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The Landscape of Short-Term Certificate Programs Across Local Labor Markets

Sophie McGuinness
Vanderbilt University

Short-term certificate (STC) programs at community colleges represent a longstanding policy priority to align accelerated postsecondary credentials with job opportunities in local labor markets. Despite large investments in developing STCs, little evidence exists about where and when STCs are opened, and whether community colleges open new programs of study in coordination with labor market trends. Using public workforce and postsecondary data, I examine health and manufacturing STC program openings to understand the conditions in which STCs are launched and whether the timing of program openings correspond with labor market activity in related industries. I find that STCs are spatially aligned across labor markets within a state, but not necessarily temporally aligned with county-specific trends. One additional STC per college is associated with labor markets that had 2-3% more employment and 4-6% greater share of employment in related industry.

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Sophie McGuinness

sophie.e.mcguinness@vanderbilt.edu

Vanderbilt University, Nashville TN

ORCID: 0009-0007-4814-6171

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Abstract

Short-term certificate (STC) programs at community colleges represent a longstanding policy priority to align accelerated postsecondary credentials with job opportunities in local labor markets. Despite large investments in developing STCs, little evidence exists about where and when STCs are opened and whether community colleges open new programs of study in coordination with labor market trends. Using public workforce and postsecondary data, I examine health and manufacturing STC program openings to understand the conditions in which STCs are launched and whether the timing of program openings corresponds with labor market activity in related industries. I find that STCs are spatially aligned across labor markets within a state, but not necessarily temporally aligned with county-specific trends. One additional STC per college is associated with labor markets that had 2-3% more employment and 4-6% greater share of employment in related industries.

Keywords: community colleges, workforce, short-term certificates, labor market alignment, adult students

Introduction

Short-term certificate (STC) programs at community colleges provide accelerated pathways to careers at the sub-associate degree level. Federal and state investments have supported the expansion of STC programs to increase educational attainment and fill mid-skill job openings (Eyester et. al., 2014; Soliz & Ecton, 2021), and STC programs now make up 44% of all community college completions (Author's analysis, IPEDS 2019). STCs can be completed in 15 months or less and provide bridges to local employment while still offering a transferable credit-bearing credential. STCs in certain fields of study have shown evidence of positive earnings gains for individuals (Dadgar & Trimble, 2015; Stevens et al., 2019; Xu & Trimble, 2016). Labor-market alignment of postsecondary programs is a particular priority in rural areas, where federal and state efforts have been targeted to address rural outmigration and gaps in postsecondary attainment. (McGranahan et. al., 2010; Lowe & Wolf-Powers, 2018). This study examines how health and manufacturing STC programs are distributed across regions and according to local labor market trends, measured through longer-term relationships between economic indicators and educational supply, as well as in the timing of a large launch of multiple new STCs.

Coordinating community college programs with industry demand could improve individual outcomes as well as address broader economic trends in worker shortages. The supply of STCs informs how college supply adapts to a rapidly changing economy with decreasing employment for those without postsecondary education (Carnevale et. al., 2016). Record worker shortages post-pandemic, driven in part by an increase in retiring among skilled workers, make questions about worker supply more urgent (Penn & Huang, 2023). Prior research has focused on whether community students sort into high-vacancy fields, finding loose alignment between

major selection and labor market trends (Baker et. al., 2018; Grosz, 2020; Acton, 2021; Sublett & Tovar, 2021). However, work focused on individual major selection can take access to navigable and affordable college pathways as a given, a key omission with respect to community colleges whose unique funding constraints can limit expanding or adapting programs (National Academies of Sciences, Engineering, and Medicine, 2017). The only causal study examining community college course offerings and faculty investments in California finds no connection between institution-level investments in faculty and course sections and labor market trends (Grosz, 2022), further motivating the need for a national descriptive examination of the distribution of career-aligned postsecondary programs.

I study the supply of community college health and manufacturing STC programs to understand how access varies spatially and according to local labor market conditions. I offer insight into the definition of "local" alignment by examining alignment at the state, commuting zone, and county-levels. Linking national data on higher education enrollments and graduation from the Integrated Postsecondary Education Data System (IPEDS), to quarterly earnings, new hires, and total employment from the U.S. Census Quarterly Workforce Indicators (QWI), I employ a fixed effects model design to understand how program offerings relate to trends in labor market indicators and a comparative interrupted time series analysis of the timing of major STC program launches.

Returns to Short-Term Certificates

Investments in STCs at community colleges can both raise individual earnings through educational attainment and support community-level local industry through workforce training (Lowe, 2007; Lowe & Wolf-Powers, 2018; Sher, 2023). Selecting a field of study aligned to

high-growth, high-wage careers has enormous consequences for later-life earnings outcomes, a choice found to be more important than picking an institution and even the decision to enroll in college at all (Altonji et. al., 2012; Kirkeboen et. al., 2016). While much literature has focused on the bachelor's degree-level, returns vary widely by field of study at the associate and sub-associate degree level as well. Studies using individual-level fixed effects designs that measure change in earnings conditional on pre- and post-enrollment earnings find that the return to an associate's degree in nursing or STEM can be as great as 30 percentage points while those in other fields provide little or no return (Stevens et. al., 2015; Dadgar and Trimble, 2015). Similarly, returns to sub-associate STC programs in allied health and manufacturing credentials have been found to be up to 16 percentage points (Xu & Trimble, 2016), but lower or even negative returns in areas like cosmetology (Dadgar & Trimble 2015; Minaya & Scott-Clayton, 2020). The strong individual earnings returns for certain STCs signal the potential for STCs to contribute to broader workforce development agendas.

Despite the importance of college major selection on later earnings outcomes, little work has documented variance in access to high-return degree pathways across colleges. In a study of California Community Colleges, Grosz (2022) finds that colleges did not apportion increases in faculty FTEs or course-sections according to changes in occupational shares of employment, but students increase their share of completions by .49 percentage points for every 1 percentage point increase in occupational share. Using a shift-share instrumental variables approach, the author disentangles a causal effect of labor market changes on institutional response separately from shifts in student demand. This study is advantaged by access to detailed records on course sections and college FTE spending, which capture a broader institutional response than will be observable using IPEDS data. However, new course sections with modified certificate lengths or

sub-specialties would appear in IPEDS. The limited institutional response identified in Grosz's (2022) study is further motivation for a national landscape analysis of institutional alignment in the form of STC availability.

A few high-quality case studies in specific states have documented the results of state investments in improving the connection between community colleges and labor markets through STCs. In interviews with community college leaders across Tennessee, Soliz et. al. (2023) find that state funding through the Labor Education Alignment Program (LEAP) increases cross-sectoral collaboration between colleges and workforce development agencies. Authors find that LEAP funding for new STC programs also led colleges to establish work-based learning programs, receive new equipment, and revise curricula based on employer partnerships. Finally, researchers in North Carolina found that state support for community college training programs increased employer engagement, leading some firms to recruit additional life sciences manufacturers to the area to increase the overall level of training support they could receive from the state (Lowe & Wolf-Powers, 2007). These case studies highlight states that have funded new STCs as a lever to promote broader alignment between colleges and local labor markets.

STCs and Regional Workforce Development

Over the past decade, federal and state policymakers have favored "localized" community college policies that emphasize bolstering local economies through postsecondary attainment. Major legislative priorities have sought to, in the words of Education Secretary Miguel Cardona, "create pathways for students to find rewarding careers that do not require them to leave their hometowns for economic opportunity" (White House, 2023). Funding through the Carl D. Perkins Act, which funds the majority of secondary and postsecondary CTE in the U.S.,

was reauthorized to include labor-market alignment as a grantee requirement (Granovskiy, 2018; Atwell et. al, 2022). In the 2010s, the federal government made major investments in STC infrastructure through the Trade Adjustment Assistance Community College and Career Training grant program, which funded 2,000 new or enhanced labor-market aligned STC programs at half of all U.S. community colleges (Mikelson et. al., 2017). States have funded major "grow your own" initiatives as well, with high profile investments in career-aligned community college programs including the Tennessee LEAP, Kentucky Works!, and ReadySC in South Carolina. Nationwide, the push for using community colleges to confer credentials that expand individual- and community-level economic wellbeing has made a systematic understanding of access to STCs a key gap in understanding the modern postsecondary landscape.

The proliferation of support for labor market-aligned postsecondary policy arose against the backdrop of economic turbulence after the Great Recession as long-standing trends in globalization and technological change. The manufacturing industry in particular has undergone rapid skills changes and decline in opportunities for workers with no college credential (Carnevale et. al., 2016). Manufacturing has seen a decline in vertically-integrated enterprises in favor of companies that are leaner and "asset light" (Change & Andreoni, 2020). Firms are less likely to house production activities or make investment in training or upskilling the manufacturing workforce. This change in industry organization has contributed to offshoring, while making domestic hiring more difficult due to reduced investment in training and employee pipeline (Change & Andreoni, 2020). In a survey of thousands of manufacturing firms in the U.S., Locke & Wellhausen (2014) found that 20% of small to medium sized manufacturers had long-term job vacancies lasting over 3 months. They identified that jobs with skills not generally available in the firm's region were the most difficult to fill, and companies with better

connections to regional schools tended to have fewer hiring issues. Post-recession investments in manufacturing STCs were poised to retain domestic manufacturing amidst firm divestment in skilled worker pipelines.

Macro-economic trends in employment and skilled worker pipelines have shifted postsecondary policy, particularly in the community college setting, to favor accelerated and labor market aligned programs. In this analysis, I show that STC programs have proliferated in number and share of 2-year college completions alongside shifting discourse around the role of community colleges. Using STC program offerings as an indicator of community college adaptability to updating or expanding programs according to industry change, I offer a national perspective on this new form of college access.

Rural STCs

Today, technical certificate completions represent 47% of completions at rural colleges, compared with 41% at non-rural community colleges (Author's calculation: IPEDS 2019). Rural students graduate from high school at higher rates but are less likely to enroll in college at comparable rates to their urban peers (Schafft & Jackson 2010). Rural areas tend to face issues with positive perception of college by young people and their families, who can be wary of the relevance of postsecondary credentials to local opportunities (Corbett 2016). Postsecondary attainment has been linked to rural outmigration, driven by rural graduates moving to areas where returns to education are higher (McGranahan, et. al., 2010; Chen and Zerquera 2018). Rural economies must also adapt to large-scale changes in technology and globalization in ways that are similar to urban economies, but at times with fewer resources and infrastructure to

provide for this flexibility (Laughlin 2016). STCs have programmatic aspects that may relieve some of these rural challenges by creating direct paths from education to local employment.

