



Amanda Bosky, PhD
University of Wisconsin-Madison

High School Coursework and Labor Force Attachment at Midlife

Center for Financial Security

University of
Wisconsin-Madison

1300 Linden Drive
Madison, WI 53706

608-890-0229
cfs@mailplus.wisc.edu
cfs.wisc.edu

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Abstract

Work during the preretirement years is a vital component of long-term wellbeing, especially with life expectancy increasing and the burden of saving for retirement shifting heavily toward workers. Employment experiences at midlife set the stage for the quality of transitions into old age and retirement. Middle-aged individuals without a strong attachment to the workforce face a future of economic vulnerability, and the stakes at this point in the life course are especially high. Though researchers often focus on contemporaneous correlates of labor force attachment, such studies ignore the potential importance of the skills that individuals develop earlier in life that prepare them for work across the life course. This study takes advantage of the recent midlife follow-up of the High School and Beyond (1980) sophomore cohort to examine how the pre-labor market skills of a cohort who transitioned to adulthood amid vast technological transformation in the labor market are related to employment over thirty years later, at midlife. Specifically, this study investigates the role of high school coursework in promoting long-term labor force attachment, with a focus on career and technical education.

JEL codes: I24, I26, J22, J24

Keywords: life course, employment, vocational education, labor force

1. Introduction

It is well established that pre-labor market skills and education play an important role in sorting workers into occupations and jobs. Workers' pre-labor market skills may also help them get promoted, learn on the job, and even manage and adapt to workforce challenges. Skill-biased technological change in the US economy over the past few decades has created many such challenges for workers whose pre-labor market skills were developed before increased computerization had a widespread impact on work environments and employer demands. For these individuals, skills may have been especially important in determining how they fared in the workforce (Cortes 2015). Understanding how workers have endured this economic transformation sheds light on the kinds of skills that help people adapt and maintain a long-term attachment to the labor force.

People who completed high school near the beginning of the technological change are still of working age today but are now entering middle age, and how they navigated the changing economy has contributed to their employment situation at midlife. Work during the preretirement years is a vital component of long-term wellbeing. At midlife, most workers are experiencing their peak in occupational position and earnings (Lachman 2004; Mendenhall et al. 2008), and separation from the workforce at this point in the life course can have severe financial consequences because workers are accumulating the wealth that will finance their retirements (Mitchell and Moore 1998). This is especially important considering that people are now working longer than they did twenty years ago due to declines in pensions and retiree health benefits and increased concerns about the ability to afford retirement in the face of increased life expectancy (Mermin, Johnson, and Murphy 2007; O'Rand 2011; Virick 2011).

Changes to Social Security since the 1980s have led to increases in labor force participation among older workers because working longer is incentivized for eligibility to obtain full benefits (Blau and Goodstein 2010; O'Rand 2011). Further, individuals who are employed experience significantly slower declines in perceived health and physical functioning compared to the non-employed, even after adjusting for differences in economic wellbeing (Ross and Mirowsky 1995). Thus, employment experiences at midlife set the stage for the quality of transitions into old age and retirement. Middle-aged individuals without a strong attachment to

the workforce face a future of vulnerability, and the stakes at this point in the life course are high.

I take advantage of the recent midlife follow-up of the High School and Beyond sophomore cohort (HS&B:SO) (Muller et al. 2019) to investigate how the pre-labor market skills of a cohort who transitioned to adulthood in the midst of the technological change are related to their labor force attachment over thirty years later, at midlife. Specifically, I examine employment status at midlife and plans for future labor force participation as two dimensions of long-term labor force attachment. The emergence of health conditions may make it particularly difficult for some individuals to maintain an attachment to the labor force as they age (Burr et al. 1996; Hayward et al. 1989; Jenkins 1991). This is a cohort that has begun to encounter these health conditions at midlife, after having experienced vast technological transformation in the workforce and the Great Recession. Their pre-labor market skills may have helped determine who was well-equipped and positioned to endure these challenges.

It is especially important for less educated workers to maintain a strong attachment to the labor force because they are likely to rely on Social Security OASI benefits for the bulk or entirety of their retirement income; working more consistently and into older ages will allow them to maximize their benefits. Workers without bachelor's degrees generally have lower incomes and accrue less personal retirement savings compared to more educated workers (Tamborini and Kim 2017), and they lack the same extent of financial safety nets provided to previous generations by strong unions and defined benefit retirement plans (Sabelhaus and Schrass 2009; Western and Rosenfeld 2011). However, less educated workers may also face unique barriers to work as they age due to higher unemployment rates, more physically demanding tasks, and changing skill requirements associated with some sub-baccalaureate occupations. Considering the importance of and barriers to long-term labor force attachment for workers without bachelor's degrees, this paper focuses on this vulnerable population.

For sub-baccalaureate workers, high school serves as a primary site for pre-labor market skill development. In this paper, I build on classic and renewed debates surrounding the school-to-work transition and how schools can best prepare students for long-term labor force attachment. I use longitudinal data that includes high school transcripts to investigate the relationship between career and technical education (CTE) in high school and long-term labor force attachment among US workers without bachelor's degrees. The term CTE evolved from

“vocational education” over the past few decades to reflect the changing nature of education in US secondary schools that prepare students for career success.¹ Though vocational education for the HS&B:SO cohort in the early 1980s was different from today’s CTE, I limit my definition of CTE for this study’s cohort to occupational coursework and exclude courses related to low-wage service occupations, general career preparation, or family and consumer sciences. This definition of CTE approximates coursework that prepares students for mid-skilled work and better aligns with modern CTE.

Extant research finds that CTE coursework in high school leads to better labor market outcomes for US workers in early adulthood because it provides students with occupational skills that employers desire (see, e.g., Arum and Shavit 1995; Mane 1999; Kreisman and Stange 2020). The long-term effects of CTE are not as clear, and scholars have theorized that CTE may be less beneficial or even harmful for students in the long run because occupation-specific skills are less transportable than the general skills gained through academic coursework (Hanushek et al. 2017; Forster, Bol, and van de Werfhorst 2016; Rözer and Bol 2019). Of course, this argument assumes that students invest in CTE at the expense of academic coursework and vice versa. However, the division of vocational and academic education is starker in countries with stronger vocational programs, such as European countries with specialized upper secondary tracks or apprenticeship models. This division in secondary education has historically been less rigid and less standardized in the US context of comprehensive public schools; it is more common for US students to take a mix of academic and vocational coursework throughout high school.

