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

Katharine E. Meyer
Brown University

Kelli A. Bird
University of Virginia

Benjamin L. Castleman
University of Virginia

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AUTHOR INFORMATION[1]
Katharine E. Meyer (corresponding author)
Brown University

Kelli A. Bird
University of Virginia

Benjamin L. Castleman
University of Virginia

ABSTRACT

With rapid technological transformations to the labor market, many working adults return to college after graduation 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" – earning two or more community college certificates or degrees – among working adults. We find stacking increases employment by four percentage points and quarterly wages by $375 (four percent). Returns are larger for individuals studying in Health and who return to college after first completing a short-term certificate.

DATA AVAILABILITY STATEMENT

This paper uses confidential data from the Virginia Community College System, the National Student Clearinghouse, and the Virginia Employment Commission. The data can be obtained by filing a request directly with these organizations. The authors are willing to assist (Katharine Meyer, katharine_meyer@brown.edu).

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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 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). 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 that may improve their labor market outcomes and stability. This pattern of multiple credential accumulation – earning two distinct and sequential postsecondary credentials – is referred to within the higher education sector as "stacking" credentials. For example, a student might complete a Certificate in Dental Assisting, and later return to the community college system to pursue an associate degree in Dental Hygiene. 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 and industries require different tasks from their workers, and workers may need additional

training from community college systems to adapt to new occupational demands and requirements (Bartel, Ichniowski, & Shaw, 2007; Carnevale, Smith & Strohl, 2010; Deming & Noray, 2019). In the wake of the sharper labor market shifts from the COVID-19 pandemic and recession, workers may pursue additional training to shift careers as layoffs shift to permanent position cuts or workers decide to pursue different careers (Berrero, Bloom, & David, 2020). Recognizing these trends, 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) and many states have expanded eligibility to individuals who already hold a postsecondary degree to support students stacking.

Despite the potential private and social value of adults obtaining additional credentials, to date there have only been a few analyses of the association between stacking credentials and labor market outcomes, with most of these analyses focused on pre-Great Recession cohorts or a subset of career pathways (Bailey & Belfield, 2017; Bohn, Jackson, & McConville, 2019; Bohn & McConville, 2016; Giani & Fox, 2017). We address this gap in the literature by estimating the return to stacking credentials among working adults who already hold a community college credential using comparative individual fixed effects with individual linear time trends. We define stacking in this analysis as earning two, non-concurrent credentials from the Virginia Community College System (VCCS) in the same broad field of study (e.g., health). We leverage a rich individual-level administrative dataset that includes term-level enrollment and graduation records from VCCS and quarterly employment records from the Virginia Employment Commission. These data enable us to compare labor market outcomes over time for individuals who complete a stack ("stack completers") with those who similarly re-enrolled in community college after completing a first credential but did not complete a second credential ("stack

attempters"). We focus on older, adult workers (those who first enrolled at VCCS when they were 20 years or older) both because older worker comprise an increasingly large share of postsecondary students but remain relatively understudied and because conditioning on work experience prior to college enrollment enables us to establish labor market trajectories pre-treatment and strengthen our causal estimates. 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 $380 quarterly wage increase (about four percent higher than the average non-stacker wages in the post period of about $8,800/quarter). Individuals stacking in Health have higher returns – about a $950 quarterly wage increase, representing an almost 11 percent wage increase relative to non-stackers' earnings. Overall, we find little evidence of significant differences in returns for female and male stackers or between Black and White stackers. Returns are higher for stackers whose first credential was a short-term or long-term certificate than for those who first completed an associate degree. We find suggestive evidence of a higher wage return from completing an associate degree as the second credential but cannot rule out that employment effects are equal across second credential length. We further leverage our administrative data to examine the relatedness of credentials within field and find stacking within the same broad field of study but with a different specializations (for instance, a credential as an emergency medical technician and another as a phlebotomist, which are both Health professions) yields higher benefits than very specific stacking (two credentials in the same specific field of study – for instance, two credentials as an emergency medical technician).

Our paper makes several contributions. First, as we note above, our study provides the first causal 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. We build on a set of studies that have started exploring the prevalence of and returns to stacking. Bailey & Belfield (2017) find no evidence of higher employment or wages for multiple credential holders, though their analysis leverages cross-sectional data using national surveys which often lack detailed information about the fields of study in which students stack. A 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 to 20 percent increase in wages depending on first credential (Bohn, Jackson, & McConville, 2019). Giani & Fox (2017) analyzed the returns to Health Professions Pathway Initiative grants awarded by the U.S. Department of Labor that encouraged the creation and promotion of stackable credentials in health fields and provides some evidence around stacking returns in the post-Great Recession era; those authors examined programs developed through the grant and found graduates of short-term certificate stacks earned quarterly wages about $3,000 higher than they did prior to the program and associate degree stackers earned about $6,000 more each quarter. We are not aware, however, of research that provides longitudinal, causal evidence on the impact of stacking credentials across a broad range of community college programs and for more recent cohorts.

Second, our paper is an important and novel complement to a substantial body of 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 associate 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 to examine returns to different types of credentials (e.g., associate degrees 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; Minaya & Scott-Clayton, 2020; Stevens, Kurlaender, Grosz, 2018; Xu & Trimble, 2016). Our work contributes to the field's growing understanding of the returns to certificates in community colleges (e.g., Cellini & Turner, 2019; Lang & Weinstein, 2013) 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. Older adult education has increased substantially in recent years, highlighting the value of understanding how individuals return to school and to what end. Between 2003 and 2013, overall enrollment of individuals older than 25 increased by 19 percent. As a result, roughly one-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). Our insights into the labor market returns to stacking contributes to a broader understanding of how labor market benefits from various higher education pathways have varied in recent years (Marcotte, 2019)

In Section II of the paper, 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 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) includes 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.[2] We leverage data from systemwide administrative records 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.[3] 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, and to limit our sample to students who do not transfer to a four-year institution after enrolling at VCCS.[4] The VEC data includes quarterly information on employer,

[2] We provide more information about the overall VCCS sample and how it compares with two-year, public, degree-granting institutions nationally and within the Southeast region in Appendix Table 1.
[3] 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.
[4] We acknowledge that NSC data is not an exhaustive record of college enrollment. However, research suggests the NSC data covered between 89.7-97.4 percent of Virginia Title IV institutions between 2005 and 2011 (Dynarski, Hemelt, & Hyman, 2015). A more recent NSC report on college completion noted 100 percent coverage of four-year

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 employment within the Commonwealth of Virginia for employers who pay into the UI system.[5]

Stacking Definition and Analytic Sample

We define stacking as earning two (or more) sub-baccalaureate credentials at VCCS in the same broad academic area (e.g., health) within nine academic terms (three academic years) – for example, completing a short-term certificate in fall 2010 and another in summer 2013.[6] Students may complete their two credentials in a shorter time than nine academic terms (for example, in fall 2010 and spring 2011), and meet our definition of stacking so long as they earn credentials in different academic terms. This aligns with the Department of Labor definition of stackable credentials as those accumulated "over time" and for the purposes of moving "along a career pathway or up a career ladder" (DOL, 2020).[7] Students may complete their credentials at different VCCS institutions and still be meet our stacking definition, but in practice few students switch institutions between credentials – we observe less than half a percent of students in our

public institutions, 100 percent coverage of two-year public institutions, and 96.1 percent coverage of four-year private institutions in Virginia as of 2019 (Shapiro et al., 2019).

