ANNENBERG
BROWN UNIVERSITY

EdWorkingPaper No. 20-317

Stacking the Deck for Employment Success: Labor Market Returns to Stackable Credentials

Katharine Meyer
Brown University

Kelli A. Bird
University of Virginia

Benjamin L. Castleman
University of Virginia

With rapid technological transformations to the labor market along with COVID-19 related economic disruptions, many working adults return to college to obtain additional training or credentials. Using a comparative individual fixed effects strategy and an administrative panel dataset of enrollment and employment in Virginia, we provide the first causal estimates of credential "stacking" among working adults. We find stacking increases employment by four percentage points and quarterly wages by $570 (seven percent). Returns are larger for individuals whose first credential is a short-term certificate and in Health and Business.

VERSION: November 2020

Suggested citation: Meyer, Katharine, Kelli A. Bird, and Benjamin L. Castleman. (2020). Stacking the Deck for Employment Success: Labor Market Returns to Stackable Credentials. (EdWorkingPaper: 20-317). Retrieved from Annenberg Institute at Brown University: https://doi.org/10.26300/jzq6-2y24

Stacking the Deck for Employment Success: Labor Market Returns to Stackable Credentials

AUTHOR INFORMATION
Katharine E. Meyer (corresponding author)
Brown University

Kelli Bird
University of Virginia

Benjamin L. Castleman
University of Virginia

ABSTRACT

With rapid technological transformations to the labor market along with COVID-19 related economic disruptions, many working adults return to college to obtain additional training or credentials. Using a comparative individual fixed effects strategy and an administrative panel dataset of enrollment and employment in Virginia, we provide the first causal estimates of credential "stacking" among working adults. We find stacking increases employment by four percentage points and quarterly wages by $570 (seven percent). Returns are larger for individuals whose first credential is a short-term certificate and in Health and Business.

Stacking the Deck for Employment Success: Labor Market Returns to Stackable Credentials

I. INTRODUCTION

Postsecondary education plays a central role in income and wealth mobility (Chetty et al., 2017) and in buffering individuals from the negative effects of economic downturns (see recent evidence from BLS, 2019; BLS, 2020). Policymakers began an ambitious push to increase college enrollment and completion rates in the United States in the late 2000s, with both federal and state governments establishing goals to increase the share of the adult population with postsecondary credentials to 60 percent or higher by 2020 (Fry, 2017; Obama, 2009). Based on current attainment levels, though, the U.S. is well short of these goals. Nationally, just under half of the adult population has some type of postsecondary credential (including workforce certificates), with substantial variation across states (Lumina, 2019). The State Higher Education Executive Officers Association (SHEEO) argues that particularly given lower numbers of high school graduates in recent and upcoming cohorts, without a substantial investment in increasing education among adults over the age of 25, few states will meet these ambitious goals (Carlson & Laderman, 2018).

Much of the policy and programmatic focus has centered on increasing the share of U.S. adults who earn their *first* postsecondary credential. Yet an increasingly common but largely understudied set of policy efforts center on supporting adults with lower-level credentials to obtain additional education and training. This pattern of multiple credential accumulation is referred to within the higher education sector as "stacking" credentials. Seventeen states have allocated funding to colleges to develop stackable credentials pathways, and ten states require that their community college systems offer and advertise stacking options (Wilson, 2016).

Several shifts in the labor market over the long- and short-term suggest stackable credentials could have meaningful economic returns to students. As technology advances, firms require different tasks from their workers, and to maintain their career trajectory many individuals must complete either formal or informal training to adapt to new occupational demands and requirements (Bartel, Ichniowski, & Shaw, 2007; Carnevale, Smith & Strohl, 2010; Deming & Noray, 2019). While some firms may have the capacity to provide that training in-house, that firm-level availability has declined over time (Smith, 2020). Other individuals may work in decentralized fields or outside traditional firms (e.g., as independent contractors in the precision production industry) and turn to community colleges to add on specific training to supplement their existing credentials.

Accompanying the pace of change in the labor market has been an increase in older adult engagement with postsecondary education and particularly with the community college system. Between 2003 and 2013, overall enrollment of individuals older than 25 increased by 19 percent and about a fifth of full-time undergraduates and two-fifths of part-time undergraduates at public two-year institutions were older than 25 in the fall 2017 semester (NCES, 2016; NCES, 2020). Between 30-38 percent of adults age 25-59 reported taking a career or job-related course in the prior year, with that share increasing across all age groups between 1991-2005 (NCES, 2018). Several states have implemented variants of their free college promise programs targeting individuals currently in the workforce (see for example Tennessee Reconnect or Indiana's Workforce Ready Grant). The Lumina Foundation and SHEEO have invested in an Adult Promise initiative to partner with states to implement such programs as well as highlighting regional programs such as UpSkill Houston that partners local businesses with area K-12 schools

and community colleges to promote credentials required for open positions (SHEEO, n.d., UpSkill Houston, n.d.).

A sharper shift in employment demand and opportunities arose in the midst of the COVID-19 pandemic, which resulted in unprecedented national unemployment, peaking at 14.7 percent in April 2020, with job postings still down about 22 percent as of September 2020 relative to the start of the year (Chetty, Friedman, Hendren, Stepner, and the OI Team, 2020). Job rebounds have varied across industry – 21 percent of individuals who last worked in leisure and hospitality were still unemployed in August 2020 relative (BLS, 2020). Some researchers predict between 32-43 percent of jobs experiencing a COVID-induced layoff will transform into a permanent position cut (Barrero, Bloom, & David, 2020). Additional training may thus prove a fruitful avenue for improved employment and earnings in the post-COVID economy.

Policies that support stacking credentials could also be a strategy to reduce racial and ethnic inequalities in educational attainment and labor market success. Forty-four percent of Black undergraduates and 46 percent of Hispanic undergraduates are enrolled at a community college, where most stacked credential programs are offered (Ma & Baum, 2016). Black and Hispanic workers have been particularly hard hit by the COVID-19 recession. Black and Hispanic workers experienced higher unemployment as of August 2020 (13 and 10.5 percent) relative to White workers (7.3 percent) and had experienced increases in unemployment compared with August 2019 (2.5 times higher for Hispanic workers, 2.4 times higher for Black workers, and 2.1 times higher for White workers) (BLS, 2020). Identifying stackable credential pathways that yield high labor market returns and coupling those recommendations with support for students exiting programs and reentering the workforce could potentially ameliorate these employment differences.

Despite the potential private and social value of adults obtaining additional credentials, to date there have only been a few descriptive analyses of the association between stacking credentials and labor market outcomes, with most of these analyses focused on pre-Great Recession cohorts. While few studies have documented the prevalence of formalized stack options, in California, about 15 percent of programs that theoretically have credentials that could be stack make that explicit connection, and stack rates are about five percentage points higher for students graduating from a credential in a well-defined stack (Bohn & McConville, 2016). Bailey & Belfield (2017) find no evidence of higher employment or wages for multiple credential holders, but are not able to consistently categorize stacks in terms of timing (e.g., credentials attained over time) or relatedness (e.g., same field of study) across the various data sources. One recent policy report on California community colleges investigated the returns to career credentials in general, inclusive of students who stack multiple credentials, and found a 6-20 percent increase in wages depending on first credential (Bohn, Jackson, & McConville, 2019). The Health Professions Pathway Initiative grants awarded by the U.S. Department of Labor encouraged the creation and promotion of stackable credentials in health fields and provides some evidence around stacking returns in the post-Great Recession era. One analysis of the initiative provides a descriptive comparison of student outcomes before and after enrolling in such programs across nine community colleges and found graduates of short-term certificate stacks earned about $3,000 more than they did prior to the program and associate degree stackers earned about $6,000 more (Giani & Fox, 2017). We are not aware, however, of research that provides causal evidence on the impact of stacking credentials across a broad range of community college programs and for more recent cohorts.

We address this gap by estimating, using comparative individual fixed effects methods, the return to stacking credentials or degrees among working adults who already hold a community college credential.[1] We leverage a rich administrative dataset that includes term-level enrollment and graduation records from the Virginia Community College System and other institutions via the National Student Clearinghouse along with matched quarterly employment and records from the Virginia Employment Commission. This enables us to condition our analysis on individuals with a work history in Virginia and compare individuals who complete a stack ("stack completers") with those who similarly returned to enroll in community college after completing a first credential but did not complete a second credential ("stack attempters"). Our analysis focuses on the overall returns to stacking, which we define as accumulating multiple credentials at VCCS over time in the same field of study. We examine heterogeneous treatment effects by student characteristics (e.g., sex) and field of study (e.g., Health vs. Business) as well as variations in returns by the types of additional credentials (e.g., returning for a certificate versus an associate degree) completed.

We find positive employment and wage returns to stacking, around a four percentage point increase in employment and $570 quarterly wage increase (around seven percent higher than the average non-stacker wages in the post period of about $8,000/quarter). Individuals stacking in Health and Business have higher returns – about $640-760 quarterly wage increase, representing an almost nine percent wage increase relative to non-stackers earnings in both fields. Overall, we find little evidence of substantial differences in returns for female and male stackers, but substantially higher returns for White stackers and nearly no benefit for Black

[1] We also investigated using a difference-in-differences methodology, but constraints we have to impose on the sample in the DiD framework result in very limited precision for this analytic approach. We elaborate on these constraints in Reviewer Appendix B.

stackers on average.[2] Returns are higher for those working adults whose first credential was a short-term or long-term certificate than for those who associate degree, for whom we find little evidence that a second credential improves employment or wages. While previous literature has found mixed returns to short-term certificates in general, we find that working adults who stack on a short-term certificate have comparable or higher (depending on outcome) labor market returns than adults who stack on an associate degree. We further leverage our administrative data to examine the relatedness of credentials within field and find that very specific stacking (two credentials in the same specific field of study – for instance, two credentials as an emergency medical technician) yield higher returns than two credentials in the same broad field of study but with different specializations (for instance, a credential as an emergency medical technician and another as a phlebotomist, which are both Health professions).