Additionally, STCs may be of particular importance for rural economies for whom manufacturing sectors are greater sources of employment (Low, 2017). Though manufacturing employment is far below historical levels, it has experienced a modest rebound over the past decade with about 1 million new jobs added since 2010, the longest period of job increases in manufacturing since the 1970s (Abel & Deitz, 2019). "Reshoring" of manufacturing jobs in the transportation sector is driving the majority of job growth, and is especially impactful for jobs in the motor vehicle production corridor in the Midwest and South (Snell, 2019). A small body of literature has examined the role of postsecondary education in this increase in domestic production, noting that curricula have been updated to reflect advancements in manufacturing technology (Jackson, 2015; Lowe & Wolf-Powers, 2018; Snell, 2019). Due to the unique economic and postsecondary context, I conduct a sub-analysis by rural counties to understand differences in alignment between education and the labor market by locality.

Data & Treatment Identification

This analysis leverages public IPEDS and U.S. Census Quarterly Workforce Indicators (QWI) from 2005-2019 to construct a national county-level panel of community college program offerings and county-level workforce indicators. I focus on health and manufacturing STC programs because they are the largest, together accounting for 40% of all community college degree completions on average, and because of the relative ease of linking these two fields of study to related industry. Many postsecondary programs train for *occupations* which can be nested within and across *industry.* Occupational classifications have hundreds of categories that

can become unwieldy for use in studying job growth and economic change (IPUMS, 2023). I therefore simplify my analysis by focusing on the largest two fields of study and relating them to labor market signals from health and manufacturing industries.

STCs offered per college are defined as the count of unique 6-digit CIP codes and sub-associate certificate-level combinations. Programs in IPEDS completions files are defined as credit-bearing pathways toward degrees or certificates, which are classified using "classification of instructional programs" (CIP) codes.[i] STCs are reported as short certificates, which can be completed one year, and long certificates, those that can be completed in over one year but less than two. CIP codes are reported by individual college administrators at three levels of specificity, with the 2-digit series representing the broadest area of study, 4-digit series consisting of programs with similar content and objectives, and 6-digit series representing specific instructional programs (NCES 2010). IPEDS reports CIP codes upon program completion, meaning that I will not observe STCs launched that never had enrollees. I might observe a false new STC if an STC reappears in the data after a period of zero program enrollment. I account for this scenario by testing robustness of results to new STCs not previously offered by the college.

Labor market outcomes are derived from U.S. Census Quarterly Workforce Indicators (QWI), sourced from a federal-state data sharing agreement covering 95% of private employers known as the Longitudinal Employer-Household Dynamics (LEHD) microdata. I use the following variables: new hires (who retained employment for at least one quarter), average monthly earnings of new hires, total firm job gains, and total industry employment. Firm job gains complement new hires to account for typical employee turnover that may artificially raise the count of new hires. I use these variables for all employees and for "some college" employees

with an associate's, certificates, or some college coursework. I use manufacturing (NAICS code 31-33) and health (NAICS code 62) industries to correspond with the higher education programs of interest. Rural counties are defined using 2015 County Typology Codes from the U.S. Department of Agriculture.

Table 1 describes the counties used in the sample that offer at least one STC in either health and/or advanced-manufacturing (CIP 51 (Health Professions), 48 (Precision Production), 47 (Mechanic and Repair Technologies) and 15 (Engineering Technologies)). On average, counties have about one community college offering 6-10 STCs in manufacturing and/or health.

Empirical Strategy

I use both a fixed effects framework and a comparative interrupted time series (CITS) design to study the relationship between STC offerings and related industry workforce trends. I first examine whether the number of STCs offered trend positively with labor market indicators holding constant annual, state, and county characteristics separately. I then test how large STC program launches are timed with local labor markets. I model outcomes for manufacturing and health pathways individually.

In the fixed effects model approach, I layer in controls for increasingly specific levels of geography to show how alignment between STCs and the labor market varies over time and space. The fixed effects framework allows me to control for all fixed characteristics associated with states, commuting zones and counties. I use controls for county-level unemployment, population, and calendar year fixed effects in all models. The most saturated county-level fixed effects model will absorb all spatial variation between STC offerings and the labor market, leaving only the relationship between STCs and near-term coordination with county-specific

trends. This model will provide the most information on whether colleges appear to adapt to hyper-local trends such as firm relocation or plant closures but will miss spatial alignment between STCs and variation in regional labor markets across the state or commuting zones. Results are presented across fixed effects model specifications to understand various components of coordination between colleges and labor markets.

I estimate the following equation:

$$Y_{rt} = \alpha + \beta_{rt}STC + W_r + \gamma_r + \theta_t + \varepsilon_{rt} \quad (1)$$

Where Y_{rt} are workforce indicators in county r in year t. $\beta_{rt}STC$ are the total number of unique short-term award levels and 6-digit CIP codes offered across all colleges in county r in year t. W_r represents annual county population, γ_r are fixed effects for geography, which are specified as state, communing zone and county respectively. θ_t are year level fixed effects ε_{rt} represents the random error term clustered at the county level. I fit this model separately by industry, rural and non-rural counties. Because it may be unreasonable to expect community colleges to respond to immediate-term changes in labor market activity, I test whether alignment of STCs with labor market signals varies when labor market signals are lagged up to 5-years prior to program opening.

The CITS model is designed to account for the frequent funding of new STC programs through legislative grant and bond passage by estimating economic conditions before and after infrastructural STC investments were made. The CITS design offers another way to understand alignment between colleges and the labor market by focusing specifically on timing and viewing large program rollouts in the context of county-level trends. In this framework, I compare

county-level labor market indicators for a given college in the years leading up to and after a large program launch. I model:

$$Y_{rt} = \beta_0 + \beta_1 PostSTC + \beta_1 PostSTC * TrtPeriod + \delta_r + \theta_t + \varepsilon_{rt} \quad (2)$$

Where Y_{rt} is an outcome for a given county r at time t. $\beta_1 PostSTC * TrtPeriod$ are a series of indicators for the difference in labor market trends for each year relative to the post-STC launch. δ_r are county-level fixed effects, and θ_t are year-level fixed effects. Standard errors are clustered at the county-level. This model is fit separately by industry, rural and non-rural counties.

To mitigate the possibility that a singular definition of "large program launch" drives results, I test three other potential treatment definitions: b) the largest sustained increase in STCs with a net increase in total STC graduates, c) the largest sustained increase in 6-digit CIP STCs that were never previously offered by a college, and d) the largest sustained increase in STCs that led to at least 20% more STCs than in prior years. Because new program codes appear in IPEDS upon completion, I adjust program start year based on program length (1 year for short STCs and 2 years for long STCs). Figure 3 shows total completions and total STCs offered at the year of large program launch, across the four definitions of launch year. In panel A for example, I show that colleges had an average of 25 additional graduates in manufacturing and 40 additional graduates in health in the treatment year. Colleges offered an average of 3 additional STCs in the year of large program launch. These increases remained for up to 4 years after the treatment year.

Findings

I begin by describing STC completions and college offerings by geography and over time. I then present fixed-effects model estimates of STC and labor market alignment across increasingly specific geographies. I discuss differences in alignment among rural and urban counties using the preferred state-level fixed effects model specification. Finally, I present results from the CITS analysis of large program launches.

Trends in STC Program offerings

Figure 1 shows that STC completions have increased over time, as have the prevalence of STCs offered by community colleges. STCs in technical engineering and advanced manufacturing have experienced gains in completion, with the overall number of completers doubling since 2005. Health STCs grew by 40% from 2005 to 2010 but have since tapered off in slightly in total completions. Figure 2 maps the landscape of colleges offering STCs, with color coding for total change in manufacturing and health industry employment from 2010 to 2019. This figure highlights regional differences in employment growth in health and manufacturing, with the "auto-corridor" stretching from the Midwest to the South showing most of the growth in manufacturing jobs and population centers across the nation showing growth in health industries. Figure A2 shows that counties in the top-quartile of STC offerings also have the highest number of new hires in corresponding industry. The average number of STCs is shown in the blue bar graphs, and trends in new hires is shown in the orange line plot.

Figure A1 shows that rural colleges have more completions in short-term certificate programs as a percentage of overall completions than the average non-rural public college. Engineering tech STCs make up 13% of all rural and 7% of all non-rural community college completions. Health STCs have made up close to 15% of all rural completions since 2005, with

some decline beginning in 2011. Health STCs have declined both overall and as a percentage of overall completions in non-rural areas from 13% in 2010 to 9% in 2019. These trends could suggest an emphasis on STC investment over associate's degree programs in rural areas, but could also signal a greater preference or demand for STC by rural students over non-rural peers.

Descriptive Estimates – Spatial vs. Temporal Alignment

Column 1 in Table 2 shows that one additional STC program in manufacturing is associated with 3.5% more net job gains in manufacturing industries, and one additional health program is associated with a 4.3% net gain in health jobs. Estimates are similar for total new hires and total employed in industry but were near zero for the earnings of new hires. Estimates were partially explained by the addition of controls for county population, unemployment, annual-fixed effects, and state-level fixed in columns shown in columns 2 through 4. The inclusion of commuting zone fixed effects (column 5) explained some of the coefficient of interest, with one additional STC within-commuting zone was associated with about a 1.7% and 1.8% increase in job gains in manufacturing and health respectively.

County-level fixed effects explained nearly all the association between STCs and labor market outcomes, indicating that STCs are not offered according to marginal changes in county-level new hires after accounting for all time-invariant county characteristics. All county-level fixed effects estimates were precise nulls, except for percent employed in health, in which an additional STC was associated with a one-percent increase in health share of employment. An additional manufacturing STC was associated with a 1% decline in county-level manufacturing job gains. Results from this analysis suggest that college and labor market alignment is explained more by spatial distribution of STC programs than temporal differences in employment. Table

A1 shows that coordination between STCs and labor market indicators does not improve with the inclusion of lagged labor market data up to 5-years. Using county-level fixed effects models, I find precise null or near-null estimates across all lagged time periods.

