CENTER FOR ANALYSIS OF POSTSECONDARY EDUCATION AND EMPLOYMENT

The Labor Market Returns to Sub-Baccalaureate College: A Review

A CAPSEE Working Paper

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March 2017

The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305C110011 to Teachers College, Columbia University. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education. The authors appreciate comments from James Benson.

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Abstract

This paper reviews recent evidence on the labor market returns to credit accumulation, certificates, and associate degrees from community colleges. Evidence is collated from estimates of earnings gaps across college students using large-scale, statewide administrative datasets from eight states. Six of these states were partners of the Center for Analysis of Postsecondary Education and Employment (CAPSEE), a research center funded by the Institute of Education Sciences of the U.S. Department of Education. CAPSEE researchers conducted extensive analyses of education and earnings in these states. Findings from these studies affirm a "CAPSEE consensus" with three main results and two key features. For associate degrees, this review affirms that completing an associate degree yields strongly positive, persistent, and consistent earnings gains: studies show that completing an associate degree yields on average approximately $4,640–$7,160 per annum in extra earnings compared to entering college but not completing an award. For certificates, the evidence shows positive but modest returns and that these returns may fade out within a few years post-college. For non-completers, there is evidence that earning more credits is associated with higher earnings. Generally, the results establish two main features. First, increments of college lead to higher earnings, but with returns that are heterogeneous by field of study. Second, the evidence is strongly suggestive that returns to college are robust to macroeconomic trends.

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1. Introduction

Going to college is one of the most important economic decisions an individual can make, and there are now hundreds of studies that have examined the economic value of college. Much of this research has focused on the value of four-year college degrees and has consistently found large earnings gains from bachelor's degree completion. Yet, over 40 percent of college students attend community colleges and are enrolled in certificate and associate degree programs. Although some of these students do transfer to four-year colleges and earn bachelor's degrees, significantly fewer than 50 percent of students who begin at community college earn a credential from either a two- or four-year college (Knapp, Kelly-Reid, & Ginder, 2012). While in the last few years, researchers have begun to pay more attention to labor market outcomes of community college students, far less information about their employment outcomes is currently available. This is a concern because, compared with those who enroll in bachelor's granting institutions, students who enroll in community colleges are far more uncertain about attending, and they are from less advantaged populations. It is these students—those with associate degrees, certificates, or no award[1]—for whom more evidence on the labor market returns to college is needed.

This discussion takes place in the midst of continuing controversy about the value of a college education. The cost of college has attracted alarm in recent years with many wondering whether college is being priced out of reach of even middle class families and whether the gross earnings gains from college are worth it (Goldrick-Rab, 2016). The confluence of rising tuition and fees for college, stagnating family incomes, and declining state subsidies for college bears most heavily on students who are on the margins of college enrollment. This has led to widespread concern about the growth of presumably unmanageable college debt.[2] Compounding these challenges, Cappelli (2015) documents how complex the college enrollment decision has become and how students are often making investments of time and money with limited or incomplete information. With higher costs of college, evidence on growing student debt is typically cited as the consequence of these developments. Yet many community college students work while enrolled in college, and a large proportion already have substantial work experience before enrolling; coupled with relatively low fees at community colleges, on average these students have low debt at the end of their time in college.[3] Nevertheless, increasing prices and the growing complexity of choices make it even more important that we identify which programs offer the best investments.

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[1] Collectively, these students are sometimes referred to as the "some college" group. The term *some college* is an artifact of Census datasets that report primarily on attainment of a bachelor's degree or higher degree. The "some college" designation is a residual category including persons who have earned a few college credits as well as persons who have completed a certificate, associate degree, or any other sub-baccalaureate credential.
[2] See Baum (2016) for a discussion of the controversy.
[3] Per FTE, students who attended two-year public colleges have average student loan balances of $3,000 (Belfield, 2013, Table 1, 2015 dollars).

In contrast to the tenor of the public discussion of the value of college, research on earnings associated with postsecondary education is more positive. It generally concludes that on average sub-baccalaureate degrees and certificates lead to higher earnings, although the returns to both vary by industry and occupation (Agan, 2013; Altonji & Zimmerman, 2017; Andrews, Li, & Lovenheim, 2016; Avery & Turner, 2012; Backes, Holzer, & Velez, 2015; Carnevale, Jayasundera, & Cheah, 2012; Carnevale, Jayasundera, & Gulish, 2016; Castex & Dechter, 2014; Melguizo & Wolniak, 2012; Turner, 2016; Vuolo, Mortimer, & Staff, 2016). The research sponsored by CAPSEE,[4] which forms the basis of this review, supports this overall conclusion but advances our understanding of the relationship between education and employment in several ways.

First, we add to the growing but still limited research on the returns to sub-baccalaureate education (Belfield & Bailey, 2011). We review analyses on eight disparate states (six of which were studied by CAPSEE researchers), generating insights about the possibility that returns vary significantly in different contexts.

Second, much of past research has used national datasets with self-reported levels of postsecondary education (e.g., the Current Population Survey or American Community Survey) or datasets with detailed information but that typically make use of very small samples (e.g., the National Longitudinal Survey of Youth). The research under review here makes use of large state datasets that include student transcripts merged with individual quarterly earnings records, which allow for the analysis of returns to particular programs and postsecondary pathways and to different types and lengths of certificates and associate degrees, and even to the accumulation of credits for those who do not complete credentials.

Third, much of the most prominent recent research that provides results on the average earnings of graduates with particular types of credentials, especially bachelor's degrees, has been descriptive. Descriptive research does not identify the different effects of the characteristics of individuals enrolling in different programs versus the effects of the programs themselves. In addition to controlling for measurable personal characteristics of students, most CAPSEE research presented here uses an individual fixed effects methodology that takes account of fixed characteristics of individuals, whether or not those characteristics can be measured.

Fourth, much of the previous research has analyzed earnings during time periods before the Great Recession; that recession was the most severe labor market downturn since 1945, and its influence on jobs and earnings is still being felt. The recession's impacts may be especially strong for workers with vocational qualifications in industries in which aggregate demand is low (Carnevale, Hanson, & Gulish, 2013; Carnevale et al., 2016). In some cases, the datasets used in

[4] Over the past six years, researchers from several institutions have undertaken coordinated studies on the labor market returns to postsecondary education (among other kinds of studies) using data from Arkansas, California, Michigan, North Carolina, Ohio, and Virginia under the auspices of the Center for Analysis of Postsecondary Education and Employment (CAPSEE), supported by the U.S. Department of Education, Institute of Education Sciences.

the studies we review allow us to compare returns to sub-baccalaureate credentials from before and after the Great Recession.

