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Local Labor Market Alignment of Short-Term Certificate Programs

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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 alignment 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 percentage points more total employment and new hires in related industries. Large launches of clustered STC programs occurred before periods of growth in health employment but declines in manufacturing. Large launches preceded earnings growth of 2-5 percentage points in both sectors.

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Local Labor Market Alignment of Short-Term Certificate Programs*

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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 alignment 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 percentage points more total employment and new hires in related industries. Large launches of clustered STC programs occurred before periods of growth in health employment but declines in manufacturing. Large launches preceded earnings growth of 2-5 percentage points in both sectors.

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

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1 Introduction

Short-term certificate (STC) programs, or accelerated, workforce-aligned credentials at the sub-associates degree level, are increasingly common at public community colleges. Federal and state investments have supported the expansion of STC programs to increase educational attainment and fill middle-skill job openings (Mikelson et al. 2017; National Governors Association 2018). These "localized" postsecondary investments 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" (The White House 2023). Efforts have been aimed at increasing the alignment between community college programming and local labor markets, which could work to address a longstanding critique that community colleges lack labor market responsiveness (Dougherty 1994; Grosz 2022). 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 and 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.

STC programs have become a key venue for workforce-aligned education (Eyster et al. 2017; Darolia et al. 2015). STCs can be completed in 15 months or less, providing occupationally-focused training while typically conferring a transferable, academic credential. Since 2010, federal and state governments have invested billions to establish thousands of new labor market aligned certificate programs across the U.S. in 'high demand' fields like health, manufacturing, and information technology (Eyster et al. 2017). STCs now make up 44% of all community college completions.[1] Certificate programs in can lead to large increases in earnings and odds of employment for completers, though there is significant variation in returns based on field of study and geography (Dadgar and Trimble 2015, Stevens et al. 2019, Xu and Trimble 2016). The proliferation of new STCs creates an opportunity to study whether postsecondary investments were made in alignment with labor markets.

[1] Author's calculation using IPEDS Completion Files AY 2019

I examine coordination between colleges and the labor market in rural areas separately. Technical certificate completions represent a 20% greater share of completions at rural colleges compared with non-rural colleges.[2] STCs may be particularly important given the context of college-going in rural areas: 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 and Jackson, 2010). Rural young people and their families can be wary of the relevance of postsecondary credentials to local opportunities (Corbett, 2016). This wariness is not without reason, as 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). Therefore, 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 and 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 and Wolf-Powers, 2018; Snell, 2019). To understand the unique economic and postsecondary context in rural areas, I conduct a sub-analysis by rurality.

In this study, I link national data on higher education completions 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 use fixed effects and interrupted time series frameworks to understand the extent to which new STC program openings correspond with local labor market trends. I offer insight into the definition of "local" alignment by examining alignment at the state, commuting zone, and county-levels. New STC programs are often launched

[2] Author's calculation: IPEDS 2019. STCs account for 47% of all completions at rural colleges compared with 41% at non-rural community colleges

in bundles after the receipt of grants or appropriations,[3] creating discontinuous spikes in the total number of programs offered. I use a data-driven approach to identify these large program launches, and describe the surrounding labor market conditions.

I find that STCs are spatially aligned across labor markets within a state or commuting zone, 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 in related industry. Large program launches, or discontinuous increases in the total number of certificate program offerings, occurred before periods of growth in health industries but decline in manufacturing industries.

2 STCs, Worker Shortages, and Industry Alignment

STC programs at community colleges provide accelerated workforce-aligned certifications at the sub-associate degree level. "Short" STCs can be completed in 6 weeks to 12 months, while "long" STCs can be completed in 12-15 months (Carruthers and Sanford 2018; Xu and Trimble 2016). Evidence for the earnings returns to STCs is mixed, with some promising evidence showing strong returns to very short certificates (Darolia et al. 2015), but other more cautionary findings showing that certificates in fields like personal care can confer limited or negative returns (Dadgar and Trimble 2015). Short certificates in manufacturing can improve probability of employment by 5 percentage points and can increase quarterly earnings (Xu and Trimble 2016). Long certificates in health can improve earnings by 30% (Stevens et al. 2019; Minaya and Scott-Clayton 2022). There is heterogeneity in returns to STC completion by field of study, geography, and length of certificate (Carruthers and Sanford 2018). For example, a construction certificate in North Carolina provided considerable returns, while a comparable certificate in Virginia did not (Xu and Trimble 2016). This could reflect differences in program quality, student preparedness, or differences in locally available employment.

Large state and federal investments in establishing new community college STC programs reached a peak in the 2010s. From 2011-2014 federal government made major investments in STC infras-

[3]Large STC investments include: Trade Adjustment Assistance Community College and Training Act (All states, 2011-2014), Labor and Education Alignment Program (Tennessee, 2011), New Economy Workforce Grant & FastForward (Virginia, 2016) Jobs and Education for Texans (Texas, 2009).

tructure 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). Subsequently, states like Virginia, Tennessee and Texas invested in new workforce-aligned certificate programs. Other programs like Georgia HOPE, KentuckyWorks! and Workforce Scholarships for the Future in South Carolina supported tuition waivers for students entering high-demand STC programs. Nationwide, the push for STC programs that support individual earnings and regional economies further motivates a study of this key piece of the modern postsecondary landscape.

Despite the policy emphasis on workforce-aligned community college programs, prior research on alignment between colleges and labor markets is limited. 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, even as 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. The limited institutional response identified in Grosz (2022) is further motivation for a national landscape analysis. My study will use a coarser measure of institutional responsiveness to labor market trends but will examine outcomes across all 50 states.

Coordination between community colleges and the workforce may mean that colleges expand offerings as industry grows or diversifies in a region. 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. High-quality case studies provide evidence for the latter scenario. Tennessee's Labor Education Alignment Program (LEAP) increased funding for new STC programs added work-based learning programs, receive new equipment, and revise curricula based on employer partnerships (Soliz et al. 2023). In North Carolina, 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 2007; Lowe and Wolf-Powers 2018). These case studies show that states that have funded new STCs in an effort to support growth of industry in regions where industry may have previously been less active.

Understanding alignment between STCs and local economies offers insight into sensitive health and manufacturing worker pipelines. Changes to manufacturing industry strategies have contributed to offshoring, while making domestic hiring more difficult due to reduced investment in in-house training (Chang and Andreoni, 2020). Firms are less likely to house production activities or make investment in training or upskilling the manufacturing workforce. In other words, the manufacturing industry has seen a decline in vertically-integrated enterprises in favor of companies that are leaner and "asset light" (Chang and Andreoni, 2020). This change in industry organization, along with changes in foreign trade agreements (Autor et al. 2016), has reduced both U.S. manufacturing employment and the availability of skilled workers suited to manufacturing jobs that have remained domestic. A survey of thousands of manufacturing firms in the U.S. found that 20% of small to medium sized manufacturers had long-term job vacancies lasting over 3 months (Wellhausen and Locke 2014).[4] Understanding how workforce-aligned manufacturing programs have corresponded, or not, to local labor market trends, is a key step in understanding manufacturing worker pipelines.

The healthcare sector has a history of worker shortages that some have tied back to bottlenecks in education pipelines (Cramer et al. 2006; Jones et al. 2018). Rural nursing positions are particularly difficult to fill (Cramer et al. 2006). The Licensed Vocational Nursing (LVN) sub-associate's certificate can ease nursing workforce shortages by offering routes into the profession not requiring a bachelor's degree (Jones et al. 2018). This study of pre-pandemic educational investments will offer important context for the health workforce post-COVID 19. As millions of skilled workers across all sectors retired early or left their jobs from 2020-2022 (Penn and Huang 2023), the healthcare sector was particularly impacted, losing over 10 million workers leading to an increase in the employee quit rate of 480% during the pandemic (Amanor-Boadu 2022). As a further hit, college enrollments declined considerably from 2020-2022 in all sectors (NCES, 2023), and particularly among high

[4]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.

school graduates entering the community college sector (NCES, 2024). This landscape analysis of existing STC programs can offer necessary insights for the current state of educated worker pipelines.