[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 or federal employees. In a similar context of Ohio UI data, Ost, Pan, & Webber (2018) estimate that, among students who are not observably employed, roughly one-third is due to individuals having zero income, while more than half (56%) is due to individuals working in a different state. Still, Scott-Clayton & Wen (2018) find no relationship between earnings and associate degree holders working in-state or out-of-state, suggesting that the missingness would not substantially bias our estimates.

[6] 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" (for example, the two-digit CIP 51 refers to "Health Professions and Related Clinical Sciences"). Our analytic sample includes students earning credentials across 24 unique two-digit CIP codes.

[7] Second enrollment lasts 3.4 terms on average with students taking an average of 6.6 credits each term (while we do not directly observe official "full-time" or "part-time" status, VCCS classifies students taking fewer than 12 credits each term as part-time and 82% of students' second enrollment terms involve fewer than 12 credits). Around 78% of students in our analytic sample work during their second enrollment.

sample enrolling at two or more VCCS institutions. We do not limit our definition of stacking to a particular combination or order of credentials but rather examine heterogeneous effects of different credential combinations and sequences. We also note that we code stacks in our data, and do not draw on official VCCS indicators of two credentials being in a "formal stack." While some VCCS colleges include clear articulations of related credentials students might consider pursuing, many do not, and we use our own coding of credential relatedness for consistent measurement across colleges in the system.

Our analysis focuses on the wage returns to stacking for working adults 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).[8] In order to examine returns to working adults, we limit our analysis to graduates who first enrolled at VCCS after turning 20 or first enrolled before turning 60 years old. 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 omit from our treated or comparison sample students whose first credential was in a transfer-intending program and omit individuals who enrolled at a non-VCCS institution following initial VCCS graduation or who ever earned 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.[9]

[8] We also estimate the returns to stacking using a comparison sample of matched graduates (using nearest neighbor 1:1 matching without replacement) who never re-enroll at VCCS and find similar, if slightly larger, estimated returns relative to the labor market trajectories of "never attempters." See Appendix Table 2 for a description of the "never attempters" sample and Appendix Table 3 for the results of this model.

[9] Among all individuals who graduate from VCCS (in the timeframe we examine) and then subsequently earn a credential at a non-VCCS institution, about 62% graduate from an in-state public four-year institution, 13% graduate from an in-state private four-year institution, 7% graduate from an out-of-state public four-year institution, and 7%

We make several limitations to which quarterly earnings data we include in our analysis. We drop graduates who do not have a VEC employment record for at least four out of the six quarters (1.5 years) immediately prior to initial enrollment in order to: (1) focus on the returns to stacking for working adults and (2) observe sufficient pre-initial-enrollment labor market trends.[10] [11] We examine post-stack earnings for up to 28 quarters (seven years).[12] In Figure 1, we provide a visualization of the employment and enrollment patterns for three example students in our sample; we discuss Figure 1 in detail in Section III as it relates to our empirical specification.

Who Stacks: Characteristics of Stackers in Virginia

Our main analytic sample described in Table 1 includes 2,556 graduates.[13] Stackers and attempters are similar on many observable demographics; about two thirds are female, 62 to 65 percent are White and 27 to 30 percent are Black. Nearly all are Virginia residents and about half are first generation college graduates (with another third missing parental education). The average age in our sample at first VCCS graduation is around 35, which aligns with our focus on working adults with pre-enrollment work histories, and stackers are about a year older on average. There are few statistically significant differences between stackers and stack attempters - stackers are marginally less likely to have received a Pell grant during their first credential and are slightly more likely to live in urban areas of the state. We note differences in the distribution of first credential between stackers and attempters: Among stackers, almost two-thirds first

graduate from an out-of-state private four-year institution. We observe no instances of students earning degrees from a different community college system after first earning a credential at VCCS.

[10] Our findings are similar if we include up to ten quarters prior to initial enrollment, see Appendix Table 4.

[11] This set of employment data restrictions follows Carruthers and Sanford's (2018) analysis of adult technical education which similarly required a work history prior to community college enrollment focus on older workers.

[12] About 77% of individuals in our main analytic sample have at least 20 post-period quarters and about 44% of individuals in our main analytic sample have at least 28 post-period quarters. Results are consistent if we limit the post period to 20 quarters (five years) following stacking, results available upon request.

[13] 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.

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.[14] [15]

III. EMPIRICAL STRATEGY

We examine the effect of stacking credentials on students' labor market outcomes using a comparative individual fixed effects model with individual linear time trends. The individual fixed effects approach examines changes in labor market trajectories within individuals over time, holding constant observed and unobserved characteristics that might affect students' access to or selection into complete a second credential. The use of individual linear time trends accounts for heterogeneity in the earnings trajectory of workers (Dynarski, Jacob, & Kreisman, 2018; Jacobson, LaLonde, & Sullivan, 2005). Finally, the comparison to individuals who enroll in a second credential program – following a similar strategy as previous studies to leverage "dropouts" as the comparison group – further accounts for selection into stacking and compares labor market outcomes for stackers relative to individuals who have similar observed community college enrollment patterns (Jepsen, Troske, & Coomes, 2014; Minaya & Scott-Clayton, 2020). This individual fixed effects approach yields valid estimates with a sufficient pre-treatment outcome trend (Jacobson, LaLonde, & Sullivan, 2005) and in recent analyses performs well

[14] We also create a matched group of attempters based on observable demographic and initial credential characteristics (using nearest neighbor 1:1 matching without replacement) and run our main analysis using this matched sample; we find similar effects as in our main analysis. Appendix Table 5 summarizes differences in demographic characteristics between stackers and attempters and then between stackers and matched attempters; Appendix Table 6 shows the estimated return to stacking using only matched attempters as the comparison group.
[15] As illustrated in Appendix Table 2, we see that stackers are relative to "never attempters" with similar first credential and labor market backgrounds more likely to be Black and Hispanic, more likely to be first-generation college students, more likely to have received the Pell grant during their first credential, and more likely to have first completed a short-term certificate.

compared with lottery and non-lottery estimates of the effects of community college engagement (Grosz, 2020).[16] We estimate the following model:

$$y_{it} = \eta_i + \omega_i t + \beta_1(Post_{it}) + \beta_2(Post_{it} * Stack_{it}) + \sigma Enroll_{it} + \tau_t + \varepsilon_{it}$$

where for individual *i* at quarter *t*, our dependent variable is either quarterly earnings (adjusted for inflation, set at zero for quarters with no recorded earnings), an indicator for being observably employed in the VEC data, or log of earnings.[17] 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 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).