Our paper makes several primary contributions. First, as we note above our study provides the first casual estimates of which we are aware of the impact of stacking credentials on labor market outcomes for a broad range of community college programs and post-Great Recession cohorts.[3] Second, our paper is an important and novel complement to a substantial body of prior work that has investigated the returns to community college credentials, but that to date has not focused on stacking. Early studies examining nationally representative surveys found positive returns to associates degree completion, with generally higher returns for women (see Belfield & Bailey, 2011 for a review of the literature). More recent work has leveraged state administrative datasets and also finds positive returns to community college credentials. These

[2] Ongoing, preliminary analyses indicate this is a result of the fields in which Black and White stackers study and the differential returns to stacking across fields.

[3] While the California report we describe earlier used an individual fixed effects model to identify within-individual returns, the focus of the report was not specifically on stacking (focused on career and technical education more broadly), incorporated only six programs of study, and did not directly examine the returns to stacking relative to a comparison group.

recent papers have examined returns to different types of credentials (e.g., associates versus certificates) and by field of study (e.g., health versus information technology) (Carruthers & Sanford, 2018; Dadgar & Trimble, 2014; Jacobsen & Mokher, 2009; Jepsen, Troske, & Coomes, 2014; Xu & Trimble, 2016). Our work extends the field's understanding of the returns to education by focusing on working adults' return to school and the relative benefit of stackable credential completion over course-taking.

Third, given an increasing policy focus on adult education and training, our work highlights a pathway for increasing educational attainment and career training among working adults who have already a postsecondary credential. Our analysis moreover highlights the disparities by race in returns to stacking and suggests the need to provide additional supports for Black working adults interested in stacking – whether to guide the programs of study in which they choose to pursue a stack or to provide improved career services to connect them with valuable employment opportunities post-stacking.

In Section II we describe the Virginia Community College System and data as well as our definitions of stacking and a summary of stacking patterns in Virginia; in Section III we outline our main empirical strategy and in Section IV we share results. We conclude in Section V with a highlight of our findings relative to the extant literature on the returns to education, a cost analysis of stacking and stack attempts, and a discussion of support strategies that could facilitate students making informed decisions about reenrollment.

II. BACKGROUND AND DATA

Virginia Community College System Context and Data

The Virginia Community College System (VCCS) is comprised of 23 colleges across the Commonwealth, geographically distributed so that no Commonwealth resident lives more than 30 miles away from a college. In the 2018-19 academic year, VCCS enrolled 228,135 students. Data for this study come from systemwide administrative records for the period from Fall 2000 to Spring 2019. These records include detailed information about each term in which a student enrolled, including program of study, courses taken, grades earned, credits accumulated, and financial aid received.[4] The records also include basic demographic information, including gender, race, parental education, and zip code. Finally, we observe all credentials awarded by VCCS colleges beginning in 2000. In addition to the VCCS administrative records, we also have access to National Student Clearinghouse (NSC) and state unemployment insurance (UI) records provided by the Virginia Employment Commission (VEC) for all students. The NSC data allows us to observe all enrollment periods and postsecondary credentials earned at non-VCCS institutions, beginning in 2004. The VEC data includes quarterly information on employer, industry (six-digit NAICS codes), and earnings, for up to five years prior to a student's first enrollment at VCCS and indefinitely during and after VCCS enrollment. The coverage of the VEC data begins in 2005. In the VEC data, we observe all non-federal employment within the Commonwealth of Virginia for employers who pay into the UI system.[5]

Stacking Definition

The Department of Labor defines stackable credentials as those accumulated "over time" and for the purposes of moving "along a career pathway or up a career ladder" (DOL, 2020). We

[4] Note that this data contains information for students enrolled in credit-bearing coursework only; VCCS colleges also offer non-credit training programs, but we are not able to observe students in these programs or their employment outcomes.

[5] Our wage data do not include earnings for individuals who work outside the Commonwealth of Virginia, such as individuals who live in Virginia but work in a neighboring state or those who migrate out of Virginia after completing their community college credential. We also do not observe earnings for self-employed workers.

therefore consider VCCS graduates to have stacked if they earned multiple credentials in different academic terms (e.g., over time) and focus our analysis on those earning multiple credentials within the same broad field of study to indicate progression along a career pathway. We use the Classification of Instructional Programs (CIP) codes – a taxonomy of high education programs created by the U.S. Department of Education – associated with students' credentials to identify stacks as multiple credentials in the same two-digit CIP code or "broad field of study" (e.g., one two-digit CIP is 51 which refers to "Health Professions and Related Clinical Sciences").

Analytic Sample

Our analysis focuses on the wage returns to stacking contrasted against the returns over time to individuals who attempted but did not complete a second credential, similar to other analyses that leverage dropouts as their comparison group (e.g., Minaya & Scott-Clayton, 2020; Jepsen, Troske, & Coomes, 2014). We limit our analytic sample to individuals who initially graduated from VCCS between the fall 2009 and summer 2014 academic terms; these are graduating cohorts for whom we can observe sufficient pre-enrollment and post-graduation quarters in our data. We further limit the timeframe to observe second credentials to nine academic terms (which corresponds to three academic years) following initial graduation. This enables us to observe second credentials and retain sufficient post-stacking quarters to observe labor market returns. As a robustness check, we extend the potential stacking window to fifteen terms (five academic years) of initial graduation using earlier cohorts for whom we can observe longer post-graduation quarters. We further omit from our treated or comparison sample students whose first credential was in a transfer-intending program and omit individuals who enroll at a non-VCCS institution following initial VCCS graduation or who ever earn a non-VCCS

credential (whether before or after first observed VCCS graduation) in order to focus our analysis on individuals likely to be in the labor market post stacking or stack attempt.

In order to examine returns to working adults, we limit our analysis to graduates who first enrolled at VCCS prior to turning 20 or first enrolled after turning 60 and drop all earnings prior to turning 18, leveraging years of potential full-time employment. We require graduates to have worked for at least four quarters prior to initial enrollment in order to (1) focus on the returns to stacking for working adults and (2) observe sufficient pre-enrollment labor market trends for our comparative individual fixed effects estimation strategy. We are able to include up to six quarters of employment prior to initial enrollment and twenty quarters following initial graduation for all cohorts in our sample. We omit from our panel of analysis any quarters between individuals' first enrollment at VCCS and their final enrollment/successful stack, given our expectation that working adults' wages while enrolled in college are not representative of their pre- or post-enrollment wage trends. Our results are robust to the inclusion of the enrollment quarters in the panel.

Who Stacks: Characteristics of Stackers in Virginia

Our final analytic sample described in Table 1 includes 2,552 graduates.[6] Stackers and attempters are similar; about two thirds are female, 60-65 percent are White and 27-30 percent are Black. Nearly all are Virginia residents and about half are first generation college graduates (with another third having missing parental education). The average age in our sample at first VCCS graduation is around 35, which aligns with our focus on working adults. There are few significant demographic differences between stackers and stack attempters - stackers are five

[6] While we condition our analysis on workforce participation prior to community college enrollment to specifically examine the returns to stacking among a working adult population, we note here that the VCCS population includes many more stackers; of the 35,660 graduates between the fall 2009 and summer 2014 academic terms who do not enroll at non-VCCS institutions in our panel, we observe 2,782 (7.8%) completed a stack.

percentage points less likely to have received a Pell grant during their first credential and are slightly older than attempters (about an 18-month difference). We do see differences in the distribution of first credential: Among stackers, almost two-thirds first completed a short-term certificate, about a fifth first completed a long-term certificate, and 14 percent first completed an associate degree. In contrast, while a slight majority (51 percent) of first degrees earned by attempters is still a short-term certificate, 34 percent first completed an associate degree and 15 percent first completed a long-term certificate. We include first degree interacted with time fixed effects in our models to compare stackers to attempters with similar backgrounds and also explore heterogeneous treatment effects to see how returns vary by individuals' first credential.

III. EMPIRICAL STRATEGY

We examine the effect of stacking credentials on students' labor market outcomes using a comparative individual fixed effects model. This approach isolates the effect within students of earning a second credential on employment and wages, holding constant observed and unobserved time-invariant characteristics of the student that might affect access to or selection into completing a second credential, while also contrasting differences in outcomes across individuals who enroll in a second credential program - those who do and do not successfully earn their second credential, following a similar strategy as previous studies to leverage "dropouts" as the comparison group (Jepsen, Troske, & Coomes, 2014; Minaya & Scott-Clayton 2020). This approach yields valid estimates with a sufficient pre-treatment outcome trend (Jacobson, LaLonde, & Sullivan, 2005) and in recent analyses performs well compared with

lottery and non-lottery estimates of the effects of community college engagement (Grosz, 2020).[7] We estimate the following model:

$$y_{it} = \alpha + \beta_1(Post_{it}) + \beta_2(Post_{it} * Stack_{it}) + \delta Intent_{it} + \gamma X_{it} + \sigma Enroll_{it} + \tau_t + \eta_i + \varepsilon_{it}$$

where for individual *i* at quarter *t*, our dependent variable is quarterly earnings (adjusted for inflation, set at zero for quarters with no recorded earnings), an indicator for being employed in the VEC data, or log of earnings.[8] The models estimating log wage returns mechanically drop zero wage quarters, representing the effect of stacking on wages, conditional on that graduate being employed. By contrast, the wage outcome that includes zero wage quarters and represents the combined effect of increased employment (the shift from zero to some wages) and increased hourly payment. $Post_{it}$ is a binary indicator that turns on the quarter following last observed enrollment or graduation from the community college system, and $Post_{it} * Stack_{it}$ interacts that exit with whether or not the individual earned a credential (subsequent models separate this out into three interactions by whether the second credential was a short-term certificate, long-term certificate, or associate degree). We also include a vector of interactions between intended second credential (or observed second credential type for stackers) and time in $Intent_{it}$.

There are a number of factors that might affect earnings in a given quarter, which we account for in vector X_{it}, which includes individuals' age and age squared in a given quarter, as

[7] In this setting, the IFE estimates tend to estimate lower returns to completion than simple pre-post comparisons (Grosz, 2020).

