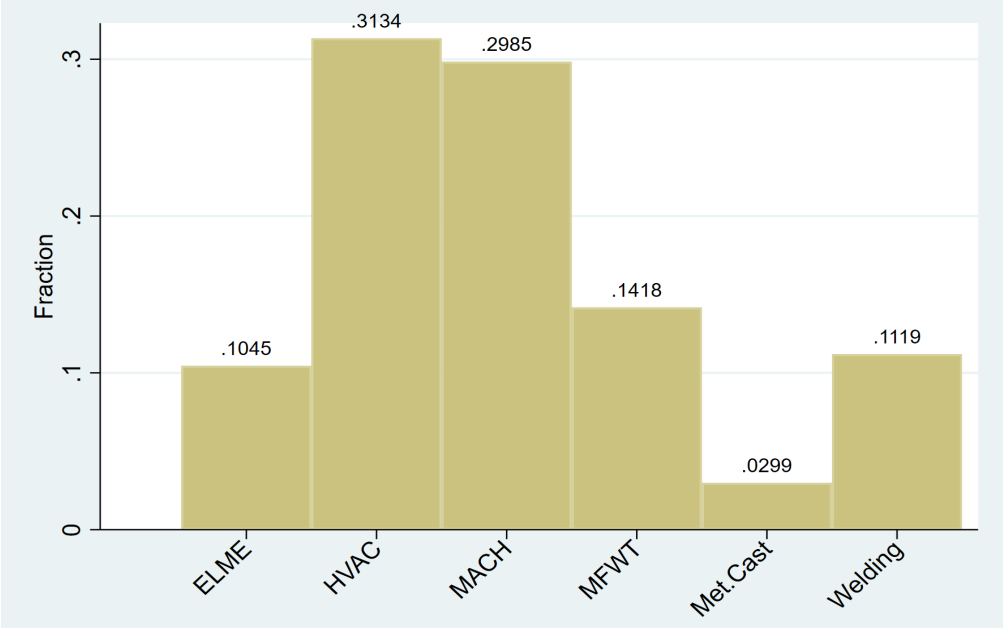
Figures 4 and 5 below show the distribution of students by programs of study for the control and treatment group respectively.

Figure 4. Distribution of Student Enrollment by Program of Study—Control Group



Student enrollment in control group programs is concentrated in the ELEC and CARP associate degree programs, with ELEC accounting for 38.1% of total enrollment and CARP 33.3%. The absolute number of treatment group enrollment differs from previously reported totals because observations with missing wage and employment data were excluded from the regression analyses (see Figure 5).

Figure 5. Distribution of Student Enrollment by Program of Study—Treatment Group



Excluding missing data observations significantly impacted the treatment group's enrollment. Representation in the HVAC and MACH programs increased, while the representation in the short-term programs dropped sharply. Short-term program enrollment in the regression sample decreased from 40% to 14%. The decline in short-term program representation does not materially impact the comparative analyses because these programs are eventually excluded from the analyses due to lack of a matching control program cohort.

Employment

High nonresponse rates for both groups on this survey question caused a pronounced skew in the employment data. Employment outcomes are only available for 70% of all treatment and control students; the remaining data observations are missing. 100% of responsive students reported being employed, 60% of which were treatment group students and the remaining 40% were control group students (see Table 2).

Table 2. Employment Rates for Control and Treatment Groups in Analytical Sample

Cohort	# Enrolled	#Responding Employed	Employment Rate
Treatment	84	61	72.6%
Control	134	117	87.3%

The employment rates reported in Table 2 are purely descriptive because data limitations preclude any meaningful group comparisons or inferences.

Skill Alignment

TSCT hypothesized that treatment group students would acquire technical skills that are closely aligned to those that are in high demand by employers as a consequence of their participation in the grant funded training programs. CWA reviewed job position titles by program of study for each analytical cohort to assess the extent to which TSCT achieved this objective and determine whether treatment group students were more likely than those in the control group to find jobs relevant to their programs of study.

Tables 3 and 4 show samples of job position titles for selected classes in each cohort.