Figure 4 displays the same estimates from the model with state fixed effects and controls for county population and unemployment (shown in Table 2 Column 4) disaggregated by rural and non-rural counties. Manufacturing STC openings in rural counties had a stronger association with labor market indicators than those opened in non-rural counties. Each additional manufacturing STC is associated with 2.3% more new hires in rural counites and 1% more new hires in non-rural counites. Manufacturing STCs added in rural counties were more strongly associated with other labor market indicators, like total employment (3%) and percentage of population employed in manufacturing (7%). Health STCs were more strongly associated with local labor market indicators, with each additional program associated with 3% more new hires with some college but no BA, and 2.8% more total employment in health industry. STCs were associated with non-rural regions who had 9.5% greater shares of employment in health.

The hexplot in Figure A3 further investigates the spatial relationship by examining whether there were more counites with high employment and low STCs (access barriers) or counties with low employment but high STC availability (alignment barriers). The plot shows total STCs offered in counties classified from high and low total industry employment and STC availability. Perfect alignment in this figure would be represented by concentration in the upper right-hand quadrant if all high STC counties were also high employment counties. Concentration in the upper left-hand quadrant would indicate access barriers, and in the lower right, alignment barriers. I find that there are more access barriers to manufacturing STCs, in which there are several high-employment manufacturing counties that have low STC availability. I detect

slightly more alignment issues in health STC availability, with many top STC counties being in regions with relatively lower health opportunities.

Descriptive Estimates – Timing of Large Program Launch

Figure 5 shows that large program launches in rural areas occurred before periods of growth in the earnings of new hires with some college (but no BA) in both health and manufacturing industry. Each point in Figure 5 compares county-level labor market statistics in each period relative to the year of the single largest, sustained program launch. Figure 5 Panel A shows that large program launches in health occur after periods of steady county-specific hiring rates and before periods of increases of up to 6% in county-specific hiring in rural counties. I find that manufacturing STC program launches occur after periods of steady or slight declines in total employment, and, in rural counties, before periods of employment decline of 10-15%. Panel B shows similar patterns in the coordination between large program launches and total employment. Panel C shows that rural health and manufacturing programs tend to be launched during periods of growth of earnings for new hires. Earnings grew by about 9% before a large program launch and continued to grow by 12% in the four years following the launch.

I test the robustness of the large program launch results across three additional treatment year definitions. Appendix Figure 4 shows that these results were consistent across varying definitions of STC program launch treatment years, though the association between rural health launches and subsequent increase in new hires was only found under treatment definition (2), or the largest program launch with some increase in net graduates.

Discussion

Counties with more new hires, job gains and higher earnings in manufacturing and health industries have greater overall access to STC programs in related industries at public community colleges, even after accounting for state-level fixed effects and trends in population and unemployment. Given the insensitivity of these estimates to controls, any omitted variables bias due to uncontrolled differences is likely minimal. This reflects spatial alignment between college STC offerings and local labor market opportunities, measured through total employment, new hires and net job gains overall and for individuals with some college below a bachelor's degree. Counties with one additional STC had an average of 3% more health employment and 2% more manufacturing employment. Further examination into why spatial alignment in manufacturing was lower than health found that counties with concentrated STC offerings had high levels of employment, but not all high employment counties had a concentration of STCs. For example, counties with top decile manufacturing employment per capita for workers with some college, but bottom decile concentration of STCs, included Minneapolis (Hennepin County) Minnesota, Baltimore Maryland, and Lehigh Pennsylvania.

STCs were not associated with to county-specific labor market trends. These findings are consistent with prior literature on the constraints community colleges trying to innovate or offer new instructional programs. Grosz (2019) found that community colleges could expand seats in existing nursing programs but did not expand the number or type of sections offered. The lack of shared trends between county-specific trends and STCs does not necessarily signal a disconnect between community colleges and counties. Non-credit degree programs are increasingly common at community colleges and often serve workforce development roles like worker retraining and employer engagement (Erwin, 2015; Van Noy & Hughes, 2022; Ullrich, 2023). There are an estimated 5 million students enrolled in non-credit programs (AACC, 2016) under

the umbrella of continuing education, community education, and contracted training (D'Amico, 2017; Erwin, 2019). STCs do offer advantages to non-credit programs by offering workers a transferable credential but can be more cumbersome to establish. Future research and data collection on non-degree programs could offer more insight into the landscape of community colleges and workforce development.

Assuming that some state or federal momentum for expanding community college capacity is needed to lead to the formation of new STCs, I test the extent to which discontinuous large program launches correspond with county-specific labor market trends. I reveal the economic climate surrounding the four years leading up to and following a large launch. In general, launch years were not systematically different from non-launch years in both health and manufacturing in non-rural counties. In rural counties, I find that STCs with some increase in net total graduates launched before periods of growth in health in rural counties. Large launches in rural manufacturing STCs appeared to follow periods of decline in manufacturing employment and come before a decrease in employment stabilizing at around 10 percentage points. This could reflect STC launches being used to retrain unemployed workers or in an attempt to attract new employers during times of decline.

Conclusion

Aligning postsecondary career and technical education with local labor markets is a top policy priority, but little research has documented the extent to which alignment takes place nor defined the geographic labor market regions in which colleges prioritize alignment. I show that community colleges respond to long standing regional economic characteristics by concentrating STCs in counties with higher employment, hires, and net job gains in corresponding industry. I

do not find evidence that STC offerings follow county-specific near-term workforce trends, therefore showing that community colleges are more likely to be spatially, rather than temporally, aligned with local labor markets. Health STCs were more geographically aligned than manufacturing, with one additional STC offered corresponding with 3.5% more new hires with some college below the bachelor's degree. Colleges in rural counties were more spatially aligned between STC offerings and related industry, which could reflect a more careful use of resources (i.e., expanding STCs only in areas of strong industry presence). In both rural and non-rural counties, county-specific labor market trends were not closely tied to new STCs.

Coordination between community colleges and the workforce may mean that colleges offer a greater selection of STCs as industries grow to help train workers for high-demand jobs. However, it may also mean that colleges open new STCs during periods of industry decline to help attract new employers to relocate to an area, or to provide displaced workers with re-training in a different sub-field. My analysis of large program launches suggests that both strategies are likely adopted by community colleges, with large launches in health corresponding with some industry growth and in manufacturing with stagnation or decline, at least for four years after program offering. Future research on how individual earnings returns to completing an STC vary according to employment opportunities in local labor markets could shed light on the extent to which alignment influences earnings or probability of employment.

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Tables & Figures

Figure 1. Top 5 Short-term certificate program completions and availability over time

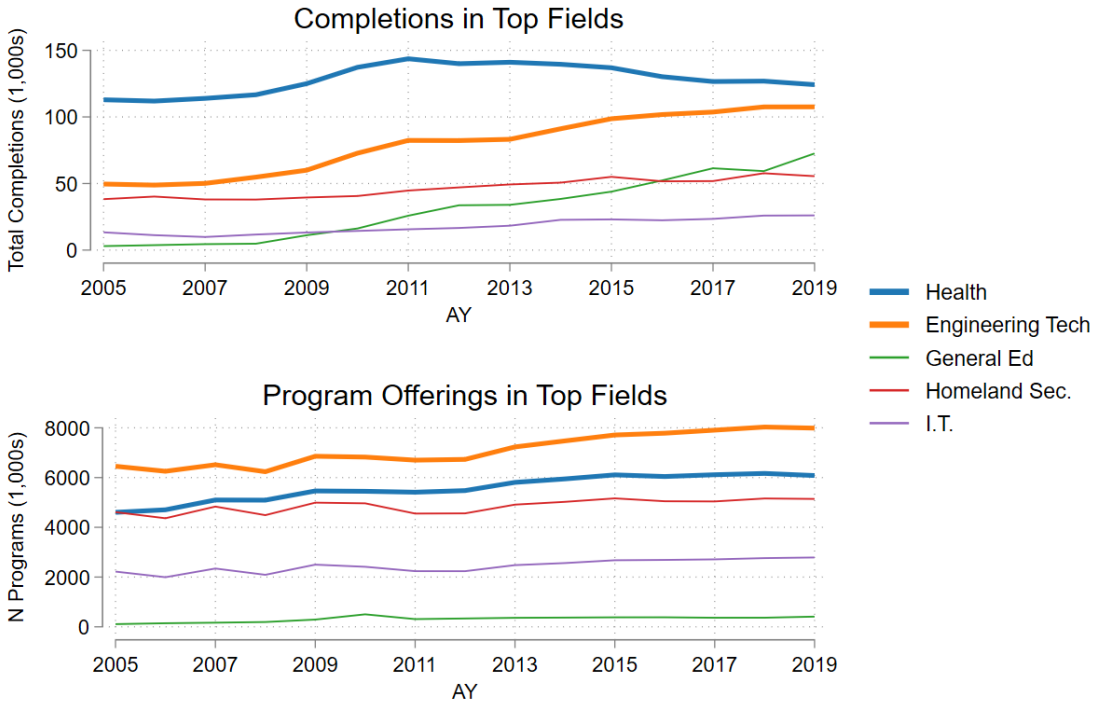


Figure Notes: Source: IPEDS completion files. Notes: Top 5 STC ranking based on total 2019 completions. Program count is the sum of unique 6-digit CIP code and sub-associate award-level combinations offered across all community colleges

Figure 2. Regional changes in industry employment and short-term certificate program offerings, 2010-2019