There are a number of enrollment behaviors that might affect earnings in a given quarter, which we account for in vector $Enroll_{it}$, which includes time varying factors related to enrollment at VCCS – specifically an Ashenfelter's Dip binary indicator for the two quarters prior to students' first observed enrollment in the panel and two quarters prior to students' re-enrollment at VCCS (Ashenfelter, 1978; Ashenfelter & Card, 1985; Heckman & Hotz, 1989), a

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

[17] 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).

binary indicator for any quarters when enrolled at VCCS, and the number of credits attempted in an enrollment quarter.[18]

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). The individual linear time trend ($\omega_i t$) accounts for time invariant characteristics (such as initial credential characteristics or student demographic) that would explain heterogeneity in earnings and accounts for individual differences in growth trends in our panel (Dynarski, Jacob, & Kreisman, 2018; Jacobson, LaLonde, & Sullivan, 2005). We also include year-quarter indicators, τ_t.

Figure 1 illustrates how key model variables are defined for three example students. Each student was employed in at least four out of the six quarters immediately preceding their initial VCCS enrollment and the Ashenfelter's Dip indicator is set to one for the two quarters immediately preceding their initial VCCS enrollment. After being enrolled for *X* (in this illustrated example, six) quarters, Stacker A earned their first credential, left VCCS, and re-enrolled *Z* (in this illustrated example, six) quarters later. Again, the Ashenfelter's Dip indicator is set to one for the two quarters prior to re-enrollment. Stacker A then earned their second credential and entered the "Post" employment period. The difference between Stackers A and B is that Stacker B remained enrolled at VCCS through their second degree, in which case there

[18] We note that about 13% of stackers ultimately earn three or more credentials. We use graduation from the second credential as the start of the post period and our enrollment indicator accounts for the potential effect of enrollment on earnings in the post-period.

was no second Ashenfelter's Dip. Attempter C follows a similar path to re-enrollment as Stacker A, except leaves VCCS without having earned their second credential.

Our empirical 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 estimate an event study model, which is a modified version of our main specification but 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 and after treatment (i.e., earning a second VCCS credential).[19] We plot the estimates from the event study in Figure 2 and observe similar employment and wage trends prior to stacking, followed by stackers having persistently higher trending employment and wage outcomes relative to attempters in the post period. 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 and while enrolled in the community college system.

IV. RESULTS

[19] We illustrate for 10 quarters prior to stacking and up to 20 quarters post stacking; since individuals have a different number of terms prior to stacking (or exit from the system), we graph these periods to maximize the number of individuals contributing to the estimate while still showing several years of a pre and post trend. We observe that 98% of our sample has at least 10 pre-period quarters and 66% of our sample has at least 20 post-period quarters.

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 75 percent for non-stackers (a five percent increase). Stackers earn about $375 more in quarterly wages – about a four percent increase over the average non-stacker quarterly wage of about $8,800. The log wage return is about seven 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 find significant positive returns to stacking in Health but not in Business, though the Business estimates have wide confidence intervals. In Health, we see stack attempters are employed about 75 percent in the post period, and stackers are 8.9 percentage points more likely to be employed. Stackers in Health also earn about $950 more each quarter than the average earnings among stack attempters (about $8,350) and the log wage effect is 11 percent. The estimated returns for stackers in non-Health and non-Business fields are small and not statistically significant; while there is potentially substantial heterogeneity in returns across other fields, our sample size does not enable us to precisely estimate those.

In Table 3, we evaluate differences in the returns to stacking by student demographics – first comparing male and female stackers in Panel A and then comparing the returns to Black and White stackers in Panel B.[20] We observe few significant differences in the returns for male and

[20] 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.

female stackers – female stackers experience a higher employment boost – and no statistically significant differences between Black and White stackers. We note that the estimated employment effects for Black stackers are not statistically different from zero and are lower than White stackers, though the estimates for each race are not statistically different from each other.

In Table 4, we show how returns to stacking vary by the first credential students completed. We modify our main model to include interactions between initial degree and treatment to report variance in returns by first credential. We find 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 four percentage points higher than non-stackers, and quarterly wages about $850 higher. Individuals who first completed a long-term certificate experience positive labor market returns, but those estimates are not significantly different than zero. Estimates for students who first earn an Applied Associate degree are mixed – we see a significant employment effect, but no significant wage or log wage effects.[21] Individuals who first completed short-term certificates likely have more to gain from returning to school – prior literature on the returns to a single credential estimates small to null effects of short-term credentials, and the comparison mean for individuals who first earn an AA is about $2,000 higher than the comparison mean for non-stackers who first earn a short-term certificate.

Turning to the question of whether returns to stacking vary by the level of second credential, we include three separate treatment indicators for each second degree type and report

[21] In the table we provide the overall test of equality of coefficients for the three initial credentials as well as a test of the equality of returns for students who first earn a short-term certificate relative to those who first earn an Applied Associate. We fail to reject the null hypothesis that the labor market returns to stacking are equal across all three initial credential types but observe significant differences in the quarterly wage and employment returns for individuals who first earned a short-term certificate relative to individuals who first earned an Applied Associate.

the results in Table 5. Here, we find larger returns to returning to school to complete an associate degree, along the lines of about a $1,200 quarterly wage increase.[22] Estimated returns are generally not statistically significant for students whose second credential is a short- or long-term certificate and we cannot rule out that the employment effect is equal across second type of credential.[23]

We further examined variation in stacking by the relatedness of credential field; in Table 6 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).[24] The majority of stackers in the sample complete specific stacks – very similar credential pairings – though we find the largest returns for stacking in the same broad but not specific field of study. Both overall (panel A) and specifically among individuals studying in Health (panel B) we see large, positive returns from broad stacking and smaller/not statistically significant returns from specific stacking. "Broad" and "specific" stacking conceptually map onto two different motivations for stacking. Two stacks in the same specific field of study could represent more of a skills-focused approach – deepening skills in a specific areas – while broad stacking could represent more of a career advancement 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).

[22] In this table, we combine any type of associate degree pursued, though in practice three quarters of associate degrees pursued were applied associate degrees.
[23] We run an analysis accounting for both first and second credential type in a supplemental table examining whether students' second credential is the same length, shorter than, or longer than their first credential. We report results in Appendix Table 7.
[24] We use "specific" to mean two credentials with the same long-form CIP code (e.g., a six-digit code) that generally refer to the same job duties in contrast with "broad" stacking which refers to two credentials with the same short-form CIP code (e.g., a two-digit code) which can refer to different career pathways in the same general industry.