[8] We observe that in 86% of individual-by-quarter records with a non-zero wage reported, there is only one source of income; another 12% of records include two sources of income (which could represent either two concurrent jobs, or an individual ending one income source mid-quarter and starting with a new income source mid-quarter).

well as a time trend interacted with each of (1) age at graduation, (2) sex, (3) nonwhite, (4) initial credential type (e.g., short-term certificate), and (5) college of first credential. We also separately include indicators for each employment quarter in the panel in τ_t. The vector $Enroll_{it}$ includes time varying factors related to enrollment at VCCS – namely a binary indicator for the two quarters prior to our first observed enrollment in the panel (Ashenfelter, 1978; Ashenfelter & Card, 1985; Heckman & Hotz, 1989) a binary indicator of terms enrolled, and the number of credits attempted in a quarter.[9]

Finally, our individual fixed effect η_i holds constant the individual to produce the estimate of the within-individual changes in labor market trajectories before and after stacking. The model assumes that selection into treatment (e.g., stacking) is based on unobserved characteristics that are fixed within an individual, and that by further accounting for time-varying economic and individual factors that might also affect selection, we obtain a causal estimate of treatment on outcomes (Angrist & Pischke, 2014).

This model, akin to a difference-in-differences approach, hinges on the assumption that trends in outcomes are similar between stack attempters and completers prior to the attainment of a second credential. To evaluate the parallel trends assumption (e.g., Angrist & Pischke, 2014; Granger, 1969) we run an event study model which modifies our main analytic model to include time indicators and time interacted with treatment indicators:

$$y_{it} = \gamma_0 + \sum_{t=0}^{q} \gamma_{-t} Time_t + \sum_{t=1}^{m} \gamma_{+t} Time_t + \sum_{t=0}^{q} \gamma_{-t} (Time_t * Stack_i) + \sum_{t=1}^{m} \gamma_t (Time_t * Stack_i) + \gamma X_{it} + \sigma Enroll_{it} + \tau_t + \eta_i + \varepsilon_{it}$$

[9] While we omit quarters from our analysis between initial enrollment and last observed enrollment/stack, some stackers return for a third enrollment period after attaining a second credential, which this accounts for.

where we omit the $Post_{it}$ and $Post_{it} * Stack_{it}$ indicators and replace them with binary indicators for each time period separately and interacted with treatment (whether or not an individual stacked) to estimate whether treatment predicts variation in outcomes prior to stack completion. We use this model to estimate the differences in outcome for periods before (t_0 through t_m) and after treatment (t_1 through q), forcing the estimated difference for the last comparison time period to be zero. As with our main model, we omit all of the quarters between first and last VCCS enrollment (or, for stackers, the quarter they earn their second credential) in order to directly compare earnings patterns for working adults outside of their educational engagement period.

We graph the event study in Figure 1 and observe similar employment and wage trends prior to first enrollment, followed by stackers having persistently higher trending outcomes relative to attempters in the post period.[10] None of the pre-period interactions are statistically significant, which supports our parallel trends argument that stackers and attempters had similar labor market trajectories as working adults prior to engaging with the community college system.

IV. RESULTS

We first display the effect of stacking for the overall sample and then by field of study in Table 2. Within each panel we present the coefficient on the Stack*Post interaction and provide a comparison mean of the average outcome for non-stackers in the post period for each sample. Overall, we estimate stackers are four percentage points more likely to be employed relative to a baseline of 77 percent for non-stackers (a nine percent increase). Stackers earn $570 more in quarterly wages – about a seven percent increase over the average base quarterly wage of about

[10] We include enrollment periods in an event study model displayed in Appendix Figure 1 which shows similar conclusions, though suggests stackers having higher employment/wages during their enrollment at VCCS.

$8,000, which includes individuals with zero wages. The conditional wage return is about five percent.

Previous research has found labor market returns to credentials varies by field of study, and we separate out our sample to examine returns to stacking in Health and Business, which are the only two fields with at least 100 stackers and 100 non-stackers in the sample. We observe some variance in returns between Health and Business – the comparison group employment is higher for Health (79 percent) with a five percentage point (six percent) increase in employment for stackers, while the comparison group employment is lower in Business (75 percent) but the stacking effect (10 percentage points, 13 percent) is twice as large as for Health. The wage returns for the two fields yield slightly different estimates, though they do not appear to be significantly different from each other or from the pooled sample estimate. The estimated returns for stackers in non-Health and non-Business fields are small and not statistically significant, suggesting that returns in those two fields drive the main effect; while there is potentially substantial heterogeneity in returns across other fields, our sample size does not enable us to precisely estimate those.[11][12]

In Table 3, we evaluate differences in the returns to stacking by individual characteristics – first comparing male and female stackers in Panel A and then comparing the returns to Black and White stackers in Panel B.[13] While we observe few significant differences in the returns for

[11] Table A1 includes enrollment quarters in the panel to establish a pre-trend and yields the same interpretation; estimates are generally higher than the main results in Table 2.

[12] Table A2 runs the same models as Table 2 but extends the time horizon for stacking to five academic years following initial graduation and observes labor market outcomes seven years following initial graduation to observe both the effects of stacking over time and the effects for stackers who take more time between credentials; we reach similar conclusions as our main estimates with three exceptions – the overall log wage effect is not significant and we find evidence of a positive employment but negative log wage effect for the "other field"; though again this groups together individuals with credentials in very different fields.

[13] We interact sex or race with treatment and report the linear combination of treatment coefficient and standard errors as well as a test of the equality of coefficients between treatment estimates. For Panel B, we limit our sample to Black or white individuals for a direct comparison of outcomes and due to low numbers of individuals identifying with other races to separately estimate effects for. This retains 91 percent of the overall analytic sample.

male and female stackers – male stackers experience a slightly higher employment boost – we see stark differences in the returns by race. Black stackers have a lower, though still positive, employment return from stacking relative to white stackers (a marginally significant difference in effect sizes), but receive no significant wage benefit from stacking, relative to high wage returns for White stackers, exacerbating the racial difference in quarterly earnings observed in the comparison/stack attempting sample.[14]

In Table 4, we show how returns to stacking vary by the first credential students completed (panel A) and then by how returns vary by the second credential students completed (panel B). While we include first degree interacted with time in our main models, we include interactions between initial degree and treatment in this analysis to report variance in returns by first credential. In panel A, we see that individuals who first completed a short-term certificate (who, as noted in Table 1, comprise the largest share of our analytic sample) have the highest, most consistent returns to stacking, with an employment rate seven percentage points higher contrasted with a 75 percent employment rate for attempters in the post period who first earned a short-term certificate, and quarterly wages about $1,000 higher. Individuals who first completed a long-term certificate experience a 10 percent wage return after stacking, and although the coefficients on employment and unconditional wages are not significantly different from zero they trend positive.[15] However, we find no evidence that stacking after completing an applied

[14] Although we are limited in our ability to examine results by race and field, our preliminary analysis suggests less of a difference between Black and White workers' returns to stacking within Health and Business and that the null to negative overall estimate of differential returns by race is driven by differences in returns in other fields, as well as evidence of a different collection of fields in the "other fields" category by race. In Table A3 we report the returns to stacking for Black and White workers by field; while Health and Business are the most common fields of study for both Black and White graduates in our sample (42 and 43 percent in Health and 19 and 16 percent for Business), the next most common fields differ. Black stackers' most common "other fields" are childcare (11 percent) and computer and information sciences support (four percent) while White graduates' most common "other fields" are engineering technology (9 percent) and mechanic/repair technology (six percent).

[15] We report on the overall test of equality across the three groups, though also examine pairwise coefficients; the confidence intervals for the returns to individuals first completing a short-term certificate and long-term certificate overlap across all through measures.

associate degree benefits individuals. Individuals who first completed certificates potentially have more to gain from returning to school – their earnings between their first and second credential are about $1,000-2,000 lower than quarterly earnings for individuals after they earned their associate degree, as we would expect from the literature on differential returns to initial credentials.

Turning to the question of whether returns to stacking vary by the second credential, we include three separate treatment indicators for each degree type and report the results in panel B. Here, we find evidence that stacking a short-term certificate improve employment and earnings, with a seven percentage point increase in employment, about a $765 quarterly wage benefit and eight percent return on wages conditional on employment. Completing an associate degree as a second credential yields similarly high wage returns, though a lower employment effect.[16] However, we find no evidence that returning to complete a long-term certificate yields positive labor market returns – though we note only about 10 percent of the sample completed or attempted a long-term certificate as their second credential.

The similarly high returns to a short-term certificate and associate degree as a second credential are quite different from previous literature that find much higher returns to associate degrees on average than certificates and that long-term certificates tend to have higher returns than short-term certificates, though also document large variation in certificate returns by field of study (Carruthers & Sanford, 2018; Dadgar & Trimble, 2014; Jepsen, Troske, & Coomes, 2014). We examined returns by second credential separately by field to explore which fields might have higher returns to short-term certificates that drive the overall high returns relative to associate degrees – while we are limited by sample size in our ability to confidently estimate returns by

[16] In this table, we combine any type of associate degree pursued, though in practice three quarters of associate degrees pursued were applied associate degrees.

field, in appendix Table A4 we examine fields with at least 100 individuals in our sample and found that the average returns to short-term certificates are likely driven by gains from Human Sciences (the field childcare credentials fall under; about $1,440 quarterly) and Business (about $1,990 quarterly) while the high returns to associate degrees are likely driven by Health (about $1,330) and Mechanic Repair (about $4,300; the modal associates in this field for our sample is in HVAC repair). The labor market returns to stacking will vary by field and type of second credential, and especially the intersection of those – on average, short-term certificates may yield similar returns as associates but this likely has more to do with more individuals stacking with short-term certificates in fields where the payoff for those shorter credentials is higher than it is evidence that a short-term certificate has a large benefit for all fields.

We further examined variation in stacking by the relatedness of credential field; in Table 5 we use a separate treatment indicator for the second credential being in the same specific field of study (e.g., two credentials in the Emergency Medical Technician field) or in the same broad but not specific field of study (e.g., two credentials in Health – one in Emergency Medical Technician and one in Registered Nursing). The majority of stackers in the sample complete specific stacks – very similar credential pairings – and we find that drives our employment and quarterly wage effects. We do find the broad stacking has a significantly higher effect on wages conditional on employment, relative to a smaller and not significantly different from zero estimate for specific stacking. These conceptually map onto two different motivations for stacking. Two stacks in the same specific field of study could represent more of a career "ladder" approach – deepening skills in a specific areas – while broad stacking could represent more of a career "switching" approach – exploring a different area of expertise in hopes of attaining a new type of job (e.g., going from a career as an EMT to one as a nurse).