3 Data

This analysis relies on a panel of total postsecondary programs offered by predominantly associate's degree granting public colleges and county labor market indicators from 2005-2019, years representing most activity in STC investment and consistent program reporting data. The panel relies on administrative data from the Integrated Postsecondary Education Data System (IPEDS) and U.S. Census Quarterly Workforce Indicators (QWI).

Postsecondary program counts include both short certificates, which can be completed one year, and long certificates, those that can be completed in over one year but less than two. Program fields of study are coded using the Classification of Instructional Programs (CIP) schema 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). Each unique combination of 6-digit CIP code and award level (either short or long certificate) contribute to the total program count. I restrict my analysis to health and advanced manufacturing 2-digit CIP codes.[5] 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).

QWI are sourced from U.S. Census Longitudinal Employer-Household Dynamics microdata, a federal-state data sharing agreement covering 95% of private employers. QWI includes indicators for new hires, average monthly earnings of new hires, total firm job gains, and total industry employment. Indicators are reported quarterly at the county by industry and education level of workers. In this analysis, I restrict to manufacturing (NAICS code 31-33) and health (NAICS code 62) industries. I focus on health and manufacturing STC programs, which are the two most popular

[5]This includes the codes CIP 51 (Health Professions), 48 (Precision Production), 47 (Mechanic and Repair Technologies) and 15 (Engineering Technologies), which together accounting for 40% of all community college degree completions (Author's calculation using IPEDS Completions AY 2005-2019)

STC fields of study, and because of the relative ease of linking these two fields of study to labor market data in related industry.[6] To understand whether labor market coordination is stronger for jobs requiring 2-year degrees or certificates, I examine outcomes for all employees and for employees with "some college," which includes associate's, certificates, or some college coursework. Rural counties are defined using 2015 County Typology Codes from the U.S. Department of Agriculture (USDA, 2024). Commuting zones are derived using U.S. Department of Agriculture Economic Research Service methodology (Fowler and Jensen 2020), which group counties based on census-derived commuting flows.

Table 1 describes county education and employment characteristics for the analytic sample of counties that had one public community college offer at least one STC in either health and/or advanced-manufacturing during at least one year in the study period. On average, counties in the analytic sample had an average of 1.2 community colleges each, which offered 6-7 unique STCs in manufacturing and 8-9 in health. Colleges awarded an average of 120-170 health certificates and 80-110 manufacturing certificates annually. An average of 5,000 individuals were employed in manufacturing and 6,000 in health in rural counties compared with an average of 11,000 in manufacturing and 17,000 in health in counties overall. The large program launches identified through an approach detailed in the next section resulted in an average of 2-4 new STC programs, compared to a steady state of close to zero new programs in non-launch years.

4 Empirical Strategy

I use both a fixed effects framework and an interrupted time series (ITS) design to study coordination between STC offerings and workforce trends in related industry. I first examine whether the number of STCs offered trend positively with labor market indicators holding constant state, commuting zone, 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. I hypothesize that rural colleges will have greater alignment between colleges and the labor market than non-rural colleges given the policy emphasis on STCs in rural areas, and

[6] 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).

their specific emphasis on local alignment.

The fixed effects model approach controls for all fixed characteristics associated with progressively more specific levels of geography, moving from states, to commuting zones and counties. This approach allows me to understand how much alignment between STC investments and local labor markets is driven by commuting zones within states, versus counties within commuting zones, versus years within counties. 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 program investments 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:

$$Y_{rt} = \alpha + \beta_{rt} STC + W_{rt} + \gamma_r + \theta_t + \epsilon_{rt} \tag{1}$$

Where Y_{rt} are county-level workforce indicators in geography r in year t. $\beta_{rt} STC$ are the total number of unique short-term award levels and 6-digit CIP codes offered in counties within geography r in year t. W_{rt} are time varying controls for county population and unemployment, γ_r are fixed effects for geography, which are specified as state, communing zone and county respectively. Secular trends effecting all units are represented as θ_t, or year level fixed effects. ε_{rt} represents the random error term clustered at the county-level. I fit this model separately by industry and rurality. As a robustness check, I test whether alignment varies when labor market signals are lagged up to 5-years prior to program opening by substituting $Y_{rt-1}...Y_{rt-5}$ for Y_{rt} in equation 1.

The ITS design offers another way to understand alignment between colleges and the labor market by focusing specifically on timing and viewing large program launches 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 begin with a panel of total STCs offered

by county, industry, and year is used to identify discontinuous increases in programs offered, or "large program launches," used to assign treatment year in the ITS analysis. I define:

$$\Delta_{rt} = STC_{rt} - STC_{r(t-1)}$$

$$TrtYear_r = t, \text{ such that } \Delta_{rt} = \max\{\Delta_{rt} \text{ for all } t\}$$

Where Δ_{rt} is the change in total programs offered in year t and county r. Each county r is assigned one $TrtYear_r$ in which Δ_{rt} was maximized.

I then model:

$$Y_{r\tau} = \delta_r + \sum_{\tau \neq -1}^{\tau} \beta^{\tau} \text{PostTrtYear}_{r\tau} + \varepsilon_{r\tau} \tag{2}$$

Where $Y_{r\tau}$ is a labor market outcome (new hires, total employment, and earnings) for a given county r at τ years until large program launch. PostSTC_r are a series of indicators for the difference in labor market trends for each year relative to the large program launch. β^{τ} is the estimated difference in Y_{rt} in year τ compared to $\tau = -1$. δ_r are county-level fixed effects. Standard errors are clustered at the county-level. This model is fit separately by industry, rural and non-rural counties.

To address the concern that a singular definition of "large program launch" drives results, I test three other potential treatment definitions: 2) the largest increase in STCs with a net increase in total STC graduates, 3) the largest increase in 6-digit CIP STCs that were never previously offered by a college, and 4) the largest increase in STCs that led to at least 20% more STCs than in prior years. Figure 3 shows total STCs offered at the year of large program launch across the four definitions of launch year. Colleges offered an average of 3 additional STCs in the year of largest program launch. The number of STCs was constant before and after the year of largest launch, lending support to my approach for identifying a single discontinuous treatment year.

There are a few limitations to my approach. First, my approach does not disentangle whether labor market trends caused educational program investments or whether educational investments stimulated economic activity. However, using well controlled descriptive models, I isolate a practical

and policy relevant measure of educational and workforce coordination currently absent from the literature. Second, because new programs are not observed until at least one completion occurs, new programs that never produced graduates will not be observed.[7] A false new program could be counted if new graduates appear in the data after a period of program dormancy. I account for these scenarios by testing robustness of results to new STCs not previously offered by the college. Finally my definition of new programs requires enough curricular and programmatic updates to result in a new 6-digit CIP code or award level designation. This measure captures programmatic changes but would miss additional sections or seats added to existing programs.

Finally, there continues to be no systematic data on non-credit degree programs offered by community colleges to serve workforce development roles like worker re-training and employer engagement (Erwin 2019; Van Noy and Hughes 2022; Ullrich 2023), in which there are an estimated 5 million students enrolled (Van Noy and Hughes 2022). More detailed data on non-degree programs and other institutional information like faculty FTEs and total course sections could provide a much needed information on institutional behavior. However, this analysis captures programs in which policy-makers have made major investments during the past decade, and are continuing to emphasize post-pandemic[8]

5 Results

5.1 Descriptive Trends

Figure 1 shows that the number of STCs offered in manufacturing grew by over 1,500 new programs since 2005. Manufacturing certificate completions have increased from 50,000 to over 100,000 in the same time frame. The number of unique health certificates have increased by about 500 since 2005. Health STC completions grew by 40% from 2005 to 2010, but have remained at a steady or slightly declining level of total completions in more recent years. The next most popular STC fields of study are in Education, Homeland Security, and Information Technology, which all have about

[7] This could create bias in the measure of labor market alignment if STC students are hired before program completion. However, this scenario is unlikely because it would have to effect 100% of students in order for the program to be fully unobserved.