Table 3. Program of Study Group 1: Control [CARP] & Treatment [MFWT]

Control Program of Study: CARP

Job Title	Freq.	Percent	Cum.
Carpenter/Apprentice	7	63.6	63.6
Builder	1	9.1	72.7
Carpenter/foreman	1	9.1	81.8
Crew/Leader/Foreman	1	9.1	90.9
Finishing Technician	1	9.1	100.0
Total	**11**	**100**	

Treatment Program of Study: MFWT

Job Title	Freq.	Percent	Cum.
Maintenance Mechanic	3	33.3	33.3
Welder	2	22.2	55.5
Fabricator/Installer	1	11.1	66.6
Fitter/Welder	1	11.1	77.7
HVAC Helper	1	11.1	88.8
Mechanic	1	11.1	100.0
Total	**9**	**100**	

Table 4. Program of Study Group 1: Control [ELEC] & Treatment [MACH]

Control Program of Study: ELEC

Job Title	Freq.	Percent	Cum.
Electrician	6	26.1	26.1
Apprentice Electrician/Linesman	3	13.0	39.1
Industrial Maintenance Electrician	3	13.0	52.1
Maintenance Electrician	2	8.7	60.9
Maintenance Mechanic	2	8.7	69.6
Maintenance Technician	2	8.7	78.3
Facilities & Maintenance Tech	1	4.3	82.6
HVAC Controls Installation/Service Tech	1	4.3	87.0
I & C Technician	1	4.3	91.3
PLC Programmer	1	4.3	95.7
System Technician	1	4.3	100.0
Total	**23**	**100**	

Treatment Program of Study: MACH

Job Title	Freq.	Percent	Cum.
Machinist	9	39.1	39.1
CNC Operator	4	17.4	56.5
Assembler/Installer	1	4.3	60.9
CNC Operator/Programmer	1	4.3	65.2
Lead Machinist	1	4.3	69.6
Machine Operator	1	4.3	73.9
Manufacturing Engineering Intern	1	4.3	78.3
P4 Setup	1	4.3	82.6
Production Operator 4	1	4.3	87.0
Quality Engineering	1	4.3	91.3
Star-Dental	1	4.3	95.7
Tool & Die Maker	1	4.3	100.0
Total	**23**	**100**	

The raw distributions show that both cohorts are equally successful in obtaining jobs which require skills that are directly related to their training. The high correlation between job placement and technical training is likely related to TSCT's overall success and efficiency in providing relevant technical training to its general student body, as opposed to any specific treatment effect related to the grant funding. Put differently, TSCT was highly successful in satisfying this program deliverable, but the job-skills match outcome, is likely a result of the College's experience and competitive advantage rather than an outcome caused by the grant funding.

Wage Treatment Effect

CWA used a treatment effect model framework to evaluate the impact of treatment program participation on wages. The wage treatment effect model test the hypothesis that treatment group students will have higher wages than students enrolled in control programs of study. Table 5 summarizes the hourly wage distribution for the two groups.

Table 5. Summary of Employment Wages (Hourly)

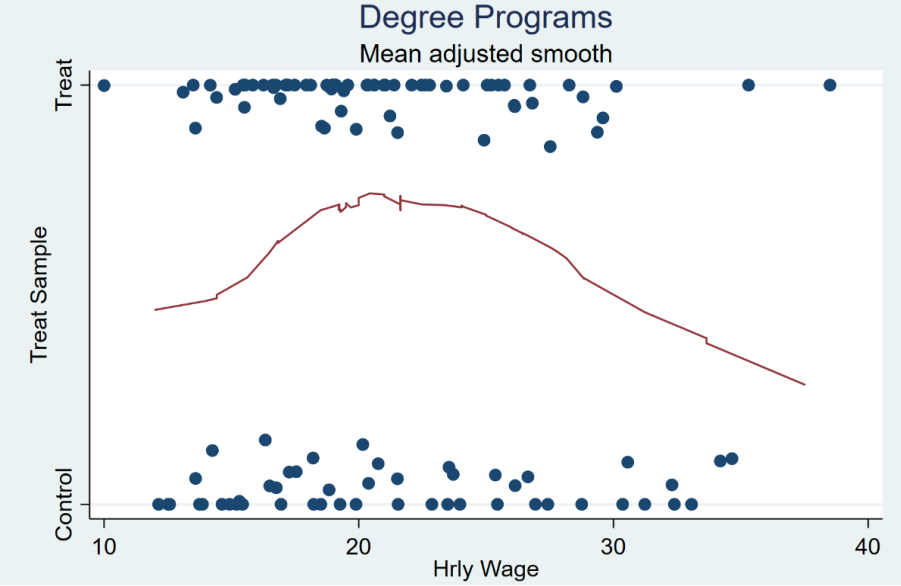
Sample	Cohort	Mean Wage	Min. Wage	Max. Wage
All Programs	Control	21.13	12.02	33.65
	Treatment	19.52	6.25	37.50
Degree Programs	Control	21.20	12.02	33.65
	Treatment	20.95	12.02	37.50