Cross-Sectional Employment

As other researchers have noted (Minaya & Scott-Clayton, 2020; Xu & Trimble, 2016), there some methodological questions about using a panel fixed effects approach for measuring binary employment measures. Further, the comparative individual fixed effects approach examines changes in labor market trajectories before and after stacking by examining the overall post period to determine likelihood of employment/average ages, but is unable to capture overall measures of employment stability that policymakers might be particularly interested in, such as whether an individual ever experienced unemployment following stacking. Therefore, we run in Table 6 a cross-sectional analysis of labor market outcomes five years following initial graduation. We include college, initial graduation year, two-digit CIP, and quarter observed (that accounts for quarterly variation within the graduation year fixed effect) fixed effects as well as the student demographics reported in Table 1, and estimate the effect of stacking on whether an individual was (1) ever employed, (2) the share of quarters employed, and (3) the share of quarters estimated to be employed at least full time for the quarters after stacking/last attempted stack.[17] Overall, the share of the sample ever employed after completing or attempting a stack is high at 93 percent for attempters, with stackers three percentage points more likely to have been employed. Attempters are on average employed during 48 percent of the quarters we observe and are employed at a full-time wages 42 percent of the time following their last observed VCCS enrollment, with stackers having worked more quarters and more full-time quarters (2-3 percentage points respectively).

Individual Cost Analysis

[17] Calculated as earning at least what forty hours at the Virginia state minimum wage would equal in a given quarter.

The tuition costs of community colleges are comparatively low among postsecondary options, with average annual tuition and fees of $3,730 in the 2019-20 academic year compared with the $10,440 average for four-year public institutions (Ma, Baum, Pender, & Libassi, 2019). VCCS tuition ranges between $154-180 across colleges, with institution and student fees resulting in an average semester cost of $2,310 for an in-state student taking 15 credit hours (VCCS, n.d.). Grant aid often covers most of these costs, though contingent on students' dependency status, enrollment intensity, or need to cover other living expenses, grant aid may not fully cover costs of enrollment. Using financial aid data from VCCS, we calculate total loans and grant aid received by students after their first enrollment (e.g., while attempting a stack). In Table 7 we outline the monetary and opportunity costs of stacking for individual attempters and stackers, though acknowledge there are societal and institutional costs to educating individuals that our analysis does not fully capture. Stackers are more likely to have received financial aid, through the rates are low – nine percent of stackers and six percent of attempters. It is unsurprising then that stackers received more grant aid (about $2,000 more) and took out more loans (about $1,100 more), given their overall higher rate of aid receipt. Although stackers enrolled in more terms and took more credits per term as part of their second credential, those differences are not significant between stackers and attempters. We also found stackers worked fewer quarters while enrolled in school, though again that difference is not significant and both stackers and attempters worked during most of their stack enrollment terms – 74 percent and 81 percent of terms, respectively. While the opportunity cost of foregone earnings terms while enrolled and actual cost of loans are not trivial, for stackers the estimated quarterly wage returns of about $570 likely recoup the investment within a couple years following graduation from their second credential.

V. DISCUSSION

In this paper, we quantify the effect of earning multiple, related community college credentials ("stacking") on labor market returns, using a unique panel dataset of Virginia Community College System graduates. Although there is a robust literature examining the overall returns to community college enrollment, there exists little causal evidence on the impact of stacking credentials for working adults on their employment and earnings trajectories. Using a comparative individual fixed effects model that examines changes in labor market trajectories within individuals as a result of stacking and compares changes in these trajectories over time across individuals who stack and those who re-enroll after initial graduation but do not complete a second credential, we find stackers are more likely to be employed and earn higher wages – both conditional and unconditional on employment. While we find little evidence of variation in returns for male and female graduates, we find that positive returns for White stackers drive the overall effect, with no positive effect for Black stackers. We find large, positive impacts of stacking among working adults in a Health or Business field (though we cannot rule out large returns to other fields that have fewer individuals in our sample).

On average, our estimates of the returns to a second credential are lower than the average returns to an initial associate degree but higher than the returns to a short-term certificate found in the extant literature. At the associate degree level, we find a quarterly, unconditional wage increase of $655 to stacking relative to the $1,300-$2,600 range estimated for initial associate degrees by Jepsen, Troske, and Coomes, 2014 (2014) and Minaya and Scott-Clayton (2020), suggesting that stacked associate degrees yield between a quarter and half the returns as an initial associate degree. Minaya and Scott-Clayton (2020) find unconditional wage returns in the range

of $400 for short-term certificates (though also evidence of negative returns in the same magnitude for men), while we estimate about a $760 unconditional wage benefit from stacking short-term certificates, suggesting almost double the returns to short-term certificates when partnered with another credential. Our analysis also finds suggestive evidence of field variation in the relative returns to associate degrees and short-term certificate (though our sample size limits our ability to precisely estimate returns in some fields). Minaya and Scott-Clayton (2020) as well as Stevens, Kurlaender, and Grosz (2015) similarly find variation across fields with some field alignment with our preliminary exploration (e.g., associate degrees having a higher benefit than certificates in Health but a smaller benefit than certificates in Business and Family/Human Sciences).

Short-term certificates have certain appeal in their defined short time to complete and thus lower cost (both in terms of total credits and estimated time away from the workforce or at reduced hours). Our results suggest they have benefits as well, and that community colleges could engage in targeted outreach to encourage stacking with a short-term certificate that supports working adults to acquire firm- or industry-specific skills. The higher returns in our analysis to specific stacking in line with a theoretical "career ladder" approach supports this hypothesis and may explain why we find higher returns to short-term certificates when used as a way to upskill in an established career trajectory relative to the returns to a short-term certificate as the sole credential. Our complementary cross-sectional analysis suggests higher employment stability among stackers relative to attempters, with stackers more likely to have ever been employed and employed for more quarters the five years following initial graduation. Our analysis of student financial aid reports as well as enrollment and engagement during stack attempts indicates that while on average stackers incur non-zero monetary and opportunity costs

enrolling in a second credential, the wage benefits likely exceed those costs within a few years of stacking.

Working adults comprise a large and growing share of the higher education population, but their paths to and through college differ from students entering the postsecondary system immediately following high school graduation. Without attending to and increasing educational opportunities and support for working adults, the United States is unlikely to attain its ambitious goals around college completion. In recent years, a growing number of states have invested in initiatives to increase adult enrollment and re-enrollment, such as the Tennessee Reconnect Grant. In light of the COVID-19 pandemic and recession, states have further expanded eligibility for their state financial aid programs to supporting working adults – for example, in Indiana, funding from the Rapid Recovery Expansion (CARES Act) enabled the state to expand eligibility for their Workforce Ready Grant to complete targeted certificates to individuals who already held a two- or four-year degree (Indiana Commission for Higher Education, 2020). In Michigan, the state used CARES Act funding to target financial aid through the "Future for Frontliners" initiative to essential workers – inclusive of healthcare workers, child care professionals, and grocery store employees – to enroll in college (Michigan Office of the Governor, 2020). The Wyoming TrailBlazer program similarly leveraged CARES Act funding to provide grants for unemployed or underemployed workers between the ages of 25-64 who experienced employment hardship due to COVID-19 (University of Wyoming, 2020). Our insights into the benefits from stacking and insights into promising pathways can inform guidance given to adults about programs they might pursue building on prior postsecondary experience.

Even absent these state initiatives, community college may see many more adults coming back to complete additional credentials in the post-COVID economy. Community college enrollment drove a large proportion of overall college enrollment increases and declines observed during and after the Great Recession of 2007-2009 (Schmitt, 2018). Summer 2020 enrollment decreased significantly among community colleges, but it remains to be seen how enrollment patterns trend during the fall and spring semesters of 2020-21 and subsequent years (National Student Clearinghouse, 2020). Yet completion rates declined concurrently with the enrollment increase in the 2000s, particularly among older enrollees and those enrolling at two-year institutions (Shapiro, Dundar, Yuan, Harrell, & Wakhungu, 2014). An overall decline in student supports at many broad-access institutions, including community colleges, contributes to or at least fails to mitigate the challenges many students face completing their educations (Deming & Walters, 2017; Scott-Clayton, 2015). As institutions contemplate encouraging re-enrollment for stacking, they should concurrently consider how best to support students after that re-enrollment, whether that be through additional stipends to support resource constraints (Barrera-Osorio, Kugler, & Silliman, 2020), personalized nudge outreach to support degree completion (Mabel, Castleman, & Bettinger, 2019), or by advocating for larger scale investments such as free college programs (Bartik et al., 2017; Gurantz, 2020; Page, Iriti, Lowry, & Anthony, 2019) or intensive advising and holistic student support (Scrivener et al., 2015).

REFERENCES

Angrist, J., & Pischke, J. (2009). *Mostly harmless econometrics: An empiricist's companion*. Princeton University Press.

Ashenfelter, O. (1978). Estimating the effect of training programs on earnings. *Review of Economics and Statistics*. 60, 47-57.

Ashenfelter, O., & Card, D. (1985). Using the longitudinal structure of earnings to estimate the effect of training programs. *The Review of Economics and Statistics*. 67, 648-660.

Barrero, J., Bloom, N., & Davis, S. (2020). COVID-19 is also a reallocation shock. Becker Friedman Institute for Economics Working Paper No. 2020-59. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3592953

Bartel, A., Ichiowski, C., & Shaw, K. (2007). How does information technology affect productivity? Plant-level comparisons of product innovation, process improvement, and worker skills. Quarterly Journal of Economics, 122(4), 1721-1758.

Bartik, T., Hershbein, B., & Lachowska, M. (2019). The effects of the Kalamazoo Promise Scholarship on college enrollment, persistence, and completion. *Journal of Human Resources, 56*(1), 269-310.