[8] New institutional grants to establish new STC programs include $25 million in Florida (Office of Governor Ron DeSantis 2024); $108 million in California (Office of Governor Gavin Newsom 2022). $89 million from Dept. of Labor and Dept. of Energy (U.S. Department of Labor 2024; U.S. Department of Energy 2024)

75,000 fewer completions than health and manufacturing fields.

Figure 2 maps county-level STC program openings and post-recession changes in total employment from 2010-2019. Green points show public predominantly associate's degree granting colleges that had a net increase in total programs offered over this time. The gradient shows the percent change in post-recession employment, with red denoting net negative change in employment and blue showing net positive change. Manufacturing employment, shown in Panel A, experienced growth in the "auto-corridor" which spans from the Midwest to the South. While new STC programs opened in counties experiencing growth in manufacturing along the auto-corridor, they were also concentrated in states with less pronounced growth in manufacturing, like North Carolina and New Jersey. Panel B shows that health employment grew in many urban population centers. New clusters of health STC programs in Atlanta, Los Angeles, and San Francisco align with industry growth, but there are also several rural counties with new health STC programs that saw declines in health employment, such as areas in Kansas, Oklahoma and Maine.

Column 1 in Tables 2 and 3 shows the unadjusted relationship between county-level economic indicators and total STCs offered in manufacturing and health respectively. Column 1 in Table 2 shows that one additional STC program in manufacturing was associated with 3 percentage points greater total employment, 2.6 percentage points more new hires, and 3.5 percentage points greater net job gains. Column 1 in Table 3 shows that an additional STC in health was associated with 5.3 percentage points greater total employment, 5.3 percentage points more new hires, and 4.3 percentage points greater net job gains in health industries. In general, the association between workforce indicators and STCs is slightly greater when QWI are measured for workers with some college but no bachelor's degree. Column 2 shows that some of this association is explained by state-level variation in STC programs. For example, including state-level fixed effects brings the estimated association between additional manufacturing STC programs and net job gains to 2.1 percentage points. This could reflect the varying level of state buy-in shown in Figure 2. States with generally higher employment in manufacturing and/or health industries are more likely to offer more corresponding STC programs.

Column 3 in Tables 2 and 3 describe the extent to which the association between STCs and local economic conditions are explained by variation in program offerings by counties within commut-

ing zones. Accounting for commuting zone fixed effects reduces the remaining within commuting zone relationship between manufacturing STCs and total employment to 1.6 percentage points and health STCs and total employment to 2.2 percentage points. This means that holding constant the distribution of STCs by commuting zone, counties with 1 additional STC had about 1-2 percentage point more economic activity in related industry.

Finally, column 4 in Tables 2 and 3 show that county-level fixed effects explained nearly all the association between STCs and manufacturing and health labor market outcomes. This indicates that STCs are not offered according to marginal changes in county-level indicators after accounting for all time-invariant county characteristics. All county-level fixed effects estimates were precise nulls, with some exceptions: 1 additional health STC was associated with a 1 percentage point increase in health share of employment, and 1 additional manufacturing STC was associated with a 1 percentage point decline in county-level manufacturing job gains. These findings suggest that college and labor market alignment is explained more by spatial distribution of STC programs than temporal differences in employment.

Results testing whether county-level temporal alignment between colleges and local labor markets improves when labor market signals are lagged are shown in Appendix Table A1. I show 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 (shown in Tables 2 and 3 Column 2) disaggregated by non-rural and rural counties, shown in blue and orange respectively. 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 was associated with 2.3 percentage points more new hires in rural counties compared with 1 percentage points more new hires in non-rural counties. Manufacturing STCs in rural areas were also about 2 percentage points more strongly associated with total employment, percentage of non-college workforce employed in manufacturing. Health STCs were more strongly associated with local labor market indicators in general, with rural counties having only slightly stronger associations than non-rural counties for some labor market indicators. Each additional health STC

program was associated with 3 percentage points more net job gains for workers with some college in rural counties, but not significantly different from 0 in non-rural counties.

5.2 Descriptive Estimates – Timing of Large Program Launch

Figures 5-7 show estimates from equation 2 comparing county-level labor market statistics in each period relative to the year of the single largest, sustained program launch. Figure 5 shows that large program launches in health occur as total employment in health is increasing, while large program launches in manufacturing occur during periods of decline. I find that manufacturing launches occur in the wake of employment declines, and ahead of further declines which level out at about 5-7 percentage points by the 4th post-period in both rural and non-rural counties. Health employment rose both before and after health STC program launches. Figure 6 shows similar, though slightly noisier results for the rate of new hires. New hires in health increased by 5.1 percentage points in rural areas and by 3 percentage points in non-rural counties three years following the large program launch. In manufacturing, new hires declined by 6 percentage points in non-rural areas. In rural areas, new hires trended downward, but were not significantly different from 0 three years after program launch.

Trends in earnings, shown in Figure 7, reveal that large program launches precede periods of earnings growth in both industries. In manufacturing, the earnings of new hires rose by 3-8 percentage points post program launch. In health, earnings rose by about 2 percentage points immediately after a large program launch and continued to grow to 5 percentage points in the four years following the launch.

I test the robustness of the large program launch results across three additional treatment year definitions. Appendix Figures A1 through A3 show that these results are robust to varying definitions of STC program launch treatment years, including when large program launch year is defined as the largest sustained increase with net positive graduates, largest sustained increase in never before offered CIP codes, and a net increase of 20% or more new CIPs than in previous years. Almost all estimated relationships are robust to these program launch definitions, though the model under definition (2), largest launch of never before offered STCs, did not identify manufacturing earnings increases after large program launches in rural areas.

6 Contribution and significance

This article examines alignment between labor markets and the availability of community college occupationally-focused STCs over the course of more than a decade of heavy investments in STC programs. I measure alignment using several geographic designations. I find that spatial, rather than temporal, distribution of STCs account for the association between STCs and labor market indicators. Counties within commuting zones had one additional STC program for every 2-3 percentage point increase in new hires, job gains and higher earnings in manufacturing and health industries. Health STCs were more geographically aligned than manufacturing, with one additional STC offered corresponding with 3.5 percentage points more new hires with some college but no bachelor's degree. STCs were not associated with county-specific labor market trends. These findings are consistent with Grosz 2022 and others highlighting constraints faced by community colleges to differently appropriate resources based on labor market trends.

As another dimension of alignment, I examine economic trends surrounding large, discontinuous investments in new STC programs. I find that large program launches in health occur during periods of labor market strengthening in both rural and non-rural counties. New hires, total employment, and earnings of new hires grew after large launches. In manufacturing, however, STCs were launched during periods of decline. 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.

I find that labor market aligned STC investments were more common and more successful in rural counties, which had stronger correlations between additional STC programs and labor market activity. STC programs could be particularly important in rural areas in adjusting to rapid economic changes and in offering postsecondary training tied to locally available employment. While there is

significant heterogeneity within the "rural" category, prior literature has shown that impacts from the Great Recession and globalization have led to particularly rapid changes in rural areas (Low 2017; Abel and Deitz 2019; Snell 2019). Indeed, my analysis finds that STCs make up a 20% greater share of community college completions in rural areas compared with non-rural areas. Manufacturing STCs open in rural counties after periods of declining employment, but before periods of employment stabilization. This is in line with the theory that STCs provide accelerated routes into new careers, potentially offering new or updated skills within manufacturing to transition workers through economic change.

The U.S. labor market has undergone rapid changes in recent decades, driven by trends in foreign trade, technological advancement, and globalization. This analysis sheds light on state and federal attempts to establish new post-secondary pathways in a rapidly evolving labor market. As communities rebuild skilled worker pipelines post-pandemic, this analysis shows that there is more room to establish new STC programs in alignment with local labor markets. A lack of data on workforce development systems has been a longstanding barrier, though more attention and efforts have been targeted at understanding workforce training resources across providers (Deming et al. 2023). Richer data on community college institutional behaviors would further improve understanding of workforce-aligned education.