One cross-sectional study has suggested that the strength of a country’s vocational program shapes the long-term labor market effects of vocational education, with stronger programs resulting in more harmful long-term effects (Hanushek et al. 2017). A handful of studies have subsequently used longitudinal data to investigate long-term effects of vocational programs in the European context — with inconsistent results — and recent scholarship has noted the need to address the effects of CTE later in life using longitudinal data in the US context (Kreisman and Stange 2020). Because of the weaker vocational program in the US, it is difficult to meaningfully measure CTE participation without information on the actual courses workers

¹ Though this type of education was called vocational education when this study’s cohort was in high school (and is still the term many other countries use today), I use the term CTE to maintain continuity with educational trends and more recent scholarship in the US context.

took in high school. In fact, previous research using the same data as the current study has shown that short-term labor market effects of CTE in the US are less pronounced using self-reports of educational program compared to transcripts (Arum and Shavit 1995), and these short-term effects vary depending on the number and mix of CTE and academic courses a student takes (Kang and Bishop 1989).

The current study is the first to examine the relationship between CTE and long-term labor force attachment among US workers using longitudinal data, and it uses high school transcript data to ensure accurate and meaningful measurement of CTE in the US educational context. This research can enrich our knowledge of how pre-labor market skills and training might be placing individuals on trajectories of work and wellbeing as they age. Understanding the long-term effects of high school CTE coursework can shed light on how changing curricular patterns over time might shape Social Security program participation, funding, and benefits for vulnerable workers in a changing economy.

2. Literature Review

2.1 Secondary education and curriculum in the U.S.

For students in the United States, high school serves as the early bookend to their transition to adulthood and is the highest level of compulsory education. Though all individuals technically share the same starting point upon completion of high school, they are not similarly equipped to navigate their futures. Students leave high school with the same credential but not the same skills (Bills 2003). High schools in the US have historically aimed to provide students with the education and skills they need to transition to their adult lives. Scholars have long debated the type of high school training that best prepares students for labor market success, with particular tensions surrounding CTE coursework.

Decades ago, most secondary schools in the US provided a stratified curriculum through formal tracking of students into general, academic, and vocational tracks, which prepared students for different positions in the industrial occupational structure (Raudenbush and Eschmann 2015). In the latter half of the 20th century, schools began shifting away from curricular tracking systems (“detracking”). Critics of tracking systems argued that tracking reproduces inequality by sorting disadvantaged students into non-academic tracks and inhibiting

their socioeconomic attainment, as non-academic tracks were low in quality and diverted students from postsecondary education (Oakes 2005; Lucas 1999; Arum and Shavit 1995). Amidst detracking efforts, the alarm raised in *A Nation at Risk* in 1983 about the competitiveness of US youth in the modern labor market led to curricular intensification and homogenization to better prepare students for an increasingly knowledge-based economy.

Labor market trends over the past few decades have only strengthened high schools' focus on academic preparation. The mid-skilled trades that once provided well-paying, secure employment to workers without college degrees have declined, and a bachelor's degree is becoming increasingly necessary for access to good jobs (Acemoglu and Autor 2011; Carnevale and Desrochers 2002; Goldin and Katz 2009; Hout 2012; Sorenson 2000). The returns to a bachelor's degree have risen substantially, and computerization and the shift to a knowledge-based economy has increased the importance of cognitive skills in occupations across the educational spectrum (Bozick and Dalton 2013; Bozick, Srinivasan, and Gottfried 2017; Gamoran 1994; Murnane, Willett, and Levy 1995).

Considering these trends, it may be that academic coursework better prepares students for the modern and long-term labor market because it not only supports bachelor's degree attainment but also the development of more general cognitive skills demanded even in sub-baccalaureate jobs in a changing and upskilling economy. However, the modernization of CTE has focused on transforming vocational education to prepare students for more highly skilled work by increasing academic rigor and incorporating a broader range of occupational fields — most of which require at least some postsecondary education. If long-term disadvantages of CTE are largely due to students taking less academic coursework, as suggested in European contexts with stronger vocational programs, then the integration of academic and vocational coursework in the US may ameliorate any possible negative effects. In fact, previous studies in the US suggest that a mix of coursework in CTE and academic courses is more beneficial even in the short-term labor market than exclusive concentration in CTE or academic courses (Campbell et al. 1987; Kang and Bishop 1989). I explore the possible complementarity of CTE and academic coursework in the long-term labor market by expanding my conceptualization of CTE participation to also investigate how students' exclusive investment in CTE or academic courses compares to investment in both.

2.2 Long-term labor market returns to CTE

Proponents of CTE coursework have traditionally argued that occupational education can provide a safety net for students who are unlikely to complete college by providing them with skills that employers demand and promoting a smooth transition into the labor force. Some critics of CTE have argued that the short-term labor market advantages of vocational education may trade off with long-term disadvantages. One reason for this possible tradeoff is that many traditional CTE occupational areas are associated with more physically demanding and dangerous jobs, which may make it difficult for workers to maintain labor force attachment as they age. Greater wear and tear on workers' bodies and higher incidence of injuries may lead to earlier disability and labor force exit; further, it becomes increasingly difficult for workers to remain in jobs that require physical strength as they age. Another reason for a possible tradeoff is that occupation-specific skills are less transportable than the more general skills gained through academic coursework, and thus their value may depreciate over time as jobs and labor market demands change.

Despite long-standing arguments that returns to vocational training may decrease or reverse across the life course relative to academic training, relatively little is known about long-term effects of CTE on employment. A cadre of studies in the past decade have empirically investigated the possible long-term tradeoff in employment outcomes for vocational versus general educational programs, and findings have been mixed (Brunello and Rocco 2017; Forster, Bol, and van de Werfhorst 2016; Forster and Bol 2018; Hampf and Woessmann 2017; Hanushek et al. 2017; Korber and Oesch 2019; Lavrijsen and Nicaise 2017; Kratz et al. 2019). However, these studies focus almost exclusively on European countries, which have more robust and structurally distinct vocational education systems compared to the US context. In fact, I am only aware of two studies that include the US as one of the countries in a comparative approach to investigating effects of vocational education across the life cycle (Hanushek et al. 2017; Forster, Bol, and van de Werfhorst 2016). Both studies use cross-sectional data from international surveys and self-reports of having completed a vocational program at either the secondary or postsecondary level.