Control group students have higher wages than students enrolled in the treatment programs of study. Control group students continue to show higher wages when the population is restricted to associate degree programs of study comparisons only.

Table 5 wage distributions suggest that the control group has better employment wage outcomes, but this finding is subject to considerable variation as evidenced by the substantial difference ($21.63) between the extreme tails of the distribution. Excluding short-term programs from the analysis does not change this result.

Disaggregating the wage distributions by program of study reveals a distinct cluster pattern. Figure 6 shows the visual representation of the relationship between group membership and wage levels. The graphic depicts a considerable wage variation across the cohorts. In fact, the graph shows that the control group appears to have distinct wages clusters that are both lower and higher than the treatment group wages at different points in the distribution.

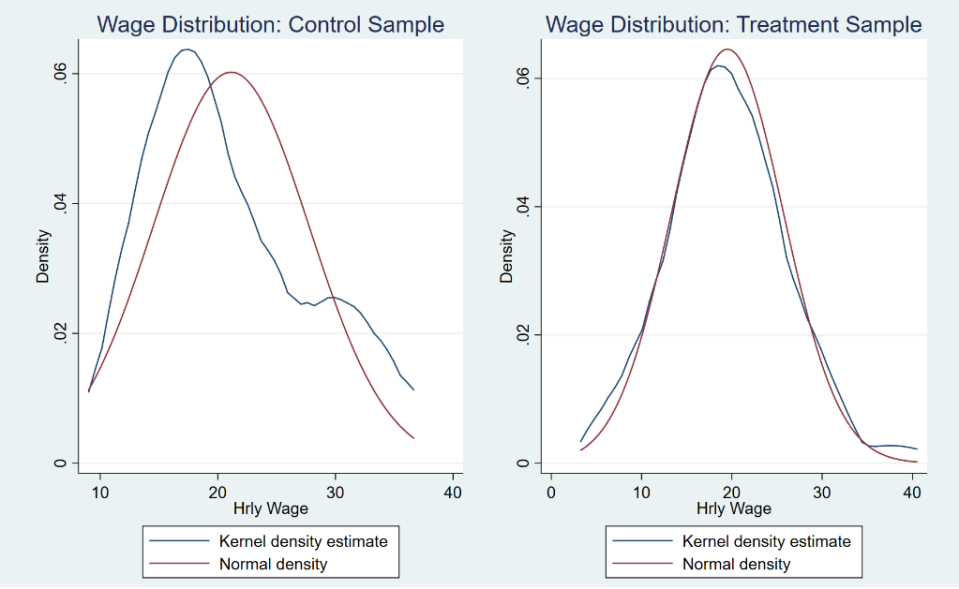
Figure 6. Distribution of Wages by Cohort



We examined the wage-cohort membership association for each program and confirmed that wage levels vary considerably depending on the program clusters on interest[4]. Moreover, wage variation affects the control group more than the treatment group (see Figure 7).

[4] See appendix for individual program distributions

Figure 7. Density Distribution of Wages by Cohort



The foregoing exploratory analyses suggest that assessing wage group differences within program clusters is more appropriate than a single sample approach. Consequently, programs of study were separated into clusters as follows:

I. Cluster 1:
   a. Control—CARP & PLBG
   b. Treatment—HVAC & MFWT

II. Cluster 2:
   a. Control—EET & ELEC
   b. Treatment—ELME & MACH

CWA assigned programs of study to each cluster based on similar sectoral labor market grouping.