While the existing research supports the conclusion that sub-baccalaureate degrees and certificates tend to have positive labor market returns, there is some recent evidence suggesting a productivity slowdown that may reduce the demand for cognitive or abstract skills. This slowdown may affect all workers with college education, but those with the fewest college-gained skills may be forced into occupations that are more service-oriented, manual, and routine. Potentially, these labor market changes may mean that—absent a bachelor's degree—the returns to college are falling and becoming more volatile. Yet, we should be cautious about applying general evidence to the group on the margin of college. Community college students follow many varied pathways through their college careers—including going part-time, switching enrollment intensity, temporarily dropping out, changing major, and transferring (indeed, many students transfer "down" to community colleges from four-year institutions as well as "up"; and there are lateral transfers too). Some community college students have come directly from high school; others are older and may be seeking retraining for a new occupation. Characterizing these students and their likely outcomes is complicated. Identifying their pathways through college and labor market returns requires large-scale data with longitudinal information on time when in college as well as labor market profiles before, during, and after college.

In this review, we draw on the significant new accumulation of evidence, largely from CAPSEE studies, on the returns to college based on administrative datasets. We report the overall findings from this evidence and highlight key results and features of the labor market returns to college. We then interpret this evidence in light of recent significant labor market changes. The conclusions indicate a general consensus on the returns to sub-baccalaureate college.

2. Estimating the Returns to College

Prior Evidence

The copious literature on the economic returns to completing a four-year college degree overwhelmingly finds very high economic returns. Looking across nine studies published since 2005, the lifetime present-value earnings gain from a four-year college degree amounts to $423,800 (see Appendix Table A1). While further investigation into the exact size of the earnings gain is helpful, the overall conclusion—that completing a four-year degree is a high-yield investment—is very unlikely to be overturned.

One might also expect high returns to the completion of community college programs based on prior evidence. In an earlier article (Belfield & Bailey, 2011), we reported strongly positive returns to most awards. Across 17 studies, the average earnings premium for an associate degree compared with a high school diploma was 13 (21) percent for men (women); and, although there were only two available studies on "shorter" credentials, earnings gains from certificates were also identifiable (see Appendix Table A2 and evidence from the Survey of Income and Program Participation [SIPP] by Carnevale, Rose, & Hanson, 2012). However, these studies are not recent enough to address significant changes to the labor market over the last decade. Generally, there is little evidence on the labor market returns for this group of college students. Moreover, the comparison group for the prior studies is typically those who did not attend college (high school graduates) rather than a within-college group. Unobserved differences between high school graduates and college enrollees may affect the size of the earnings premium.

Data and Methodology

This review draws on recent studies that are distinctive with respect to data and method.[5] The datasets used are large-scale, longitudinal student transcripts merged with individual quarterly earnings records. Each study's analysis is slightly different, but the combined datasets are similarly constructed by conjoining information from three different types of datasets. The first type is composed of information on all first-time-in-college, credit-seeking students within a state community college system across some years in the early to mid-2000s. This dataset includes transcript information, including credits accumulated, award receipt, and field of study, as well as basic personal information (e.g., age, gender, race/ethnicity), and financial aid received (loans and grants per semester), but it typically does not include information on high school performance.

The second type of dataset is composed of student-level data from the National Student Clearinghouse (NSC).[6] The NSC tracks students as they transfer to other Title-IV eligible colleges, as more than one third of all community college students do (Hossler et al., 2012). The NSC dataset includes information on institutions attended, enrollment durations, awards obtained, and field of study at each institution subsequent to enrollment within the initial system. Notably, the NSC data allow for the identification of community college students who eventually obtained a bachelor's degree or higher and those who obtained any other degree, certificate, or diploma at a transfer college.

The third type of dataset is composed of individual quarterly earnings data obtained from Unemployment Insurance (UI) records. These data are typically available for the period before, during, and after enrollment in college.

For each state, the combined dataset—from transcripts, transfer, and earnings—is large and includes longitudinal college and labor market behavior over a window of at least 10 years,

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[5] Most of these studies were undertaken by CAPSEE researchers and funded by the Institute of Education Sciences, U.S. Department of Education, through Grant R305C110011 to Teachers College, Columbia University.
[6] The dataset for Ohio does not rely on merged data from the NSC.

including years prior to college entry.[7] The state datasets include only the college-going population, allowing for detailed comparisons within college-educated groups.

Across the individual studies, the combined datasets vary slightly. They vary with respect to the cohorts, although most cohorts are the entering classes of 2002 to 2005. They vary with respect to the period of reported earnings, although all cover at least two years before college and at least three years post-college. In this review, all reported earnings are adjusted for inflation and presented in 2014 dollars.

In terms of method, the studies attempt to address bias on unobservable individual characteristics using a fixed effects specification. Most prior analyses of education and earnings either present cross-tabulations of earnings by education level (see Carnevale, Rose, & Cheah, 2011) or use the so-called Mincerian earnings function, which uses ordinary least squares (OLS) to regress the log of earnings on the number of years of education, work experience, and other demographic variables (see Belfield & Bailey, 2011, for examples). The potential problem with these approaches is that education may be correlated with other characteristics that are not included in the analysis, such as motivation, thereby overestimating the effect of education. The consensus among economists is that for broad categories, such as years of education, the various biases in the OLS approach tend to offset each other, resulting in reasonable estimates for the economic returns to years of schooling (Rouse, 2007). But this argument is much less convincing when studying the returns to detailed categories of education such as degrees in particular fields of study, completion of certificate programs, or choices of different pathways through higher education. This is discussed in more detail in Belfield and Bailey (2017).