Though informative, analyses of patterns across the life cycle using cross-sectional data cannot separate out age, period, and cohort effects (Forster, Bol, and van de Werfhorst 2016); they also face limitations due to retrospective reporting of educational experiences and lack of

contemporaneous pre-labor market measures. The measures of vocational education used in these studies are problematic for understanding long-term effects in the US context because they do not separate out secondary schooling; US high schools award general diplomas and do not have the types of structured vocational programs more prevalent in European countries. In fact, Hanushek et al. (2017) note that inaccurate reporting of education type at the secondary level is a substantial problem for U.S. respondents in their sample. Coursework is a more appropriate measure for secondary vocational education in the US context; indeed, previous research has shown that early labor market effects of CTE in the US are more pronounced using transcripts versus self-reports on program of study (Arum and Shavit 1995). In this study, I am able to accurately measure CTE participation using high school transcripts; further, using transcript data has the added benefit of allowing me to account for students' exclusive or complementary investment in CTE and academic coursework.

Despite the lack of scholarship on CTE and long-term labor market outcomes in the US, many studies have used longitudinal US data to examine relationships between CTE and early labor market outcomes (for a review, see Bishop and Mane 2004). Among this existing literature, the longest time span I am aware of is a study that estimates earnings 14 years after high school using NLS-72 data and finds returns to high school CTE as high as returns of a college degree (Gray, Huang, and Jie 1993). A recent study that uses NLSY97 to examine labor market outcomes an average of 10 years after high school finds that the positive relationship between CTE and employment is driven by students who do not ultimately attain a college degree, and it is the depth rather than the breadth of CTE training that matters (Kreisman and Stange 2020).

Of the existing research on CTE and early labor market outcomes, at least a couple of studies (Arum and Shavit 1995; Campbell et al. 1987) use the same data as this paper (HS&B:SO), and others use the HS&B senior cohort (Kang and Bishop 1989; Mane 1999). Using HS&B:SO, Arum & Shavit (1995) find positive effects of vocational education on employment four years after high school, confirming a short-term positive relationship between CTE and labor force attachment for the cohort in this study. In this paper, I investigate whether this relationship holds for long-term labor force attachment over 30 years after high school, or whether a tradeoff exists in the US between early advantages of CTE and later-life disadvantages in the labor market.

3. Data and Descriptive Statistics

3.1 High School and Beyond Midlife Follow-up

This study uses data from the sophomore cohort of the High School and Beyond study (HS&B:SO). HS&B:SO is a nationally representative longitudinal survey of people who were high school sophomores in the U.S. in 1980 ($n=14,830^2$), with follow-ups conducted in 1982, 1984, 1986, 1992, and 2014. In addition to the surveys, HS&B:SO also collected secondary and postsecondary transcripts for cohort members. For my analyses, I primarily use data from 1982, when most respondents are in their senior year of high school, and 2014, when respondents are approximately 50 years old. About 65 percent of eligible cohort members answered the 2014 follow-up ($n=8,790$) (Muller et al. 2019). For all descriptive and multivariable analyses, I employ appropriate HS&B:SO survey weights for the midlife follow-up, which account for the sampling design and attrition to maintain a nationally representative sample (of high school sophomores in 1980).

I limit my sample in three ways. All outcomes are from the midlife follow-up, so I first limit my sample to cohort members who responded to the midlife survey ($n=8,790$). Second, I limit my sample to respondents without a bachelor's degree, as effects of CTE on employment outcomes should be concentrated among individuals who do not attain a college degree (Kreisman and Stange 2020). I measure bachelor's degree completion as of the midlife survey, using respondents' self-reports of educational attainment across all survey waves and postsecondary transcripts. This drops about 3,610 midlife respondents who attained bachelor's degrees and an additional 20 who were missing data on educational attainment. Finally, I also limit my sample to respondents with high school transcript data available, which drops an additional 590 cases. These filters result in a final analytic sample of about 4,570 respondents without bachelor's degrees.

3.2 Variables

I investigate two dimensions of labor force attachment. The first dimension is current employment, which is a categorical indicator of employment status at the time of the midlife

² All sample sizes for restricted-use data are rounded to the nearest 10 per NCES guidelines

survey in 2014 and indicates if a respondent is currently working, unemployed, or out of the labor force. Due to small cell sizes for some categories, I collapse the original response categories, but I do so in such a way that labor force attachment is reflected in the groupings. I combine unemployed and “temporarily laid off, on sick or other leave” into one category to represent persons still in the labor force but not currently working. In addition, I combine retired, disabled, and homemaker into one category to reflect persons who are out of the labor force. I count respondents as missing if they indicated an employment status of “other.”

Table 1 presents the distribution of the analytic sample across employment status categories and their underlying components, overall and by gender. At age 50, almost 85% of respondents without a college degree are in the labor force. Among the 15% who are out of the labor force, almost two-thirds are out of the labor force due to disability whereas very few say they have retired. Women are more likely to be out of the labor force, and their reasons for non-participation are different from those of men. Though the overall proportion of men and women who report being disabled is similar, disability makes up a much larger portion of men’s non-participation. The overall labor force participation and employment rates for the analytic sample are comparable to 2014 national estimates for people ages 45-54, though they are on the higher end for people without bachelor’s degrees (NCES 2018). This likely reflects the fact that the sample is nationally representative of high school sophomores in the US in 1980, making it slightly more select than the comparable US population for that age cohort because the sample would not include people who dropped out prior to sophomore year or adult immigrants.

