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Did the American Reinvestment and Recovery Act Expand and Improve Vocational Training at Community Colleges?

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This study explores whether the Trade Adjustment Assistance Community College and Career Training (TAACCCT) Program, the largest federal investment in community colleges in this nation's history, expanded and improved vocational training programs. We find that, on average, the completion of credentials in career-technical fields increased at institutions receiving a TAACCCT in the first wave of the program, compared with other public, 2-year colleges. In particular, credentials in business, health care, and information technology (IT)-related fields increased, and the growth is concentrated in certificates. Our findings support previous literature examining the relationship between college funding and student outcomes, and suggest that additional funding enables public 2-year colleges to expand and improve technical education programs, despite some of the unique challenges facing these programs.

Keywords: *community colleges, postsecondary education, vocational education, quasi-experimental analysis*

Globalization and rapid technological change have altered the structure of the labor market, increasing the availability of middle-skill jobs, which complement technology and often require some postsecondary training, and decreasing the demand for lower-skilled workers performing primarily repetitive tasks that require no education beyond high school (Autor, 2014; Autor & Dorn, 2013; Levy & Murnane, 1996). Jobs such as working on a factory line, which may once have provided a living wage, have been replaced by low-wage retail and service jobs. In industries such as manufacturing or health care, middle-skill jobs that require problem-solving or programming provide more hope of middle-class wages, but require education beyond a high school degree. To access jobs that formerly required no more than a secondary school education, most workers must now acquire some form of postsecondary training.

Vocational training programs at community colleges could help workers who have been displaced by skill-biased technological change, and research suggests that, on average, students graduating with short, vocational credentials from community colleges experience a positive economic return (Bahr et al., 2015; Bettinger & Soliz, 2017; Carruthers & Sanford, 2018; Dadgar & Trimble, 2015; Jepsen et al., 2014; Marcotte, 2019; Marcotte et al., 2005; Stevens et al., 2015; Turner, 2016; Xu & Trimble, 2016). In addition, researchers have demonstrated that, during times of recession, enrollments in vocational programs and community colleges increase (Acton, 2021; Foote & Grosz, 2020). However, some of the programs in highest demand might not have the capacity to serve all interested students (Grosz, 2020), and others have been criticized for providing training that is out of date or not well-aligned with local labor market needs (Holzer, 2015).

Recent federal and state initiatives have provided resources for public 2-year colleges to expand and improve their vocational programs, but colleges may struggle to collaborate with outside stakeholders, or constraints on available space or the local pool of potential instructors may prevent seats in training programs from being elastically supplied. Although there is a growing consensus among policymakers and educators that collaboration with outside stakeholders is essential for improving workforce training at community colleges,[1] anecdotal evidence suggests that, though some colleges have successfully maintained long-term relationships with local employers, these relationships can be difficult to get off the ground and are hard to maintain (Barnow & Smith, 2016; Soliz et al., forthcoming). Moreover, rapid technological shifts in many of the industries targeted by these programs may be difficult for college to keep up with.

This study explores whether the Trade Adjustment Assistance Community College and Career Training (TAACCCT) Program, the largest single federal investment in community colleges in this nation's history, and part of the American Recovery and Reinvestment Act (ARRA) of 2009, expanded and improved vocational training programs at public 2-year colleges. We make use of data primarily from the Integrated Postsecondary Education Data System (IPEDS), and a differences-in-differences approach, which leverages variation in the location and timing of grant recipients, to answer the following three research questions. First, did the TAACCCT Program expand the capacity (as measured by credential completions) of vocational training programs at grant-receiving colleges? Next, did the TAACCCT Program improve the quality vocational training (as measured by institutional spending) at recipient colleges? Finally, how do the effects of receiving TAACCCT funding vary across programs of study?

We find evidence to suggest that the TAACCCT Program increased both the capacity and quality of vocational training at grant-receiving institutions, particularly in the first wave of the program. We find that, on average, receiving TAACCCT funding in 2011 increased the completion of short credentials in career-technical fields, compared with other public, 2-year colleges, which suggests that TAACCCT increased program capacity. In particular, the number of credentials completed in the fields of manufacturing, business, health, and information technology (IT) increased, and the increases are concentrated in the completion of short certificates. Moreover, we find evidence that colleges receiving TAACCCT funding in 2011 increased spending on academic support, on average, compared with later and non-recipient colleges. This suggests that TAACCCT may also have improved program quality. Our study demonstrates that funding, as well as the incentives provided by application requirements, allowed institutions to increase capacity and there was sufficient demand on the student side the fill seats. Our findings support previous research demonstrating that changes in funding impact enrollment and completions at public colleges (Deming & Walters, 2017).

By examining the national impact of the TAACCCT Program, this article makes several contributions. First, although grant recipients in 2012 to 2014 were required to conduct evaluations, the studies did not all use causal methods or focus on the same outcomes. Our study provides a national look at the average causal effect of this large investment in community colleges on a consistent set of outcomes. Next, by focusing on individual grants, program-level evaluations may have missed broader impacts. If colleges purchased new equipment, hired additional instructors, or were better able to sustain relationships with industry or other stakeholders, these actions could have spillover effects beyond the particular program targeted by the grant. Our study, which examines the impact of receiving a grant on credential completions across fields of study, may capture these spillover effects, which an impact evaluation of a single program may miss. Next, in addition to student-focused outcomes such as enrollment and completions, we examine how institutional spending changed as a result of TAACCCT. This allows us to make inferences about mechanisms behind any changes to enrollment and completions resulting from grant receipt. Finally, a national look at TAACCCT allows us to compare the impacts of the program across years and across targeted fields of study.

The rest of this article is organized as follows. The next section provides background on the TAACCCT program and reviews literature on postsecondary vocational training that motivates this study. We then describe the data and methods, followed by the results. The final section of this article discusses the policy implications of our findings.

Background and Literature Review

Theoretical Motivation: Supply-Side Issues

While much of higher education policy research focuses on student, or demand-side, issues, such as college affordability and lack of academic preparation, institutional, or supply-side, constraints can also affect enrollment, persistence and completion. Seats in higher education may not be elastically supplied, and so institutional capacity constraints can affect college student outcomes if colleges are limited by the availability of space for classrooms and workshops, or the time and availability of instructors. However, funding could increase access to higher education if it allows institutions to make capital investments and hire more instructors or staff. Indeed, research suggests that college enrollment and completion rates are positively correlated with changes in funding for higher education (Bound et al., 2010, 2019; Bound & Turner, 2007; Chakrabarti et al., 2020) and that the way institutions spend funding impacts student outcomes (Deming & Walters, 2017).

Maintaining high-quality career-technical programs may be particularly expensive because of rapidly changing technologies (Deming & Noray, 2019). Funding could improve and expand programs if it allows institutions to purchase new equipment to train students with up-to-date, in-demand skills. Funding could also provide money for internships, which give students valuable work experience and build connections between colleges and local industry. Colleges could also use grant money to hire additional staff who, as well as providing student services, could help support collaborations with local industry and workforce development agencies. Finally, the additional funds could provide resources to hire additional faculty, which may increase the number of seats available in a program and also help keep training up-to-date if instructors are coming from local industries.