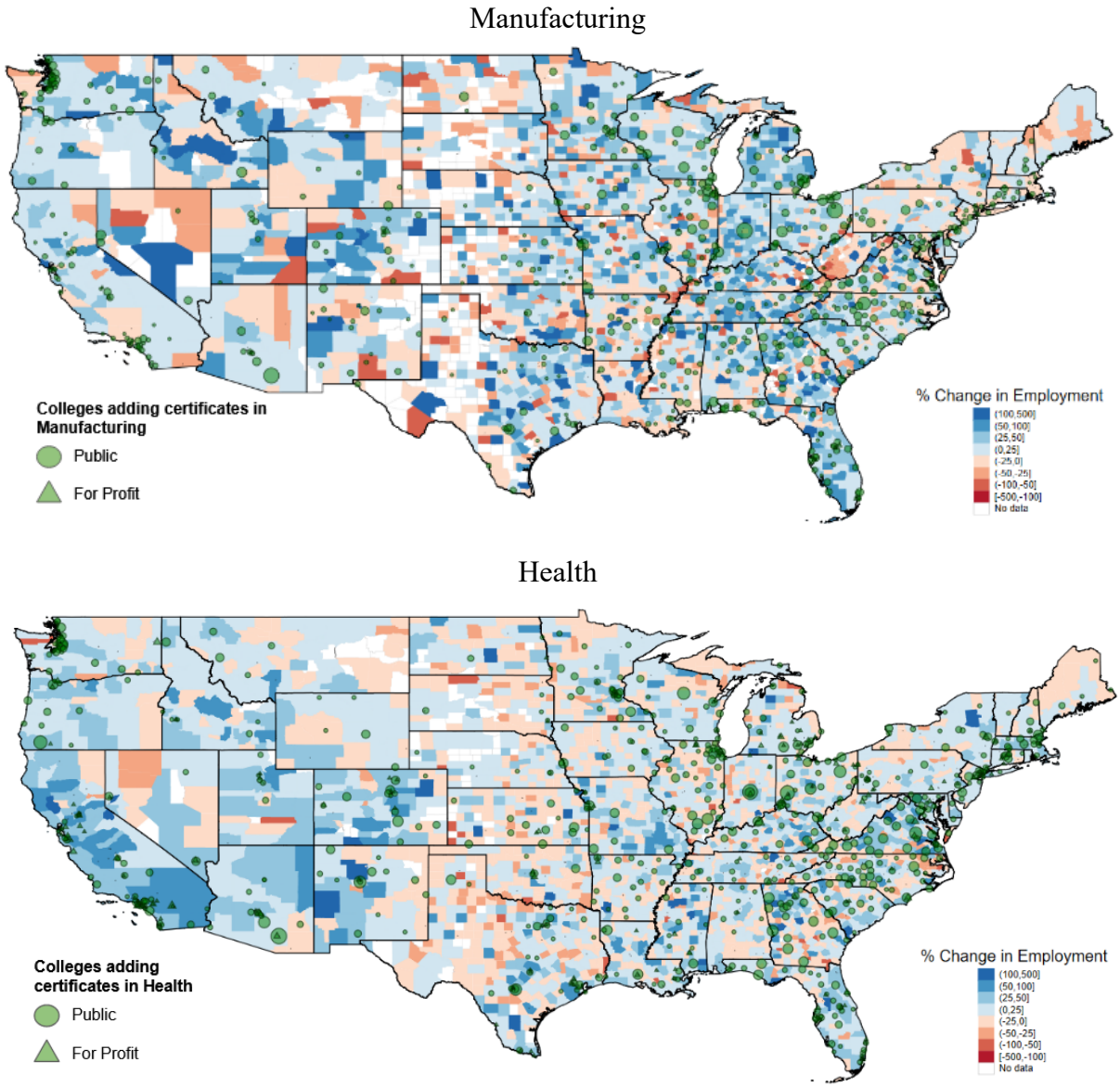
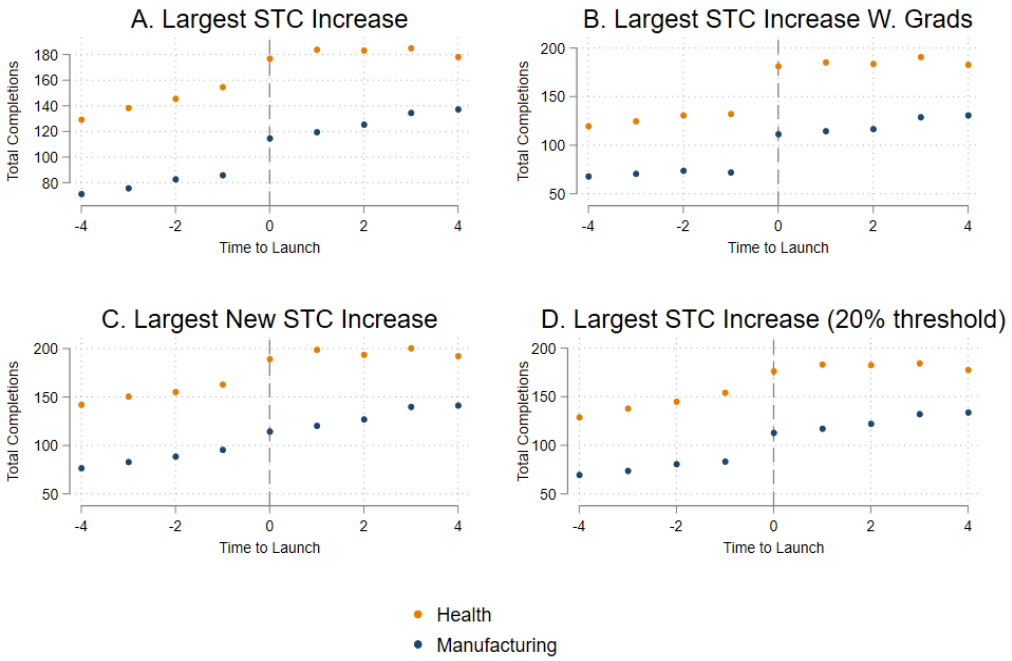


Figure Notes: shading represents county-level percentage change in number employed in health & manufacturing sectors from 2010-2019. Points represent colleges adding new award levels or sub-programs of study within health & manufacturing departments. Size of point is relative to the number of new programming options added between 2010-2019. Employment data are from QWI; postsecondary data from IPEDS.

Figure 3. Validation of program opening treatment year: Total short-term certificate completions by time to treatment year

a) Total Completions



b) Total STCs

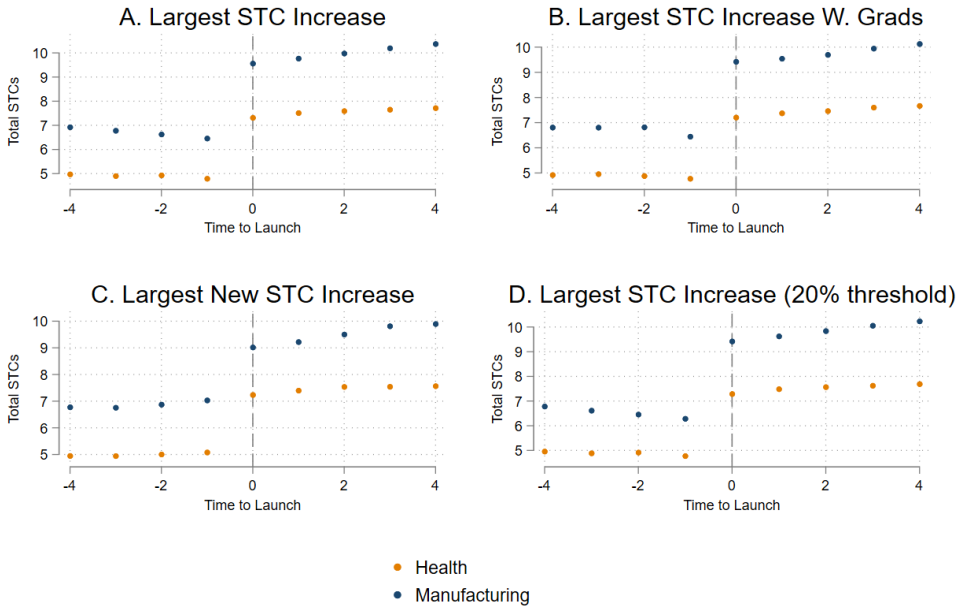


Figure Notes: Treatment year is defined as the largest single sustained net increase in new short-term certs awarded in a county. Horizontal axis represents time to treatment year. Vertical axis represents total county completions in health or manufacturing short-term certificates.

Figure 4. Relationship between labor market indicators and STC offerings, under model with State fixed effects