Bohn, S., & McConville, S. (2018). Stackable Credentials in Career Education at California Community Colleges. Public Policy Institute of California. California. https://www.ppic.org/wp-content/uploads/stackable-credentials-in-career-education-at-california-community-colleges-october-2018.pdf

Bailey, T., & Belfield, C. R. (2017). Stackable credentials: do they have labor market value? (CCRC Working Paper No. 97). New York, NY: Teacher's College, Columbia University

Bohn, S., Jackson, J., & McConville, S. (2019). Career pathways and economic mobility at California's community colleges. Public Policy Institute of California. https://www.ppic.org/wp-content/uploads/career-pathways-and-economic-mobility-at-californias-community-colleges.pdf

Barrera-Osorio, F., Kugler, A., & Silliman, M. (2020). Hard and soft skills in vocational training: Experimental evidence from Colombia. National Bureau of Economic Research Working Paper No. 27548. https://www.nber.org/papers/w27548

Mabel, Z., Castleman, B. L., & Bettinger, E. P. (Working Paper). Finishing the Last Lap: Experimental Evidence on Strategies to Increase College Completion for Students at Risk of Late Departure. Retrieved from https://scholar.harvard.edu/files/zmabel/files/finishing_the_last_lap_-_working_paper_2-27-19.pdf

Bureau of Labor Statistics. (2019). *Employment status of the civilian noninstitutional population by certification and licensing status and selected characteristics, 2019 annual averages*. Retrieved from https://www.bls.gov/cps/cpsaat50.pdf.

Bureau of Labor Statistics. (2020). *The employment situation – October 2020*. Retrieved from https://www.bls.gov/news.release/pdf/empsit.pdf

Carruthers, C., & Sanford, T. (2018). Way station or launching pad? Unpacking the returns to adult technical education. *Journal of Public Economics, 165*(2018), 146-159.

Carlson, A., & Laderman, S. (2018). The power of a promise: Implications and importance of adult promise programs. State Higher Education Executive Officers Association Report. Retrieved from https://files.eric.ed.gov/fulltext/ED603919.pdf

Carnevale, A. P., Smith, N., & Strohl, J. (2013). Recovery: Job growth and education requirements through 2020. *Georgetown University Center of Education and the Workforce*.

Chetty, R., Friedman, J. N., Hendren, Stepner, and the OI Team (2020). The economic impacts of COVID-19: Evidence from a new public database built using private sector data. Working Paper. Retrieved from https://opportunityinsights.org/wp-content/uploads/2020/05/tracker_paper.pdf

Chetty, R., Friedman, J. N., Saez, E., Turner, N., & Yagan, D. (2017). Mobility report cards: The role of colleges in intergenerational mobility. Retrieved from http://www.equality-of-opportunity.org/papers/coll_mrc_paper.pdf.

Dadgar, M., & Trimble, M. J. (2014). Labor market returns to sub-baccalaureate credentials: How much does a community college degree or certificate pay? *Educational Evaluation and Policy Analysis, 37*(4), 399-418.

Deming, D., & Walters, C. (2017). The impact of price caps and spending cuts on U.S. postsecondary attainment. Working Paper. Retrieved from https://scholar.harvard.edu/files/ddeming/files/DW_Aug2017.pdf

Deming, D., & Noray, K. (forthcoming). Earnings dynamics, changing job skills, and STEM careers. *Quarterly Journal of Economics*.

Department of Labor (2020). Increasing credential, degree, and certificate attainment by participants of the public workforce system. Training and Employment Guidance Letter No. 15-10. Retrieved from https://wdr.doleta.gov/directives/attach/TEGL15-10.pdf.

Fry, R. (2017). US still has a ways to go in meeting Obama's goal of producing more college grads. Washington, DC: Pew Research Center.

Giani, M. & Fox, H. L. (2017). Do stackable credentials reinforce stratification or promote upward mobility? An analysis of health professions pathways reform in a community college consortium. *Journal of Vocational Education & Training, 69*(1), 100-122.

Grosz, M. (2020). The returns to a large community college program: Evidence from admissions lotteries. *American Economic Journal: Economic Policy, 12*(1), 226-53.

Granger, C. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica, 37*, 424-38.

Gurantz, O. (2020). What does free community college buy? Early impacts from the Oregon Promise. *Journal of Policy Analysis and Management*, *39*(1), 11-35.

Heckman, J., & Hotz, J. (1989). Choosing among alternative nonexperimental methods for estimating the impact of social programs: The case of manpower training. *Journal of the American Statistical Association, 84*(408), 862-874.

Indiana Commission for Higher Education (2020). *Workforce Ready Grant*. Retrieved from https://www.in.gov/che/4773.htm

Jacobsen, L. & Mokher, C., (2009). *Pathways to boosting the earnings of low-income students by increasing their educational attainment*. [Hudson Institute and CNA Report]. Retrieved from https://files.eric.ed.gov/fulltext/ED504078.pdf

Jepsen, C., Troske, K., & Coomes, P. (2014). The labor market returns to community college degrees, diplomas, and certificates. *Journal of Labor Economics, 32*(1), 95-121.

Jacobson, L., Lalonde, R., & Sullivan, D. (2005). Estimating the returns to community college schooling for displaced workers. *Journal of Econometrics, 125*(1-2), 271-304.

Jepsen, C., Troske, K., & Coomes, P. (2014). The labor market returns to community college degrees, diplomas, and certificates. *Journal of Labor Economics, 32*(1), 95-121.

Lumina Foundation (2019). A stronger nation [Report]. Retrieved from https://www.luminafoundation.org/our-work/stronger-nation/

Michigan Office of the Governor (2020, April 29). Governor Whitmer announces "Futures for Frontliners," a G.I. Bill program for essential workers [Press Release]. Retrieved from https://www.michigan.gov/whitmer/0,9309,7-387-90499_90640-527530--,00.html

Ma, J., Baum, S., Pender, M., & Libassi, C. (2019). *Trends in student aid 2019*. Trends in Higher Education Series, College Board. Retrieved from https://research.collegeboard.org/pdf/trends-student-aid-2019-full-report.pdf

Ma, J., & Baum, S. (2016). *Trends in community colleges: Enrollment, prices, student debt, and completion*. [Research Brief, College Board]. Retrieved from https://research.collegeboard.org/pdf/trends-community-colleges-research-brief.pdf

Minaya, V., & Scott-Clayton, J. (2020). Labor market trajectories for community college graduates: How returns to certificates and associate's degrees evolve over time. *Education Finance and Policy*, p.1-62.

National Center for Education Statistics (2016). *Postsecondary Education*. Digest of Education Statistics. Retrieved from https://nces.ed.gov/programs/digest/d14/ch_3.asp

National Center for Education Statistics (2020). *College student employment*. Digest of Education Statistics. Retrieved from https://nces.ed.gov/programs/coe/pdf/coe_ssa.pdf

National Center for Education Statistics (2018). *Participation rate of person, 17 years old and over, in adult education during the previous 12 months*. Digest of Education Statistics. Retrieved from https://nces.ed.gov/programs/digest/d18/tables/dt18_507.40.asp

National Student Clearinghouse (2020). Fall enrollment. Retrieved from https://nscresearchcenter.org/stay-informed/

Obama, Barack. “The President Addresses Joint Session of Congress.” *The White House*, The United States Government, 24 Feb, 2009, https://obamawhitehouse.archives.gov/video/EVR022409#transcript.

Page, L. C., Iriti, J. E., Lowry, D. J., & Anthony, A. M. (2019). The promise of place-based investment in postsecondary access and success: Investigating the impact of the Pittsburgh Promise. *Education Finance and Policy*, *14*(4), 572-600.

State Higher Education Executive Officers Association (n.d.). Adult Promise. Retrieved from https://sheeo.org/project/adult-promise/

Smith, B. (2020). Microsoft launches initiative to help 25 million people worldwide acquire the digital skills needed in a COVID-19 economy. Official Microsoft Blog. https://blogs.microsoft.com/

Stevens, A. H., Kurlaender, M., & Grosz, M. (2018). Career technical education and labor market outcomes: Evidence from California community colleges. *Journal of Human Resources*, 1015-7449R2.

Schmitt, E. (2018). *Census shows Great Recession’s impact on college enrollment*. Census Bureau. Retrieved from https://www.census.gov/library/stories/2018/06/going-back-to-college.html

Shapiro, D., Dundar, A., Yuan, X., Harrell, A. T., Wild, J. C., & Ziskin, M. B. (2014). *Some college, no degree: A national view of students with some college enrollment, but no completion* (Signature Report No. 7). National Student Clearinghouse.

Scrivener, S., Weiss, M., Ratledge, A., Rudd, T., Sommo, C., & Fresques, H. (2015*). Doubling graduation rates: Three-year effects of CUNY’S Accelerated Study in Associate*

Programs (ASAP) for developmental students. MDRC Report. Retrieved from https://www.mdrc.org/sites/default/files/doubling_graduation_rates_fr.pdf

Scott-Clayton, J. (2015). The shapeless river: Does a lack of structure inhibit students' progress at community colleges? In B. L. Castleman, S. Schwartz, & S. Baum, *Decision making for student success: Behavioral insights to improve college access and persistence* (pp. 102-123). New York, NY: Routledge Press.

University of Wyoming (2020, August 4). *Grants available to adult learners at UW, community colleges* [Press release]. Retrieved from https://www.uwyo.edu/uw/news/2020/08/grants-available-to-adult-learners-at-uw,-community-colleges.html#:~:text=Gov.,the%20impacts%20of%20COVID%2D19.