On the other hand, funding may not be sufficient to improve vocational education at community colleges if institutions respond to increases in funding for one program by transferring pre-existing funds to other programs, thus not improving funding for the targeted program. In addition, it may be difficult to hire faculty and academic support staff if there is not a local pool of labor with the required expertise. Students could shift from programs within the college or from competing programs at other colleges, thus increasing credential completion in a given program but not increasing access to higher education overall. Also, it might be difficult to recruit students into these programs if most students come to college with the goal of earning an academic credential, and see career-technical education as inferior to more standard academic programs. It also might not be possible to provide technical training to students who are not academically prepared. More than 50% of students entering community colleges require remedial education in English or mathematics (National Center for Education Statistics [NCES], 2020). Finally, if increasing capacity in certain types of programs requires building relationships with outside stakeholders in industry, it is not clear whether funding alone will increase program capacity.

Background on the TAACCCT Program

The goal of the TAACCCT program was to prepare adults for high-wage, high-skill employment in growth industries by increasing credential attainment in fields that match employer needs (Mikelson et al., 2017). Colleges could apply for grants, which the U.S. Department of Labor (DOL) awarded in four, annual waves starting in 2011. Applications were assessed based on their statement of need, detailed work plan, and proposal for evaluating program outcomes (Cohen et al., 2017). The primary purpose of TAACCCT funding was to build infrastructure, and grantees used the funds to purchase equipment, hire instructors and develop new curricula (Durham et al., 2017). To ensure that the programs developed as part of the grants were aligned with local employer needs, grantees were

required to engage with stakeholders in the local workforce development system and use labor market data from workforce investment boards, local or state government agencies, employers and industry associations, labor organizations, or other local education agencies (Mikelson et al., 2017). Health care and manufacturing were the industries most often targeted by TAACCCT grants (Mikelson et al., 2017). The grants funded the development or improvement of credentialing programs meant to take 2 years or less to complete.

Applicants were selected to receive grants based on their statement of need (30 points), work plan (45 points), and ability to measure progress and outcomes (25 points; Employment and Training Administration, DOL, 2014). In the statement of need, applicants were asked to demonstrate that there would be labor needs in the industries targeted in their proposals and that the training programs they would develop would meet those needs. Preference was given to communities that could demonstrate they were losing jobs as a result of foreign trade. Applicants also had to provide a detailed work plan which demonstrated that they had the capacity to manage the new program and also that they were involving the necessary stakeholders, including employers. Finally, applicants had to demonstrate that they had procedures in place for capturing data to track student progress and outcomes, as well as a plan for analyzing program data and tracking long-term outcome measures.

The requirements for TAACCCT grantees were informed by early evidence from sectoral partnerships. Sectoral partnerships involve collaboration between education-providing agencies and specific industries or businesses. Research suggests that participating in training provided through sectoral partnerships can increase students' wages and probability of employment (Maguire et al., 2010), and some of the success of these programs has been attributed to the close involvement of employers in these training programs (Holzer, 2015). At least partly as a result of this type of research, a key piece of initiatives such as the TAACCCT has been to require colleges to collaborate with local industries in the development of new vocational programs (Eyster et al., 2017). TAACCCT grantees were supposed to develop collaborations with industry partners (i.e., employer and industry associations, community-based organizations, and employers) who then participated in the training programs in various ways including by offering internships, taking part in curriculum development, and creating professional credentials (Eyster et al., 2017).

Although all TAACCCT grant recipients from 2012 onward were required to include evaluations, only a handful used quasi-experimental methods. For example, in Round 4, of the 72 grant recipients, only 25 used a comparison or control group in their evaluations (Scott et al., 2020). Of the 25 grantees that completed impact evaluations in Round 4, only 6 found positive impacts on either credentials earned or employment, and only eight grantees found positive impacts of grant activities on program completion (though not all impact studies used the same outcomes; Scott et al., 2020). In their Round 4 synthesis report, Scott et al. (2020) suggest that, based on the impact reports, some promising practices include: tying classroom instruction to completion of skills and competencies, instead of seat time; contextualizing learning using models, such as I-BEST; and including a dedicated staff person to support student success.

Only a handful of the TAACCCT studies use methods with stronger internal validity than propensity score matching. Bozick et al. (2020) use administrative data from Stark State Community College and a differences-in-differences approach to examine the impact of receiving a TAACCCT grant on students' labor market outcomes in the ShaleNET consortium, which focused on developing training and credentials to serve the growing energy industry in the Ohio/Pennsylvania region. To understand whether training specifically tied to a local industry's needs benefits students above and beyond related, but less specific training, the authors compare students in a new petroleum technology certificate program with students in the broader heating, ventilation, and air-conditioning (HVAC) program. They find that individuals completing the petroleum technology credentials experience the largest return, suggesting that credentials aligned with particular industries are more valuable (at least in the short term) than more general credentials.

Our article builds on the literature examining vocational training at public 2-year institutions by exploring whether a large federal funding initiative, the TAACCCT Program, increased the capacity of vocational programs at community colleges, as well as the quality of those programs. Our study makes an important contribution to the studies seeking to evaluate the TAACCCT program by applying rigorous causal methods to evaluate the average effects of the program across a consistent set of outcomes. We also explore whether there are spillover effects associated with TAACCCT, which has not been examined in any previous study of which we are aware.

Empirical Strategy

Data

To estimate the effect of receiving a TAACCCT grant on community college outcomes, we make use of the IPEDS from 2008 to 2016 merged with data from the Census, American Community Survey (ACS), Bureau of Labor Statistics (BLS) and Grapevine Survey.[2] We run models including only TAACCCT recipients as well as models in which the comparison group in each model comprised community colleges that have not yet received their first TAACCCT grant and colleges that never received TAACCCT funding.

Though some private non-profit and for-profit institutions received TAACCCT funding, this article focuses on public 2-year colleges. We do this first because the vast majority of the funds went to 2-year colleges in the public sector. Second, the findings from this study have the greatest implications for community colleges which, because of their bureaucratic structures, may have more difficulty rapidly developing new programs or updating old programs in response to technological change than private sector colleges. Finally, community colleges are meant to serve their local communities and the ARRA was at least in part intended to use public money to stimulate local economies. It is community colleges whose missions most clearly align with the goals of the stimulus program.

After reducing the sample to public 2-year colleges, we exclude colleges such as the Tennessee Colleges of Applied Technology, tribal colleges, and military colleges that have unique institutional missions and thus may not serve as a good comparison group for the typical community college. This leaves a sample of 541 institutions that received a TAACCCT grant in one of the four waves and, in the primary comparison group, and approximately 539 colleges that never received a grant. The sample is based on colleges that were public 2-year colleges in 2011, 2012, 2013, and 2014. After 2014 some colleges changed sector, but they were kept in the sample. Other colleges closed or combined with other institutions, changing the sample size over time. Grant-receiving institutions are scattered around the United States because the program mandated that at least 0.5% of funding be allocated to each of the 50 states in each wave of the program (Mikelson et al., 2017). Table 1 displays the number of grants by targeted industry as well as providing a crosswalk between the North American Industry Classification System (NAICS) codes used by the DOL and the Classification of Instructional Program (CIP) codes used by IPEDS.