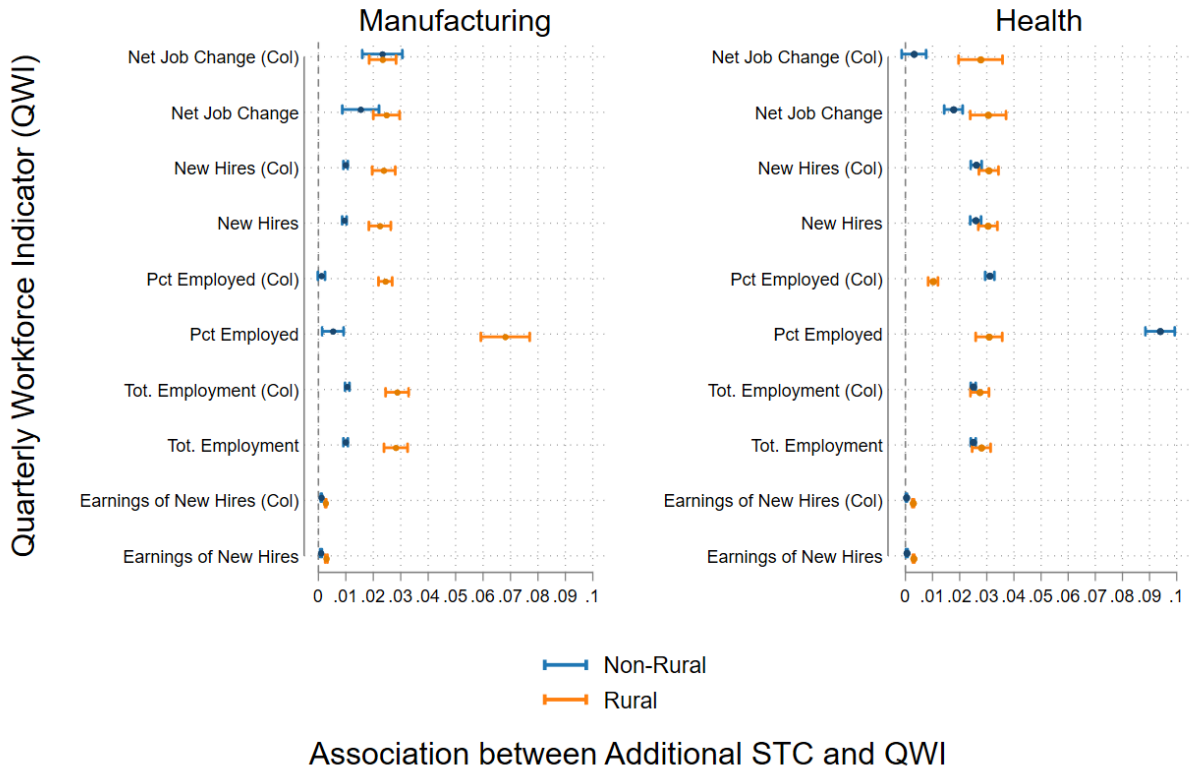
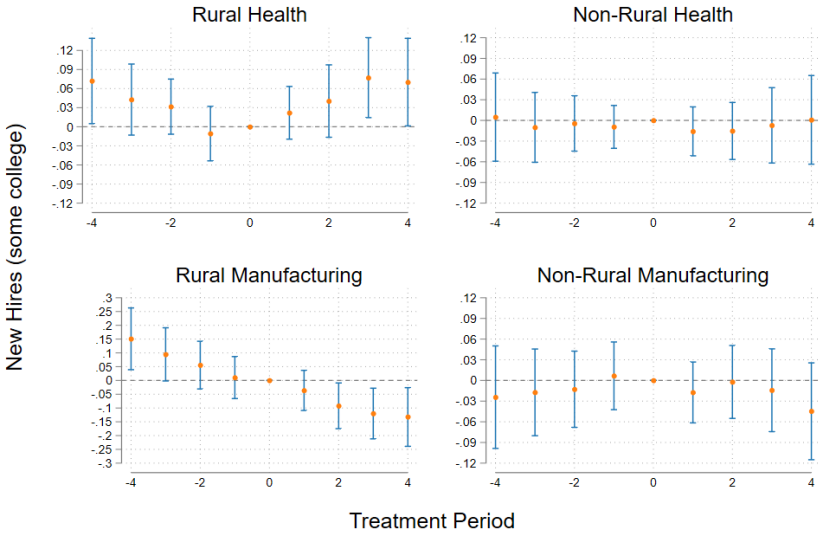


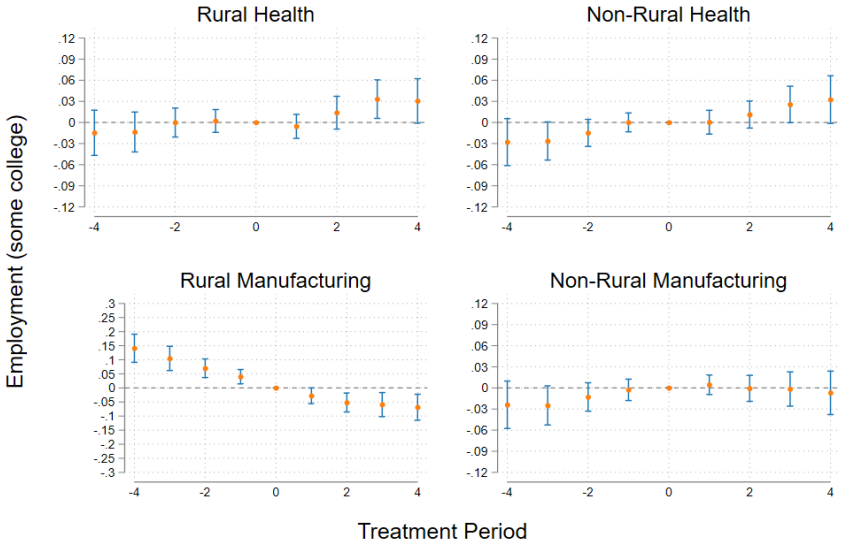
Figure Notes: Estimates from state level fixed effects model of the association between QWI and STCs in non-rural and rural counties, adjusted for baseline state-characteristics, total population, and unemployment rates. "Col" indicates QWI for workers with some college (incl. Associate's or Certificates) but no Bachelor's degree. All outcomes log transformed except Percent Employed outcomes.

Figure 5. CITS Model Estimates: Timing of STC program launch with new industry hires, total employment and earnings of new hires, all with some college (AA or below)

A) New Hires (some college)



B) Total Employment (some college)



C) Earnings of New Hires (some college)

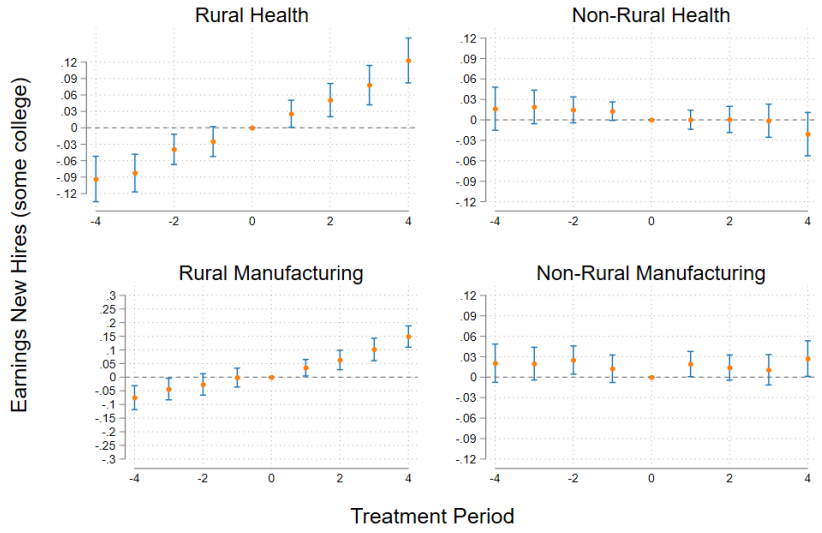


Figure Notes: Comparative interrupted time series (CITS) plots of the relationship between new hires by time to large program launch for all counties and rural counties. Trends adjusted for baseline county-characteristics, total population, and unemployment rates. Model specification (2) largest launch conditional on net positive graduates.

Table 1. Description of the sample: U.S. counties with colleges offering short-term certificates in manufacturing or health

	All Counties		Rural Counties	
	Manufacturing	Health	Manufacturing	Health
County characteristics	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Avg. Total Public 2-YR Colleges	1.23	1.24	1.11	1.12
	(1.21)	(1.20)	(0.67)	(0.66)
Avg. Total STC Programs	10.74	8.11	8.36	6.21
	(11.03)	(8.16)	(6.36)	(5.12)
Largest Program Increase	4.86	4.78	3.99	3.91
	(5.04)	(5.00)	(3.44)	(3.40)
Annual New Programs	0.50	0.29	0.41	0.24
	(2.00)	(1.56)	(1.71)	(1.12)
N Graduates	137.59	182.23	89.19	117.71
	(224.09)	(294.84)	(153.00)	(160.62)
Population	287,239	290,056	112,221	107,919
	(635,865)	(635,844)	(320,438)	(314,075)
County Employment				
Total Employment	10,957	19,031	4,492	6,016
	(23,750)	(41,711)	(10,333)	(17,674)
New Hires	3,381	8,373	1,553	2,749
	(6,932)	(18,141)	(3,693)	(8,879)
Quarterly Earnings of New Hires (2021 USD)	$ 3,742.31	$ 2,743.81	3,371.90	2,579.87
	$ (1,306.78)	$ (465.93)	(1,257.06)	(449.28)
N Counties	663	679	382	390

Table Notes: 2015 characteristics of counties with at least one public 2-year college offering health or manufacturing short-term certificates. Source: IPEDS and Census LEHD.

Table 2. Relationship Between STCs Offered and Labor Market Indicators, Across Model Specifications

QWI (Workforce Indicators)	(1) No Controls	(2) Year FE	(3) County Chrs	(4) State FE and County Chrs	(5) CZ FE	(5) County FE
Manufacturing						
Net Job Gains	0.035***	0.040***	0.022***	0.021***	0.017**	-0.011*
	(0.004)	(0.005)	(0.004)	(0.008)	(0.007)	(0.006)
Adj. R-Squared	0.0164	0.209	0.304	0.372	0.526	0.611
Net Job Gains (Col)	0.042***	0.041***	0.027***	0.024***	0.017**	-0.009
	(0.004)	(0.004)	(0.004)	(0.007)	(0.008)	(0.008)
Adj. R-Squared	0.0255	0.254	0.315	0.382	0.512	0.615
Total Employment	0.030***	0.031***	0.017***	0.021***	0.016***	-0.000
	(0.002)	(0.003)	(0.001)	(0.007)	(0.005)	(0.001)
Adj. R-Squared	0.0133	0.425	0.599	0.683	0.882	0.995
Total Employment (Col)	0.031***	0.032***	0.018***	0.021***	0.016***	-0.001
	(0.002)	(0.003)	(0.001)	(0.007)	(0.005)	(0.001)
Adj. R-Squared	0.0143	0.414	0.593	0.678	0.877	0.995
New Hires	0.026***	0.027***	0.015***	0.017**	0.012**	-0.000
	(0.002)	(0.003)	(0.002)	(0.007)	(0.006)	(0.001)
Adj. R-Squared	0.0102	0.427	0.579	0.654	0.859	0.958
New Hires (Col.)	0.028***	0.029***	0.016***	0.018**	0.013**	-0.001
	(0.002)	(0.003)	(0.002)	(0.007)	(0.006)	(0.001)
Adj. R-Squared	0.0117	0.418	0.579	0.656	0.859	0.962
Percent Employed	0.073***	0.088***	0.095***	0.039**	0.036***	-0.006
	(0.007)	(0.004)	(0.006)	(0.019)	(0.012)	(0.006)
Adj. R-Squared	0.00966	0.0475	0.0583	0.279	0.756	0.955
Percent Employed (Col.)	0.025***	0.029***	0.031***	0.014**	0.012***	-0.002
	(0.002)	(0.001)	(0.002)	(0.005)	(0.004)	(0.002)
Adj. R-Squared	0.0126	0.0570	0.0651	0.314	0.768	0.959
Earnings of New Hires	0.003***	0.002***	0.000	0.002	0.002*	-0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
Adj. R-Squared	0.00368	0.0636	0.225	0.372	0.658	0.854
Earnings of New Hires (Col.)	0.003***	0.002***	0.000	0.002*	0.001*	-0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
Adj. R-Squared	0.00389	0.0739	0.233	0.380	0.655	0.828
Observations	11,794	11,794	11,794	11,794	11,794	11,794