In order to address this causality issue, the research reported here uses the individual fixed effects method to estimate the quarterly earnings returns. The advantage of the fixed effects estimation approach is that individual fixed characteristics can be differenced out and that pre-award earnings capture latent differences in work productivity (see Jepsen, Troske, & Coomes, 2014). The indicator for college award captures the deviation from the expected earnings of each individual as they obtain that award. Specifically, the fixed effects approach follows that in Jacobson, LaLonde, and Sullivan (2005):

$$Y_{iq} = \alpha + \beta \boldsymbol{AWARD}_{iq} + \gamma ENROLL + \delta TIME + \zeta(TIME{*}\boldsymbol{Z}) + \rho_i + \eta_q + \varepsilon_{iq}$$

This specification estimates earnings Y for individual i in quarter q, where the quarters cover the period before, during, and after college. The equation specification is intended to

[7] UI earnings data have low imputation, self-reporting, and nonresponse bias. However, UI data exclude independent contractors, military personnel, some federal personnel, and those working in the informal sector. Workers who migrate out of state are also excluded. Overall, UI coverage is reasonably high, with more than 90 percent of college enrollees having at least one wage record. For more information on the quality of these datasets, see Liu, Belfield, and Trimble (2015).

identify the impacts β of the vector of $\boldsymbol{AWARD}_{iq}$, which includes diplomas, certificates, and associate and bachelor's degrees, which take the value 1 in the quarter in which they were earned and all subsequent quarters. Students may accumulate more than one award, and each award has the value 1 across the entire time period after receipt.

The specification includes a variable *ENROLL* for quarters when the student is enrolled in college and quarterly time trends *TIME* to account for earnings growth and quarter-specific shocks to the labor market. In addition, each study includes a set of interactions between the time trends and a vector $\boldsymbol{Z}$ of individual personal, demographic, and/or financial aid attributes. Finally, the specifications include student fixed effects (ρ_i), time fixed effects (η_q), and an error term (ε_{iq}).

The intent of each study is to estimate the effects of award receipt compared to enrolling but not receiving the award, on quarterly earnings. However, the studies in this review use slightly different specifications in terms of control variables and how these covariates are interacted with time trends. Therefore, we interpret the covariates—particularly those with complicated, multiple TIME interactions—with some caution. In a separate paper, Belfield and Bailey (2017) investigate the robustness of these fixed effects specifications.

It is important to note that these estimates are the independent, separable returns to associate degrees and certificates; these estimates are not sheepskin effects but returns to the credits and award simultaneously. That is, if an individual accumulates two awards, her returns from college would be the sum of the two figures. Although obvious, this is noteworthy because some awards can be stacked without restarting the entire education sequence. So, a student who completes an associate degree may then transfer to a four-year college and complete a bachelor's degree after 60 credits—not 120 credits; similarly, credits from certificates can be transferred toward the completion of an associate degree. The proportion of students who have multiple awards is substantial: approximately half of all associate degree holders complete a bachelor's degree, and one third of certificate holders complete a two-year or four-year degree (Bailey & Belfield, 2012).

Overall, this analytical approach allows the estimation of the returns to college more accurately than prior studies and for cohorts that have faced significantly altered economic conditions.

3. Summary of Evidence on Returns to College

Returns to Awards

The returns to associate degrees across the state-level studies are summarized in Table 1 (sources for each result are given in the table notes). These results are for all persons, including those with zero earnings in a given quarter (assuming at least one quarter of earnings over the entire period). The figures show the expected quarterly earnings gain in 2014 dollars from having an associate degree (independent of receipt of other awards) versus going to college and not completing an award. As percent gains, these figures can be compared to average earnings of non-completers (shown in the right column of Table 1). As a comparison, non-completers earn 20 credits (the equivalent of 1.67 semesters of full-time study) on average.

The returns to associate degrees are strongly positive and statistically significant across each state. Given the slight differences in specifications, time periods, and cohorts, the results across the states exhibit a consensus. For each quarter after college, individual earnings are approximately $1,160 ($1,790) higher for male (female) associate degree holders. These associate degree holders completed their degrees between 2002 and 2008, and so these earnings gains are for those in the workforce during and after the Great Recession. With average quarterly earnings over this post-college working period of approximately $7,200, the gains from associate degree completion are 18 (26) percent. Per annum, the earnings gains from having an associate degree are $4,640 ($7,160); as context, this one-year amount is below the average debt per community college student. The studies also establish that the returns to associate degrees persist over the time after college exit. (Studies vary in how they model the persistence of returns, so it is not possible to provide a summary value for persistence of earnings gains.)

The returns to certificates across the statewide analyses are summarized in Table 2. Overall, these estimates show positive but modest returns to the completion of a certificate. On average, the returns to male (female) certificate holders are $530 ($740) per quarter; this equates to $2,120 ($2,960) per annum. However, some studies find returns that are negative, others find returns that are not statistically significant, and the estimates vary widely across states. In further analyses, some studies find that these returns attenuate over time after receipt. Using Ohio data, Minaya and Scott-Clayton (2017, Table 2) estimate returns for certificates that are flat across the length of time after completion for women, although the returns do grow modestly for men. Bahr (2016, Table 7) finds mixed evidence for attenuation in returns from certificates in California.

Table 1: Summary Results From Fixed Effects Specifications—Quarterly Earnings Gains for Associate Degree Holders (2014 Dollars)

	Quarterly Earnings Gain for Associate Degree Over No College Award 5–9 Years After Entry		Study Details: Mean Earnings of Non-Completers; Earnings Years; Cohort Years [Data Source]
	Men	**Women**	
Kentucky	$1,740	$2,770	$5,190; 2000–08; 2002–03 [KCTCS]
Michigan	$1,560	$2,540	N/A; 1998–2011; 2003 [5 colleges]
North Carolina	$1,260	$2,120	$6,440; 1996–11; 2002–04 [NCCCS]
California*	$1,650	$1,650	$4,700; 2000–12; 2002–05; [CCCCO]
Ohio	$1,420	$1,810	$6,570; 2001–2013; 2001–04 [OBR]
Virginia	$910	$1,350	N/A; 2001–2013; 2006–08 [VCCS]
Washington	$480	$1,000	N/A; 2001-09; 2001 [WSBCTC]
Arkansas	$290	$1,040	$6,905; 1996–2011; 2001–04; [ARC]
State-Level Average	**$1,160**	**$1,790**	

Note. Sources: Jepsen et al. (2014) (Kentucky); Bahr, Dynarski, Jacob, Kreisman, Sosa, and Wiederspan (2015) (Michigan); Liu et al. (2015) (North Carolina); Bahr (2016) (California); Bettinger and Soliz (2016) (Ohio); Xu, Jaggars, and Fletcher (2016) (Virginia); Dadgar and Trimble (2015) (Washington); Belfield (2015) (Arkansas). Data sources: KCTCS (Kentucky Community & Technical College System), NCCCS (North Carolina Community College System), CCCCO (California Community Colleges Chancellor's Office), OBR (Ohio Board of Regents) VCCS (Virginia Community College System), WSBCTC (Washington State Board for Community and Technical Colleges), ARC (Arkansas Research Center). *Indicates pooled by gender. Standard errors range between 25–163; all results are statistically significant, $p < .01$.