Methods

We make use of a differences-in-differences approach to estimate the effect of receiving a TAACCCT grant on per-pupil college spending, enrollment, completions,[3] and completions by field of study.[4] Given that the TAACCCT grants targeted particular fields of study, such as advanced manufacturing and IT, changes to enrollments and completions in those fields may be the best evidence that the grants had an impact. One weakness of our study is that IPEDS only reports credential completions by field of study, not enrollments. As a result, we potentially underestimate the effect of these grants, if they caused more individuals to enroll in targeted fields but not all of those who enrolled completed a credential. On the other hand, even if there is some economic return to course-taking in technical fields (Kane & Rouse, 1995), economic outcomes are best, on average, for those who complete credentials. Therefore, credential completion may be the most important college-level outcome to measure when evaluating the impact of the TAACCCT Program.

TABLE 1

CIP/NAICS Crosswalk and TAACCCT Grants by Field of Study

Fields of study	CIP codes	NAICS codes	Institutions receiving grant in this category
Agriculture	• Agriculture, agriculture operations, related sciences (01)	• Agriculture, forestry, fishing, hunting (11)	40
Business	• Business, management, marketing, related support services (52)	• Professional, scientific, and technical services (54) • Finance, insurance (52) • Management of companies and enterprises (55) • Retail trade (44–45) • Administrative support, waste management, remediation services (56)	172
Construction	• Construction trades (46)	• Construction (23)	53
Health care	• Health professions (51)	• Health care, social assistance (62)	233
IT	• Computer and information sciences and support (11)	• Information (51)	43
Manufacturing	• Engineering technologies (15) • Manufacturing professions (47) • Precision production (48)	• Manufacturing (31–33)	288
Natural resources	• Natural resources, conservation (03)	• Mining, quarrying, oil, and gas extraction (21) • Utilities (22)	51

Note. Education and transportation grants are not included here or in the analysis because of small sample sizes. CIP = Classification of Instructional Program; NAICS = North American Industry Classification System; TAACCCT = Trade Adjustment Assistance Community College and Career Training; IT = information technology.

Our estimation strategy leverages variation in the awarding of TAACCCT grant funds and the timing of the grants. The primary identifying assumption behind differences-in-differences models is that trends in outcomes for treatment and comparison groups before treatment are parallel. Figures 1 to 3 plot event studies to explore this assumption. The plots suggest that trends are parallel for our primary outcomes of interest, at least in the years immediately preceding treatment. Raw trends in outcomes are also displayed in Supplementary Appendices A, B, and C in the online version of the journal.

In our differences-in-differences model, the first difference is whether or not an institution received a TAACCCT grant and the second difference is before and after the first round of TAACCCT funding became available, in a given wave. The intuition for this approach is provided by the following model:

$$y_{itcs} = \gamma_t + \alpha_i + \beta_1 PostXTAACCCT_{itcs} + Post_{itcs} + X_{tcs} + \varepsilon_{itcs}, \quad (1)$$

in which y are outcomes for institution i, in time t, in county c, in state s. Outcomes include enrollment, full-time equivalent (FTE) enrollment, total vocational certificate and associate degree completions, per-pupil[5] spending on instruction, academic support and student services, as well as completions in TAACCCT-targeted industries. In the specification above, γ_t are year fixed effects and TAACCCT is the treatment indicator, which is coded 1 for institutions that received a TAACCCT grant in a particular year and zero for institutions that have not yet received a grant. X is a vector of county and state-level covariates, including county population levels, college-age population, average wages, unemployment rate, and state appropriations to higher education, which may affect both selection into treatment and outcomes. Finally, α_i are college fixed effects, which control for any non-time varying differences across institutions. The coefficient of interest is the β_1 on the treatment-time interaction. In the years after each wave of the program, these coefficients estimate the effect on the outcomes, for treated colleges,

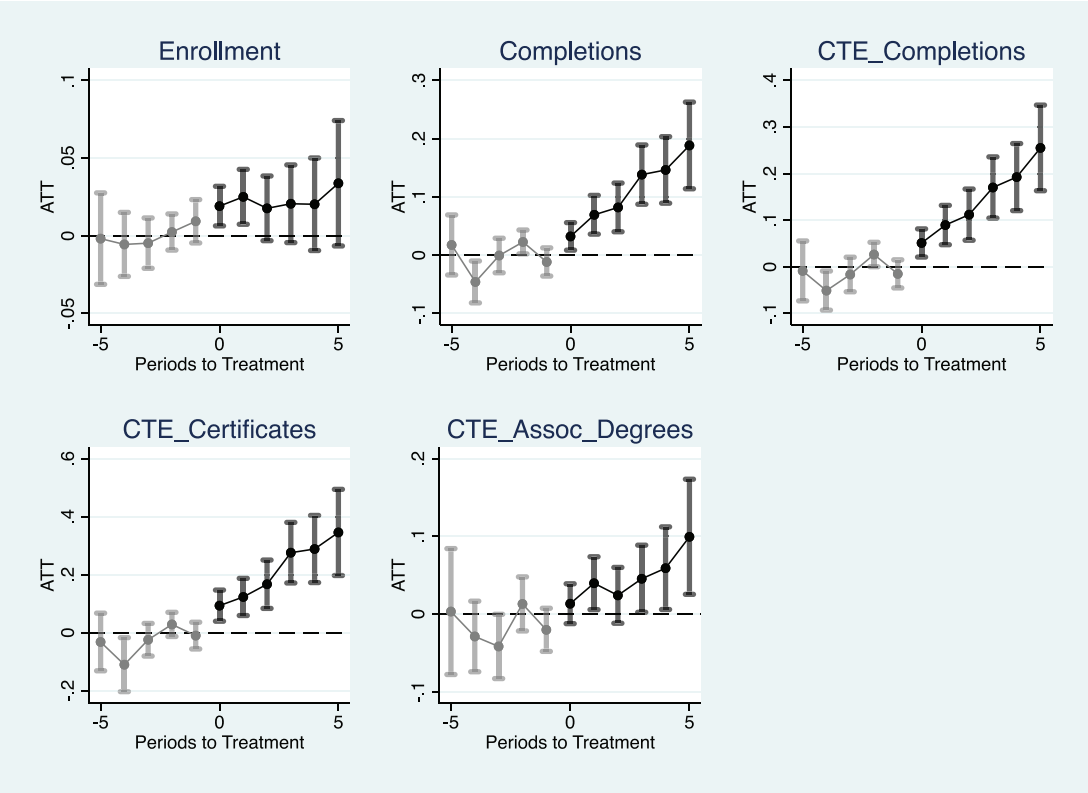

FIGURE 1. *Event-study models for enrollment and completion outcomes.*
Note. Never-treated colleges are the comparison group. All outcomes are log-transformed. All models include institution fixed effects and control for average county wage, unemployment rate, population, and poverty rate, as well as state population age 18 to 35, population age 18, and appropriations per full-time equivalent enrollee. Standard errors are clustered by institution. Plots were generated using "csdid" commands (Rios-Avila et al., 2021), and there is no explicit omitted category. See Callaway and Sant'Anna (2021) for more detail. ATT = Average Treatment Effect on the Treated; CTE = Career and Technical Education.
Source. Integrated Postsecondary Education Data System.

of receiving TAACCCT funding. Standard errors are clustered by institution.