Table 1. Employment Status at Midlife

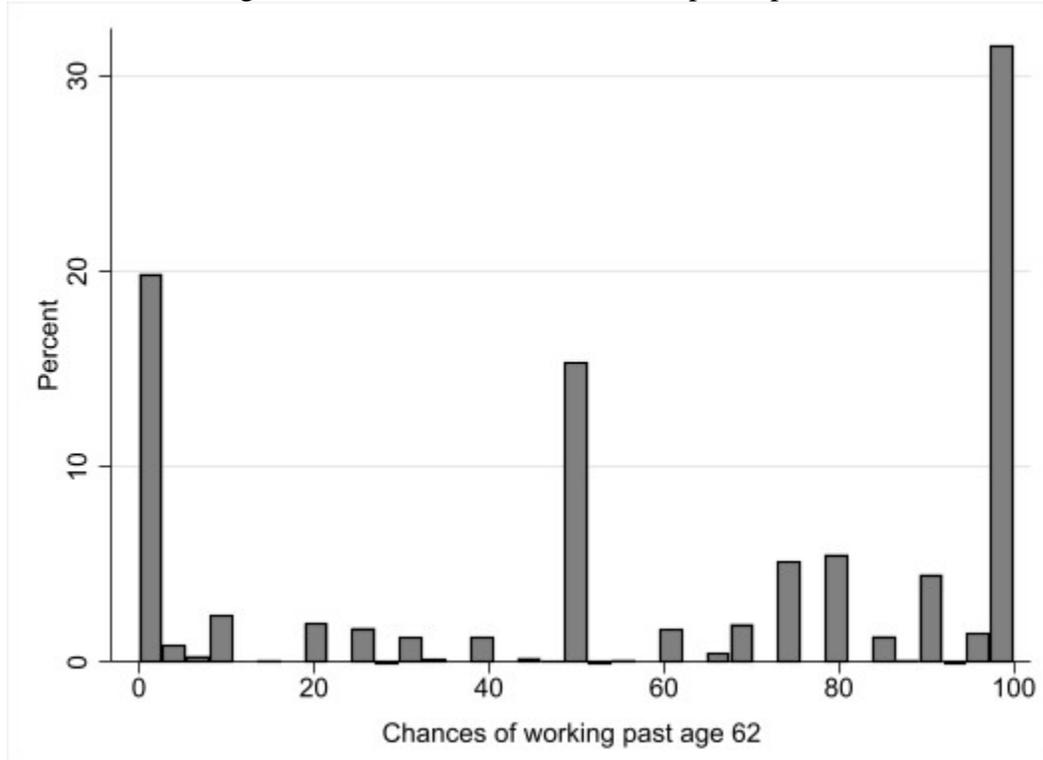
	Overall		
	%	Women	Men
Working	78.4	75.9	80.9
Unemployed	6.2	5.9	6.5
Unemployed	4.7	5.0	4.3
Temporarily laid off/on leave	1.6	1.0	2.2
Out of labor force	15.4	18.2	12.7
Retired	1.6	1.0	2.4
Disabled	9.8	9.5	10.2
Homemaker	4.0	7.9	0.1

n = 4,470

SOURCE: U.S. Department of Education, National Center for Education Statistics, High School and Beyond Study (HS&B) Restricted-use Data File.

The second dimension of labor force attachment is plans for future labor force participation, which is based on a respondent's self-reported percent chance of working full-time after age 62 — the early retirement age for claiming Social Security OASI benefits. This question was asked of all respondents, regardless of their current employment status. Respondents could enter an integer between 0 and 100 to indicate the percent chance that they would be working after age 62, and I use the responses in their original format as a continuous measure. Consistent with other surveys that have included this item, Figure 1 shows a multi-modal distribution of responses that exhibits spikes at meaningful values and has a slight negative skew. I tested a variety of transformations and approaches to using this variable, but results were substantively similar across specifications; thus, I use the original 0-100 percent chance for ease of interpretation.

Figure 1. Plans for future labor force participation



SOURCE: U.S. Department of Education, National Center for Education Statistics, High School and Beyond Study (HS&B) Restricted-use Data File.

My definition of CTE coursework is limited to courses that are considered specific labor market preparation, or occupational education — meaning, they are linked to specific occupational areas and not general career preparation or family and consumer sciences. I include courses in the following occupational areas: agriculture and natural resources; business and marketing; healthcare; technology; and trade and industry. I exclude courses connected to sub-baccalaureate service occupations (food service and hospitality; childcare and education; personal and other services); lower-skill service occupations are distinct from the other occupational areas in that they are less likely to provide stable work in skilled jobs. For the HS&B:SO cohort, who were in high school from about 1978-1982, the majority of CTE coursework is concentrated in business or trade and industry.

I classify CTE courses using the Classification of Secondary School Courses (CSSC) codes, which are six-digit course identification codes assigned to each course on a student's high

school transcript. This taxonomy was developed by NCES specifically for the HS&B transcripts (National Center for Education Statistics 1985). I measure the number of total credits earned in CTE coursework using a common metric standardized across schools. One credit is equivalent to one Carnegie unit, which corresponds to a course that meets for one period per day for the entire school year.

Using this definition of CTE credits, I create two categorical variables to measure CTE coursework. The variables are both based on an existing classification scheme of occupational course-taking (Dalton et al. 2013), which is outlined in Table 2. The first variable is *CTE intensity* and uses the four detailed categories of the classification scheme, identifying respondents as CTE nonparticipants, samplers, explorers, or concentrators. This is a standardized classification scheme based solely on course credits and does not reflect any kind of certification or completion of specific CTE programs, as high school CTE programs and their requirements vary across states. The second variable is *CTE/math investment* and interacts the classification scheme with math course-taking to jointly measure investment in occupational and academic or college preparatory coursework. In this context, investment refers to the intensity of students' curricular focus in academic and vocational education in terms of meeting a certain threshold of coursework; it does not refer to a monetary investment. For *CTE/math investment*, respondents are categorized as CTE investors, math investors, both, or neither. This interaction of CTE and academic coursework mimics the substance of debates surrounding long-term effects of CTE coursework in a changing and upskilling labor market, allowing me to compare tradeoffs and complementarity of CTE and academic coursework. CTE investment is based on the two broader categories of the classification scheme in Table 2, and math investment is based on whether respondents' highest math course was at least Algebra 2 or above in high school. I focus on math because it is the academic subject that is most strongly correlated with college completion and labor force outcomes; for the HS&B:SO cohort, Algebra 2 would be considered college preparatory math.

Table 2. Classification Scheme for Occupational Course-taking

<i>Noninvestor</i>	Nonparticipant: fewer than 1 total CTE credits Sampler: 1 to fewer than 3 total CTE credits
<i>Investor</i>	Explorer: 3 or more total CTE credits, but no single occupational area with 3 or more credits Concentrator: 3 or more total CTE credits in at least one occupational area

The distribution of the analytic sample across the coursework variables is presented in Table 3. The descriptive statistics for *CTE intensity* show that most respondents took at least one credit of occupational CTE, and the modal category for both women and men is concentrator. Though CTE course-taking was more common for the HS&B:SO cohort in general compared to more recent cohorts (Kreisman and Stange 2020), levels of CTE coursework are particularly intense for the analytic sample because it is limited to respondents without bachelor's degrees. Still, NCES data from a more recent cohort (HSL:09) indicates that over 90% of all secondary students enroll in CTE courses and about 20% of all high school graduates are CTE concentrators. The descriptive statistics for *CTE/math investment* indicate that most respondents are CTE investors, whereas less than 10% are purely math investors. However, a good portion of respondents invested in both CTE and math, or in neither. Students who invested in neither may be considered as receiving a "general" education, which does not specifically prepare them for college or skilled occupations. Overall, the course-taking patterns are remarkably similar for women and men, with high levels of investment in CTE for both. However, it is worth noting that the occupational areas in which women and men invest are different and reflect the highly gender-segregated sub-baccalaureate labor market (Ainsworth and Roscigno 2005; Grubb 2002; Jepsen, Troske, and Coomes 2014), with HS&B:SO women concentrating mainly in business and men in trade and industry.