CWA first estimated gross wage differentials between the treatment and program based control groups for each cluster. Table 6 shows a statistically significant raw wage differentials for cluster (1) programs between the groups. The wage treatment effect is positive and estimated at $3.96 per hour.

Table 6. Cluster 1 Uncontrolled Treatment Effect Model

Treatment-effects estimation (N=49)

Hourly Wage Level	Coefficient	Robust Std.Err.	Z	P-Value	95% Con. Interval	
					Lower	Upper
Average Treatment Effect (Treatment vs Control)	3.96	1.84	2.15	0.031	0.36	7.56
Potential Outcome Mean (Control)	17.63	1.41	12.47	0.000	14.86	20.40

Table 6 suggests that enrollment in the cluster (1) treatment programs has a positive effect on hourly wages as compared to students enrolled in unsubsidized programs of study. The average hourly wage for control students is $17.63 compared to an average hourly wage of $21.59 for treatment group students.

The gross wage differential is statistically significant, but this result may due to a number of factors, including individual characteristics among others. TSCT students are equally exposed to a number of development opportunities, one of which is internships. Internship opportunities provide key benefits to participating students. For example, students with access to internships are exposed to role models, coaches, and an applied setting within which their new skills can be refined. Beyond these, students have access to opportunities to obtain and practice soft skills. These exposures are increases worker value and when combined with technical training, these intangible internship benefits can have a positive impact on wages.
CWA attempts to account for these cumulative internship effects on wages by including an internship dummy in a simple regression model; to assess whether the gross wage differential is a consequence of participating in the treatment programs of study or a result of access to internship opportunities. Table 7 presents a semi-controlled treatment effect model, which controls for the impact of exposure to an internship on wage levels for cluster (1).

Table 7. Cluster 1 Controlled Treatment Effect Model

Treatment-effects estimation (N=49)

Hourly Wage Level	Coefficient	Robust Std.Err.	Z	P-Value	95% Con. Interval	
					Lower	Upper
Average Treatment Effect (Treatment vs Control)	4.13	1.71	2.41	0.016	0.76	7.50
Potential Outcome Mean (Control)	17.34	1.30	13.27	0.000	14.80	20.40

Controlling for the exposure to an internship increases the average treatment effect to $4.13/hour. The semi-controlled regression model shows that students in the comparison group have lower hourly wages ($17.34) on average, than students enrolled in the treatment programs of study, for whom the estimated average hourly wage of was $21.47.

The gross wage differential for students enrolled in cluster (2) programs reveal a different pattern. According to Table 8, the gross wage differential is negative and statistically significant for cluster (2) programs.

Table 8. Cluster 2 Uncontrolled Treatment Effect Model
Treatment-effects estimation (N=69)

Hourly Wage Level	Coefficient	Robust Std.Err.	Z	P-Value	95% Con. Interval	
					Lower	Upper
Average Treatment Effect (Treatment vs Control)	-2.77	1.24	-2.25	0.025	-5.22	-0.36
Potential Outcome Mean (Control)	23.21	1.07	21.68	0.000	21.11	25.31

The negative treatment effect is estimated at a cost of $2.77 per hour. Put differently, students enrolled in cluster (2) treatment programs experienced an opportunity cost for their choice, when compared to students enrolled in unsubsidized programs of study (control group). Students enrolled in the cluster (2) control group programs experienced a positive wage return. The average hourly wage for control students was $23.21 as opposed to an average hourly wage of $20.43 for treatment group students.

Table 9 shows results from the semi-controlled treatment effect model, in an attempt to account for factors that can explain the wage differential wage for cluster (2) programs.