Table 2: Summary Results From Fixed Effects Specifications—Quarterly Earnings Gains for Certificate Holders (2014 Dollars)

	Quarterly Earnings Gain for Certificate Over No College Award 5–9 Years After Entry		Study Details: Mean Earnings of Non-Completers; Earnings Years; Cohort Years [Data Source]
	Men	**Women**	
Kentucky	$360	$350	$5,190; 2000–08; 2002–03 [KCTCS]
Michigan	$990	$670	N/A; 1998–2011; 2003 [5 colleges]
North Carolina	$530	$170	$6,440; 1996–11; 2002–04 [NCCCS]
California*	$1,440	$1,440	$4,700; 2000–12; 2002–05; [CCCCO]
Ohio	$1,250	$1,040	$6,570; 2001–2013; 2001–2004 [OBR]
Virginia	-$180 NS	$450 NS	N/A; 2001–2013; 2006–2008 [VCCS]
Washington	$210	$1,680	N/A; 2001–09; 2001 [SBCTC]
Arkansas	-$380	$80 NS	$6,905; 1996–2011; 2001–04; [ARC]
State-Level Average	**$530**	**$740**	

Note. Sources: Jepsen et al. (2014) (Kentucky); Bahr et al. (2015) (Michigan); Liu et al. (2015) (North Carolina); Bahr (2016) (California); Bettinger and Soliz (2016) (Ohio); Xu et al. (2016) (Virginia); Dadgar and Trimble (2015) (Washington); Belfield (2015) Arkansas. Data sources: KCTCS (Kentucky Community & Technical College System), NCCCS (North Carolina Community College System), CCCCO (California Community Colleges Chancellor's Office), OBR (Ohio Board of Regents), VCCS (Virginia Community College System), WSBCTC (Washington State Board for Community and Technical Colleges), ARC (Arkansas Research Center). *Indicates pooled by gender. All results are statistically significant, $p < .01$, unless indicated by "NS."

It is important to emphasize that different types of certificates have different returns. Given this variation, the returns to certificates must be interpreted carefully. First, certificates are vocational, and the returns to them are thus more sensitive to fluctuations across industries and occupations. Second, some certificates are classed as "diplomas" across some states and in some fields: using data from Kentucky, Jepsen et al. (2014) find gains from earning a certificate of only 2 percent but find gains from a diploma that are as high as 5 to 14 percent. Third, certificate programs can vary in length. In North Carolina, a certificate requires 29–38 credits; in Ohio, a certificate requires 58–59 credits. In California, Bahr (2016) and Stevens, Kurlaender, and Grosz (2015) identify different certificates with fewer than 10 and more than 30 credits.[8] Finally, some certificate holders may have fewer credits than non-completers (who on average have 20 college credits).

Broadly, certificates that require more credits have higher earnings gains. For Virginia, Jaggars and Xu (2016, Table 4) report earnings gains per quarter of $110 for short-term

[8] Typically, certificates require fewer credits than associate degrees, but even this is not always the case as some certificates may require more credits than degrees. For Colorado, Turner (2016) reports that certificate holders have 85 credits.

certificates (defined as requiring less than one year of full-time study) and $180 for long-term certificates (defined as requiring one or more years of full-time study). In their comparison of certificates in North Carolina and Virginia, Xu and Trimble (2016) estimate returns that are increasing with the length of the certificate. For Washington State, Dadgar and Trimble (2015) identify positive returns for one-year certificates but negative returns for certificates of less than one year in duration. However, for California, Bahr (2016) finds sizeable differences in returns across certificates of different lengths—but with no clear evidence that longer certificates yield higher earnings.

Returns to Credits

The studies reviewed here show that there are positive returns for human capital accumulation in college even when a student does not complete an award. Earlier studies also found earnings gains from credits or years of study at community college that do not lead to a completed degree; gains are identifiable for as little as a semester's worth of credits (Jacobson et al., 2005).

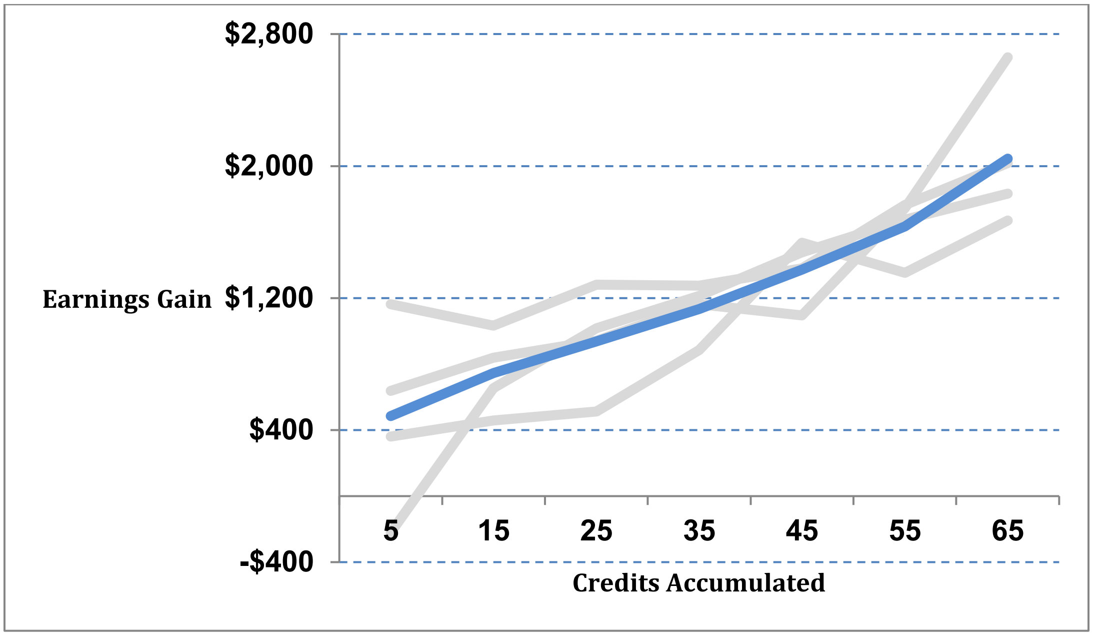
Figure 1 shows increasing earnings gains for students who do not complete awards but accumulate progressively more credits.[9] The association is broadly linear. For North Carolina, Liu et al. (2015) estimate that each credit accumulated by male (female) community college students is associated with gains of $17 ($29) per quarter (0.4 [0.7] percent higher earnings). For Kentucky, Jepsen et al. (2014, Table 7) estimate returns per credit of $9 ($18). However, for California, Bahr (2016, Table 3, Model 3) identifies mixed returns per credit and finds that these returns to credits vary by field of study.