Health						
Net Job Gains	0.043***	0.050***	0.018***	0.026***	0.018***	-0.000
	(0.004)	(0.005)	(0.004)	(0.007)	(0.007)	(0.003)
Adj. R-Squared	0.0102	0.384	0.545	0.593	0.693	0.779
Net Job Gains (Col)	0.038***	0.043***	0.020***	0.018***	0.012	0.010
	(0.005)	(0.006)	(0.003)	(0.006)	(0.008)	(0.007)
Adj. R-Squared	0.0105	0.266	0.397	0.452	0.544	0.625
Total Employment	0.053***	0.053***	0.016***	0.029***	0.022***	0.001
	(0.004)	(0.003)	(0.001)	(0.007)	(0.008)	(0.001)
Adj. R-Squared	0.0181	0.448	0.683	0.745	0.874	0.997
Total Employment (Col)	0.052***	0.053***	0.017***	0.029***	0.021***	0.001
	(0.003)	(0.003)	(0.001)	(0.007)	(0.008)	(0.001)
Adj. R-Squared	0.0188	0.446	0.679	0.739	0.870	0.997
New Hires	0.053***	0.054***	0.018***	0.031***	0.023***	0.003**
	(0.004)	(0.003)	(0.002)	(0.007)	(0.008)	(0.001)
Adj. R-Squared	0.0183	0.438	0.660	0.716	0.845	0.958
New Hires (Col.)	0.054***	0.055***	0.020***	0.031***	0.023***	0.003**
	(0.003)	(0.003)	(0.001)	(0.007)	(0.008)	(0.001)
Adj. R-Squared	0.0194	0.436	0.658	0.712	0.847	0.965
Percent Employed	0.121***	0.114***	0.077***	0.057*	0.041	0.011**
	(0.007)	(0.013)	(0.010)	(0.032)	(0.031)	(0.005)
Adj. R-Squared	0.0215	0.0251	0.0761	0.264	0.618	0.966
Percent Employed (Col.)	0.040***	0.040***	0.030***	0.018	0.013	0.003*
	(0.003)	(0.004)	(0.004)	(0.011)	(0.010)	(0.002)
Adj. R-Squared	0.0194	0.0274	0.0515	0.247	0.645	0.968
Earnings of New Hires	0.004***	0.003***	-0.000	0.002**	0.001	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)
Adj. R-Squared	0.00683	0.115	0.258	0.426	0.665	0.817
Earnings of New Hires (Col.)	0.003***	0.003***	-0.001	0.002**	0.001	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)
Adj. R-Squared	0.00635	0.129	0.268	0.461	0.668	0.801
Observations	12,180	12,180	12,180	12,180	12,180	12,180

Table Notes: Coefficients represent the relationship between one additional STC program offered and new hires. All outcomes log transformed except percent employed. Robust standard errors are clustered at the calendar year, state, commuting zone, and county-level across columns 2-5 respectively. County characteristics include average unemployment, population size, and rural status from USDA County Typology.

Appendix

Figure A1. Percent of all within 2-digit CIP code completions in STCs by Non-Rural and Rural colleges

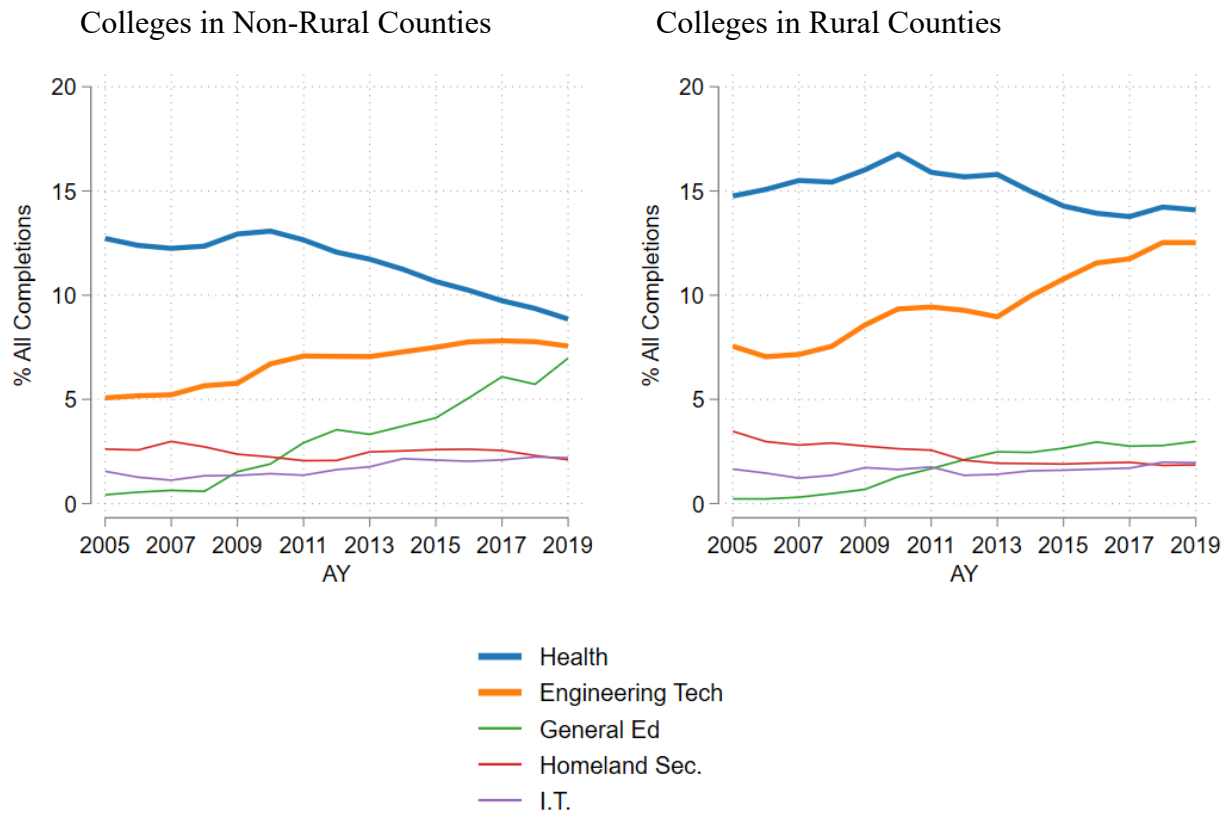


Figure Notes: Source: IPEDS completion files. Notes: Top 5 STC ranking based on total 2019 completions. Program count = unique 6-digit CIP code and award-level. Rural counties identified using USDA County Typology Codes.

Figure A2. Trends in new hires and quarterly earnings of new hires by quartile of total STCs

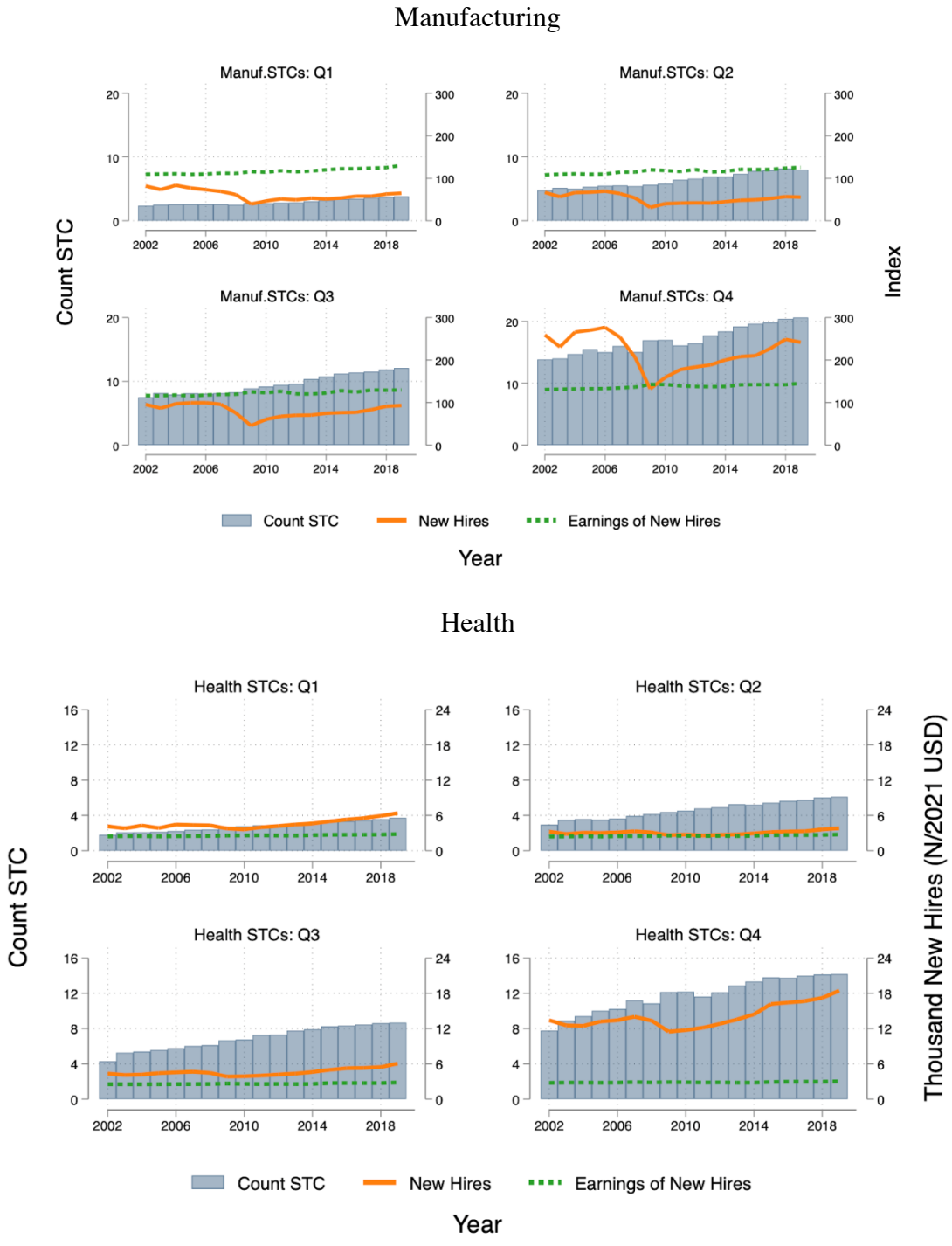


Figure Notes: Source: IPEDS completion files. Notes: Quartile assigned using average annual count of STCs from 2002-2019. STC count = unique 6-digit CIP code and sub-associate certificate level