Table 9. Cluster 2 Controlled Treatment Effect Model

Treatment-effects estimation (N=69)

Hourly Wage Level	Coefficient	Robust Std.Err.	Z	P-Value	95% Con. Interval	
					Lower	Upper
Average Treatment Effect (Treatment vs Control)	-2.80	1.24	-2.25	0.05	-5.23	-0.36
Potential Outcome Mean (Control)	23.28	1.05	22.12	0.000	21.12	25.34

Controlling for the exposure to an internship increases the average treatment effect to -$2.80/hour. In the semi-controlled regression model the average hourly wage for control students is estimated at $23.28 as opposed to an average hourly wage of $20.48 for treatment group students.

The wage distribution graphics, discussed earlier (see Figures 6 and 7), show considerable variation within program clusters. Program based analyses showed that students enrolled in the ELEC control program of study have significantly higher wages than all other programs and therefore exhibit a strong influence on the regression results. Furthermore, wage differences are only partially controlled in the second stage models; a number of individual worker characteristics are not observed and therefore omitted from the regression model; which can lead to inflated wage effects. Additionally, programs are assigned to a cluster based on rough approximations and are not fully representative of an exact skills-match between the treatment and control clusters; which can also lead to a misidentification of the relationship between cohort membership and its associated impact on wages.

Statistical Control Group Treatment Effect Models

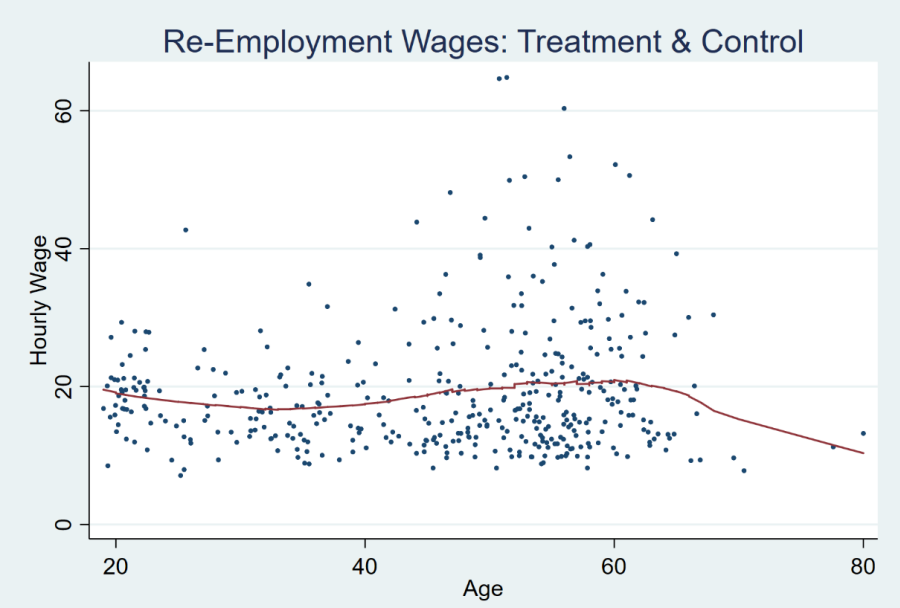
Comparing wage outcomes between a program-based control and the treatment groups showed that participating in grant funded training programs has a meaningful impact of student employment wages; but this impact is dependent on the program of study a student chooses. Limited measurements and lack of available data on individual worker characteristics can yield biased estimates and an incorrectly specified causal relationship. CWA implemented an alternative set of treatment-control analyses to test the robustness and consistency of the program based control results.

CWA constructed two supplementary statistical control groups used to alternatively assess the treatment group's wage outcomes. These supplementary groups are comprised of workers who re-entered the workforce after experiencing a spell of unemployment and did not receive any formal training for the duration of the spell.

CWA considers the statistically constructed control groups to be more appropriate comparators than the program based control group. Relying on the statistical control groups helps to eliminate confounders such as simultaneous exposure of the treatment program based control groups to TSCT environmental factors that can bias the counterfactuals and the derivative treatment effect model estimates.

The statistical control group is considerably older than the TSCT treatment group; this demographic imbalance creates a structural misalignment between the analytical cohorts.