Table 3. CTE Course-taking

	Women	Men
<i>CTE intensity</i>		
Concentrator	40 %	44 %
Explorer	37	30
Sampler	19	22
Nonparticipant	3	3
<i>CTE/math investment</i>		
CTE investor	62	59
Math investor	7	9
Both	16	15
Neither	15	16

n = 4,570

SOURCE: U.S. Department of Education, National Center for Education Statistics, High School and Beyond Study (HS&B) Restricted-use Data File.

I include covariates that may be associated with selection into coursework or otherwise confound the relationship between coursework and labor market outcomes. All covariates are measured when respondents are in high school and include sociodemographic characteristics, school characteristics, and achievement/skills. Sociodemographic characteristics include race, family structure, family income, parent education, parent occupation, and disability status. School characteristics include school sector and urbanicity. Achievement/skills measures include overall weighted GPA, math achievement test score, and locus of control.

3.3 Analytic Strategy

I examine the long-term relationship between high school CTE coursework and midlife labor force attachment with a series of multinomial logistic regressions for categorical outcomes and ordinary least squares (OLS) regressions for continuous outcomes. Results from multinomial logistic regressions are reported as average predicted probabilities for ease of interpretation and comparison across models. I estimate two nested models for each predictor-outcome pair. The base model shows the bivariate relationship, and the full model shows the independent relationship net of all covariates. I present gender-stratified analyses for all models to account for

gendered CTE course-taking and labor market experiences and opportunities. All analyses include appropriate survey weights and clustered standard errors at the high school level (using the `svy` command suite in Stata). I use single imputation to handle missing data on covariates.

Future plans for analysis include: correction for selection into the analytic sample; multiple imputation of missing covariate data; and incorporation of school course offerings and patterns of early labor force attachment into the analytic approach.

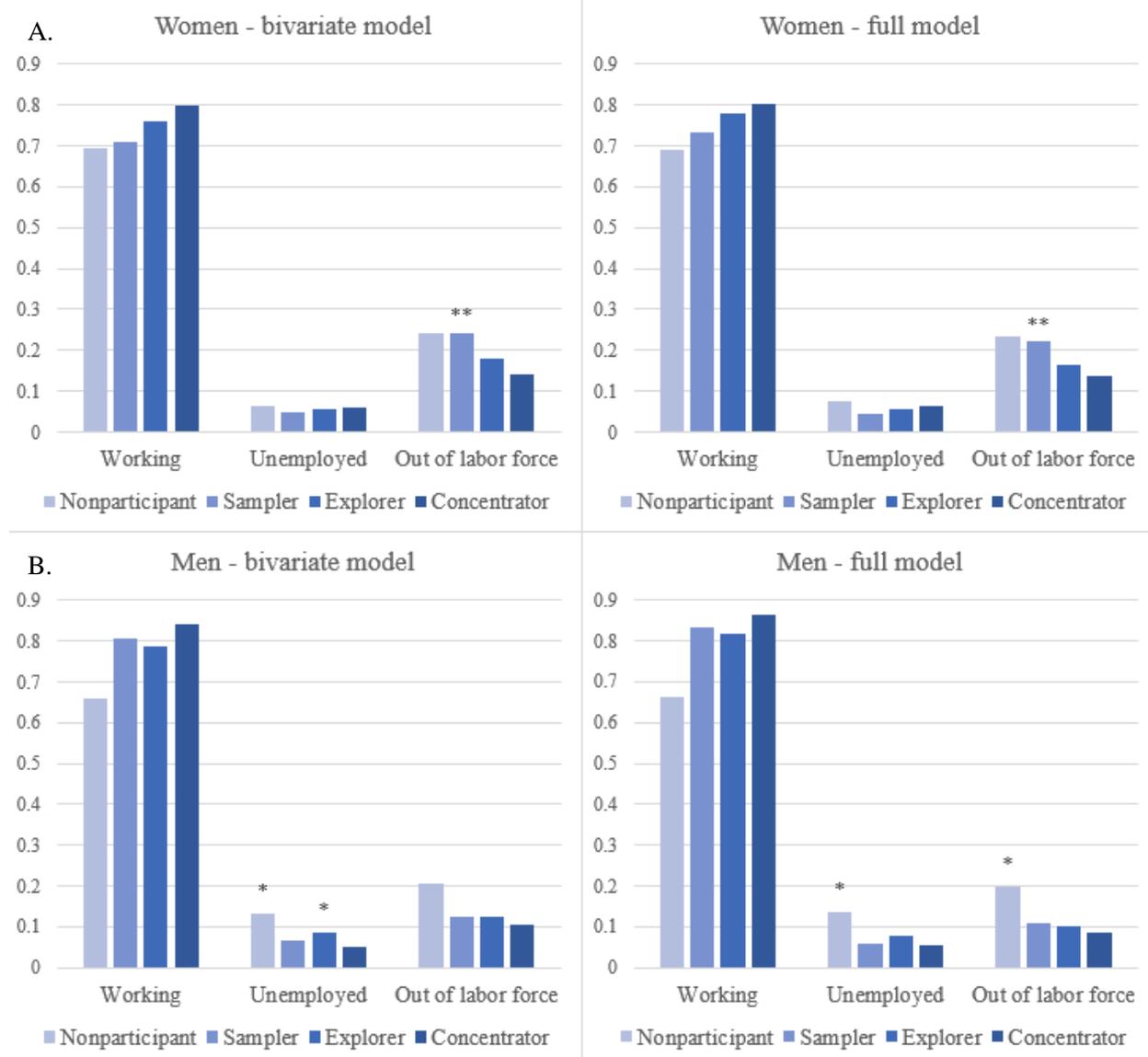
4. Results

Figure 2 presents average predicted probabilities from multinomial logistic regressions estimating the relationship between CTE intensity in high school and employment status at midlife, among respondents without bachelor's degrees. Panel A presents the bivariate and full models for women, and Panel B shows the same models for men. For both women and men, adjusting for covariates in the full model does very little to change the bivariate relationship between CTE intensity and employment status, implying that the patterns are not driven by differences in observed skills and sociodemographic and school characteristics between students.