Figure A3. Alignment between STC offerings and total employment for workers with some college

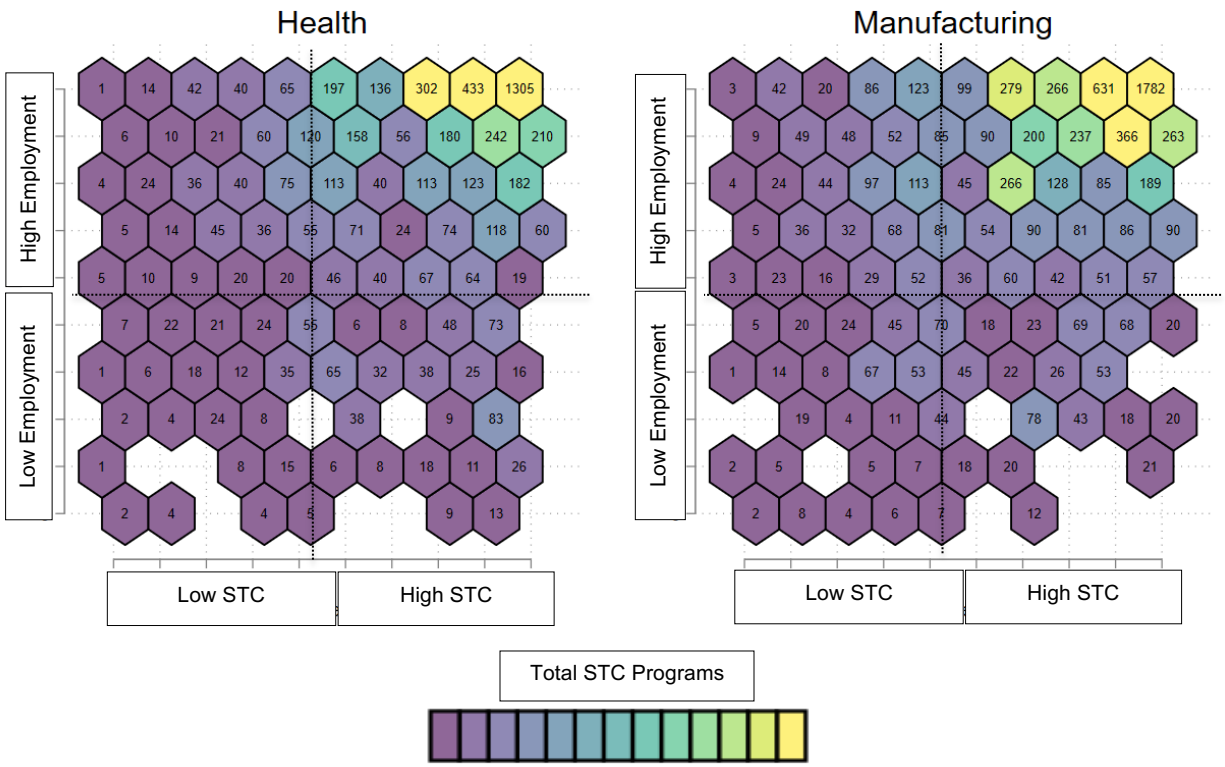
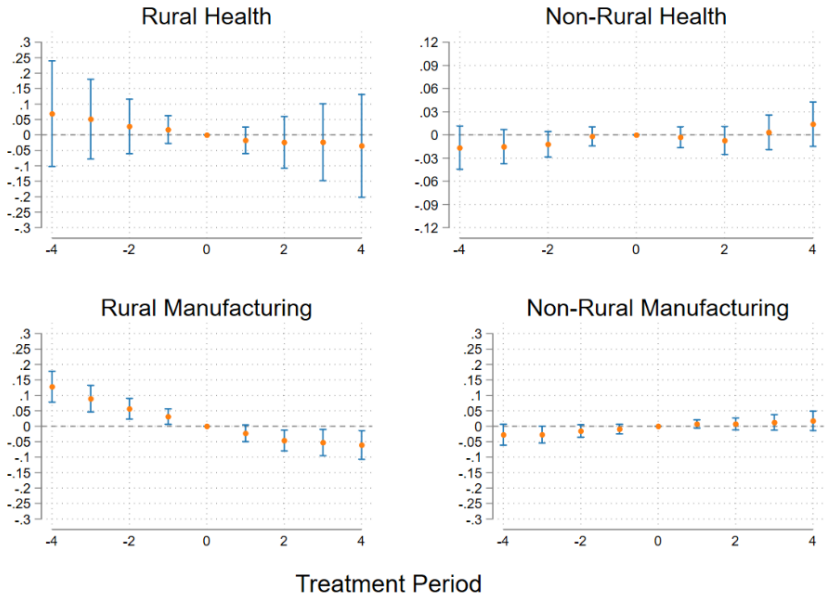


Figure Notes: Counties are rank ordered and assigned to 10 equal bins according to total industry employment and again according to total availability of STCs. Hexplot (Jann, 2019) shows crosstab between industry and employment ranking, with color scale representing the total concentration of short-term certificate programs. Number in hex = total STCs offered.

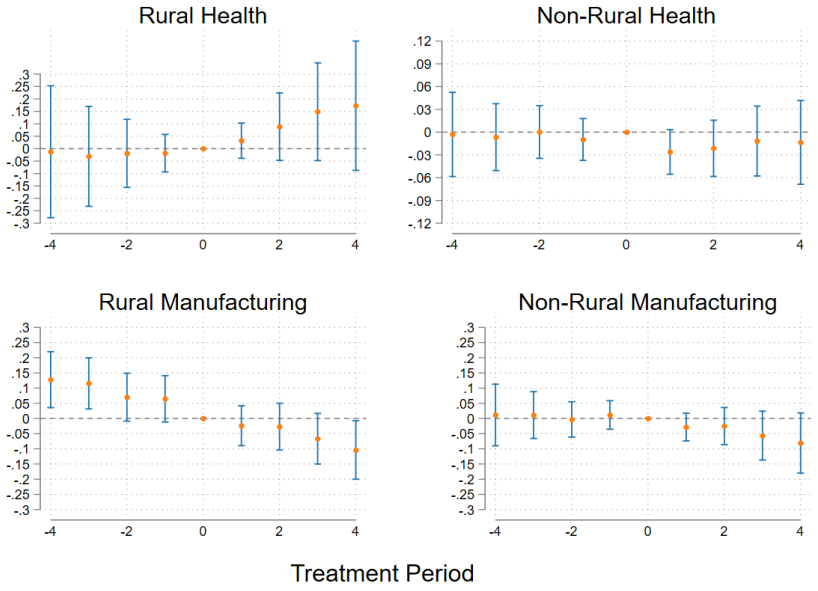
Figure A4. CITS model estimates: Large program launch results across treatment year definitions

a. Specification (1): Largest sustained increase

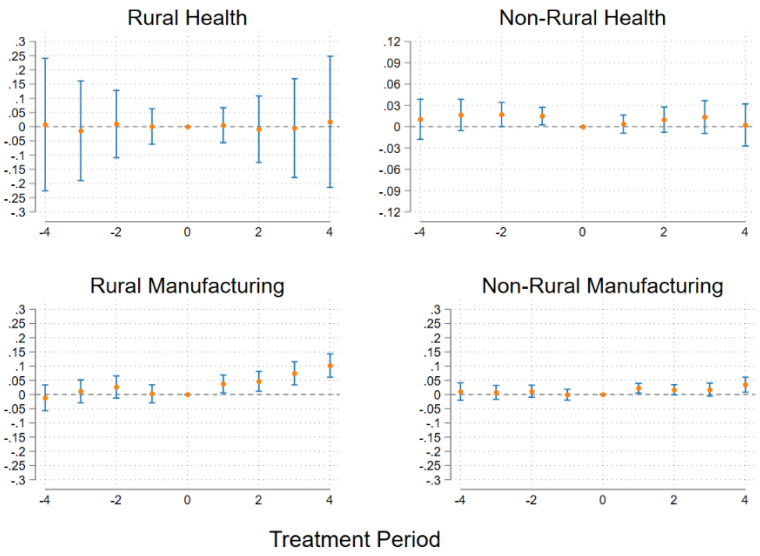
i) Total Employment (Some College)



ii) New Hires (Some College)

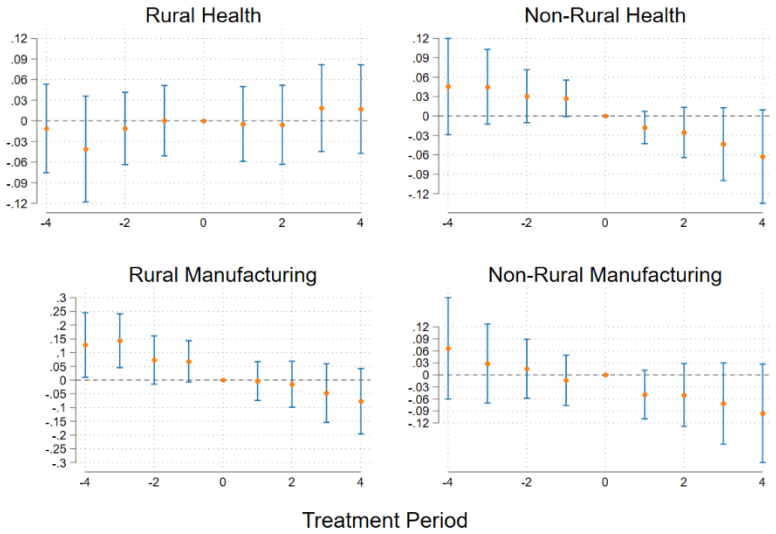


iii) Earnings of New Hires (Some College)