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 7 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, (3) the share of quarters estimated to be employed at least full time, and (4) average quarterly wages for the quarters, measured for quarters after stacking/last attempted stack through the last observed quarter (up to 28 quarters or seven years).[25] Overall, the share of the sample ever employed after completing or attempting a stack is high at 92 percent for attempters, with stackers three percentage points more likely to have been employed. Attempters are on average employed during 64 percent of the quarters we observe and are employed at a full-time wages 57 percent of the time following their last observed VCCS enrollment. Stackers are four percentage points more likely to be employed and five percentage points more likely to be employed full-time. While the average quarterly wages in the post-period for attempters was about $8,660, stackers on average earned

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

about $730 more, though we do not observe significant differences in wage slopes between stackers and attempters. We also run the cross sectional analysis for Health stackers relative to Health attempters in panel B of Table 7, and find slightly larger treatment effects, even off higher employment rates for attempters.

Individual Cost Analysis

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 per credit hour 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 8 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 – ten percent of stackers and seven percent of attempters. It is unsurprising then that stackers received more grant aid (about $1,700 more) and took out more loans (about $1,000 more), given their overall higher rate of aid receipt. Stackers also enroll for more terms and take more credits per term, as would be expected given they are completing full credentials while attempters are "dropping out" or leaving without completing a

second credential. 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; stackers and attempters typically work most of their terms in school which also helps offset the opportunity costs of additional education.

V. DISCUSSION

In this paper, we quantify the effect of stacking credentials – earning multiple, related community college credentials – 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 with individual specific linear time trends, we find stackers are more likely to be employed and earn higher wages – both conditional and unconditional on employment. While we cannot rule out equal labor market returns by student sex or race, we generally see higher returns for female stackers and for White stackers. We find large, positive impacts of stacking among working adults in a Health field (though we cannot rule out large returns to other fields that have fewer individuals in our sample).

We estimate completing an associate degree as a second credential increases quarterly wages by about $1,200, and do not find a significant wage effect of earning a short-term certificate or long-term certificate as a second credential. For comparison, Minaya and Scott-Clayton (2020) find null to negative quarterly wage effects from short-term certificates but about a $1,300-$2,600 quarterly wage increase from earning an associate degree, with the returns to

long-term certificates falling in the middle (about $1,800 for female graduates and a positive $1,100 benefit to male graduates but only over an extended post period). Our estimated effects for earning an associate degree are close to the lower end of their estimates for an initial associate degree. This comparison examines the returns from two different enrollment patterns, (e.g., enrolling immediately in an associate degree versus enrolling after already holding a credential), and likely very different types of students. First, individuals stacking have already recouped some labor market benefits from their credential, and we would hypothesize the benefit of a credential relative to "some college" will be smaller than the benefit of the same credential relative to "no college." It is also unclear whether the counterfactual to stacking would be "immediately pursue and earn the higher-level credential" or if these students would only obtain an associate degree because they were able to engage in a shorter-term certificate and potentially apply credits from that first credential to their second enrollment.

Our complementary cross-sectional analysis also 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 and meet labor market demands. 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 coming years. 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). However, community college enrollment declined two years in a row in the midst of the COVID-19 pandemic (National Student Clearinghouse, 2020; 2021). Recent research suggests that students, in the face of economic uncertainty, prefer shorter and flexible programs (DeLuca et al, 2021). As students contemplate returning to school as the COVID-19 pandemic wanes, they may prefer programs

such as short-term certificates that they can stack for career advancement rather than immediately enrolling in longer degree programs.

It is important to consider the comparison group in our analysis – students who enrolled but did not complete a second credential. 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).

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TABLES

Table 1: Main Analytic Sample

	Stackers	Stack Attempted	
Student Characteristics			
Female	0.66	0.64	
Asian	0.02	0.02	
Black	0.27	0.30	
Hispanic	0.04	0.04	
White	0.65	0.62	
Virginia Resident	0.98	0.99	
First-Generation	0.51	0.50	
Missing Parental Education	0.34	0.34	
Ever Received Pell	0.48	0.54	+
Age at Initial Degree	36.91	35.39	**
Military Service	0.04	0.02	*
Rural	0.27	0.30	
Urban	0.47	0.44	**
Suburban	0.16	0.16	
Initial Credential Characteristics			
Short-term certificate	0.65	0.51	***
Long-term certificate	0.21	0.15	***
Applied Associate	0.14	0.34	***
N graduates	809	1747	2556

Notes: Compares individuals who completed a stack ("stackers" - earned two non-concurrent credentials at VCCS) to individuals who attempted but did not complete a second credential ("stack attempted" - completed one credential at VCCS and re-enrolled without earning a second credential after their initial graduation). 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.

+p<0.10, *p<0.05, **p<0.01, ***p<0.001

Table 2: Effect of Stacking on Labor Market Outcomes

	Employed		Quarterly Wages		Log Quarterly Wages	
Panel A: Full Sample						
Stack*Post	0.040	**	377.45	+	0.07	*
	(0.017)		(228.998)		(0.036)	
Comparison Mean	0.746		8790.124		9.075	
N graduates	2,556		2,556		2,556	
N observations	110,600		110,600		88,009	
Panel B: Health						
Stack*Post	0.089	**	955.52	**	0.11	+
	(0.029)		(380.760)		(0.061)	
Comparison Mean	0.759		8362.543		9.009	
N graduates	1,081		1,081		1,081	
N observations	46,465		46,465		37,273	
Panel C: Business						
Stack*Post	0.026		67.70		0.06	
	(0.035)		(454.430)		(0.067)	
Comparison Mean	0.737		9107.368		9.142	
N graduates	454		454		454	
N observations	19,999		19,999		16,126	
Panel D: Other Fields						
Stack*Post	-0.013		-287.64		0.03	
	(0.027)		(340.784)		(0.057)	
Comparison Mean	0.738		9064.082		9.112	
N graduates	1,021		1,021		1,021	
N observations	44,136		44,136		34,610	

Notes: Robust standard errors in parentheses. Models include individual-specific time trends as well as an individual fixed effect, as well as indicators for each quarter in the panel, indicators for quarters when students were enrolled at VCCS and controls for the number of credits enrolled each quarter, as well as Ashenfelter's Dip indicators for the four quarters prior to students first VCCS enrollment and Ashenfelter's Dip indicators for the two quarters prior to students' second VCCS enrollment. +p<0.10, *p<0.05, **p<0.01, ***p<0.001

Table 3: Effects of Stacking on Labor Market Outcomes, by Sex and Race

	Employed		Quarterly Wages		Log Quarterly Wages
Panel A: By Sex					
Male Stackers	0.000		32.224		0.086
	(0.027)		(436.019)		(0.056)
Female Stackers	0.064	**	573.655	*	0.068
	(0.022)		(262.861)		(0.047)
Test of difference	0.019		0.214		0.748
Male comparison mean	0.744		10494.51		9.30
Female comparison mean	0.748		7775.68		8.94
N observations	2556		2556		2556
N graduates	110600		110600		88009
Panel B: By Race					
Black Stackers	0.019		354.692		0.029
	(0.029)		(389.609)		(0.061)
White Stackers	0.050	*	310.235		0.073
	(0.022)		(294.414)		(0.047)
Test of difference	0.274		0.909		0.471
Black mean	0.766		8596.341		9.013
White mean	0.738		8856.763		9.100
N observations	2338		2338		2338
N graduates	101022		101022		80492