In the full model for women in Panel A, the relationship between CTE intensity and women's probabilities of working is largely linear, with greater CTE intensity corresponding to greater chances of employment. A woman who was a CTE concentrator in high school is more than 10 percentage points more likely to be working at midlife versus a woman who was a CTE nonparticipant (<1 credit). The beneficial effect of CTE intensity on employment is largely due to the association between CTE intensity and labor force participation; women who took more CTE are less likely to be out of the labor force at midlife. Women's probabilities of unemployment are relatively low and vary only slightly by CTE intensity. The full model in Panel B shows a different pattern for men. Though CTE concentrators have the highest rates of employment, no linear pattern is present for increasing CTE intensity as it was for women. Instead, any level of CTE participation is markedly beneficial for men's long-term employment versus nonparticipation. Men who were CTE nonparticipants are twice as likely to be unemployed or out of the labor force compared to men who participated in CTE. Of course, it is worth keeping in mind that a small percentage of respondents were CTE nonparticipants (3%), so estimates for this category for both men and women may be the least reliable. Regardless, the

overall results for both men and women are not consistent with a long-term tradeoff wherein CTE might have harmful effects on employment later in life. At the very least, greater CTE intensity in high school does not appear to have detrimental effects on employment at midlife; in fact, it may have long-term benefits, especially for women who do not attain bachelor’s degrees.

Figure 2. CTE Intensity in High School and Employment Status at Midlife

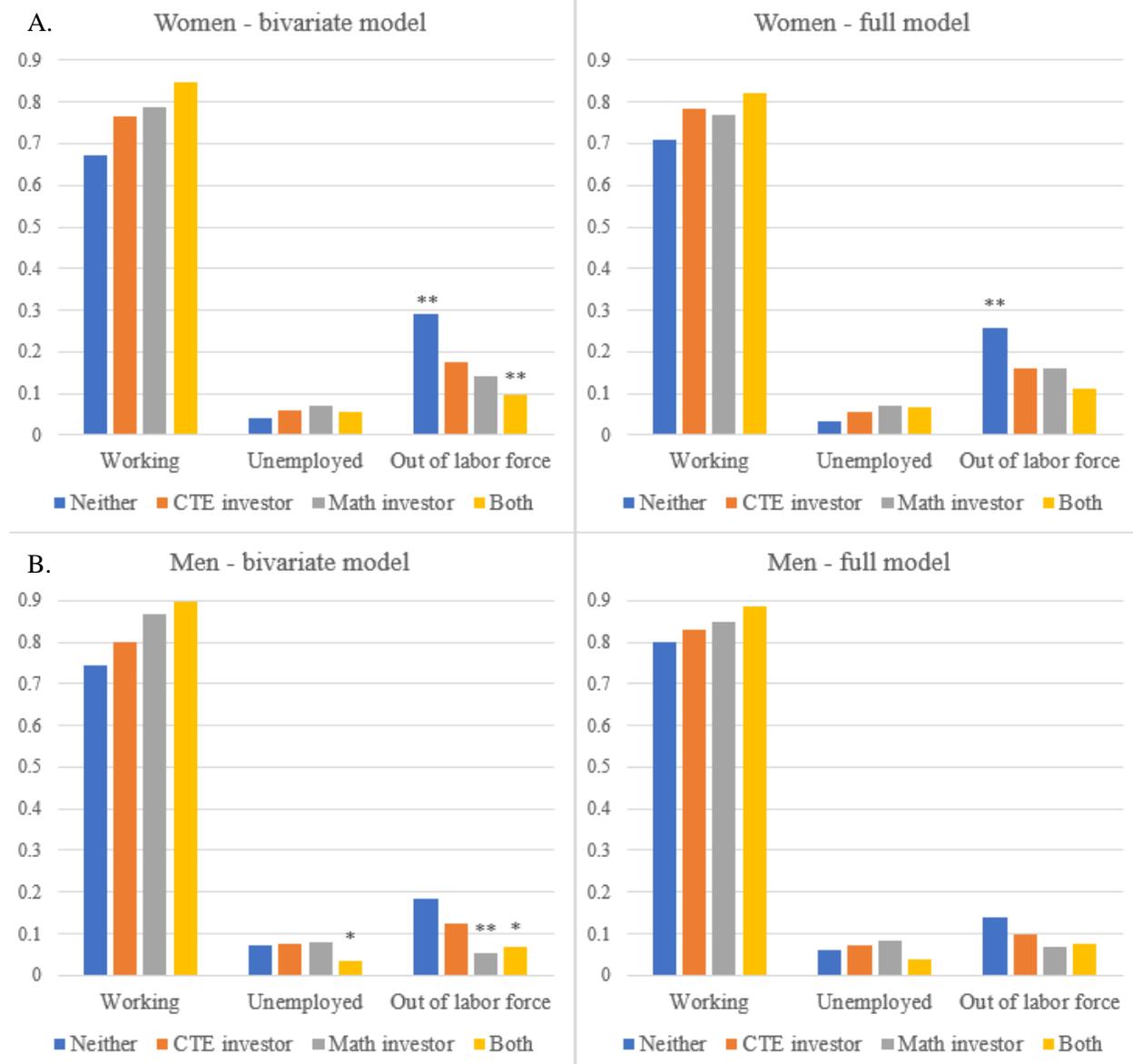


*p<.05, **p<.01, ***p<.001 - indicates that the relative risk ratio (RRR) for that category is significantly different from the RRR for CTE concentrators (RRRs estimated with “working” as base outcome); n = 4,470
 SOURCE: U.S. Department of Education, National Center for Education Statistics, High School and Beyond Study (HS&B) Restricted-use Data File.

Figure 3 presents predicted probabilities from similar models for the relationship between CTE/math investment and employment status. This allows a comparison of long-term labor market effects of different types of coursework for individuals who did not end up attaining bachelor's degrees. In contrast to the CTE intensity models, covariate adjustment in the full models for CTE/math investment noticeably changes the patterns for both women and men. This implies greater selection into college-preparatory math coursework than into CTE coursework based on skills and sociodemographic and school characteristics, as might be expected.