Figure 8. Distribution of Age—Full Sample



Two methods were used to correct the demographic imbalance, which Figure 8 makes clear is necessary, given the quadratic relationship between age and employment wages, supporting the need to balance the cohorts. In the first method, a statistical control group was created by truncating the sample so that dislocated workers, in the aggregate, will not be older than the maximum age of the TSCT treatment sample (35 years). In the second method, a statistical control group was constructed using Coarsened Exact Matching (CEM) to balance the age of the two cohorts. The results for both groups are presented in the following discussion.

Figure 9. Distribution of Age—Balanced Sample

Figure 9 shows that the truncated control sample maintains the wage-age relationship as the large sample, but with less dispersion due to fewer outliers. Balancing the sample significantly reduces the number of control observations, but it also reduces the number of extreme values in the sample that are very likely to bias the results and obscure meaningful wage variation, which can cause models estimates to be falsely negative statistical insignificance. The scatter plot in Figure 10 shows areas of common support for wages in both the treatment and control groups.

Figure 10. Wage Scatter Plot: Age Truncated Sample

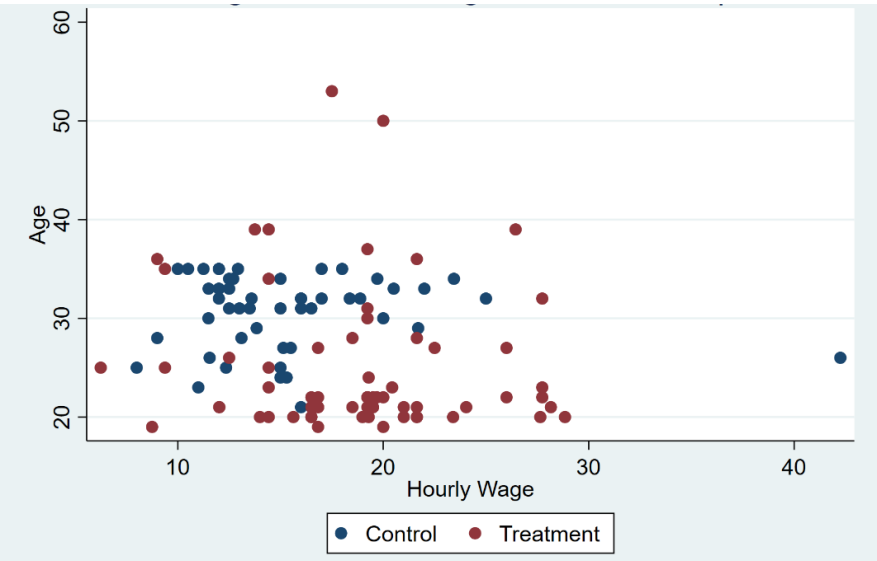


Figure 10 and summary statistics (not shown) confirm that consistency in wage levels and ages between the cohorts improved. Tables 10 and 11 below report results from the treatment effect regression models based on the statistical control groups.

Raw wage differentials using the two statistically constructed control groups are consistent with the program-based estimates.

Table 10. Truncated Sample Uncontrolled Treatment Effect Model

Treatment-effects estimation (N=114)

Hourly Wage Level	Coefficient	Robust Std.Err.	Z	P-Value	95% Con. Interval	
					Lower	Upper
Average Treatment Effect (Treatment vs Control)	3.31	0.99	3.35	0.001	1.37	5.25
Potential Outcome Mean (Control)	15.41	0.77	20.12	0.000	13.91	16.92

Coarse Exact Matched Sample
Treatment-effects estimation (N=114)

Hourly Wage Level	Coefficient	Robust Std.Err.	Z	P-Value	95% Con. Interval	
					Lower	Upper
Average Treatment Effect (Treatment vs Control)	3.32	1.02	3.27	0.001	1.33	5.31
Potential Outcome Mean (Control)	15.41	0.77	20.12	0.000	13.91	16.91

According to Table 10, the treatment effect is positive and estimated at $3.31 per hour. Enrollment in the TSCT treatment programs appears to have a positive effect on hourly wages as compared to workers who were not exposed to formal training. The average hourly wage for control students is $15.41 compared to a higher average hourly wage of $18.72 for treatment group students; the coarsened exact matched control sample shows results of similar magnitude and significance.