Notes: Robust standard errors in parentheses. Models include individual-specific time trends as well as an individual fixed effect, as well as indicators for each quarter in the panel, indicators for quarters when students were enrolled at VCCS and controls for the number of credits enrolled each quarter, as well as Ashenfelter's Dip indicators for the four quarters prior to students first VCCS enrollment and Ashenfelter's Dip indicators for the two quarters prior to students' second VCCS enrollment.
+p<0.10, *p<0.05, **p<0.01, ***p<0.001

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

	Employed		Quarterly Wages		Log Quarterly Wages	
Short-term Certificate	0.041	+	852.988	**	0.111	**
	(0.021)		(288.884)		(0.046)	
Long-term Certificate	0.036		649.190		0.089	
	(0.043)		(488.591)		(0.085)	
Applied Associate	0.111	**	-281.905		0.056	
	(0.047)		(572.109)		(0.087)	
Test of short-term = long-term = AA	0.805		0.481		0.628	
Test of short-term = AA	0.001		0.000		0.230	
Comparison means						
Short-term certificate	0.730		7994.646		8.995	
Long-term certificate	0.739		8153.247		9.062	
Applied Associate	0.774		10223.962		9.187	
N observations	2,556		2,556		2,556	
N graduates	110,600		110,600		88,009	

Notes: Robust standard errors in parentheses. Models include individual-specific time trends as well as an individual fixed effect, as well as indicators for each quarter in the panel, indicators for quarters when students were enrolled at VCCS and controls for the number of credits enrolled each quarter, as well as Ashenfelter's Dip indicators for the four quarters prior to students first VCCS enrollment and Ashenfelter's Dip indicators for the two quarters prior to students' second VCCS enrollment. Test of differences reports the p-value on the postestimation test of equality of coefficients for the two groups. +p<0.10, *p<0.05, **p<0.01, ***p<0.001

Table 5: Effect of Stacking on Labor Market Outcomes, by Second Credential Type

	Employed		Quarterly Wages		Log Quarterly Wages	
Short-term Certificate	-0.010		-224.773		-0.006	
	(0.024)		(319.517)		(0.041)	
Long-term Certificate	0.079	+	-169.102		-0.007	
	(0.048)		(404.462)		(0.085)	
Applied Associate	0.036		1167.308	***	0.274	***
	(0.023)		(293.010)		(0.049)	
Test of short-term = long-term = AA	0.167		0.002		0.000	
Comparison means						
Short-term certificate	0.785		7631.322		8.894	
Long-term certificate	0.707		5621.287		8.619	
Applied Associate	0.719		6034.823		8.691	
N observations	2556		2556		2556	
N graduates	119534		119534		92914	

Notes: Robust standard errors in parentheses. Models include individual-specific time trends as well as an individual fixed effect, as well as indicators for each quarter in the panel, indicators for quarters when students were enrolled at VCCS and controls for the number of credits enrolled each quarter, as well as Ashenfelter's Dip indicators for the four quarters prior to students first VCCS enrollment and Ashenfelter's Dip indicators for the two quarters prior to students' second VCCS enrollment. Test of differences reports the p-value on the postestimation test of equality of coefficients for the two groups. +p<0.10, *p<0.05, **p<0.01, ***p<0.001

Table 6: Effect of Stacking on Labor Market Outcomes, by Field Relatedness

	Employed		Quarterly Wages		Log Quarterly Wages	
Panel A: Overall						
Stack in same broad field of study	0.136	***	1093.164	***	0.216	***
	(0.032)		(352.447)		(0.065)	
Stack in same specific field of study	-0.004		46.035		0.018	
	(0.018)		(265.857)		(0.040)	
Test of difference	0.000		0.010		0.005	
Comparison mean	0.746		8790.12		9.07	
N graduates	2556		2556		2556	
N observations	110600		110600		88009	
Panel B: Health						
Stack in same broad field of study	0.183	***	1671.084	***	0.299	***
	(0.043)		(460.468)		(0.089)	
Stack in same specific field of study	0.010		355.346		-0.014	
	(0.032)		(526.678)		(0.074)	
Test of difference	0.000		0.041		0.004	
Comparison mean	0.759		8362.54		9.01	
N graduates	1081		1081		1081	
N observations	46465		46465		37273	

Notes: Robust standard errors in parentheses. Models include individual-specific time trends as well as an individual fixed effect, as well as indicators for each quarter in the panel, indicators for quarters when students were enrolled at VCCS and controls for the number of credits enrolled each quarter, as well as Ashenfelter's Dip indicators for the four quarters prior to students first VCCS enrollment and Ashenfelter's Dip indicators for the two quarters prior to students' second VCCS enrollment. Test of differences reports the p-value on the postestimation test of equality of coefficients for the two groups. +p<0.10, *p<0.05, **p<0.01, ***p<0.001

Table 7: Cross Sectional Employment Outcomes

	Ever Employed		Share Employed		Share Employed FT		Average Wages		Wage Change
Panel A: Overall									
Stackers	0.03	**	0.04	**	0.05	***	731.82	*	140.28
	(0.011)		(0.013)		(0.014)		(316.328)		(195.193)
Comparison Mean	0.92		0.64		0.57		8660.48		1249.59
N	2555		2555		2555		2555		2555
R^2	0.08		0.19		0.18		0.18		0.05
Panel B: Health									
Stackers	0.05	***	0.06	***	0.07	***	1972.47	***	-29.15
	(0.015)		(0.019)		(0.021)		(483.850)		(279.774)
Comparison Mean	0.94		0.67		0.59		8213.10		1210.59
N	1080		1080		1080		1080		1080
R^2	0.17		0.28		0.26		0.23		0.09

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 8: Monetary and Opportunity Costs of Stacking

	Stackers	Attempters	Difference	
Share receiving stack financial aid	0.10	0.07	0.03	***
			(0.004)	
Average stack grant aid	5057.28	3195.04	1748.88	***
			(240.478)	
Average stack loan aid	3181.05	2003.30	975.49	**
			(336.903)	
Average stack terms enrolled	4.06	3.17	0.71	***
			(0.110)	
Average credits/stack term	7.42	6.23	1.25	***
			(0.154)	
Share of stack terms employed	0.70	0.81	-0.11	***
			(0.018)	
N	809	1,747	2,556	