Though patterns are slightly different for women and men, the categories with the highest and lowest probabilities of working are the same. Women and men who invested in both CTE and math have the highest probabilities of employment, whereas those who invested in neither CTE nor math have the lowest. The gap between investing in both and investing in neither is particularly large for women, with a 10 percentage point difference in employment. Unlike with CTE nonparticipants, neither of these categories is particularly rare — about 15% of women and men in the analytic sample fall into each. These results imply a complementarity between CTE and college-preparatory math coursework that yields long-term benefits in the labor market, suggesting that a combination of general and occupational skills is optimal for long-term labor force attachment. These findings also indicate that students who invest in neither CTE nor college-preparatory academic coursework are most likely to be out of the labor force at midlife, and this disadvantage is again more apparent for women. Ancillary analyses indicate that for both women and men, much of the disadvantage of having invested in neither CTE nor math is driven by greater probabilities of disability at midlife. It may be that these individuals end up in more physically taxing low-skilled jobs, lack the skills to transition to other fields, or face lower opportunity costs of exiting the labor force.

Figure 3. CTE/Math Investment in High School and Employment Status at Midlife



*p<.05, **p<.01, ***p<.001 - indicates that the relative risk ratio (RRR) for that category is significantly different from the RRR for CTE investors (RRRs estimated with “working” as base outcome); n = 4,470
 SOURCE: U.S. Department of Education, National Center for Education Statistics, High School and Beyond Study (HS&B) Restricted-use Data File.

The results for employment status suggest that CTE does not have long-term negative effects on employment and may instead have long-term benefits for labor force attachment, especially when paired with college-preparatory math coursework. Though I cannot know if

these trends will continue as workers age, I can examine workers' plans for future labor force participation, which has been shown to be highly predictive of workers' retirement timing. This can provide some insight as to whether patterns in labor force attachment at midlife are likely to persist into older ages and translate into longer workforce participation.

Tables 4 and 5 presents results from OLS regressions estimating the relationships between the CTE course-taking measures and respondents' chances of working beyond age 62. In Table 4, greater CTE intensity seems to be correlated with greater chances of working beyond age 62, but none of the categories are significantly different from CTE concentrators for women or men. The magnitude of the differences across categories is larger for women than for men. However, accounting for current labor force participation in Model 3 attenuates most of the variation across categories, suggesting that any positive relationship between CTE intensity and plans to work beyond age 62 operates largely through workforce attachment at midlife. Table 5 shows the same models for CTE/math investment. As with employment status, the patterns for women and men on this variable are slightly different. Investing in both CTE and math slightly increases women's chances of working beyond age 62, while math investment alone increases men's odds of working beyond age 62; however, none of these relationships are significant. Mirroring the findings on employment, investment in neither CTE nor math is harmful for both women and men's future plans to work. This is largely explained by the fact that people who invested in neither type of coursework are more likely to be out of the labor force already. Thus, taken together, the findings from Table 4 and 5 suggest that CTE does not appear to have much relationship with early retirement plans beyond its association with labor force attachment at midlife.

Table 4. CTE Intensity and Future Plans to Work:
Coefficients from OLS Regressions Predicting Chances of Working beyond Age 62

<i>Covariates included</i>	Women			Men		
	1	2	3	1	2	3
	No	Yes	Yes	No	Yes	Yes
<i>CTE intensity (ref: Concentrator)</i>						
Explorer	-3.194 (2.406)	-2.717 (2.417)	-1.427 (2.277)	-0.250 (2.889)	0.268 (2.866)	1.254 (2.557)
Sampler	-5.486 (2.931)	-5.234 (2.955)	-1.014 (2.679)	-1.918 (2.932)	-2.178 (3.017)	-1.147 (2.644)
Nonparticipant	-10.05 (7.213)	-9.629 (6.864)	-5.304 (5.534)	-3.393 (7.740)	-4.588 (7.274)	0.992 (7.655)
Out of labor force			-44.69*** (2.404)			-49.34*** (2.856)
Constant	58.810 (1.578)	51.030 (7.114)	63.550 (6.537)	62.990 (1.849)	55.180 (6.909)	64.860 (6.650)
R-squared	0.004	0.020	0.202	0.001	0.036	0.198

*** p<0.001, ** p<0.01, * p<0.05; robust standard errors with clustering on schools in parentheses

SOURCE: U.S. Department of Education, National Center for Education Statistics, High School and Beyond Study (HS&B) Restricted-use Data File.

Table 5. CTE/Math Investment and Future Plans to Work:
Coefficients from OLS Regressions Predicting Chances of Working beyond Age 62

<i>Covariates included</i>	Women			Men		
	1 No	2 Yes	3 Yes	1 No	2 Yes	3 Yes
CTE/math investment (<i>ref: CTE investor</i>)						
Math investor	1.845 (3.757)	2.376 (4.094)	3.022 (3.744)	6.463 (3.831)	1.648 (4.153)	-0.395 (3.911)
Both	5.437 (2.870)	5.092 (3.018)	3.499 (2.884)	0.273 (3.089)	-4.600 (3.038)	-5.671 (2.951)
Neither	-5.321 (3.351)	-5.540 (3.261)	-0.949 (2.802)	-6.682* (3.304)	-5.859 (3.296)	-3.380 (2.925)
Out of labor force			-44.58*** (2.398)			-49.25*** (2.872)
Constant	56.100 (1.344)	51.160 (7.168)	63.680 (6.638)	62.770 (1.636)	56.670 (6.871)	66.050 (6.613)
R-squared	0.006	0.022	0.202	0.007	0.039	0.201

*** p<0.001, ** p<0.01, * p<0.05; robust standard errors with clustering on schools in parentheses

SOURCE: U.S. Department of Education, National Center for Education Statistics, High School and Beyond Study (HS&B) Restricted-use Data File.