Statistical control group analyses allowed CWA to include individual worker characteristics as controls in the supplementary models. Inclusion of these characteristics will likely yield improved estimation of the causal relationship and resulting point estimates; particularly in light of the previous counterfactual bias.

Table 11 presents a modified treatment effect regression model re-specified to include controls for the impact of workers' age and the length of time spent away from the workforce for re-skilling or inability to find a job.

Table 11. Truncated Sample Controlled Treatment Effect Model

Treatment-effects estimation (N=114)

Hourly Wage Level	Coefficient	Robust Std.Err.	Z	P-Value	95% Con. Interval	
					Lower	Upper
Average Treatment Effect (Treatment vs Control)	3.46	1.60	2.16	0.031	0.33	6.60
Potential Outcome Mean (Control)	13.87	1.40	9.93	0.000	11.14	16.61

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Coarse Exact Matched Sample
Treatment-effects estimation (N=114)

Hourly Wage Level	Coefficient	Robust Std.Err.	Z	P-Value	95% Con. Interval	
					Lower	Upper
Average Treatment Effect (Treatment vs Control)	2.75	1.62	1.69	0.090	-0.43	5.94
Potential Outcome Mean (Control)	14.47	1.37	10.54	0.000	11.78	17.16

Controlling for the individual age of a worker and the time spent away from the formal labor force slightly increases the average treatment effect to $3.46/hour. In the re-specified model the average hourly wage for students in the control group is estimated at $13.87, $2.75 lower that the estimated average hourly wage of $17.33 for treatment group students. Though, the wage point estimate is decreased in the CEM balanced sample, the wage effect remains statistically significant.

Estimates from the two statistical control groups indicate that formal training has a significant and positive impact on wages. Annually a worker can reasonably expect his or her earnings and increase between $5,720 and $7,197 if he or she invests in training to re-skill or update his/her technical skills.

Additional Training Benefits

CWA obtained additional data on dislocated workers to measure the impact of foregoing formal skills upgrading on average re-employment wage earnings for the full sample statistical control. CWA analyzed changes between a worker's dislocated and re-entry wages by selected age groups. These analyses show that on average workers who do not participate in training programs after a job loss experience an average wage loss when they eventually return to the workforce (see Table 12).

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Table 12. Wage Changes: Dislocated Workers

Age Group	Mean (Std. Dev.)	Min.	Max.	N
20 – under 25	-1.96 (3.29)	-4.00	2.80	4
25 – under 30	3.41 (9.84)	-4.95	31.75	11
30 – under 35	-2.21 (7.80)	-28.00	15.75	26
35 and older	-0.50 (2.18)	-4.00	1.93	8

On average the full sample experiences a wage loss on re-entry into the workforce; but from Table 12 it is clear that loss is not true for all groups. Workers older than 25 but younger than 30 saw their wages increase, but all other age groups experienced a wage loss. These gross summaries are certainly devoid of a number of labor market complexities—but the summary outcome of average wage losses on re-entry for untrained workers remains.

The various analytical iterations discussed in this report show consistently that the enrolling in TSCT's treatment associate degree programs of study has a positive effect on employment wages; which when juxtaposed to the wage losses reported in Table 12 can be interpreted as an additional wage premium for workers choosing to upgrade or re-skill themselves.

Alternatively, CWA compared dislocated worker job search times with those of students enrolled in TSCT treatment programs of study. Dislocated workers spent an average of 9.7 months searching for new employment to replace loss earnings. Some workers spent more than 27.4 months searching for jobs, the median time to new employment was 6.7 months for the dislocated worker sample.

In contrast, TSCT treatment group students spent considerable less time finding jobs upon completion of their training. The average search time was 2.4 months for TSCT treatment group students, with a median search time of 1.1 months. A small share of TSCT students were able to find jobs shortly before graduation, the longest search time in the sample was 12.1 months. Students enrolled in the HVAC program had the shortest average search times (0.84), less than a month. Workers who chose to re-skill or upgrade their skills appeared to accrue an additional benefit--near immediate transfer into gainful employment.