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

FIGURES

FIGURE 1: Example Enrollment Pathways

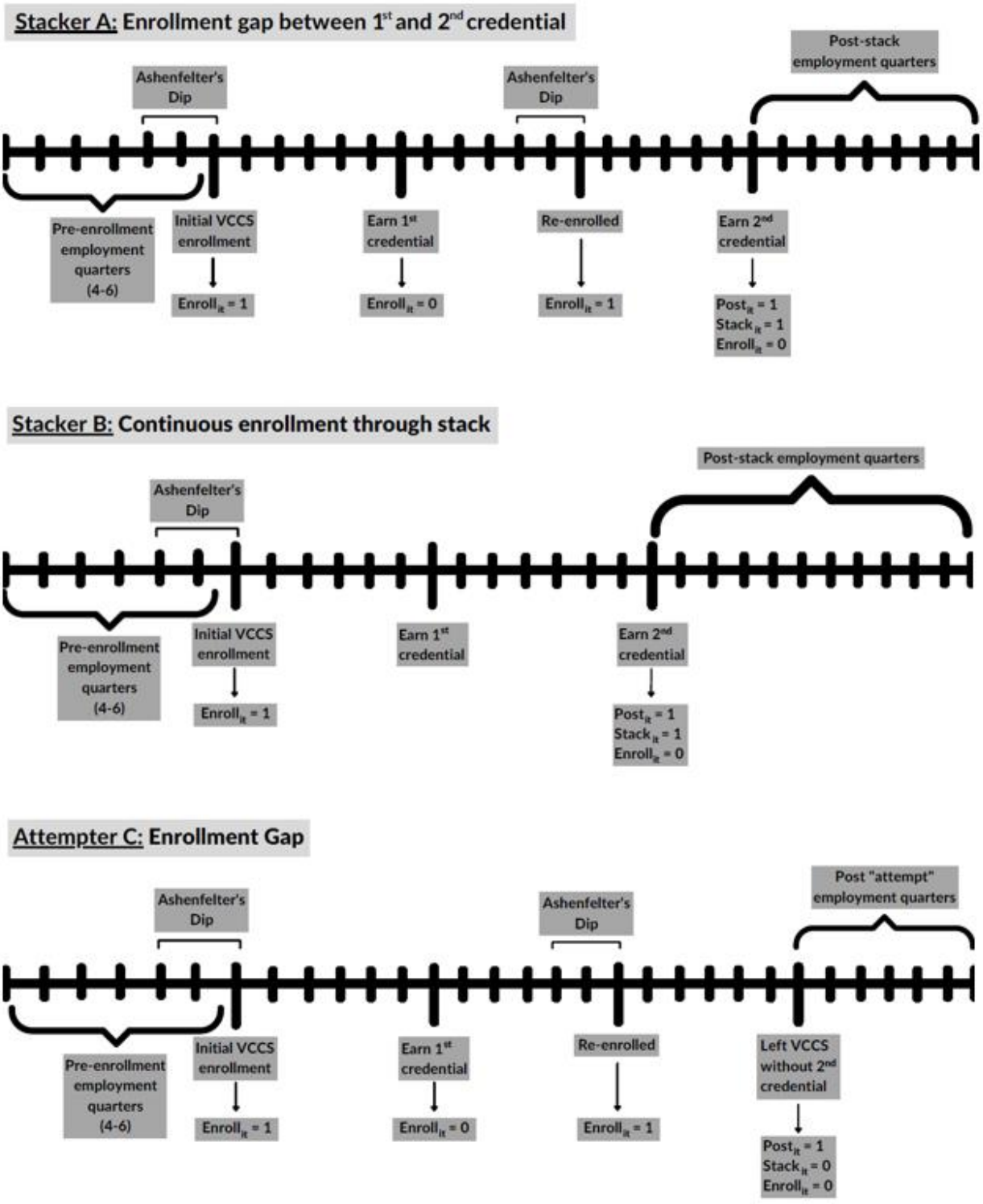


Figure 2: Event Study Plots of Stacking Effect

Figure 2a: Event Study Plot of Quarterly Wages

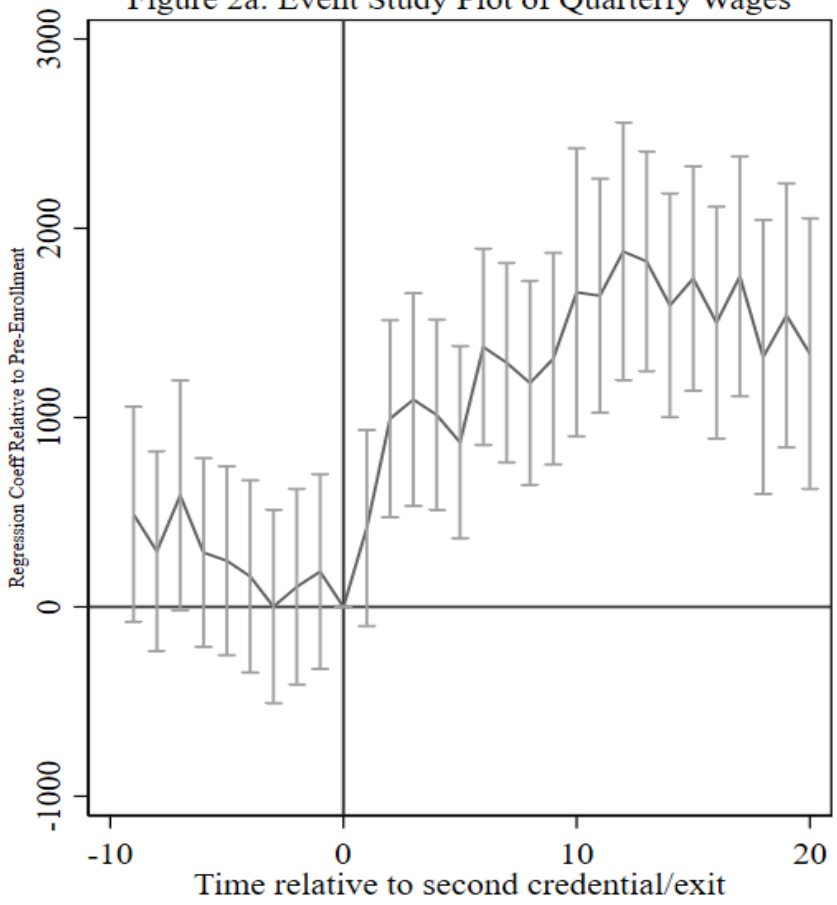
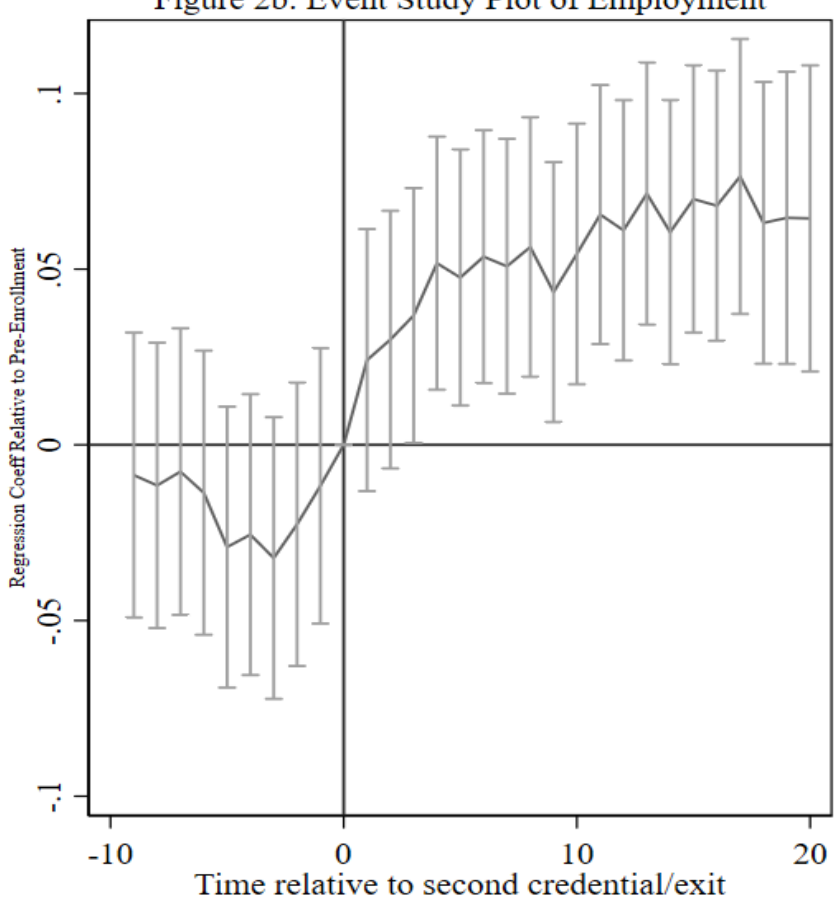