Evidence on the returns to awards and on the returns to credits can be combined to approximate the returns to award receipt *per se*. If the returns to the award are simply the same as the returns to an equivalent number of credits, then the returns to award receipt are zero. However, if the returns to the award are higher than the returns to equivalent credits, this indicates that the award itself has value. This value may be a sheepskin effect—i.e., employers may use the receipt of an award as a proxy for latent productivity. Alternatively, there may be a synergy effect: the combination and accumulation of credits within the award may represent a more valuable accumulation of skills than credits alone.[10]

[9] No estimates are available for Arkansas, Ohio, or Washington.

[10] For example, 60 random credits that do not correspond to an award are unlikely to be as valuable as 60 engineering credits that correspond to an associate degree in engineering.

Figure 1: Quarterly Earnings Gains by Credit Accumulation—Non-Completers in North Carolina and Virginia (2014 Dollars)



Note: Sources: Liu et al. (2015); Jaggars and Xu (2016). Blue line is average; light gray lines are male/female growth curves in North Carolina and Virginia.

The evidence indicates that accumulating 60 credits is not as valuable as completing an associate degree. But the results are not conclusive.[11] Clearly, for states where there is only weak evidence of returns per credit (e.g., California and Michigan), the accumulation of credits with no award is not as valuable as the award. For Kentucky, the expected gains from an associate degree far exceed the returns to an equivalent number of credits (for men [women] the award receipt effect is $1,320 [$1,760]). However, for North Carolina and Virginia, the difference between credits and the degree is negligible. Also, the small gap in returns between certificate holders and persons with equivalent numbers of credits suggests that award receipt effects are not large. Although we cannot rule out either a sheepskin effect or synergy effect, the magnitude of the effect appears likely to be modest but imprecisely estimated.

[11] As noted, associate degree holders typically have more than 60 credits. For comparisons, we assume that associate degree holders have 70 credits.

Differences in Returns by Field

Thus far, the evidence indicates a reasonably consistent return to postsecondary education. However, all the studies have identified significant differences in earnings gains according to the field of study.[12]

Table 3 shows the highest return field of study for associate degree holders, as well as fields where returns are significantly higher than average. Notably, earnings gains are highest for health-related fields in every state. Also, as shown in column 3, earnings gains are higher for quantitative or technical–vocational courses; in very few cases are the returns high in the humanities, social sciences, or other academic disciplines. However, this does not mean that the returns to other fields are not statistically significantly different from zero. In many state analyses, returns are positive and statistically significant across a range of fields. Importantly, the pattern is not the same by state across narrowly defined subjects. That is, for example, the returns to associate degrees in math are relatively high in some states and relatively low in others; the same is true for other subjects, including culinary arts, mechanics, education, and business.

When field of study is defined more generally, the disparity between vocational and academic disciplines is clearer.[13] Specifically, the returns to associate degrees in sciences (AS), which are awarded for completion of technical or occupational programs, are much greater than the returns to associate degrees in arts (AA), which are designed to prepare students for transfer to four-year colleges; and in fact the returns to AA degrees are not substantially different from zero over those of non-completers. For North Carolina, Liu et al. (2015) find that returns to AS degrees are $1,490 ($2,500) but that returns to AA degrees are zero ($520). For Ohio, Bettinger and Soliz (2016, Table 3) report returns that are one third higher for graduates of technical colleges than for graduates of community colleges, although in Ohio all graduates out-perform non-completers. These results suggest that academic associate degrees are low in returns; they are unlikely to be more valuable than simply accumulating credits.

[12] Differences in returns by field of study partly explain the significant differences by gender. Female students typically have higher returns than male students, although the gap is narrower for more advanced qualifications. This pattern may be explained by the very high returns to health subjects—as well as higher completion rates at the two-year level.

[13] On the importance of postsecondary career and technical education, see Carnevale, Jayasundera, & Hanson (2012).

Table 3: Quarterly Earnings Gains by Highest Earning Field of Study (2014 Dollars)

	Highest Earnings Gain by Field		
	Associate Degree	**Certificate**	**Other Fields Where Earnings Gains Were Higher for Associate Degrees**
Kentucky	Health	Health	Other vocational
Michigan	Health	Nursing	Technical, business
North Carolina	Allied health	Allied health	Business, construction, mechanics, nursing
California	Health	Health	Sciences, engineering, industrial technologies, law, protective services
Ohio	Health	Health	Business, computing, IT, engineering, security, mechanics
Virginia	Transport	Business	Math, nursing, allied health
Washington	Nursing	Nursing	Allied health, mechanics, engineering, business, social sciences

Note. Sources: Jepsen et al. (2014) (Kentucky); Bahr et al. (2015) (Michigan); Liu et al. (2015), Xu and Trimble (2016) (North Carolina); Bahr (2016) (California); Bettinger & Soliz (2016) (Ohio); Xu et al. (2016), Xu and Trimble (2016) (Virginia); Dadgar and Trimble (2015) (Washington). Results for Arkansas are not available. All results are statistically significant, $p < 0.01$.

CAPSEE Consensus

We summarize the evidence reviewed above as a consensus of clearly positive and consistent returns to associate degrees; modest and probably temporary returns to certificates, with the size of the returns varying positively with the duration of study; and some evidence of returns to credit completion. Notably, the results in Tables 1 and 2 show the returns to each independent award: if a student has two awards, she obtains additive earnings gains. Finally, these analyses uniformly show that field of study matters, with returns that are especially high for awards in health-related fields, high for directly vocational subjects, but negligible for academically focused associate degrees.