5. Conclusion

The ability to hold a job is crucial at midlife, as this period is when people accumulate the majority of their retirement savings and are particularly vulnerable to the effects of job loss. However, individuals may face obstacles to work at midlife due to skill obsolescence or deteriorating health, and their susceptibility to and ability to weather these challenges influences their labor force attachment. Though previous research on employment has often focused on individuals' contemporaneous circumstances, this ignores the role that pre-labor market skills may play in preparing people for work across the life course. This paper focused on high school as a primary site of pre-labor market skill development for workers in the US without bachelor's degrees and investigated the relationship between CTE coursework in high school and long-term labor force attachment. In contrast to theories and European studies that indicate a tradeoff between beneficial short-term and detrimental long-term labor market effects of CTE, my

findings suggest that CTE coursework in high school is not harmful for long-term labor force attachment among US individuals without bachelor's degrees.

Though both women and men seem to benefit from taking more CTE coursework, the patterns differed by gender. The relationship between CTE intensity and employment at midlife is relatively linear for women, with greater concentration in CTE corresponding to higher probabilities of employment. This is largely because women who took more CTE coursework are less likely to be out of the labor force at midlife. For men, it is mainly participation in CTE rather than intensity of concentration that is associated with employment at midlife. Men without bachelor's degrees who did not participate in CTE in high school are more likely to be unemployed and to be out of the labor force at midlife.

Consistent with research on short-term labor market effects of CTE in the U.S., my results also suggest a complementarity between CTE and academic coursework for long-term labor force attachment. Individuals without college degrees who invested in both CTE and college-preparatory math coursework in high school have the highest probabilities of employment at midlife. Those who invested in neither CTE nor academic coursework have the lowest probabilities of employment, and individuals who invested in only one area of coursework fall somewhere in the middle. Though investment in neither area is associated with greater probabilities of being out of the labor force for both women and men, the benefit of investment in both areas differed slightly by gender. For women, investment in both areas corresponds to especially low chances of being out of the labor force; for men, it corresponds to especially low chances of unemployment.

The patterns for workers' chances of working beyond age 62 were relatively similar to those for midlife employment status, though I found almost no statistically significant differences by coursework. This implies that investment in CTE does not harm individuals' chances of working beyond early retirement age; patterns suggest that non-investment in CTE may lower chances of working beyond age 62, especially if individuals invest in neither CTE nor academic coursework. The strongest predictor of future labor force participation is current labor force participation at midlife, and most variation in future work plans by coursework is driven by individuals' current labor force participation. Thus, to the extent high school coursework affects midlife workers' plans of working beyond age 62, it may largely be through early labor force exit.

This was the first study to investigate the long-term effects of CTE in the US context using longitudinal data and employed accurate measures of course-taking using high school transcripts. The findings support the basic conclusions from the cross-sectional study by Hanushek and colleagues (Hanushek et al. 2017), which suggested that the tradeoff between short-term and long-term effects of CTE that seems to exist in some European contexts may not exist in the US due to its weaker vocational education program. This paper's results highlight the unique nature of secondary vocational education in the US context of comprehensive schooling, as the "effects" of CTE varied depending on the intensity of investment and the mix of courses taken. The slightly different patterns by gender underscore the importance of incorporating gender into studies of returns to CTE, especially considering gendered employment patterns and gender-segregated sub-baccalaureate occupations and CTE coursework.

These findings have implications for scholarly debates surrounding the "college-for-all" ethos and modern CTE. Some scholars argue that curricular intensification and a focus on preparing all students for college comes at the expense of valuable occupational training that might benefit students who will not ultimately attend or complete college. Between 1980 and 2004, the percentage of high school students expecting to attain a bachelor's degree rose from less than 50% (Goyette 2008) to almost 90% (Rosenbaum 2011). The increase in expectations has been greatest among students who plan to enter occupations that have the lowest percentages of bachelor's degree recipients (Goyette 2008). Though all students who expect a bachelor's degree may technically be able to enroll in college in light of open admissions policies, less than half of students who plan to get bachelor's degrees actually succeed in attaining them (Rosenbaum, Stephan, and Rosenbaum 2010). The results in this paper suggest that investment in college-preparatory academic coursework will not harm students' long-term labor force attachment, even if they do not attain bachelor's degrees. However, a combination of academic and vocational education may indeed provide the largest benefits for most students, which aligns with modern CTE's focus on preparing students for more highly skilled occupations and incorporating more academically rigorous curricula.

Though this study was the first to use longitudinal data to examine the long-term relationship between high school CTE and labor market outcomes in the US, it has some limitations. As a first step to understanding long-term effects of CTE, this paper largely focused on describing relationships rather than establishing causality. Adjusting for covariates associated

with selection into coursework only slightly attenuated observed patterns, but future work can strengthen causal inference using methods beyond covariate adjustment. Another possible limitation is the measurement of CTE and academic coursework, as coursework can be measured in myriad ways, and curricular definitions and standards change over time. However, I used existing classifications and scholarship to inform my approach to measuring coursework, results were robust to multiple specifications in ancillary analyses, and findings largely aligned with expected patterns based on previous research. Finally, this study only focused on labor force attachment, which is a relatively blunt labor market outcome. Future work should focus on more detailed labor market outcomes such as income or occupations to understand how effects of CTE may vary across outcomes, as the results from this study cannot be generalized to other labor market outcomes.

This study has a few implications for policy related to education and workforce participation across the life course. First, results suggest that schools may be able to best prepare students for long-term labor force participation by focusing on developing both occupational and academic skills, especially for students who are least likely to attain bachelor's degrees. It may be that a combination of academic and occupational skills can help students gain entry into skilled occupations in early adulthood and also help them adapt and maintain attachment to the workforce as skill requirements change over time. The least advantageous curriculum seems to be when students invest in neither college-preparatory academics nor CTE, which leads to early labor force exit.

Second, these findings imply that changing curricular trends over the past few decades could lead to stronger labor force attachment at midlife and longer workforce participation among more recent cohorts of high school students, if patterns found in this study hold over time. Curricular intensification over the past few decades means that fewer students are receiving a "general" education, in which they invest in neither college-preparatory academic nor CTE coursework. Further, the modernization of CTE means that more CTE students are investing in both academic and occupational skills rather than occupational training coming at the expense of academic rigor. Longer and stronger attachment to the labor force means increased funds paid into Social Security, and fewer workers exiting the labor force due to disability or early retirement means fewer claims outside of full OASI benefits. This is not only vital for the

continuation of Social Security programs, but also for workers' long-term financial security in the face of increased life expectancy and importance of personal retirement savings.

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Center for Financial Security

School of Human Ecology
University of Wisconsin-Madison

1300 Linden Drive
Madison, WI 53706

608-890-0229
cfs@mailplus.wisc.edu
cfs.wisc.edu

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