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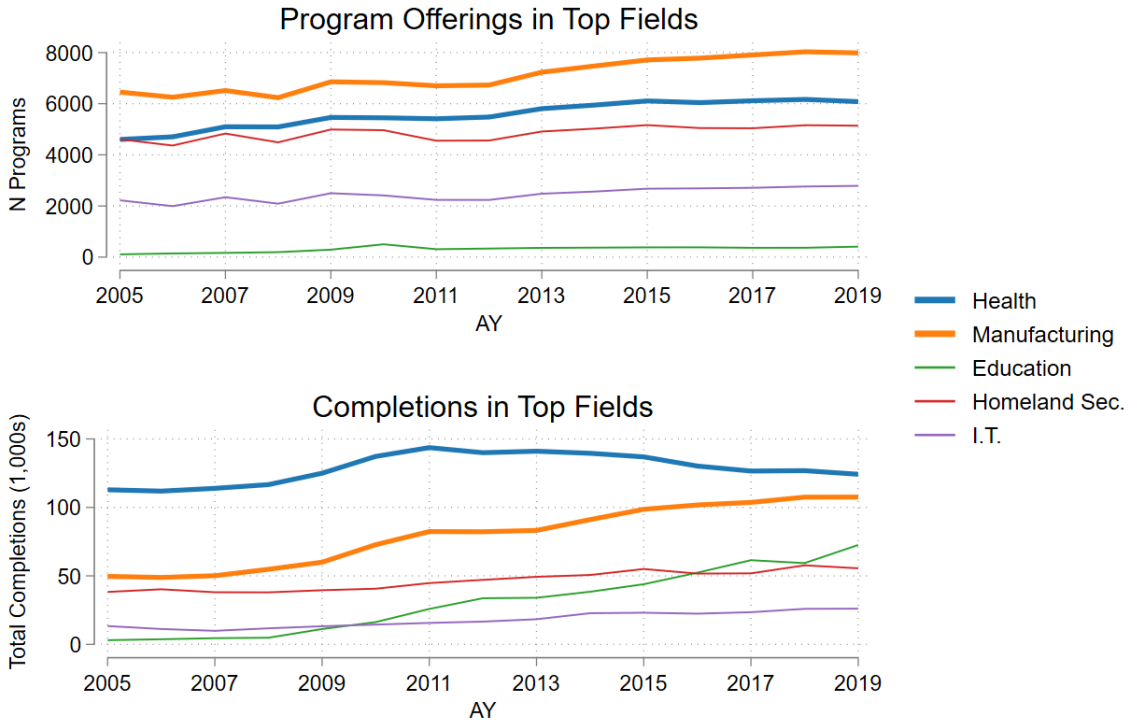
Figures and Tables

Figure 1: Relationship between labor market indicators and new STC programs



Notes: Program count is the sum of unique 6-digit CIP code and sub-associate award-level combinations offered across U.S. predominantly associate's degree-granting institutions, "community colleges." Total completions are all conferrals of sub-associate's credit-bearing certificates across U.S. community colleges. Top fields based on most commonly completed certificate fields of study in 2019 across all U.S. community colleges. *Source*: IPEDS Completions Files (AY 2005-2019) and QWI

Table 1: Description of the sample: U.S. counties with colleges offering short-term certificates in manufacturing or health (AY 2005-2019)

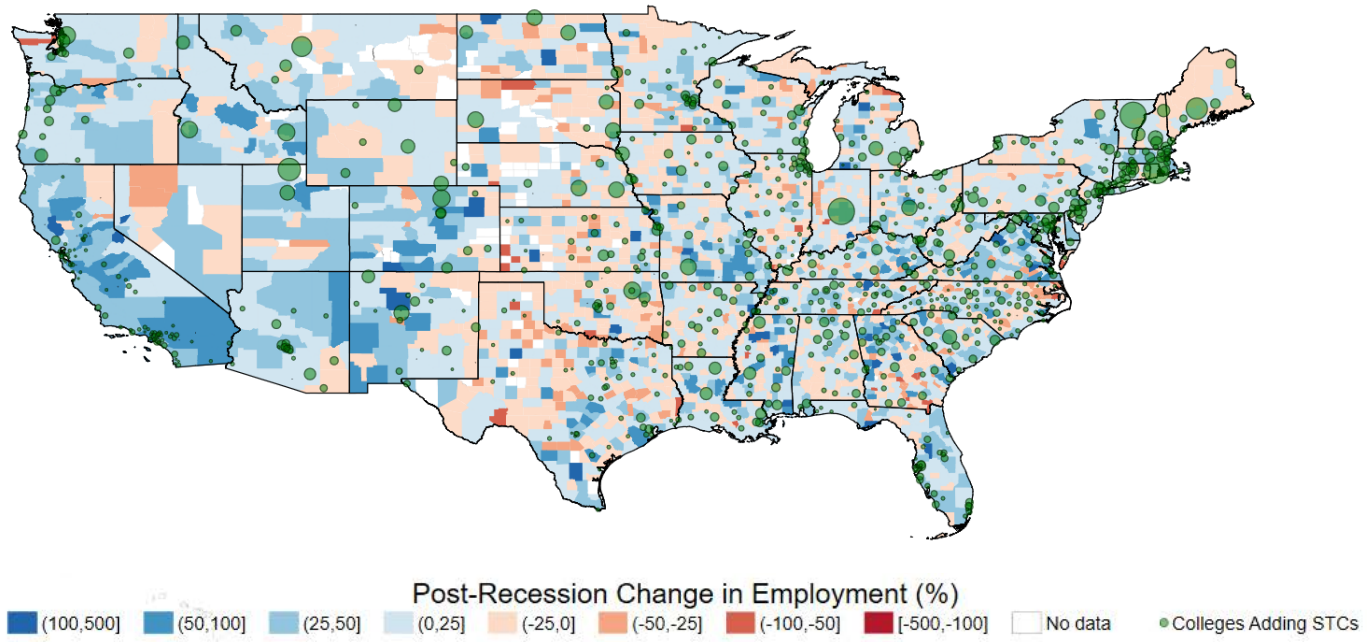
	All Counites		Rural Counties	
	Health	Manufacturing	Health	Manufacturing
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
County Education Characteristics				
Avg. Total Public 2-Year Colleges	1.22	1.21	1.11	1.11
	(1.06)	(1.07)	(0.64)	(0.65)
Avg. Total STC Programs	7.24	9.39	5.84	7.87
	(7.75)	(10.57)	(5.74)	(7.77)
Largest Program Increase	2.52	3.61	2.19	2.89
	(2.58)	(4.31)	(2.39)	(2.91)
Annual New Programs	0.18	0.25	0.20	0.24
	(1.53)	(2.09)	(1.54)	(2.12)
N Graduates	168.99	111.08	117.49	80.69
	(274.73)	(207.84)	(182.43)	(178.00)
County Employment Characteristics				
Population over 25	182,383	182,411	73,325	75,484
	(387,401)	(388,840)	(187,207)	(191,527)
Total Employment	17,157	10,978	5,933	4,916
	(35,745)	(23,622)	(15,563)	(11,474)
New Hires	7,126	3,265	2,573	1,594
	(14,776)	(7,098)	(7,377)	(3,706)
Job Gains	1,970	990	691	446
	(4,455)	(2,204)	(2,014)	(1,106)
Net Job Gains	336	-129	104	-82
	(1,309)	(1,059)	(589)	(589)
Quarterly Earnings of New Hires (2021 USD)	2,666	3,628	2,504	3,268
	(512)	(1,114)	(497)	(964)
N Counties	784	755	490	472

Notes: County characteristics averaged at the county-by-year level from AY 2005-2019. Analytic sample includes a balanced panel of counties that have at least one public 2-year college offering health or manufacturing short-term certificates in at least one year during the study period. Standard deviations shown in parenthesis calculated over counties. *Source*: IPEDS and QWI.