A key issue is the variability in returns to college and why this variability exists. At a general level, returns appear to be "heterogeneous"—i.e., some college students are earning much more than others. One interpretation is that this heterogeneity undermines the conclusion that college is valuable on average. Potentially, even when the average return is high, if the distribution of returns to college is bimodal then some students—those who experience very large gains from college attendance—definitely should attend college and some students—those who receive little or no earnings gains—almost certainly should not. For instance, it might be argued that, unless the student completes an award, college is not a good investment. Under this interpretation, the average returns are not informative about the expected returns to college, especially if any new enrollees are less prepared for college (and so end up in the lower mode).

Students are taking a high risk from enrolling in college: given heterogeneity, they may do very well or they may not be able to pay back their loans.

However, variation is not as important if it derives from differences in investments in college. So, if the variation arises because some students enroll for only a few credits and others complete an associate degree, such variability does not undermine the conclusion that college is valuable on average. We refer to this as "incremental variability": some students earn more from college because their investment is greater. If students who invest more earn more or if programs with more intensive resources lead to higher earnings, then this is a desirable feature of college education. Moreover, it implies that college is less risky: each student who enrolls receives some benefit.

On the whole, the evidence shows both heterogeneity and incremental variability. More credits and "longer" awards lead to progressively higher earnings (incremental variability), but there are additional returns to completing degrees and in some cases certificates (heterogeneity). Notably, we caution that any observed variation should not be automatically identified as heterogeneity. Some certificates, as we have just noted, may earn more than others because they are longer. Moreover, some certificate holders may earn less than non-completers because the non-completers actually accumulated more credits. Similarly, given positive returns to credits, some of the variation in returns to associate degrees may reflect greater credit accumulation across these degrees. Higher returns to female students are partially explained by their higher credit accumulation and superior preparedness on entry to college.

Even the most obvious instance of heterogeneity—higher returns to health disciplines—may also be partially explained by the extra effort required in the high-return fields. For example, health programs in community colleges typically enroll students with higher ability, and these programs are more intensive (requiring more credits to complete). They may also be more expensive: in a recent study, Altonji and Zimmerman (2017) find a strongly positive correlation between the cost of degree programs by field and the subsequent earnings of graduates in those fields. From a social perspective, these differences therefore represent incremental investments rather than heterogeneity.

Finally, it may be difficult to establish that heterogeneity has increased over time. If more able students are increasingly sorted into more intensive programs (as found by Bound, Lovenheim, & Turner, 2010), this would magnify the variation in returns (see also Eide, Hilmer, & Showalter, 2016). However, this sorting reflects incremental variability and not heterogeneity.

The CAPSEE review evidence indicates some heterogeneity—by field and for completers—but the extent of this heterogeneity cannot be easily estimated. There are many instances where differences in outcomes reflect variations in increments of investments in college.

Other Evidence on Returns

Recent evidence from similar studies supports the three main conclusions from the CAPSEE consensus regarding the size of the returns to awards, the incremental returns, and the heterogeneity in returns by discipline.

Backes et al. (2015) estimate fixed effects specifications of the returns to college in Florida. Their specifications differ from those in Table 1 because they include all education groups (high school dropouts and graduates) and, for 2000–04 cohorts, they track earnings from 1998 to 2011. Nevertheless, the coefficients are very similar to those in Tables 1 and 2: compared to students who graduated from high school and either did not attend college or did not complete a college award, the earnings gain per associate degree is $1,820 per quarter and the earnings gain per certificate is $1,640 per quarter.[14] These coefficients are similar to those reported in Tables 1 and 2 above (accounting for the comparison group, including those who never attended college). Other results from Florida affirm the consensus described above. The returns to credits for non-completers are high; the returns to vocational awards are relatively high (at 35 percent for AS degrees but only 2 percent for AA degrees); and the returns to health programs are especially high (Backes et al., 2015, Table 5).

Using the same fixed effects specification and similar data for female welfare recipients in Colorado, Turner (2016) finds near-equivalent results. Adjusting for the types of associate degrees, the estimated earnings gain from completing an associate degree is $1,840. Returns to certificates are especially strong for this group, with gains of $720 per quarter. Turner (2016, Table 4) also finds that earnings increase with more credits (with statistically significant gaps for those with fewer than 30 credits), although the results are sensitive to model specification. Finally, Turner (2016, Table 2) calculates earnings gains for AS degrees of $2,200 but only $432 for AA degrees.

Castex and Dechter (2014) use two National Longitudinal Survey of Youth (NLSY) datasets to examine changes in outcomes for young adults over the last two decades.[15] Controlling for an array of individual characteristics, including test scores and ability metrics, the earnings gains are similar to the consensus values. (The percentage earnings gains are shown in Appendix Figure A1). In 2014 dollars, the quarterly earnings gains per male (female) associate degree holder over a high school graduate are $2,270 ($1,960) for the NLSY79 cohort and $4,050 ($1,930) for the NLSY97 cohort. As these gains are relative to a combination of high school graduates and those who did not complete any postsecondary award, they equate to returns to associate degrees relative to non-completers of $1,000–$2,000.

Vuolo et al. (2016) estimate the returns to college using the longitudinal Youth Development Survey. Although a small sample, the survey includes measures of biweekly

[14] Backes et al. (2015) do not perform separate analyses by gender. However, their dataset does allow them to control for high school test scores.

[15] The NLSY79 sample have earnings profiles starting in the mid-1980s. The NLSY97 sample have earnings profiles starting in the mid-2000s.

earnings from 2005 to 2011, and earnings gains can be calculated relative to non-completers at either a two-year or four-year college. These estimates are very close to the consensus values for associate degrees. Adjusted to 2014 dollars, the returns over non-completers for associate degree holders are $2,250 per quarter. For certificate holders, however, the returns are -$790.