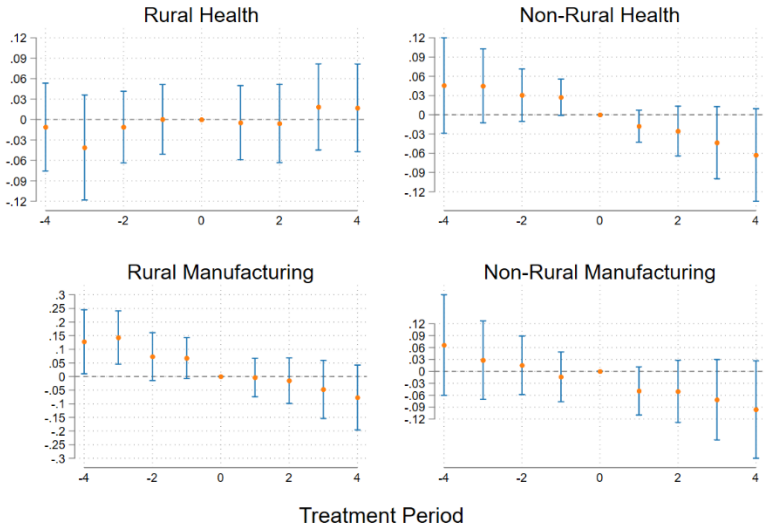


b. Specification (3): Largest Increase of Never Before Offered CIPS

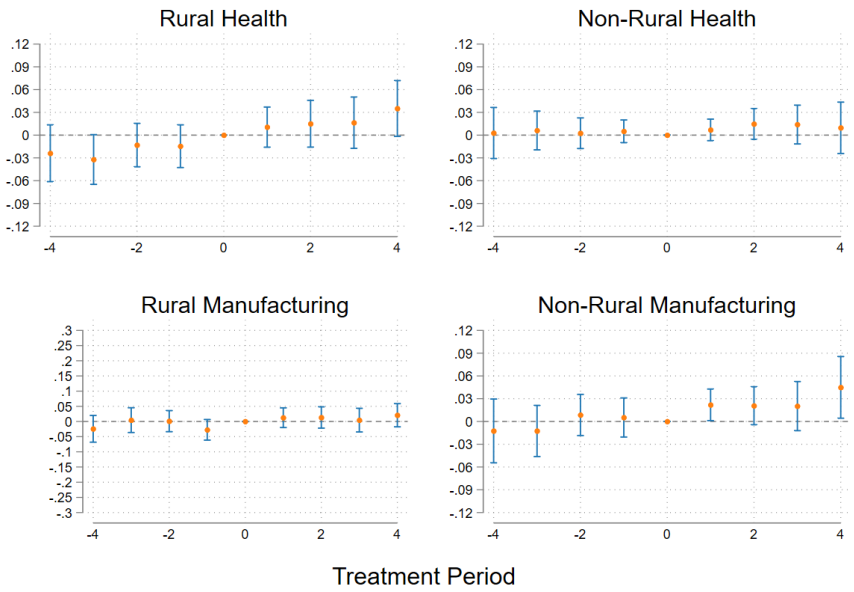
i) Total Employment (Some College)



ii) New Hires (Some College)

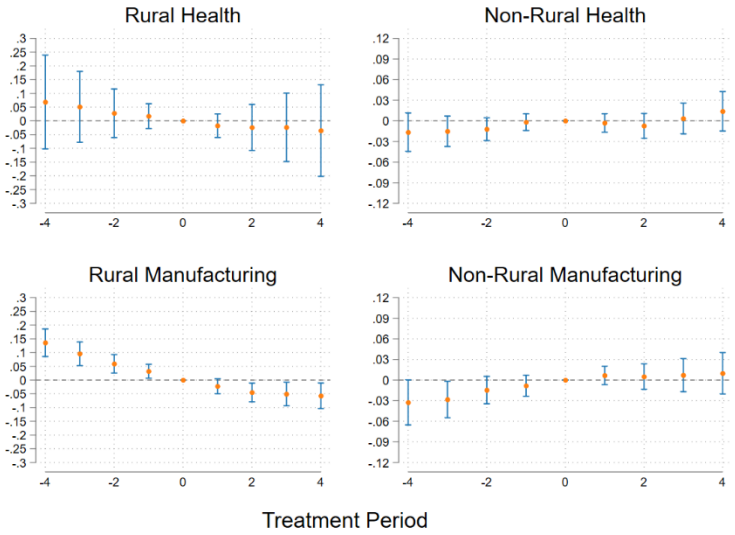


iii) Earnings of New Hires (Some College)

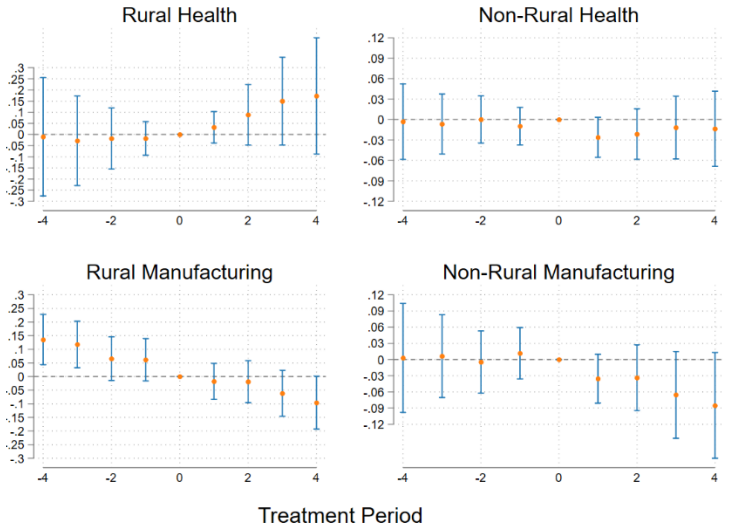

Rural Health
Non-Rural Health
Rural Manufacturing
Non-Rural Manufacturing
Treatment Period

c. Specification (4): Largest Increase of CIPS >= 20% discontinuous increase

i) Total Employment (Some College)



ii) New Hires (Some College)



iii) Earnings of New Hires (Some College)

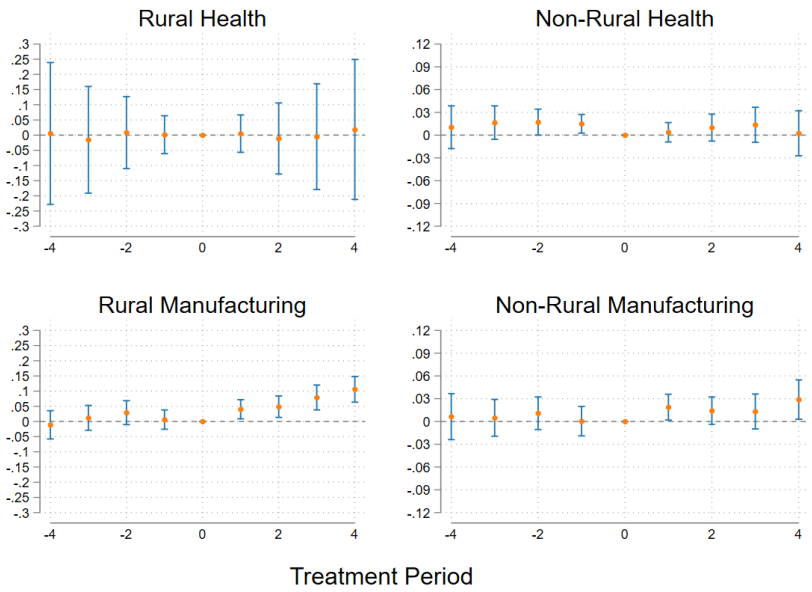


Figure Notes: Comparative interrupted time series (CITS) plots of the relationship between new hires by time to large program launch for all counties and rural counties. Trends adjusted for baseline county-characteristics, total population, and unemployment rates across model specifications.

Table A1. Robustness check: are colleges more responsive to labor market signals from prior years?

LN(New Hires)	(1) No lag	(2) Lag 1	(3) Lag 2	(4) Lag 3	(5) Lag 4	(6) Lag 5
N Manuf. STCs	.00049	-0.000362	-0.00238*	.00029	-0.00170	0.00198**
	(0.00071 9)	(0.00104)	(0.00124)	(0.00113)	(0.00127)	(0.000837)
Observations	7,736	7,736	7,736	7,736	7,736	7,736
R-squared	0.967	0.956	0.960	0.962	0.959	0.958
N Health STCs	0.00301*	-0.000787	0.00111	0.00142	-0.00169	-0.00133
	(0.00149)	(0.00171)	(0.00197)	(0.00164)	(0.00195)	(0.00209)
Observations	8,066	8,066	8,066	8,066	8,066	8,066
R-Squared	0.958	0.958	0.962	0.973	0.973	0.973
State FE	X	X	X	X	X	X
Calendar Year FE	X	X	X	X	X	X
County Chrs.	X	X	X	X	X	X

Table Notes: Estimates for the relationship between one additional STC program offering and natural log of new hires in manufacturing and health industries. Columns present estimates across new hires lagged by up to five years.

End Notes

[i] All institutions receiving federal Title IV funding under the Higher Education Act (HEA) are required to report program completion data to IPEDS. College administrators follow guidance from NCES to assign CIP codes to each instructional program, which could lead to some variability across institutions in how 6-digit program codes are assigned. In 2010, 12 new manufacturing and 30 new health 6-digit CIP code options were added to the CIP schema. There were 8 health CIP6 codes re-classified using a one-to-one update. No existing 6-digit CIP codes were formally re-classified into multiple new CIPs. New CIP codes released in 2010 made up 1% of all STC completions in 2019. Though results are robust to the inclusion or exclusion of these CIPs, final estimates exclude these 6-digit CIPs.