UpSkill Houston (n.d.). UpSkill Houston: About. Retrieved from https://www.houston.org/upskillhouston#continuedacclaim

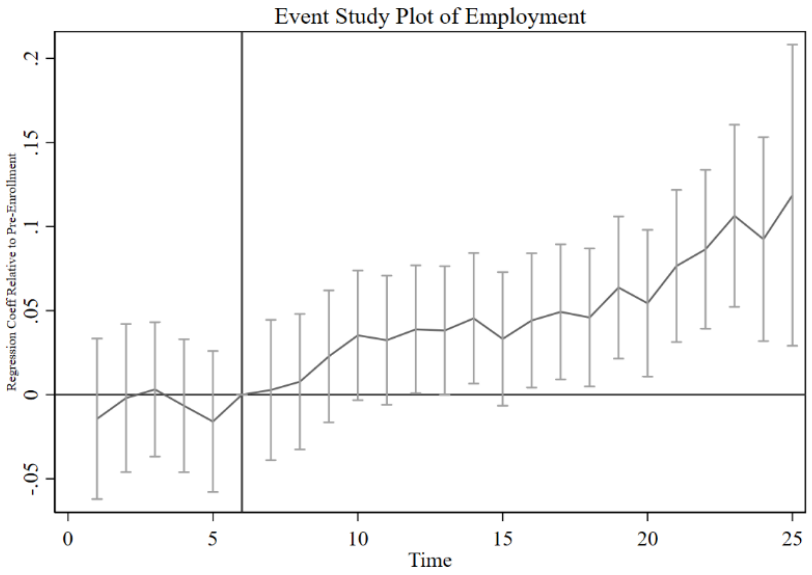
VCCS (n.d.). *Current tuition rates*. Retrieved from https://www.vccs.edu/application-information/#tuition-fees

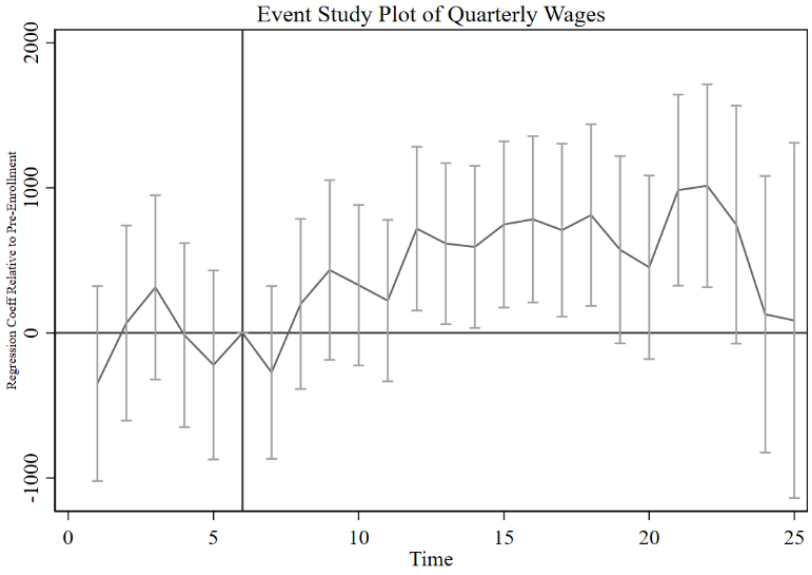
Wilson, B. (2016). S*kills in the states: Stackable credential policy*. Retrieved from the National Skills Coalition website: https://www.nationalskillscoalition.org/resources/publications/file/Stackable-Credential-Scan-2.pdf.

Xu, D., & Trimble, C. R. (2016). What About Certificates? Evidence on the Labor Market Returns to Nondegree Community College Awards in Two States. *Educational Evaluation and Policy Analysis. 38*(2). 272–292.

FIGURES

FIGURE 1: Event Study, Omitting Enrollment Phases





TABLES

Table 1: Stack Attempters & Completers

	Stackers	Stack Attempted	
Graduate Demographics			
Female	0.66	0.64	
Asian	0.02	0.02	
Black	0.27	0.30	
Hispanic	0.04	0.04	
White	0.65	0.61	
Virginia Resident	0.98	0.99	*
First-Generation	0.51	0.49	
Missing Parental Education	0.34	0.34	
Ever Received Pell	0.48	0.53	**
Age at Initial Degree	37.03	35.48	***
Military Service	0.04	0.02	
Rural	0.27	0.30	
Suburban	0.47	0.43	
Urban	0.16	0.16	
Missing Locale	0.09	0.11	
Initial Degree			
Initial Degree: Short-term certificate	0.65	0.51	***
Initial Degree: Long-term certificate	0.21	0.15	***
Initial Degree: Applied Associates	0.14	0.34	***
N graduates	813	1,739	

Notes: First-generation indicates that the highest recorded graduation of the student's parents of record is less than college graduation. Ever received Pell indicates whether individual received a Pell grant prior to their first graduation. Age is age at first graduation from VCCS. Several credentials is an indicator for whether a student earned multiple credentials from a VCCS institution within nine academic terms of initial graduation. Stacked credentials is a subset of the several credentials group and indicates that the student's two credentials shared the same two-digit (broad) or six-digit (specific) CIP (Classification of Instruction Program) code.
*p<0.05, **p<0.01, ***p<0.001

Table 2: Effect of Stacking on Labor Market Outcomes

	Employment		Wages		Log Wages	
Panel A: Full Sample						
Stack*Post	0.04	***	568.25	***	0.05	**
	(0.01)		(112.40)		(0.02)	
Comparison mean	0.77		7968.04		8.96	
N observations	52,066		52,066		42,487	
N graduates	2,552		2,552		2,552	
Panel B: Health						
Stack*Post	0.05	***	636.85	***	0.07	*
	(0.01)		(159.95)		(0.03)	
Comparison mean	0.79		7283.66		8.88	
N observations	21,552		21,552		17,790	
N graduates	1,081		1,081		1,081	
Panel C: Business						
Stack*Post	0.10	***	758.10	**	0.03	
	(0.02)		(274.88)		(0.04)	
Comparison mean	0.75		8622.12		9.07	
N observations	9,557		9,557		7,902	
N graduates	453		453		453	
Panel D: Other Fields						
Stack*Post	0.00		245.89		0.03	
	(0.01)		(192.27)		(0.03)	
Comparison mean	0.77		8375.14		9.00	
N observations	20,957		20,957		16,795	
N graduates	1,018		1,018		1,018	

Notes: Robust standard errors in parentheses. Models include individual fixed effects, a time trend, year and quarter fixed effects, college-by-year fixed effects, fixed effects for various graduate characteristics (race, sex, age of initial degree, initial degree type, intended second credential) interacted with time, age in a given quarter, and indicators for time enrolled at VCCS during first and second credential attempts and an indicator for the two quarters prior to initial enrollment (Ashenfelter dip).
*p<0.05, **p<0.01, ***p<0.001

Table 3: Effect of Stacking on Labor Market Outcomes, by Demographics

	Employment		Wages		Log Wages	
Panel A: Sex						
Male Stackers	0.06	***	628.69	**	0.02	
	(0.01)		(215.95)		(0.03)	
Female Stackers	0.04	***	534.22	***	0.06	**
	(0.01)		(124.89)		(0.02)	
Test of Diff	0.030		0.662		0.135	
Male comparison mean	0.78		9611.77		9.17	
Female comparison mean	0.77		7049.71		8.84	
N observations	52,066		52,066		42,487	
N graduates	2,552		2,552		2,552	
Panel B: Race						
Black Stackers	0.03	*	169.65		-0.02	
	(0.01)		(204.47)		(0.03)	
White Stackers	0.05	***	675.85	***	0.09	***
	(0.01)		(142.33)		(0.02)	
Test of Diff	0.071		0.013		0.002	
Black comparison mean	0.78		7450.19		8.89	
White comparison mean	0.77		8242.40		8.99	
N observations	47,748		47,748		39,006	
N graduates	2,335		2,335		2,335	

Notes: Robust standard errors in parentheses. Models include individual fixed effects, a time trend, year and quarter fixed effects, college-by-year fixed effects, fixed effects for various graduate characteristics (race, sex, age of initial degree, initial degree type, intended second credential) interacted with time, age in a given quarter, and indicators for time enrolled at VCCS during first and second credential attempts and an indicator for the two quarters prior to initial enrollment (Ashenfelter dip). Models include an interaction between characteristic (e.g., sex, race) and the treatment indicators. Test of differences reports the p-value on the postestimation test of equality of coefficients for the two groups.

*p<0.05, **p<0.01, ***p<0.001

Table 4: Effect of Stacking on Labor Market Outcomes, by Credential Type

	Employment		Wages		Log Wages	
Panel A: First Credential						
First: Short-term certificate	0.07	***	1097.74	***	0.06	**
	(0.01)		(138.44)		(0.02)	
First: Long-term certificate	0.03		425.02		0.10	*
	(0.02)		(222.37)		(0.05)	
First: Applied Associate	0.00		-1127.22	***	-0.01	
	(0.02)		(296.20)		(0.05)	
Test of Diff	0.000		0.000		0.128	
Short-term certificate mean	0.75		7300.85		8.87	
Long-term certificate mean	0.76		7339.10		8.92	
Applied Associate mean	0.80		9221.73		9.09	
N observations	52,066		52,066		42,487	
N graduates	2,552		2,552		2,552	
Panel B: Second Credential						
Second: Short-term certificate	0.07	***	764.86	***	0.08	**
	(0.01)		(185.61)		(0.03)	
Second: Long-term certificate	0.00		-367.69		-0.08	
	(0.02)		(259.34)		(0.05)	
Second: Associate degree	0.04	***	655.35	***	0.05	*
	(0.01)		(141.01)		(0.03)	
Test of Diff	0.000		0.000		0.004	
Short-term certificate intending mean	0.77		8060.62		8.99	
Long-term certificate intending mean	0.80		6670.13		8.76	
Associate intending mean	0.75		7237.92		8.87	
N observations	52,066		52,066		42,487	
N graduates	2,552		2,552		2,552	

Notes: Robust standard errors in parentheses. Models include individual fixed effects, a time trend, year and quarter fixed effects, college-by-year fixed effects, fixed effects for various graduate characteristics (race, sex, age of initial degree, initial degree type, intended second credential) interacted with time, age in a given quarter, and indicators for time enrolled at VCCS during first and second credential attempts and an indicator for the two quarters prior to initial enrollment (Ashenfelter dip). Models in panel A test heterogeneous treatment effect by including an interaction between first credential and the treatment indicators. Models in panel B test variance in returns by including separate treatment indicators for each type of second credential stacked. Test of differences reports the p-value on the postestimation test of equality of coefficients for the two groups.