Figure 2: Regional changes in industry employment and STC program offerings, 2010-2019

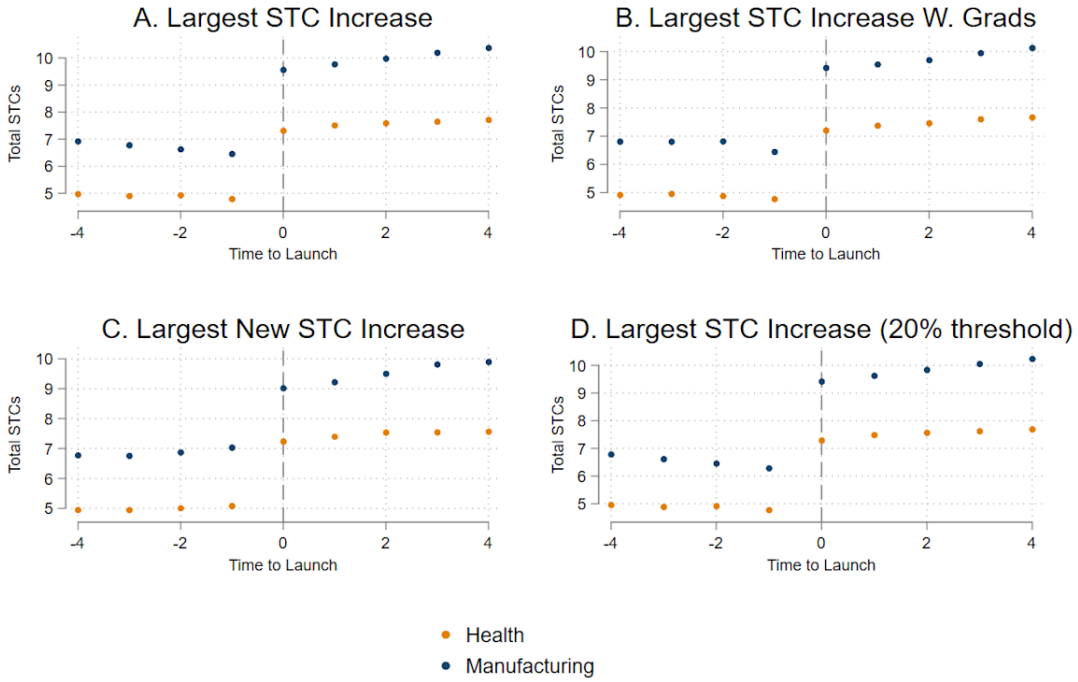
(a) Manufacturing

(b) Health



Notes: Shading represents county-level percentage change in number employed in health or manufacturing sectors separately from 2010-2019. Points represent colleges adding new STCs in health or manufacturing. Point size reflects relative in-state share of completions. *Source*: IPEDS, QWI

Figure 3: Validation of program opening treatment year: Total STCs offered by time to treatment year



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. *Source*: IPEDS and QWI

Table 2: Relationship Between STCs Offered and Labor Market Indicators for Manufacturing

Workforce Indicators	(1) No Controls	(2) State FE	(3) CZ FE	(4) County FE
Total Employment	0.030***	0.021***	0.016***	-0.000
	(0.002)	(0.007)	(0.005)	(0.001)
Total Employment (Some Col.)	0.031***	0.021***	0.016***	-0.001
	(0.002)	(0.007)	(0.005)	(0.001)
New Hires	0.026***	0.017**	0.012**	-0.000
	(0.002)	(0.007)	(0.006)	(0.001)
New Hires (Some Col.)	0.028***	0.018**	0.013**	-0.001
	(0.002)	(0.007)	(0.006)	(0.001)
Earnings of New Hires	0.003***	0.002	0.002*	-0.000
	(0.000)	(0.001)	(0.001)	(0.000)
Earnings of New Hires (Some Col.)	0.003***	0.002*	0.001*	-0.000
	(0.000)	(0.001)	(0.001)	(0.000)
Net Job Gains	0.035***	0.021***	0.017**	-0.011*
	(0.004)	(0.008)	(0.007)	(0.006)
Net Job Gains (Some Col.)	0.042***	0.024***	0.017**	-0.009
	(0.004)	(0.007)	(0.008)	(0.008)
Percent Employed	0.073***	0.039**	0.036***	-0.006
	(0.007)	(0.019)	(0.012)	(0.006)
Percent Employed (Some Col.)	0.025***	0.014**	0.012***	-0.002
	(0.002)	(0.005)	(0.004)	(0.002)
Observations	11,794	11,794	11,794	11,794

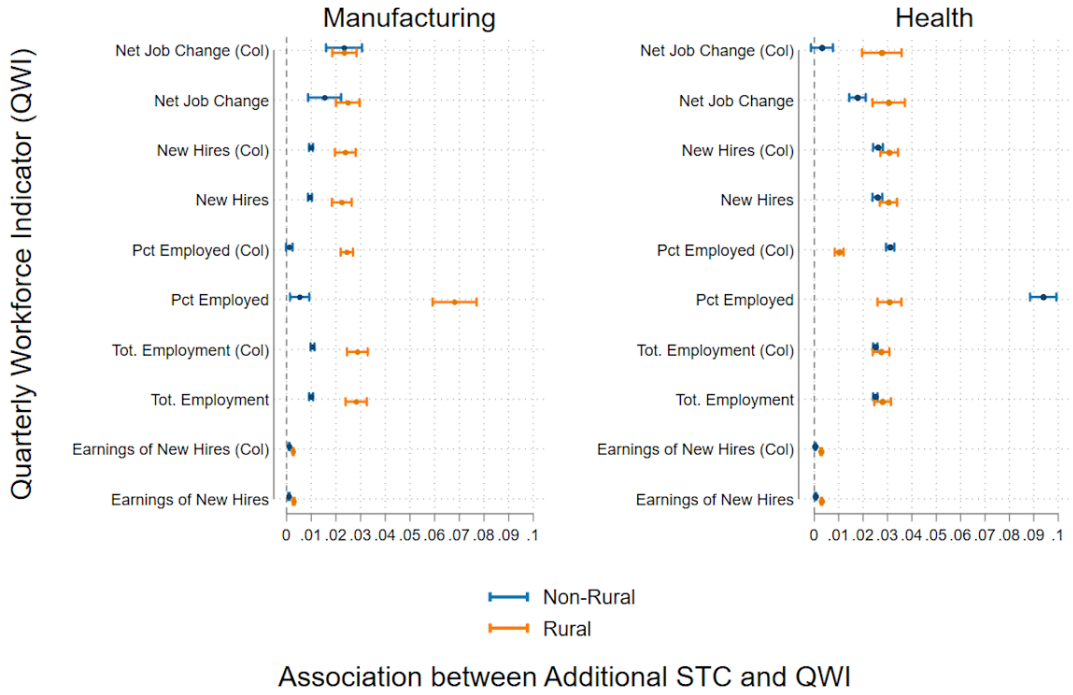
Notes: Estimated relationship between one additional STC program offered and workforce indicators from coefficients in model 1. Some Col = employee ever enrolled in college and/or completed a certificate or associate's degree. All outcomes log transformed except percent employed. Robust standard errors are clustered at the county level. Time-variant controls for county average unemployment, population size, and rurality included in all adjusted models. *Source*: IPEDS and QWI

Table 3: Relationship Between STCs Offered and Labor Market Indicators for Health