However, a growing body of literature has shown that the standard approach for estimating pooled effects from this type of policy roll-out produces biased estimates because already treated units may sometimes be used as the comparison group (e.g., Baker et al., 2022; Goodman-Bacon, 2019). To address the critiques of these models, we implement the approach developed by Callaway and Sant'Anna (2021) which estimates wave-specific effects before aggregating across them. In our preferred specification, the comparison group comprised public 2-year colleges that never received a TAACCCT grant. As a robustness check, we also run models in which the comparison group includes both colleges that never received a grant and those that have not yet received a grant. Callaway and Sant'Anna's (2021) approach allows for the estimation of the average effects of receiving a grant as well as effects disaggregated by each wave of grant distribution.

We also estimate event-study models of the following form:

$$y_{itcs} = \sum_{t=2008}^{2016} \beta_t \left(\gamma * \text{TAACCCT}\right)_{itcs} + \text{TAACCCT}_{itcs} + X_{tcs} + \gamma_t + \alpha_i + \theta_{itcs}, \quad (2)$$

in which the parameters are defined the same as in equation 1 except, γ_t are year fixed effects. The event-study models allow us to examine the parallel trends assumption. We use the csdid

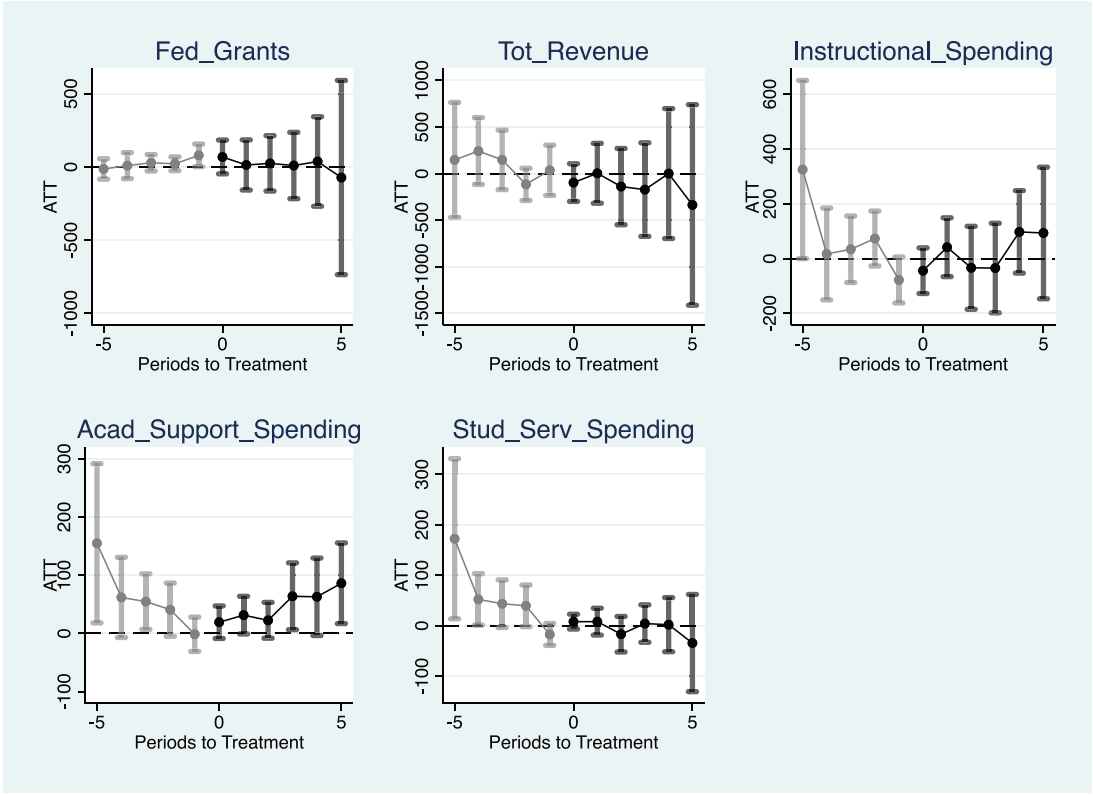

FIGURE 2. *Event-study models for per-pupil institutional finance outcomes.*
Note. Never-treated colleges are the comparison group. All outcomes are per full-time equivalent enrollment. All models include institution fixed effects and control for average county wage, unemployment rate, population, and poverty rate, as well as state population age 18 to 35, population age 18, and appropriations per full-time equivalent enrollee. Standard errors are clustered by institution. Plots were generated using "csdid" commands (Rios-Avila et al., 2021), and there is no explicit omitted category. See Callaway and Sant'Anna (2021) for more detail. ATT = Average Treatment Effect on the Treated.
Source. Integrated Postsecondary Education Data System.

package in Stata to produce all of our estimates (Rios-Avila et al., 2021).

Potential Weaknesses

Selection into treatment may bias our estimates. Institutions that applied for and were selected to receive TAACCCT grants may have been higher quality institutions before receiving the grants and had higher completion rates. However, the statistics displayed in Table 2, and described in more detail below, suggest that there are not large differences between the colleges that received TAACCCT grants and those that did not. We also include covariates and institutional fixed effects in our models to control for potential sources of bias.

Second, we believe that examining the effects of the grants on vocational credential completions and institutional spending is an effective way to answer the question of whether TAACCCT expanded and improved career-technical education at recipient colleges. However, colleges could have increased completions via multiple pathways, which we can only partially observe. For example, an increase in completions could mean colleges were successfully able to expand their capacity for providing vocational training by purchasing additional equipment, hiring additional faculty, and finding sufficient classroom space. Increases in credential completions could also mean that the grant funding created higher quality programs from which more students graduated, though the