Recent studies also show incremental returns to investments in college. Most obviously, incrementalism is evident in studies on the returns to college quality. There are now several studies showing higher returns for attendance at more selective colleges (Avery & Turner, 2012). Most recently, Andrews et al. (2016) look at the returns to college quality across the distribution of earnings for students in Texas. They find strongly positive returns to college quality, with students at flagship universities having higher earnings than students at four-year colleges, who in turn have higher earnings than graduates of community colleges.[16]

Evidence for transfer students in Texas also shows the incremental aspect of returns.[17] Andrews, Li, and Lovenheim (2014) find that students who transfer from a community college or four-year college to a flagship university in Texas do not have the same labor market outcomes as students who have attended the flagship university for their entire period in college. The longer a student has attended a flagship university, the higher his earnings. Similarly, Reynolds (2012) finds that students who intend to complete a bachelor's degree would be much better off starting at a four-year college than starting at a two-year college and then transferring up: he finds large and pervasive negative impacts on labor market outcomes for men and women (that are unlikely to be offset by selection effects).

Research about adding a bachelor's degree onto an associate degree also supports the incremental result. Agan (2013) finds that students who complete a two-year degree, transfer, and then complete a four-year degree earn more than students who complete a two-year degree, transfer, but do not complete a four-year degree, who in turn earn more than students who complete a two-year degree but do not transfer. Indeed, as noted above, the CAPSEE evidence in Tables 1 and 2 indicates that each qualification is independently valuable and additive—i.e., each award adds incrementally to earnings.

Finally, recent studies affirm the heterogeneity in returns across fields of study and colleges. Andrews et al. (2016) look at the returns to college quality across the distribution of earnings for students in Texas. They find strongly varied returns by subject. And Webber (2014) finds returns that are twice as large for STEM graduates over those in the arts/humanities, with a lifetime dollar gap of over $0.7 million. Similar results are found by Melguizo and Wolniak (2012) and Altonji and Zimmerman (2017).

[16] College quality effects appear to be greater for disadvantaged students. For minority students, returns are 7 percent higher if a student graduates from a more selective versus non-selective four-year college (Dale & Krueger, 2014).

[17] Belfield et al. (2013) also find evidence that longer periods at a transfer college are associated with higher earnings. Male (female) dropouts from four-year colleges have lifetime earnings gains of $52,000 ($73,000) over high school graduates. Dropouts from two-year colleges have earnings gains of $77,000 ($38,000).

Features of Returns to College

In addition to establishing a consensus on returns to awards and incremental investments in college, the statewide studies reveal some new patterns of labor market outcomes for sub-baccalaureate college goers.

First, transcript data show non-trivial extra credit accumulation by award holders. Students who do not complete college earn on average 20 credits before exiting (data for Ohio and North Carolina). However, associate degree completers earn 77–81 credits (for Colorado, Turner, 2016, reports that the average award recipient has 70 credits). These credit totals are much higher than the 60 credits that are generally required for an associate degree. And non-completers may be as far as 60 credits behind the degree holders—i.e., the non-completers may be a full degree-length away from completion—because while they have earned credits, they may not have earned credits that are required for a particular associate degree program.

Second, the earnings profiles show a clear Ashenfelter dip, a drop in mean earnings before enrollment in college. The Ashenfelter dip is associated with the phenomenon of persons entering college after losing jobs or experiencing other negative shocks to employment. As a result, individual earnings profiles tend to show a decline in earnings just before the student enrolls in college. Overall, the Ashenfelter dip is \$200 to \$500 in each of the 2–4 quarters before enrollment. For Virginia, the estimated dip is \$480 per quarter in the two years before college enrollment (Jaggars & Xu, 2016, Table 2); for North Carolina, it is \$370 for men (\$210 for women) in the four quarters prior to enrollment (Liu et al., 2015, Table 6). Finally, for Colorado welfare recipients, Turner (2016) estimates a decline in quarterly earnings by \$900–\$1,400 (from \$1,700–\$2,200 down to \$800) over one year prior to entry (with most of the decline in the quarter prior to enrollment). For California and Michigan, Bahr et al. (2015) and Bahr (2016) report an unspecified but significant Ashenfelter dip. However, the overall pre-college decline in earnings is much greater for students who complete their award. For Kentucky, the decrease in earnings in the two quarters prior to enrollment is \$2,000 (\$1,000) for male (female) associate degree holders; but for students who do not complete their award, the Ashenfelter dip is \$400 (\$500) (Jepsen et al., 2014). For Ohio, the dip for associate degree completers is \$1,000 (\$500), and for those who ultimately receive no award, it is \$350 (\$200) (Bettinger & Soliz, 2016). Clearly, students who are more committed to college are sacrificing more work time on entry.

Third, many students work intensively while in college. In quarters enrolled in college, the earnings change is estimated at -\$470 (-\$340) in North Carolina, -\$390 in Michigan, and -\$420 (\$220) in Arkansas. These amounts are relatively low compared to the quarterly earnings gains post-college, especially for those who complete an associate degree (see Table 1). This in-college work suggests two counter-acting transmissions. On the one hand, some of the returns to college may actually be returns to work experience while in college (Henderson, Polachek, & Wang, 2011). On the other hand, income earned in college reduces the opportunity cost of attending college. How students coordinate work and college is an important area for future work, particularly for disadvantaged students.

Finally, earnings growth appears to be quite rapid after exiting college. There is evidence for rapid earnings growth in the years following exit from community college in North Carolina (Liu et al., 2015). For Virginia, Jaggars and Xu (2016, Table 4) identify sharp increases in earnings post-college. Before college, earnings are growing at $70–$80 per quarter for all students; in college, earnings are growing more slowly, at $40–$60 per quarter. However, after exiting college, the earnings of non-completers are growing at $100 per quarter, and the earnings of certificate holders and associate degree holders are growing at $180 and $240 per quarter respectively. Minaya and Scott-Clayton (2017, Table 2) estimate quarterly returns for male (female) Ohio associate degree holders as $1,363 ($2,014) with a five-year follow-up and $1,741 ($2,627) with a nine-year follow-up (see also Bahr et al.,2015, for Michigan results). Hence, lifetime returns to college may be even greater than indicated from the results in Table 2 (where the follow-up period is less than nine years).