Workforce Indicators	(1) No Controls	(2) State FE	(3) CZ FE	(4) County FE
Total Employment	0.053***	0.029***	0.022***	0.001
	(0.004)	(0.007)	(0.008)	(0.001)
Total Employment (Some Col.)	0.052***	0.029***	0.021***	0.001
	(0.003)	(0.007)	(0.008)	(0.001)
New Hires	0.053***	0.031***	0.023***	0.003**
	(0.004)	(0.007)	(0.008)	(0.001)
New Hires (Some Col.)	0.054***	0.031***	0.023***	0.003**
	(0.003)	(0.007)	(0.008)	(0.001)
Earnings of New Hires	0.004***	0.002**	0.001	-0.000
	(0.000)	(0.001)	(0.001)	(0.000)
Earnings of New Hires (Some Col.)	0.003***	0.002**	0.001	-0.000
	(0.000)	(0.001)	(0.001)	(0.000)
Net Job Gains	0.043***	0.026***	0.018***	-0.000
	(0.004)	(0.007)	(0.007)	(0.003)
Net Job Gains (Some Col.)	0.038***	0.018***	0.012	0.010
	(0.005)	(0.006)	(0.008)	(0.007)
Percent Employed	0.121***	0.057*	0.041	0.011**
	(0.007)	(0.032)	(0.031)	(0.005)
Percent Employed (Some Col.)	0.040***	0.018	0.013	0.003*
	(0.003)	(0.011)	(0.010)	(0.002)
Observations	12,180	12,180	12,180	12,180

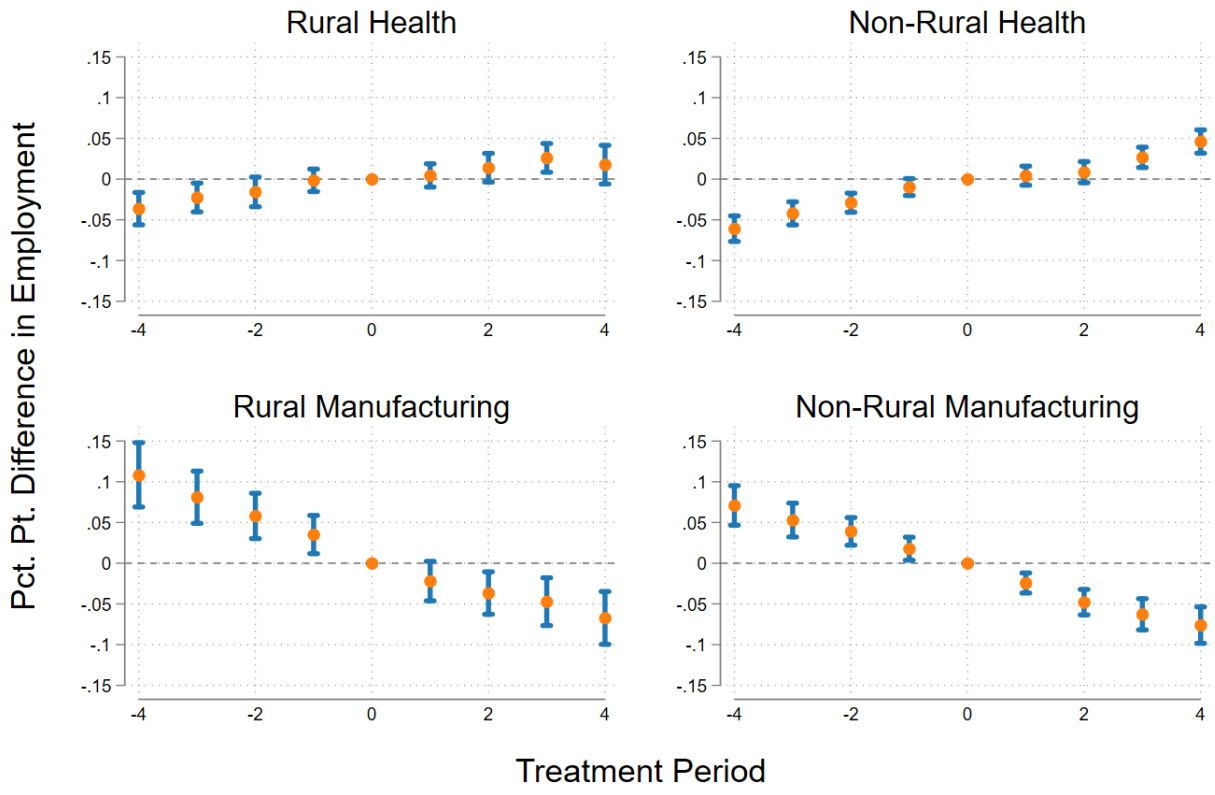
Notes: Estimated relationship between one additional STC program offered and workforce indicators from coefficients in model 1. Some Col = employee ever enrolled in college and/or completed a certificate or associate's degree. All outcomes log transformed except percent employed. Robust standard errors are clustered at the county level. Time-variant controls for county average unemployment, population size, and rurality included in all adjusted models. *Source*: IPEDS and QWI

Figure 4: Rural/Non-Rural: Relationship Between STCs Offered and Labor Market Indicators



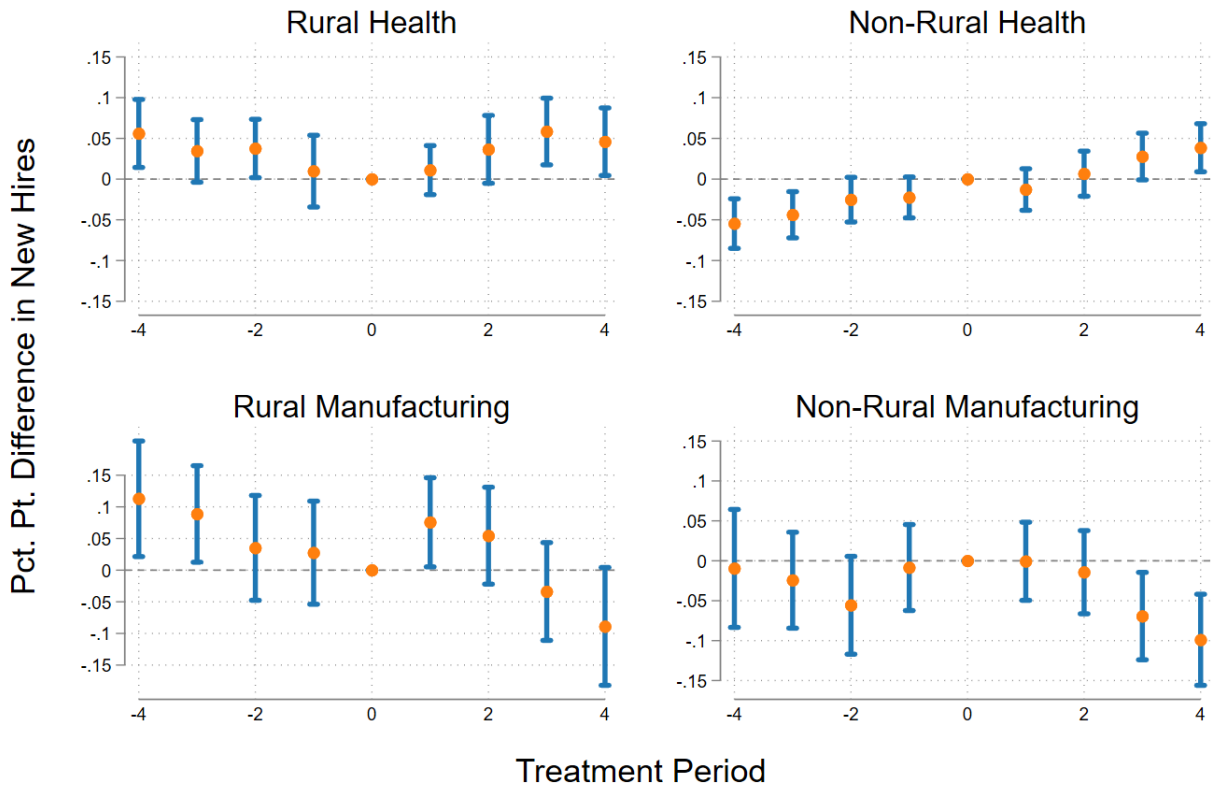
Notes: Estimates from state level fixed effects model of the association between labor market indicators and STCs in non-rural and rural counties, adjusted for state-level fixed effects, total population, and unemployment rates. "Col" indicates QWI for workers with some college (incl. associate's or certificates) but no bachelor's degree. Rural designations drawn from USDA (2015). All outcomes log transformed except Percent Employed outcomes. *Source*: IPEDS and QWI