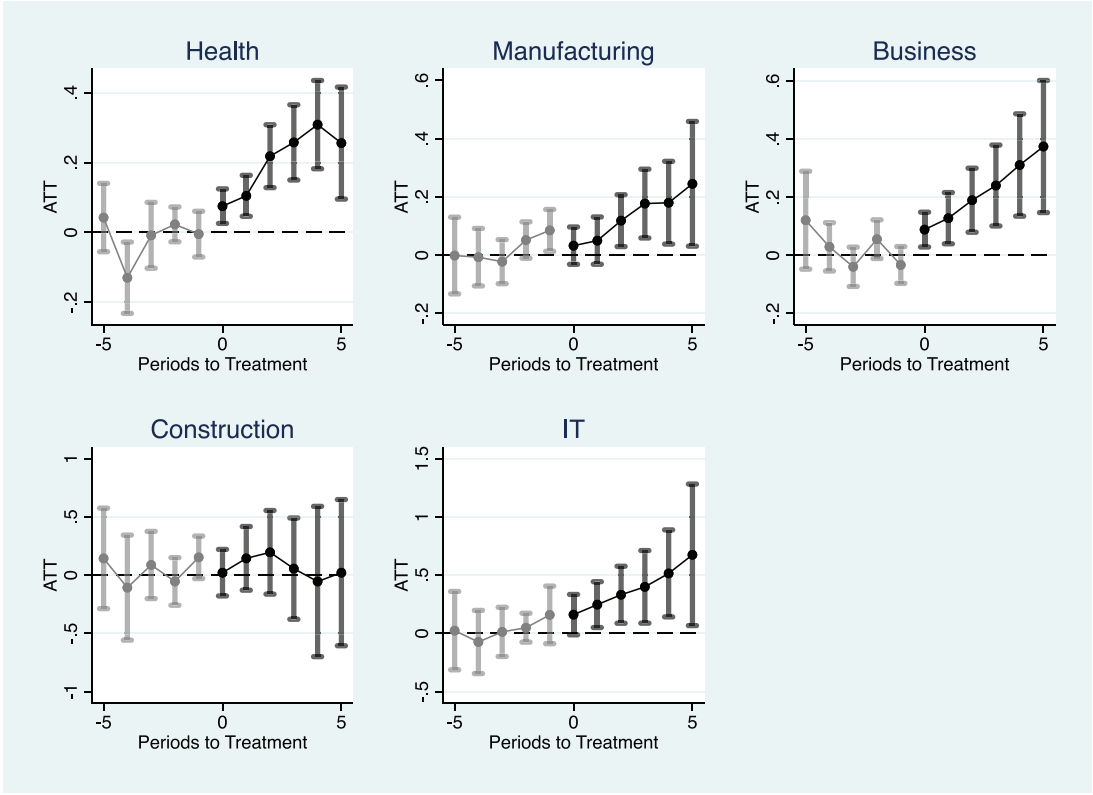

FIGURE 3. *Event-study models for field of study outcomes.*
Note. Never-treated colleges are the comparison group. All outcomes log-transformed. All models include institution fixed effects and control for average county wage, unemployment rate, population, and poverty rate, as well as state population age 18 to 35, population age 18, and appropriations per full-time equivalent enrollee. Standard errors are clustered by institution. Plots were generated using "csdid" commands (Rios-Avila et al., 2021), and there is no explicit omitted category. See Callaway and Sant'Anna (2021) for more detail. ATT = Average Treatment Effect on the Treated.
Source. Integrated Postsecondary Education Data System.

college's capacity to provide training had remained the same. We make use of data on institutional spending to explore these hypotheses, but we do not have access to some more specific measures, such as number of faculty in a program. Finally, increases in vocational completions could mean that students shifted into these programs from other programs within the colleges or from other sectors, either because the TAACCCT-funded programs became more attractive, students were more aware of them, or students were recruited into them.

Results

Table 2 displays descriptive statistics for public 2-year colleges in 2010, the year before the first wave of TAACCCT grants were awarded. We compare colleges that received a TAACCCT in 2011, 2012, 2013, and 2014 (Columns 1 through 4, respectively) with the pooled averages across waves (Column 5) and also public 2-year colleges that never received a TAACCCT (Column 6). In general, no clear patterns emerge to suggest that one group of colleges is higher quality or more equipped to graduate students than any of the others. Colleges that received TAACCCT funding are, on average, slightly larger than comparison group schools. Colleges that did not receive funding are slightly more likely to be rural than those that did receive funding, but the difference is small. Variables, such as instructional spending per FTE student and instructional staff per FTE are of particular

TABLE 2

Descriptive Statistics

Institutional characteristics	(1) 2011 recipients	(2) 2012 recipients	(3) 2013 recipients	(4) 2014 recipients	(5) All recipients	(6) No TAACCCT
FTE enrollment	4,725.22	6,281.63	5,677.65	5,437.11	5,312.60	3,748.51
	(4,465.31)	(4,850.38)	(4,976.17)	(4,596.18)	(4,674.10)	(4,705.68)
% students White	65.67	60.35	59.89	52.68	61.97	59.44
	(22.76)	(23.24)	(27.29)	(23.70)	(23.93)	(24.09)
% students Black	11.64	16.52	12.96	13.64	13.25	15.33
	(14.65)	(17.35)	(14.48)	(17.33)	(15.78)	(17.11)
% students Hispanic	9.12	8.88	12.71	15.86	10.38	12.31
	(12.55)	(12.21)	(15.84)	(17.24)	(13.77)	(16.55)
Rural	0.30	0.25	0.25	0.30	0.28	0.35
	(0.46)	(0.43)	(0.43)	(0.46)	(0.45)	(0.48)
Instr. spending per FTE	4,898.44	4,665.31	5,483.68	4,832.98	4,902.34	5,101.94
	(1,626.65)	(1,303.46)	(2,975.91)	(1,534.04)	(1,773.66)	(3,428.44)
Total Staff per FTE	0.17	0.14	0.16	0.17	0.16	0.16
	(0.09)	(0.05)	(0.07)	(0.08)	(0.08)	(0.10)
Instr. staff per FTE	0.10	0.08	0.10	0.10	0.09	0.09
	(0.06)	(0.03)	(0.04)	(0.05)	(0.05)	(0.05)
% staff full-time	0.19	0.20	0.20	0.16	0.19	0.21
	(0.08)	(0.07)	(0.08)	(0.06)	(0.07)	(0.09)
% instr. staff full-time	0.34	0.36	0.37	0.29	0.34	0.37
	(0.16)	(0.17)	(0.21)	(0.14)	(0.17)	(0.18)
State appropriations per FTE	3,344.43	2,797.62	3,131.51	3,415.30	3,194.16	3,510.54
	(1,961.39)	(1,410.76)	(2,083.12)	(2,009.19)	(1,873.95)	(2,902.04)
Local appropriations per FTE	1,320.56	1,618.04	3,192.45	1,709.34	1,666.81	1,740.80
	(2,045.86)	(1,903.33)	(4,295.63)	(1,984.87)	(2,450.71)	(4,760.16)
% receiving financial aid	76.42	75.20	73.28	70.19	74.93	73.70
	(15.89)	(16.46)	(15.47)	(18.27)	(16.39)	(19.65)
% receiving Pell Grant	53.09	51.42	52.29	49.01	52.06	51.94
	(15.48)	(13.93)	(14.63)	(17.12)	(15.26)	(17.75)
Poverty rate	13.98	15.36	14.30	13.92	14.35	16.17
	(3.04)	(3.27)	(3.09)	(3.31)	(3.18)	(2.51)
Unemployment rate	9.34	9.47	9.88	9.49	9.46	10.31
	(2.59)	(2.38)	(2.51)	(2.64)	(2.54)	(2.80)
Observations	273	132	65	71	541	539

Note. TAACCCT = Trade Adjustment Assistance Community College and Career Training; FTE = full-time equivalent.
Source. Integrated Postsecondary Education Data System, Census, Bureau of Labor Statistics, Grapevine Survey.

interest because they may be measures of institutional quality, which could affect our outcomes in the absence of treatment. However, each of the groups of colleges has similar values across these potential measures of quality.