Figure 2b: Event Study Plot of Employment



Note: Event study of differential outcomes between stackers and attempters relative to second credential attainment or second exit from community college. N=2,556

APPENDIX – TABLES

Appendix Table 1: Virginia Community College System and Two-Year, Public Institutions Nationally

	VCCS	Non-VCCS	National Differential		Regional Differential	
Enrollment	1187	1134	53		370	
			(377.259)		(379.776)	
Asian	0.03	0.03	-0.01		0.01	*
			(0.007)		(0.007)	
Black	0.17	0.14	0.02		-0.09	***
			(0.025)		(0.028)	
Hispanic	0.09	0.21	-0.12	***	0.01	
			(0.015)		(0.014)	
White	0.65	0.52	0.14	***	0.07	
			(0.038)		(0.040)	
Female	0.54	0.52	0.02	**	0.00	
			(0.009)		(0.010)	
Completion Rate (150%)	0.32	0.29	0.03	*	0.03	*
			(0.014)		(0.016)	
Net Price	6685.48	7256.46	-570.98		496.26	
			(358.245)		(381.276)	
N Institutions	23	776	799		219	

Notes: Data from the Integrated Postsecondary Education Data System (IPEDS) downloaded via the Urban Institute Education Data Portal. Demographic data as of the 2018-19 academic year; completion rate and net price retrieved from the 2017-2018 academic year. Reports Virginia and National average characteristics and outcomes for two-year, public, degree-granting institutions. Tests for differences between Virginia institutions and national average as well as Virginia institutions relative to other Southeast states (AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, and WV).

Appendix Table 2: Sample Characteristics, Stackers and Never Attempters

	Stackers	Never Attempted Stack		Never Attempted Stack, Matched	
Student Characteristics					
Female	0.66	0.57		0.65	
Asian	0.02	0.03	+	0.01	*
Black	0.27	0.22	***	0.27	
Hispanic	0.04	0.03	***	0.05	
White	0.65	0.70	***	0.66	
Virginia Resident	0.98	0.99		0.99	
First-Generation	0.51	0.45	***	0.53	
Missing Parental Education	0.34	0.40	***	0.32	
Ever Received Pell	0.48	0.40	***	0.47	
Age at Initial Degree	36.91	36.45		36.92	
Military Service	0.04	0.02	***	0.04	
Rural	0.27	0.29		0.28	
Urban	0.47	0.39	***	0.48	
Suburban	0.16	0.19		0.14	
Initial Credential Characteristics					
Short-term certificate	0.65	0.41	***	0.67	
Long-term certificate	0.21	0.11	***	0.19	
Applied Associate	0.14	0.48	***	0.13	
N graduates	809	6643		809	

Notes: Compares individuals who completed a stack ("stackers" - earned two non-concurrent credentials at VCCS) to individuals who never attempted a second credential at VCCS overall and for a matched subsample of never attempters (using nearest neighbor 1:1 matching without replacement). 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.

+p<0.10, *p<0.05, **p<0.01, ***p<0.001

Appendix Table 3: Effect of Stacking on Labor Market Outcomes, Relative to Never Attempters

	Never Attempted Stack			Never Attempted Stack, Matched		
	Employed	Quarterly Wages	Log Quarterly Wages	Employed	Quarterly Wages	Log Quarterly Wages
Panel A: Full Sample						
Stack*Post	0.030 +	332.839	0.014	0.060 **	885.274 ***	0.109 **
	(0.016)	(216.631)	(0.030)	(0.021)	(273.898)	(0.041)
Comparison Mean	0.707	6020.241	8.712	0.707	6020.241	8.712
N graduates	7452	7452	7452	1618	1618	1618
N observations	357462	357462	274041	76803	76803	59549
Panel B: Health						
Stack*Post	0.031	-324.455	-0.076	0.087 **	881.001 +	0.111
	(0.026)	(368.538)	(0.054)	(0.035)	(457.682)	(0.071)
Comparison Mean	0.707	6020.241	8.712	0.707	6020.241	8.712
N graduates	2804	2804	2804	711	711	711
N observations	137142	137142	108621	33557	33557	26240
Panel C: Business						
Stack*Post	0.046	1047.492 **	0.111 *	0.063	1102.903 +	0.081
	(0.029)	(407.595)	(0.048)	(0.039)	(571.593)	(0.069)
Comparison Mean	0.707	6020.241	8.712	0.707	6020.241	8.712
N graduates	1191	1191	1191	336	336	336
N observations	58226	58226	45248	16158	16158	12850
Panel D: Other Fields						
Stack*Post	-0.001	279.829	0.041	0.020	616.458	0.129 *
	(0.024)	(332.546)	(0.047)	(0.034)	(406.897)	(0.063)
Comparison Mean	0.707	6020.241	8.712	0.707	6020.241	8.712
N graduates	3457	3457	3457	571	571	571
N observations	162094	162094	120172	27088	27088	20459