Figure 5: ITS Model Estimates: Total Employment



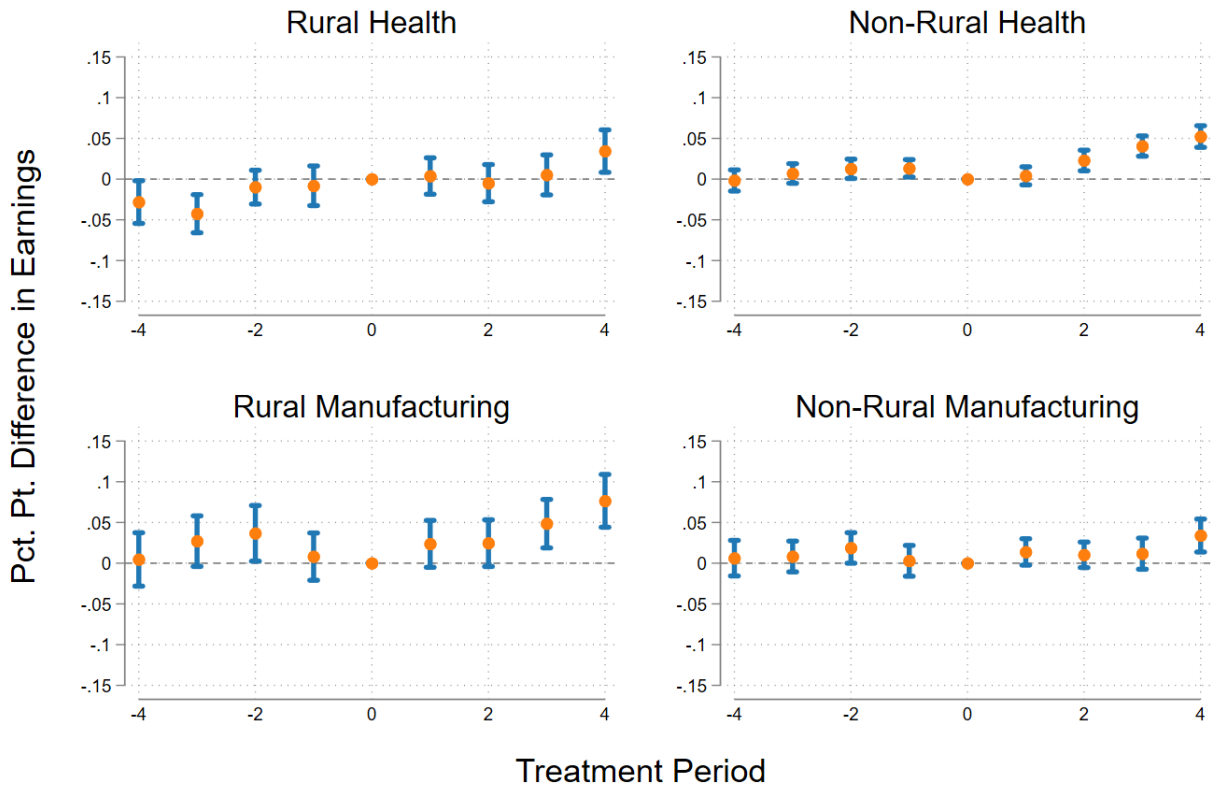
Notes: Interrupted time series (ITS) plots of the relationship between timing of large program launch and total employment by rurality. Trends adjusted for baseline county-characteristics, total population, and unemployment rates. Estimating equation 2 under model specification (1) largest STC launch.
Source: IPEDS, QWI

Figure 6: ITS Model Estimates: New Hires



Notes: Interrupted time series (ITS) plots of the relationship between timing of large program launch and total new hires by rurality. Trends adjusted for baseline county-characteristics, total population, and unemployment rates. Estimating equation 2 under model specification (1) largest STC launch.
Source: IPEDS, QWI

Figure 7: ITS Model Estimates: Earnings



Notes: Interrupted time series (ITS) plots of the relationship between timing of large program launch and earnings of new hires by rurality. Trends adjusted for baseline county-characteristics, total population, and unemployment rates. Estimating equation 2 under model specification (1) largest STC launch.
Source: IPEDS, QWI

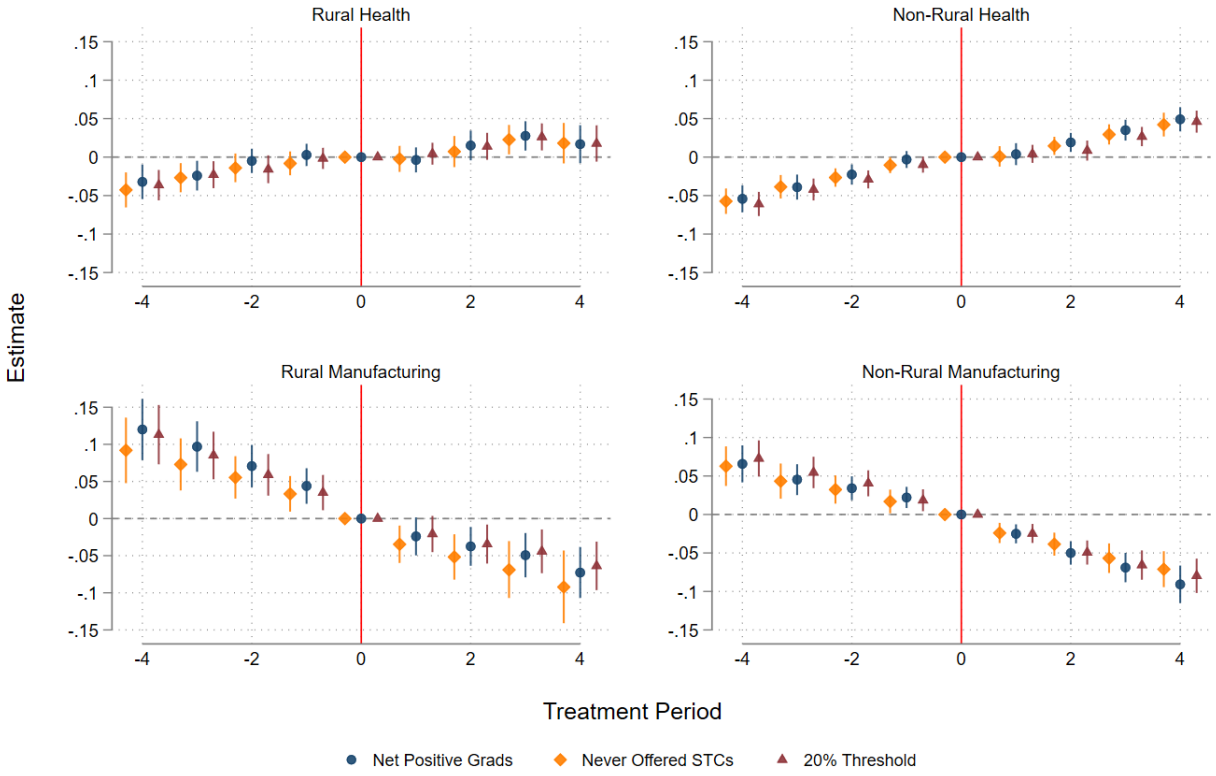
7 Appendix

Table A1: Robustness check: Estimated relationship between college program offerings and labor market indicators lagged up to 5 years

	(1)	(2)	(3)	(4)	(5)	(6)
LN(New Hires)	No lag	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
N Manuf. STCs	.00049	-0.000362	-0.00238*	.00029	-0.00170	0.00198**
	(0.000719)	(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