*p<0.05, **p<0.01, ***p<0.001

Table 5: Effect of Stacking on Labor Market Outcomes, by Field Relatedness

	Employment		Wages		Log Wages	
Stack in same broad field of study	0.01		-99.42		0.08	**
	(0.01)		(167.41)		(0.03)	
Stack in same specific field of study	0.06	***	871.47	***	0.03	
	(0.01)		(129.22)		(0.02)	
Test of Diff	0.000		0.000		0.023	
Comparison Mean	0.77		7968.04		8.96	
N observations	52,066		52,066		42,487	
N graduates	2,552		2,552		2,552	

Notes: Robust standard errors in parentheses. Models include individual fixed effects, a quarter fixed effect, fixed effects for various graduate characteristics (race, sex, age at initial graduation, initial graduation college, and intended second credential) interacted with time, age in a given quarter, and indicators for time enrolled at VCCS, total quarters enrolled for, and an indicator for the two quarters prior to initial enrollment (Ashenfelter dip).
*p<0.05, **p<0.01, ***p<0.001

Table 6: Cross Sectional Employment Outcomes

	Ever Employed	Share Employed	Share Employed FT
Stackers	0.03**	0.02**	0.03**
	(0.01)	(0.01)	(0.01)
Comparison Mean	0.93	0.48	0.42
N	2,552	2,552	2,552

Notes: Robust standard errors in parentheses. Models include individual demographics reported in table 1 along with college, graduation year, field of study, and quarter of observation fixed effects.
*p<0.05, **p<0.01, ***p<0.001

Table 7: Monetary and Opportunity Costs of Stacking

	Stackers	Attempters	Difference	
Share receiving stack financial aid	0.09	0.06	0.03	***
			(0.00)	
Average stack grant aid	5011.55	3093.04	2067.89	***
			(238.92)	
Average stack loan aid	3165.59	1975.32	1139.03	***
			(327.92)	
Average stack terms enrolled	4.05	3.15	0.85	
			(0.11)	
Average credits/stack term	7.85	6.21	1.75	
			(0.14)	
Share of stack terms employed	0.74	0.81	-0.07	
			(0.02)	
N	813	1,739	2,552	

Notes: Robust standard errors in parentheses. Models include individual demographics reported in Table 1 along with college, graduation year, and field of study fixed effects.
*p<0.05, **p<0.01, ***p<0.001

APPENDIX A – TABLES

Table A1: Effect of Stacking on Labor Market Outcomes, Including Enrolled Quarters in Panel

	Employment		Wages		Log Wages	
Panel A: Full Sample						
Stack*Post	0.06	***	730.62	***	0.07	***
	(0.01)		(72.06)		(0.01)	
Comparison Mean	0.77		7968.04		8.96	
N observations	93,929		93,929		75,608	
N graduates	2,552		2,552		2,552	
Panel B: Health						
Stack*Post	0.10	***	1483.52	***	0.15	***
	(0.01)		(116.65)		(0.02)	
Comparison Mean	0.79		7283.66		8.88	
N observations	39,591		39,591		32,110	
N graduates	1,081		1,081		1,081	
Panel C: Business						
Stack*Post	0.08	***	371.10	*	0.02	
	(0.01)		(167.99)		(0.03)	
Comparison Mean	0.75		8622.12		9.07	
N observations	17,092		17,092		13,883	
N graduates	453		453		453	
Panel D: Other Fields						
Stack*Post	0.01		-39.30		0.04	
	(0.01)		(121.95)		(0.02)	
Comparison Mean	0.77		8375.14		9.00	
N observations	37,246		37,246		29,615	
N graduates	1,018		1,018		1,018	

Notes: Robust standard errors in parentheses. Models include individual fixed effects, a time trend, year and quarter fixed effects, college-by-year fixed effects, fixed effects for various graduate characteristics (race, sex, age of initial degree, initial degree type, intended second credential) interacted with time, age in a given quarter, and indicators for time enrolled at VCCS during first and second credential attempts and an indicator for the two quarters prior to initial enrollment (Ashenfelter dip).
*p<0.05, **p<0.01, ***p<0.001

Table A2: Effect of Stacking on Labor Market Outcomes, longer term

	Employment		Wages		Log Wages	
Panel A: Full Sample						
Stack*Post	0.09	***	781.94	***	0.01	
	(0.01)		(132.28)		(0.02)	
Comparison Mean	0.77		8388.52		9.02	
N observations	50,430		50,430		40,606	
N graduates	1,899		1,899		1,899	
Panel B: Health						
Stack*Post	0.09	***	991.82	***	0.07	*
	(0.01)		(182.09)		(0.03)	
Comparison Mean	0.79		7737.77		8.95	
N observations	21,408		21,408		17,290	
N graduates	833		833		833	
Panel C: Business						
Stack*Post	0.10	***	829.98	**	-0.01	
	(0.02)		(329.10)		(0.05)	
Comparison Mean	0.75		8984.24		9.13	
N observations	8,376		8,376		6,856	
N graduates	304		304		304	
Panel D: Other Fields						
Stack*Post	0.04	**	17.28		-0.09	**
	(0.01)		(232.14)		(0.03)	
Comparison Mean	0.77		8838.85		9.06	
N observations	20,646		20,646		16,460	
N graduates	762		762		762	

Notes: Robust standard errors in parentheses. Models include individual fixed effects, a time trend, year and quarter fixed effects, college-by-year fixed effects, fixed effects for various graduate characteristics (race, sex, age of initial degree, initial degree type, intended second credential) interacted with time, age in a given quarter, and indicators for time enrolled at VCCS during first and second credential attempts and an indicator for the two quarters prior to initial enrollment (Ashenfelter dip).
*p<0.05, **p<0.01, ***p<0.001

Table A3: Labor Market Returns to Stacking, by field and race

		Employed	Wages	Ln(Wage)
Health	Black Stackers	0.099***	778.202**	0.050
		(0.02)	(332.93)	(0.06)
	White Stackers	0.029*	440.795*	0.072
		(0.01)	(192.41)	(0.04)
	Test of Diff	0.001	0.311	0.719
Business	Black Stackers	0.057*	900.934	-0.029
		(0.03)	(461.93)	(0.07)
	White Stackers	0.118***	727.014*	0.114
		(0.02)	(353.42)	(0.06)
	Test of Diff	0.026	0.707	0.035
Other	Black Stackers	-0.058**	-761.645*	-0.075
		(0.02)	(330.59)	(0.05)
	White Stackers	0.034*	757.349**	0.077
		(0.02)	(248.31)	(0.04)
	Test of Diff	0.000	0.000	0.004

Notes: Robust standard errors in parentheses. Models include individual fixed effects, a time trend, year and quarter fixed effects, college-by-year fixed effects, fixed effects for various graduate characteristics (race, sex, age of initial degree, initial degree type, intended second credential) interacted with time, age in a given quarter, and indicators for time enrolled at VCCS during first and second credential attempts and an indicator for the two quarters prior to initial enrollment (Ashenfelter dip). Models include an interaction between characteristic (e.g., race) and the treatment indicators. Test of differences reports the p-value on the postestimation test of equality of coefficients for the two groups.

*p<0.05, **p<0.01, ***p<0.001

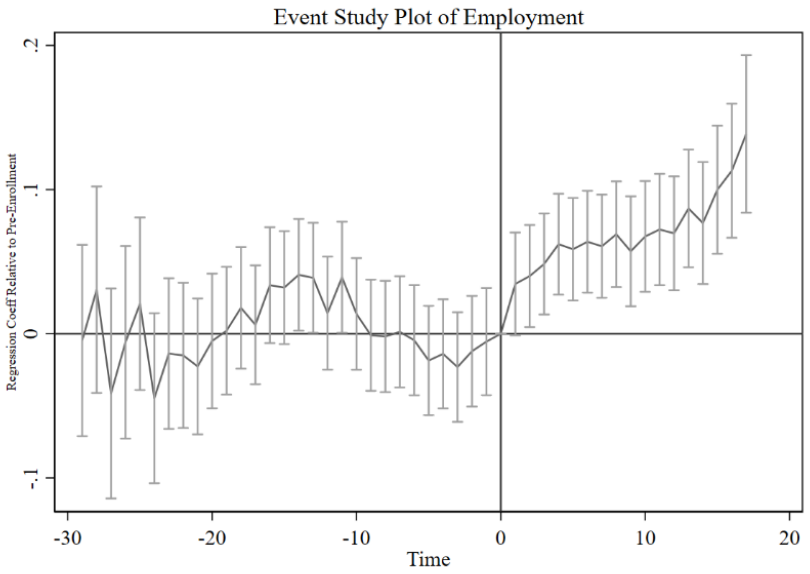
Table A4: Wage returns to stacking at different second credential levels, by field

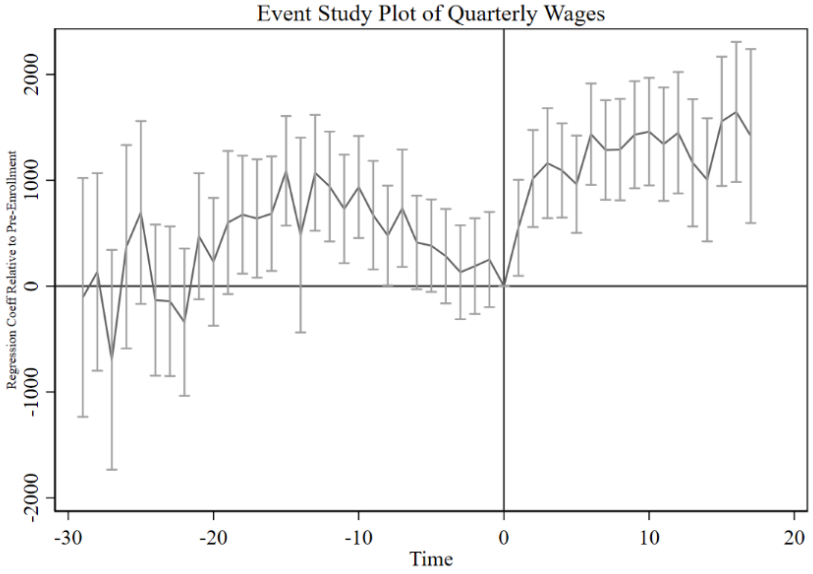
	Short-term Certificate		Long-term certificate		Associate degree		Observations	F-test
Computer Information Stack	944		7336		-220		2,067	0.264
	(855.75)		(4346.24)		(986.47)			
Comparison Mean	10,754		2,151		8,312			
Engineering Technology Stack	643		7388	***	1102		4,195	0.000
	(726.08)		(1071.98)		(577.47)			
Comparison Mean	12,307		10,118		7,600			
Human Sciences Stack	1442	*	116		-1293	***	2,858	0.000
	(720.58)		(696.06)		(357.99)			
Comparison Mean	3,456		8,012		5,062			
Mechanic Repair Stack	-1907	*	739		4301	***	2,926	0.000
	(957.85)		(1034.29)		(710.43)			
Comparison Mean	11,163		3,015		9,319			
Health Stack	324		-1515	***	1325	***	21,552	0.000
	(248.52)		(307.03)		(220.52)			
Comparison Mean	5,571		6,507		6,925			
Business Stack	1991	***	661		60		9,557	0.000
	(443.26)		(537.48)		(328.71)			
Comparison Mean	13,068		7,010		7,119			