Notes: Robust standard errors in parentheses. Models include individual-specific time trends, an individual fixed effect, as well as indicators for each quarter in the panel, indicators for quarters when students were enrolled at VCCS and controls for the number of credits enrolled each quarter, as well as Ashenfelter's Dip indicators for the two quarters prior to students first VCCS enrollment and Ashenfelter's Dip indicators for the two quarters prior to students' second VCCS enrollment. +p<0.10, *p<0.05, **p<0.01, ***p<0.001

Appendix Table 4: Effect of Stacking on Labor Market Outcomes, Additional Pre-Enrollment Data

	Employed		Quarterly Wages		Log Quarterly Wages	
Panel A: Full Sample						
Stack*Post	0.038	*	319.533		0.068	+
	(0.019)		(235.477)		(0.037)	
Comparison Mean	0.746		8790.124		9.075	
N graduates	2556		2556		2556	
N observations	119534		119534		92914	
Panel B: Health						
Stack*Post	0.079	**	912.206	**	0.093	
	(0.031)		(389.313)		(0.062)	
Comparison Mean	0.746		8790.124		9.075	
N graduates	1081		1081		1081	
N observations	50282		50282		39203	
Panel C: Business						
Stack*Post	0.020		-168.996		0.060	
	(0.038)		(466.381)		(0.067)	
Comparison Mean	0.746		8790.124		9.075	
N graduates	454		454		454	
N observations	21601		21601		17107	
Panel D: Other Fields						
Stack*Post	-0.006		-272.804		0.036	
	(0.028)		(355.429)		(0.058)	
Comparison Mean	0.746		8790.124		9.075	
N graduates	1021		1021		1021	
N observations	47651		47651		36604	

Notes: Robust standard errors in parentheses. Models include individual-specific time trends, an individual fixed effect, as well as indicators for each quarter in the panel, indicators for quarters when students were enrolled at VCCS and controls for the number of credits enrolled each quarter, as well as Ashenfelter's Dip indicators for the two quarters prior to students first VCCS enrollment and Ashenfelter's Dip indicators for the two quarters prior to students' second VCCS enrollment. Results vary from main model in that this table includes up to 10 quarters of pre-initial-enrollment data rather than six in the main model.
+p<0.10, *p<0.05, **p<0.01, ***p<0.001

Appendix Table 5: Sample Characteristics, Stackers and Attempters

	Stackers	Stack Attempted		Stack Attempted, Matched	
Student Characteristics					
Female	0.66	0.64		0.66	
Asian	0.02	0.02		0.02	
Black	0.27	0.30		0.27	
Hispanic	0.04	0.04		0.04	
White	0.65	0.62		0.64	
Virginia Resident	0.98	0.99		0.99	
First-Generation	0.51	0.50		0.50	
Missing Parental Education	0.34	0.34		0.34	
Ever Received Pell	0.48	0.54	+	0.46	
Age at Initial Degree	36.91	35.39	**	37.04	
Military Service	0.04	0.02	*	0.02	+
Rural	0.27	0.30		0.25	
Urban	0.47	0.44	**	0.49	
Suburban	0.16	0.16		0.17	
Initial Credential Characteristics					
Short-term certificate	0.65	0.51	***	0.64	
Long-term certificate	0.21	0.15	***	0.19	
Applied Associate	0.14	0.34	***	0.17	
N graduates	809	1747		809	

Notes: Compares individuals who completed a stack ("stackers" - earned two non-concurrent credentials at VCCS) to individuals who attempted but did not complete a second credential ("stack attempted" - completed one credential at VCCS and re-enrolled without earning a second credential after their initial graduation) overall and for a matched subsample of attempters (using nearest neighbor 1:1 matching without replacement). 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.
+p<0.10, *p<0.05, **p<0.01, ***p<0.001

Appendix Table 6: Effect of Stacking on Labor Market Outcomes, Relative to Matched Attempters

	Employed		Quarterly Wages		Log Quarterly Wages	
Panel A: Full Sample						
Stack*Post	0.057	***	721.409	**	0.105	***
	(0.020)		(276.369)		(0.039)	
Comparison Mean	0.707		6020.241		8.712	
N graduates	1,618		1,618		1,618	
N observations	76,798		76,798		60,437	
Panel B: Health						
Stack*Post	0.121	***	1400.265	**	0.175	***
	(0.034)		(444.910)		(0.066)	
Comparison Mean	0.707		6020.241		8.712	
N graduates	709		709		709	
N observations	32,984		32,984		25,766	
Panel C: Business						
Stack*Post	0.058	**	434.422		0.092	
	(0.040)		(579.197)		(0.074)	
Comparison Mean	0.707		6020.241		8.712	
N graduates	337		337		337	
N observations	16,261		16,261		13,142	
Panel D: Other Fields						
Stack*Post	-0.022		-25.792		0.022	
	(0.030)		(431.911)		(0.061)	
Comparison Mean	0.707		6020.241		8.712	
N graduates	572		572		572	
N observations	27,553		27,553		21,529	

Notes: Robust standard errors in parentheses. Models include individual-specific time trends and individual fixed effects, as well as indicators for each quarter in the panel, indicators for quarters when students were enrolled at VCCS and controls for the number of credits enrolled each quarter, as well as Ashenfelter's Dip indicators for the two quarters prior to students first VCCS enrollment and Ashenfelter's Dip indicators for the two quarters prior to students' second VCCS enrollment.
+p<0.10, *p<0.05, **p<0.01, ***p<0.001

Appendix Table 7: Effect of Stacking on Labor Market Outcomes, by Direction of Credential

	Employed		Quarterly Wages		Log Quarterly Wages	
Progressive Stack	0.033		700.737	**	0.174	***
	(0.023)		(291.310)		(0.050)	
Supplemental Stack	0.137	***	594.364		0.049	
	(0.043)		(541.017)		(0.075)	
Lateral Stack	0.011		-338.608		-0.084	+
	(0.024)		(345.791)		(0.049)	
Test of equality	0.027		0.039		0.000	
Comparison mean	0.746		8790.124		9.075	
N graduates	2556		2556		2556	
N observations	110600		110600		88009	

Notes: Robust standard errors in parentheses. Models include individual-specific time trends as well as an individual fixed effect, as well as indicators for each quarter in the panel, indicators for quarters when students were enrolled at VCCS and controls for the number of credits enrolled each quarter, as well as Ashenfelter's Dip indicators for the four quarters prior to students first VCCS enrollment and Ashenfelter's Dip indicators for the two quarters prior to students' second VCCS enrollment. A “progressive” stack means the second credential is longer than the first, a “supplemental” stack means the second credential is shorter than the first, and a “lateral” stack means the second credential is the same length as the first. Test of differences reports the p-value on the postestimation test of equality of coefficients for the three types of credential combinations.

+p<0.10, *p<0.05, **p<0.01, ***p<0.001

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.