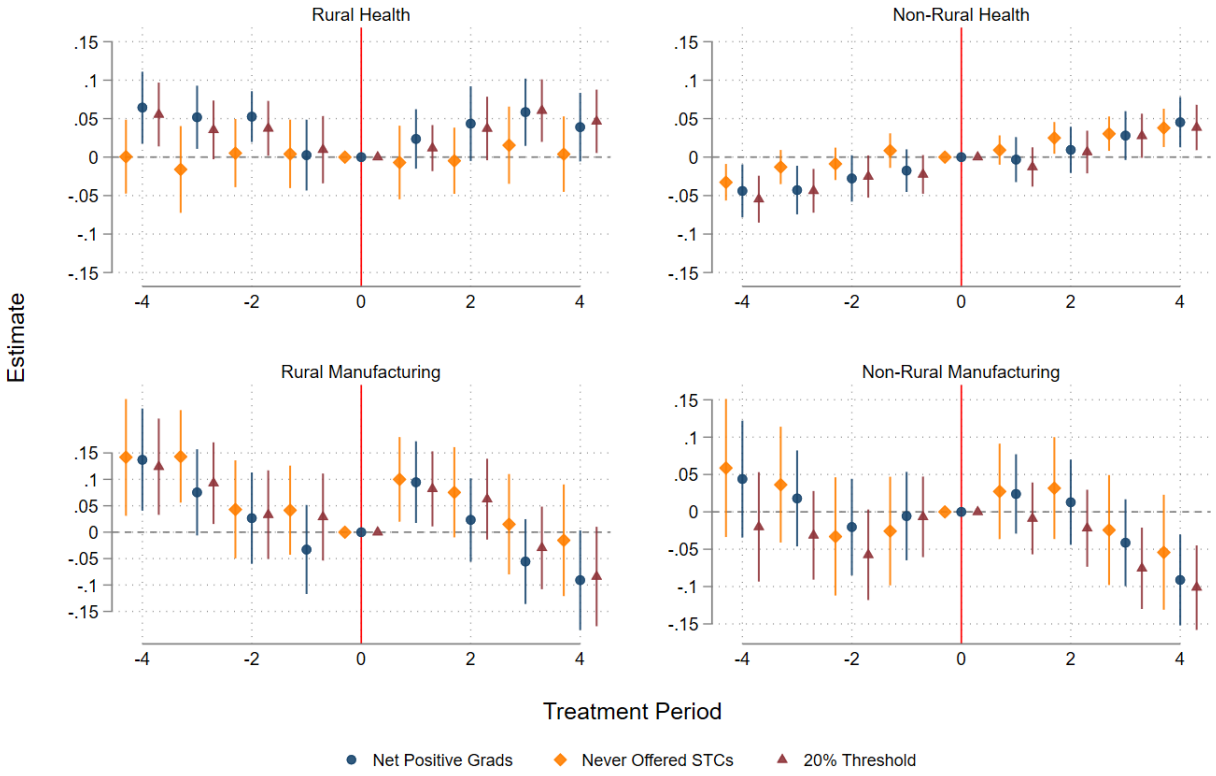
Notes: Table Notes: Estimates from equation 1 of the relationship between one additional STC program offering and natural log of new hires in manufacturing and health industries. Columns present estimates across new hires lagged by up to five years. *Source*: IPEDS and Census LEHD.

Figure A1: ITS Model Estimates with Varying Treatment Definitions: Total Employment



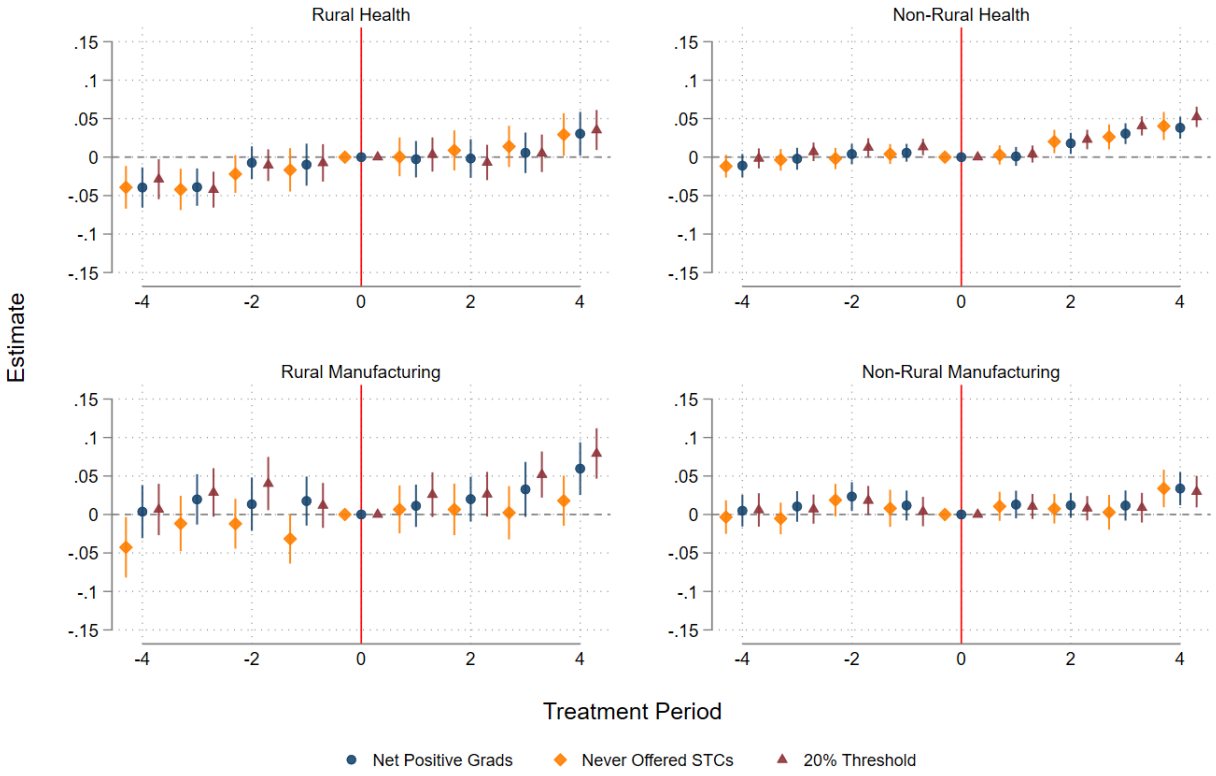
Notes: Interrupted time series (ITS) plots of the relationship between timing of large program launch and total employment by rurality. Trends adjusted for baseline county-characteristics, total population, and unemployment rates. Points show outcomes with varied definitions of large program launches, including definition 1) largest launch with net overall positive graduates, 2) largest launch of never before offered certificates, 3) largest launch that increased total offered programs by at least 20%. *Source*: IPEDS, QWI

Figure A2: ITS Model Estimates with Varying Treatment Definitions: New Hires



Notes: Interrupted time series (ITS) plots of the relationship between timing of large program launch and new hires by rurality. Trends adjusted for baseline county-characteristics, total population, and unemployment rates. Points show outcomes with varied definitions of large program launches, including definition 1) largest launch with net overall positive graduates, 2) largest launch of never before offered certificates, 3) largest launch that increased total offered programs by at least 20%. *Source*: IPEDS, QWI

Figure A3: ITS Model Estimates with Varying Treatment Definitions: Earnings



Notes: Interrupted time series (ITS) plots of the relationship between timing of large program launch and Earnings of New Hires by rurality. Trends adjusted for baseline county-characteristics, total population, and unemployment rates. Points show outcomes with varied definitions of large program launches, including definition 1) largest launch with net overall positive graduates, 2) largest launch of never before offered certificates, 3) largest launch that increased total offered programs by at least 20%. *Source*: IPEDS, QWI