Figures 1 and 2 display the event-study models for the main outcomes and institutional finance outcomes, respectively. The plots in Figure 1 suggest that, for most outcomes, there is no statistically significant difference in the trends for colleges that received a TAACCCT grant compared with those that did not before treatment. The plots for the completions and Career and Technical Education (CTE) completions outcomes show that 2 years before treatment there are marginally statistically significant differences between the trends, and results for those outcomes should be treated with caution. For the other outcomes in Figure 1, there are no statistically significant differences between trends for at least 3 years before treatment. There are not statistically significant differences in pre-trends for the first three institutional finance outcomes displayed in Figure 2. However, there are statistically significant differences between treatment and comparison group trends for per-pupil academic support spending 3 years before treatment and for per-pupil student service spending 5

TABLE 3

Effect of Receiving a TAACCCT on Enrollment and Completions

	FTE enrollment		Total completions		CTE completions		Sub-associate CTE completions		Associate CTE completions	
Post × TAACCCT	0.022*	0.031**	0.099***	0.086***	0.131***	0.093***	0.198***	0.159***	0.041*	0.009
	(0.010)	(0.010)	(0.019)	(0.016)	(0.025)	(0.020)	(0.038)	(0.031)	(0.018)	(0.018)
Post × 2011	0.040**	0.056***	0.128***	0.108***	0.179***	0.122***	0.222***	0.170***	0.069*	0.029
	(0.014)	(0.015)	(0.026)	(0.022)	(0.033)	(0.027)	(0.050)	(0.039)	(0.026)	(0.025)
Post × 2012	−0.005	−0.001	0.091**	0.081**	0.096**	0.076**	0.188**	0.165**	0.018	−0.008
	(0.012)	(0.012)	(0.028)	(0.025)	(0.032)	(0.028)	(0.056)	(0.053)	(0.021)	(0.022)
Post × 2013	−0.011	−0.020	0.021	0.046	0.020	0.034	0.164	0.162*	−0.022	−0.024
	(0.022)	(0.016)	(0.044)	(0.036)	(0.057)	(0.038)	(0.088)	(0.073)	(0.037)	(0.032)
Post × 2014	0.005	−0.008	−0.003	−0.019	0.014	−0.004	0.079	0.043	−0.024	−0.060
	(0.017)	(0.016)	(0.029)	(0.028)	(0.033)	(0.032)	(0.067)	(0.065)	(0.033)	(0.030)
Covariates	*Y*		*Y*		*Y*		*Y*		*Y*	
N	9,090	9,090	9,090	9,090	9,050	9,050	8,877	8,877	8,216	8,216

Note. All outcomes are log-transformed. In each model, the treatment group is public 2-year colleges receiving their first TAACCCT grant in a given wave, the comparison group comprised public 2-year institutions that never received a TAACCCT grant. Coefficients were estimated using Callaway and Sant'Anna's (2021) approach and the "csdid" commands in Stata (Rios-Avila et al., 2021). Covariates include institution fixed effects and control for average county wage, unemployment rate, population and poverty rate, as well as state population age 18 to 35, population age 18 and appropriations per full-time equivalent enrollee. Standard errors are clustered by institution. TAACCCT = Trade Adjustment Assistance Community College and Career Training; FTE = full-time equivalent; CTE = Career and Technical Education.

*$p < .05$. **$p < .01$. ***$p < .001$.

Source. Integrated Postsecondary Education Data System, Census, Bureau of Labor Statistics, Grapevine Survey.

years before treatment. Particularly, findings related to the academic support outcome should be interpreted with that caveat in mind.

Table 3 displays the coefficients from models estimating the effect of receiving a TAACCCT on institutions' FTE enrollment, overall completions, total vocational completions, and vocational completions disaggregated by level of award. The top panel displays the estimates pooled across waves, while the remaining four panels display the results disaggregated by the wave of the program. We report results on FTE enrollment to increase the plausibility of our main results of interest related to program completions. If we find statistically significantly larger numbers of vocational program completions in TAACCCT-receiving institutions, compared with schools that never received a TAACCCT, we would also expect to see either differences in enrollment or shifts across program types in colleges. Though we cannot observe enrollments by program, below we explore whether program completions appeared to have shifted as a result of the grants, for example, from academic to vocational completions.

The results displayed in Table 3 suggest that there were positive effects, on average, on enrollment and completions for colleges that received a grant compared with those that never did. Moreover, our estimates suggest that these effects were driven by colleges receiving a grant in the first, and sometimes second, waves. The results displayed in Column 1 of Table 3 suggest that there are statistically significantly larger enrollments, on average, in colleges that received TAACCCT grants in 2011, compared with those that received a grant later or never received one. Specifically, the results suggest that, for colleges receiving their first grant in the 2011 wave, enrollments went up by approximately 4%, on average, compared with colleges that received a grant later or never received a grant.

Columns 3 through 5 of Table 3 focus on the main outcomes of interest: total vocational completions, sub-associate (i.e., certificate) completions in vocational fields and associate degree completions in vocational fields. In Column 3, the coefficients of interest suggest that receiving TAACCCT funding had a positive and statistically significant effect on vocational completions at colleges receiving grants in the 2011 and 2012 waves. In Column 3, the coefficient for the 2011 wave suggests that vocational completions increased by approximately 20%, on average, relative to comparison group colleges.[6] Moreover, the coefficients displayed in Column 4 suggest

TABLE 4

Effect of Receiving a 2011 TAACCCT on Per-Pupil Institutional Spending

	Federal non-operating grants		Total non-operating revenue		Instruction—salaries and wages		Academic support—salaries and wages		Student services—salaries and wages	
Post × TAACCCT	20.429	30.726	−106.891	148.542	10.628	126.785**	42.795*	19.195	−2.655	27.217*
	(114.865)	(65.331)	(221.342)	(114.752)	(61.231)	(42.852)	(17.686)	(10.951)	(16.588)	(10.933)
Post × 2011	96.328	105.780	−185.430	195.710	8.654	207.378**	64.484**	33.323*	−1.685	41.676**
	(172.848)	(96.342)	(326.199)	(165.746)	(94.421)	(60.453)	(21.844)	(13.624)	(22.385)	(14.240)
Post × 2012	−129.177	−90.982	77.269	111.755	−23.383	25.635	−1.725	1.874	−6.120	17.019
	(67.854)	(65.523)	(224.414)	(166.461)	(49.981)	(46.531)	(18.265)	(15.848)	(17.498)	(14.759)
Post × 2013	−109.707	−116.591	−355.897	−218.698	−112.94	−28.959	−9.580	−6.637	−30.880	−9.392
	(80.189)	(67.359)	(199.129)	(139.904)	(103.571)	(43.746)	(43.500)	(14.769)	(27.728)	(22.406)
Post × 2014	56.937	6.749	223.495	338.274	281.138	5.252	77.016	−5.159	34.563	−9.162
	(72.877)	(62.062)	(230.456)	(174.558)	(189.432)	(46.549)	(49.783)	(16.816)	(33.383)	(16.766)
Comparison mean	2,113.96		8,425.59		3,001.965		500.97		639.77	
Covariates	*Y*		*Y*		*Y*		*Y*		*Y*	
N	9,090	9,090	9,090	9,090	9,090	9,090	9,090	9,090	9,090	9,090