Notes: Robust standard errors in parentheses. Models include individual fixed effects, a time trend, year and quarter fixed effects, college-by-year fixed effects, fixed effects for various graduate characteristics (race, sex, age of initial degree, initial degree type, intended second credential) interacted with time, age in a given quarter, and indicators for time enrolled at VCCS during first and second credential attempts and an indicator for the two quarters prior to initial enrollment (Ashenfelter dip). Models include separate treatment indicators for each type of second credential stacked and run the main model by field of study. Test of differences reports the p-value on the postestimation test of equality of coefficients.
*p<0.05, **p<0.01, ***p<0.001

APPENDIX A – FIGURES

FIGURE A1: Event Study, Including Enrollment Phases





APPENDIX B – Stack Availability and Difference-in-Differences Attempt

In this reviewers appendix, we detail our exploration of variation in stack availability throughout the VCCS system and attempt to leverage that variation for a difference-in-differences analysis of the effect of stack availability on stack likelihood and subsequent labor market outcomes. Ultimately, we were not able to identify sufficient program-level variation and the match between our analytic sample and programs with variation was not large enough to provide precise estimates of the effects of availability on student enrollment and labor market outcomes.

Strategy 1: Leverage variation in broad stack availability

We first documented the extent to which colleges in the VCCS system varied in the number of credentials availability in each broad field of study (e.g., Health) identified at the two-digit CIP level. We first appended graduation files from the 2009-10 academic year through the 2016-17 academic year for a total of 175,077 unique graduates. We then flagged unique academic plans within college-by-field (e.g., the number of unique academic plans observed in this panel for graduates of Blue Ridge Community College in Health). In Table B1 we show that while some colleges at VCCS offer more fields than others (ranging from eight fields offered at Eastern Shore to 25 fields available at Northern Virginia) between 59-93 percent of fields offered across VCCS colleges have a stack option – that is, they offer more than one unique degree in each field. The number of degrees offered within a stack vary across colleges, but on average fields with a stack option offer between 7-8 unique degree programs – this ranges from two degrees in a field to 58 unique degrees offered in Business at Northern Virginia. We also documented in Table B2 the variation by stack and found that some fields were widely available and widely stackable (e.g., all 23 VCCS colleges offered Health and Business degree and all 23 offered

multiple degrees in those fields). Other fields were less commonly offered and did not have any stack options (e.g., two colleges offer degrees in Architecture and three offer degrees in English Language Arts/Letters, but none of those colleges offered multiple degrees in those fields). Given that stacking was widespread in the broad field of studies that our sample most commonly completed credentials in (e.g., Health and Business), we turned to examine variation in stack opportunities by specific field of study (e.g., "Accounting" or "Registered Nursing").

Strategy 2: Leverage variation in specific stack availability

We examined, based on our dataset of graduates, which colleges offered stacks in specific fields of study (e.g., "Registered Nursing"). We hypothesized this would be especially relevant given the large share of stackers in our sample who completed specific stacks and the higher returns to specific relative to broad-but-not-specific stacking. Our proposed analytic strategy was to identify colleges that offered multiple specific fields of study within the same broad field of study (e.g., a college offered both "Registered Nursing" and "Emergency Medical Technician" programs within the "Health" field) and to leverage variation across colleges in stack availability among those programs, as illustrated in the matrix below:

Sample Difference-in-Differences Framework for Stack Availability		
	College A	College B
Program A (e.g., RN)	Stack available	No stack available
Program B (e.g., EMT)	No stack available	No stack available

We decided to limit comparisons to within the same broad field of study as the most theoretically comparable comparison group, though acknowledge that within a broad field of study some specific fields of study likely have very different characteristics. We identified 845 unique College*CIP combinations (for example, "web page design" at Northern Virginia would count as a College*CIP combination). Some 57 percent of those programs offered a stack option. However, as we applied within and across college and field restrictions to create comparison groups, our sample size of programs dwindled. Below we detail each requirement and the number of programs remaining:

- Total College*CIP combinations: 845
- College must offer multiple specific fields of study within a broad field of study: 665
- College must vary within broad field of study in whether specific fields offer stack: 576
- Specific field of study has stacks at one college but not another: 207
- Repeat restriction that college offers multiple specific fields of study within a broad field of study after removing specific fields of study that do not have variation in stack availability: 122

The remaining 122 unique College*CIP programs enabled us to, for example, compare stack likelihood among graduates of the "web page design" programs and "computer/information general" programs at two colleges where at one college neither field offered a stack but at the second college there was a stack option in "web page design." We then merged this list of programs to a broader sample of individuals than our main analysis (since our main analysis is limited to individuals who returned to stack and we were interested in exploring the effect of availability on likelihood of attempting a stack). This retained 1,507 graduates, including 74 stackers. The sample size limits our ability to precisely estimate outcomes, though we observe

graduates of treated College*CIP programs have higher stacking rates, and tend to have better labor market outcomes, though the labor market outcome estimates and standard errors are large (Table B3).

APPENDIX B – TABLES

Table B1: Stack Availability by VCCS College

VCCS College	Total Fields Available	Share Fields with Stack	Average Number of Degrees per Stack
Blue Ridge	13	0.846	6.7
Central Virginia	18	0.667	8.1
Dabney S. Lancaster	14	0.786	5.0
Danville	16	0.813	8.5
Eastern Shore	8	0.875	4.4
Germanna	13	0.769	5.2
J. Sargeant Reynolds	17	0.882	7.8
John Tyler	17	0.765	8.9
Lord Fairfax	17	0.647	8.4
Mountain Empire	17	0.765	7.0
New River	13	0.923	7.0
Northern Virginia	25	0.680	11.5
Patrick Henry	17	0.588	8.4
Paul D. Camp	12	0.750	6.0
Piedmont Virginia	16	0.750	4.9
Rappahannock	11	0.818	5.6
Southside Virginia	13	0.846	8.0
Southwest Virginia	17	0.765	9.8
Thomas Nelson	15	0.933	8.6
Tidewater	21	0.857	11.8
Virginia Highlands	12	0.917	7.7
Virginia Western	20	0.800	7.7
Wytheville	13	0.692	8.6

Notes: Table documents the total number of fields (e.g., Health) in which the college offers degrees as observed by at least one student graduating from that degree program, the share of fields with a stack option (identified as the college offering more than one degree in the field) and the average number of degrees offered within stacks. Leverages graduation records from the 2009-10 through 2016-17 academic years to identify degree offerings.

Table B2: Stack Availability by Broad Field of Study

Field of Study	Total Colleges Offering Field	Share Colleges Offering Stack	Average Number of Degrees per Stack
Agriculture	11	0.727	3.63
Natural Resources	9	0.333	3.67
Architecture	2	0.000	0.00
Communications Technology	3	0.333	2.00
Computer/Information Sciences	23	0.957	8.27
Personal/Culinary Services	12	0.750	2.67
Education	7	0.143	2.00
Engineering	13	0.538	3.14
Engineering Technology	23	1.000	13.83
Foreign Language	10	0.500	2.80
Family/Human Sciences	21	0.905	3.47
Legal	17	0.353	3.33
English Language and Literature	3	0.000	0.00
Liberal Arts	23	1.000	10.00
Multi/Interdisciplinary	9	0.889	3.88
Parks & Recreation	7	0.286	2.50
Science Technologies	5	0.200	2.00
Security & Protective Services	22	0.955	4.71
Public Administration	3	0.333	5.00
Social Sciences	5	0.800	4.00
Construction	18	0.667	4.50
Mechanic Repair Technology	23	0.913	6.29
Precision Production	18	0.889	3.56
Transportation	6	0.667	2.25
Visual and Performing Arts	16	0.875	5.79
Health	23	1.000	17.87
Business	23	1.000	16.26

Notes: Table documents the total number of colleges that offer degree programs in each field (e.g., Health) as well as the share of colleges with a stack option in that field and the average number of degree programs those colleges offered if a stack was available. Leverages graduation records from the 2009-10 through 2016-17 academic years to identify degree offerings.

Table B3: Preliminary DID Results

	Stack	Stack Specific	Stack Broad		Employed		Wages	Log Wages
Treated Field	-0.04	-0.01	-0.03	*	0.06		793.46	-0.09
	(0.03)	(0.02)	(0.01)		(0.06)		(1077.24)	(0.13)
Treated College	-0.01	0.00	-0.02		-0.16	**	-1674.12	-0.05
	(0.02)	(0.02)	(0.01)		(0.05)		(931.08)	(0.12)
Treated College*Field	0.05	0.03	0.02		0.11		2066.35	0.19
	(0.03)	(0.03)	(0.02)		(0.07)		(1191.65)	(0.15)
Comparison mean	0.04	0.00	0.04		0.55		4805.51	8.69
N	1507	1507	1507		1507		1507	919
R^2	0.05	0.08	0.04		0.10		0.09	0.12

Notes: Model employs a difference-in-differences framework with treated field and treated college fixed effects within a broad field of study fixed effect to examine the effect of stack availability on graduates' stack likelihood and labor market outcomes. Includes student covariates reported in table 1.