Note. In each model, the treatment group is public 2-year colleges receiving their first TAACCCT grant in a given wave, the comparison group comprised public 2-year institutions that never received a TAACCCT grant. Coefficients were estimated using Callaway and Sant'Anna's (2021) approach and the "csdid" commands in Stata (Rios-Avila et al., 2021). Covariates include institution fixed effects and control for average county wage, unemployment rate, population and poverty rate, as well as state population age 18 to 35, population age 18 and appropriations per full-time equivalent enrollee. Standard errors are clustered by institution. TAACCCT = Trade Adjustment Assistance Community College and Career Training.

*$p < .05$. **$p < .01$.

Source. Integrated Postsecondary Education Data System, Census, Bureau of Labor Statistics, Grapevine Survey.

that the increase in vocational completions is driven by sub-associate level completions (i.e., certificates). The coefficient in Column 4 for the 2011 wave suggests that certificate-level completions in CTE-related fields increased by approximately 25%, on average, for colleges receiving grants. The results for the 2012 wave of grantees follow a similar pattern. The pooled estimates in the top panel suggest that receiving a TAACCCT grant had a statistically significant effect on enrollment, completions and vocational completions, particularly at the sub-associate degree level.

The coefficients on the models for later waves of TAACCCT grantees suggest positive growth, in general, in enrollment, completions, and vocational completions, though not statistically significantly differences from the comparison group colleges. It is possible that TAACCCT provided a jump start to the first wave of recipients but that in later years both recipient and non-recipient colleges were experiencing increases in completions in the aftermath of the Great Recession.

In addition to effects on capacity, as measured by enrollment and completions, we are also interested in how TAACCCT affected the quality of programs at colleges that received grants. To make inferences about quality, we explore whether TAACCCT affected spending at institutions receiving grants. First, we explore whether TAACCCT increased the amount of revenue colleges had to spend. Institutions were instructed to report funding received from the ARRA in the total non-operating revenues categories in IPEDS. We also display results for federal nonoperating grants, in case some TAACCCT grants were mistakenly reported in this category. Table 4 displays the effect of receiving a TAACCCT grant, first with effects pooled across the first three waves and then for each of the four waves separately, on revenue and spending variables.

We do not find statistically significant differences in revenue for colleges that received TAACCCT grants, on average, compared to those that did not. This is a bit puzzling though it could mean that, for colleges receiving grants, the TAACCCT money just made up for shortfalls resulting from the recession. It could also mean untreated colleges were benefiting from other post-recession programs so that, because all public 2-year colleges were receiving increases in funding, the schools receiving a TAACCCT grant did not end up with more revenue, on average, than the schools that did not receive these grants. It could also be that the financial

reporting for IPEDS is particularly challenging for schools and prone to delay or other issues. The descriptive plots displayed in Online Appendix B demonstrate that the other revenue and total revenue outcomes are fairly noisy.

The last three columns of Table 4 provide suggestive evidence that public 2-year colleges receiving a TAACCCT grant in 2011 may have increased spending on instruction and academic support compared to colleges that never received one. Community colleges receiving a TAACCCT in 2011 also spent approximately US$64 more on academic support per pupil, on average. These findings are in line with the goals of the TAACCCT program which allowed institutions to hire instructors and develop new curricula and programs that included support staff (Durham et al., 2017). These findings also suggest that receiving a TAACCCT grant may not only have allowed colleges in the first wave to increase capacity, relative to comparison group colleges, but also to improve program quality by providing additional supports to students.

Spillover Effects or Competition With Other Programs

Our third question is whether the effects of TAACCCT vary across field of study. This analysis has two parts. First, we explore whether receiving a grant affected completions in the targeted field of study. We also explore whether receiving TAACCCT funding influenced other programs of study at grant-receiving colleges. On one hand, receiving a large amount of funding for one program could allow a college to increase capacity or quality in another program, if, for example, additional equipment or instructors acquired for one program, could also be used for a related program. On the other hand, funneling resources into one program could draw students away from other programs. To explore this question, we run models in which colleges receiving a TAACCCT grant in a particular subject are compared colleges that never received a grant of this type. We run this model on all subject completion outcomes so we not only explore the effect of receiving a health care–related TAACCCT on health care completions, but also on manufacturing, business, agriculture, IT, construction, and academic completions. Fields of study are defined by CIP codes and the industries targeted by TAACCCT grants are defined by NAICS codes. Table 1 displays a crosswalk between these two coding schemes as well as providing a count of the TAACCCT grants of each industry type. We pool grantees across waves of the program to overcome the problem of small sample sizes.

Figure 3 displays event-study models for field of study outcomes. There are statistically significant differences in trends when comparing manufacturing completions for colleges that received a manufacturing-related TAACCCT grant to those that never received a grant. However, for the other outcomes, there are not statistically significant differences in trends for at least 3 years leading up to treatment. Table 5 displays the results from estimating the effect of receiving a particular type of TAACCCT grant on program-specific, subbaccalaureate completions. Columns 1 through 5 display the results for health care–related fields, manufacturing, business, construction, and IT, respectively. Column 6 displays the effect of receiving a grant on completions in liberal arts. Because of the statistically significant difference in trends, we will not interpret the results of the models for which schools receiving manufacturing-related grants were the treatment group.

Recipients of health, business and IT-related grants experienced statistically significant increases in completions in the targeted field of study, on average. Our results suggest that colleges receiving grants in construction did not experience statistically significant increases in the targeted programs. We find some suggestive evidence of positive spillover effects. For example, colleges receiving business-focused grants also had statistically significant increases in health and IT-related fields of study. However, many colleges received grants in multiple subjects, so it is not clear whether these types of effects across programs would have occurred in the absence of the additional grants. On the other hand, we find no effect of the TAACCCT grants on liberal arts completions at the community colleges in our sample, suggesting that the increases in completions in targeted fields did not occur at the expense of completions in non-technical fields.

TABLE 5

Effect of Receiving a TAACCCT on Completions by Field of Study

	Health total	Manufacturing total	Business total	Construction total	IT total	Liberal arts total
Post × health	0.183***	0.124*	0.097**	0.071	0.298***	0.045
	(0.037)	(0.051)	(0.035)	(0.060)	(0.062)	(0.049)
N	6,373	6,373	6,373	6,373	6,373	6,373
Post × manufacturing	0.123***	0.110*	0.055	0.087	0.184***	0.016
	(0.031)	(0.043)	(0.035)	(0.052)	(0.050)	(0.031)
N	6,871	6,871	6,871	6,871	6,871	6,871
Post × business	0.176***	0.043	0.188***	0.097	0.346***	0.014
	(0.047)	(0.065)	(0.050)	(0.065)	(0.067)	(0.037)
N	5,829	5,829	5,829	5,829	5,829	5,829
Post × construction	0.149	0.169	0.051	0.078	0.196	0.031
	(0.077)	(0.095)	(0.086)	(0.151)	(0.111)	(0.076)
N	4,770	4,770	4,770	4,770	4,770	4,770
Post × IT	0.289**	0.152	0.227*	0.175	0.333**	0.114
	(0.086)	(0.108)	(0.105)	(0.099)	(0.109)	(0.095)
N	4,680	4,680	4,680	4,680	4,680	4,680

Note. All outcomes are log-transformed. In each model, the treatment group comprised public 2-year colleges that received a TAACCCT, and the comparison group comprised public 2-year institutions that never received a TAACCCT grant. Coefficients were estimated using Callaway and Sant'Anna's (2021) approach and the "csdid" commands in Stata (Rios-Avila et al., 2021). All models include institution fixed effects and control for average county wage, unemployment rate, population and poverty rate, as well as state population age 18 to 35, population age 18 and appropriations per full-time equivalent enrollee. Standard errors are clustered by institution. TAACCCT = Trade Adjustment Assistance Community College and Career Training; IT = information technology.

*$p < .05$. **$p < .01$. ***$p < .001$.

Source. Integrated Postsecondary Education Data System, Census, Bureau of Labor Statistics, Grapevine Survey.

Robustness Check

Some community colleges (e.g., in Florida) also offer bachelor's degrees. Because we defined our sample as colleges in the public 2-year sector, we exclude institutions that offer both BAs and shorter credentials. To test whether our estimates are robust to the inclusion of BA-granting community colleges, we redefined our sample to include these institutions and re-ran our models. We do not find that redefining our sample this way has a substantive effect on our findings. These results are available upon request. We also re-ran our models using a comparison group that included both not yet and never treated colleges, as opposed to just never treated. These results are displayed in the Online Appendix. Our estimates are consistent across these different model specifications.

Discussion and Policy Implications

This study makes use of a differences-in-differences approach to estimate the causal effect of increases in funding for vocational education and training provided by the TAACCCT Grant Program. Our results suggest that this program had statistically significant, positive effects on credential completion in vocational fields at public 2-year colleges and that these effects were driven by the earlier waves of funding. When we disaggregate by field of study, we also find evidence that credential completion increased in health, manufacturing, business and IT-related fields of study. Health, manufacturing and IT were among the fields most commonly targeted by the TAACCCT Program.

We have two hypotheses for why the results may be primarily driven by the first wave of the program. First, institutional revenue is not statistically significantly different for grant recipients compared to other colleges. This suggests that community colleges who had not yet received a TAACCCT or who never received one may have been benefiting from other programs at this time. For example, in 2014, Tennessee made a large investment in its community and technical

colleges that benefited many schools that did not receive a TAACCCT. Our second hypothesis is that, as the country pulled itself out of the recession, it may have been harder to recruit and keep students into these types of workforce training programs. Research has demonstrated that, when the economy is bad, students select into career and technical education programs, but when the economy is good seats can be hard to fill.

This study builds on previous literature exploring the relationship between funding and credential completion in higher education (Bound et al., 2010, 2019; Bound & Turner, 2007; Chakrabarti et al., 2020; Deming & Walters, 2017). Although it may seem self-evident that more money will lead to more degrees, how institutions make use of funding mediates the relationship between funding and credential completion (Deming & Walters, 2017). We find that the influx of funding from TAACCCT did increase credential completion in vocational training programs, as the grants program intended. Moreover, we find some evidence that being awarded a TAACCCT grant led colleges to increase spending on academic support, which may have mediated increases in credential completion.

In assessing the national impact of the TAACCCT Program, ideally we would be able to examine the effects on students' labor market outcomes as well as credential completions, but we are limited by our data. An important feature of the TAACCCT Program was that it incentivized institutions to assess local labor markets and collaborate with local industries to make sure training programs were aligned with labor market needs. Engaging in these tasks successfully may benefit all vocational education and training at a community college, not just programs directly funded by TAACCCT. However, anecdotal evidence suggests that these types of collaborations may be difficult to build in the short term. An important question for future research is whether the different institution types that contribute to workforce development (such as colleges, industries, and local economic development agents) were able to successfully collaborate in the interest of improving students' access to local labor markets and industries' access to pool of highly skilled labor. The best way to test this will be to examine the labor market outcomes students in TAACCCT-funded programs and colleges.

Improving career-technical, or vocational, training programs at community colleges has the potential to improve the lives of workers by providing access to living wages, and to improve local economies by creating a pool of workers with up-to-date technical skills. At the same time, technical training programs may put workers in a tenuous position if the industries they are preparing to work in are undergoing continuous changes as a result of rapid technological advancements or international competition. Stackable credentials, which are a series of short credentials which can be combined into a more advanced credential, are one possible solution to this problem but the small amount of evidence to date suggests that stacking is not prevalent (Bailey & Belfield, 2017). It is up to college leaders, educators and policymakers to make sure short credential programs, such as those developed with TAACCCT funds, are a pathway to further education when it becomes necessary for individuals to upskill or that part of these programs of study are general education courses that give students the foundation they need to grow on the job.

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Notes

1. Two pieces of federal legislation, the Workforce Innovation and Opportunity Act (WIOA) and the Perkins Act, include provisions that shape vocational training programs at community colleges. The WIOA incentivizes coordination across agencies in developing programs that meet local employers' needs, emphasizing training that leads to industry-recognized credentials, and in developing career pathways (Heinrich, 2015). The reauthorization of Perkins in 2012 called for "more effective alignment of CTE with labor market needs and high-growth industry sectors" and "stronger collaboration among . . . postsecondary institutions, employers and industry partners" (Dortch, 2012, p. 1).

2. We use the Grapevine Survey for data on state appropriations for higher education, which we use as a covariate in our models.

3. This study focuses on credentials that require 2 years or less of full-time study. IPEDS divides these credentials into three categories: associate degrees that take at 2 years of full-time study to complete, long certificates that take at least 1 but less than 2 years of full-time study to complete, and short certificates, which take less than 1 year of full-time study to complete. When reporting results for sub-associate level completions, we combine short and long certificates.

4. We used the CIP codes in the IPEDS completion data to define the field of study of credentials and based our classification of "vocational" loosely on previous literature, such as Stevens et al. (2015).

5. Per-pupil spending variables are calculated by dividing by 2010 full-time equivalent enrollment.

6. Throughout our analyses, we consistently find larger effects on completions than enrollments. We believe the discrepancy between enrollment and completion estimates is a result of the fact that the enrollment outcome is enrollment for the whole institution (not just the vocational programs), whereas the completion outcomes are just for the vocational programs. So there could be small increases in enrollment that lead to larger increases in completions if the new enrollments are mostly going to the vocational programs that were the target of the Trade Adjustment Assistance Community College and Career Training grants.

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