We use this information and the evidence from Tables 1 and 2 to calculate expected lifetime private returns to completing an associate degree or certificate versus non-completion. The private returns are calculated as the net present value of the earnings gains minus the fees and tuition and lost earnings while attending college. The calculation is based on a Monte Carlo simulation of 10,000 trials; the parameter values are reported in Appendix Table A3. The distribution of earnings gains for each award is derived from Tables 1 and 2. The growth rate for earnings gains is derived from the results for Ohio (Minaya & Scott-Clayton, 2017); the mean rate of growth in earnings is +1.5 percent for associate degrees but -1.5 percent for certificates (i.e., the earnings gap is predicted to fade out). These earnings gaps are assumed to persist for 20 years post-enrollment and are discounted at a rate of 3.5 percent; all amounts are expressed in 2014 dollars. Tuition and fees for college are taken from Integrated Postsecondary Education Data System (IPEDS) data and are applied per additional credit obtained by associate degree holders and certificate holders. Lost earnings are based on the results for Arkansas, Michigan, and North Carolina reported above. These earnings are lost for each quarter the student is in college.

Table 4 shows the net present-value private gains from completing an award based on 10,000 simulations from the data. The distributions of outcomes are shown in Appendix Figures A2 and A3. The gains are substantial for those who complete an associate degree. The expected earnings gains are $97,640; net of tuition/fees and lost income when enrolled, the net gain from completion is $82,180. This predicted gain is expected to be strongly positive: less than 4 percent of simulations yield negative results (i.e., where costs exceed benefits, see Appendix Figure A2). There are also positive gains for certificate holders: the lifetime earnings advantage is $30,960; when costs are subtracted, the net gain is $23,380. However, one standard deviation around the estimate includes zero, and in 22 percent of the simulations the net gain is below zero.

Overall, when considered over an extended period, the net gains from award completion (over some college credits) appear to be substantial, and they easily exceed tuition and fees and lost income.

Table 4: Present-Value Gains for Community College Awards Net of Costs

Comparison to Non-Completers	Mean	SD	Min.	Max.
Associate degree				
Tuition/fees	$11,860	5,790	$750	$30,000
Lost income in college	$3,610	1,230	$470	$8,190
Earnings gain post-college	$97,640	42,720	$13,960	$245,780
Net gain	$82,180	43,146	-$17,340	$228,740
Certificate				
Tuition/fees	$5,140	2,280	$750	$30,000
Lost income in college	$2,170	950	$0	$8,190
Earnings gain post-college	$30,960	31,560	-$101,020	$159,840
Net gain	$23,380	31,670	-$111,470	$152,240

Note: See also Appendix Table A3. 10,000 simulations. All figures in present values at date of first enrollment in college in 2014 dollars (rounded to nearest $10). Discount rate 3.5 percent. Lifetime earnings gain modelled over 20 years from enrollment.

4. Key Challenges to the CAPSEE Consensus

The above evidence is persuasive of the CAPSEE consensus. However, there are several potential challenges to this consensus. First, there are empirical concerns—methodological and with respect to data quality—that may influence the results. Second, these returns are averages for current enrollees; there is no guarantee that newly enrolled marginal students would do as well. Third, this evidence covers the mid-2000s and so only partially examines the impact of the Great Recession, which—officially dating from December 2007 to June 2009—was an extremely strong negative shock to the labor market. Finally, there is a substantial recent debate over the decline in skill-biased technological change and whether the high returns to college have now disappeared. With the exception of the first challenge of methodology and data quality, which is addressed in a separate paper (Belfield and Bailey, 2017), we address these challenges here.

Returns to Marginal Students

One concern is that the average returns reported here may not apply to the marginal students who might be encouraged to enroll—students who are on the margin of deciding whether or not to go to college. Marginal students may have lower interest or aptitude for college or may have higher opportunity costs; therefore, their expected returns might be lower. However, there may be a significant number of students who face exogenous constraints or information constraints that hinder enrollment. These students may be expected to have returns close to the average: the reason they do not enroll has little to do with their ability to benefit.

In focusing on students at community college, the CAPSEE evidence does relate to students on the margin of enrollment. Many community college programs are open access, and students often register for courses immediately before classes start (rather than preparing for college in the last year of high school). Also, studies do adjust for differences in ability. Although these differences do reduce the earnings gains, a significant premium remains. For completers, at least, there is no difference between the earnings gains by high school GPA: students with low GPAs have earnings gains comparable to those of students with high GPAs; there are also comparable returns for completers with a GED and those with a high school diploma. Similarly, there is no clear difference in gains for completers who start college-ready versus students who start in developmental education (see Appendix Figures A4 and A5). In a direct study of marginal students in Florida, Zimmerman (2014) finds that returns are equivalent above and below the test-score cut-off for enrollment. Finally, it is not clear how influential latent ability is in biasing upward the returns to college.[18]

Overall, it is unlikely that the returns to new enrollees or to students who extend their time in college will be significantly below those accruing to award completers (as per Tables 1 and 2).

The Impact of the Great Recession

The Great Recession (GR) was the "deepest downturn in the postwar era," with sharp declines in labor force participation, employment, and hours of work (U.S. Bureau of Labor Statistics, 2012). The GR may partly explain the decline in labor force participation of persons with an associate degree (from 69 percent in 2000 to 55 percent in 2012) and the decline in absolute real earnings (Carnevale, Hanson, & Gulish, 2013). Looking at the college-educated workers without bachelor's degrees, Carnevale et al. (2016) identify significant volatility, with 1.8 million job losses during the GR followed by 3.1 million job gains by 2016. The downturn was also persistent, with an unemployment rate in 2012 still above its 2006 level. The GR's distinctive features have led to extensive discussion over whether the basic structure of the U.S. labor market has been altered, including the returns to human capital (Elsby, Hobijn, & Sahin, 2010; Freeman, 2013; Rothstein, 2012; Larrimore, Burkhauser, & Armour, 2013).

To some extent, the CAPSEE consensus evidence does cover the period of the GR. The student cohorts are entering college from 2002–2006 and are therefore exiting college during or

[18] Although unobserved ability is presumed to be important, its effect is sensitive to model specifications. Marcotte (2010) finds that controlling for school quality and academic ability lowered returns to associate degrees by 19 percent for men but *raised* them by 10 percent for women. However, Webber (2016) identifies a significant influence of cognitive and non-cognitive characteristics. In the most extensive treatment, Carneiro, Heckman, and Vytlacil (2011) find results to be sensitive to the instruments applied and to the expression of the returns in terms of local, average, or marginal treatment effects. In most—but not all—cases, the marginal returns are expected to be lower than the average returns.

after the GR. Also, the earnings data span up to 2014 and so cover labor market activity several years after the official GR end date.

Potentially, the GR may have compressed earnings across education levels. However, the distinctive features of the GR were such that it more likely polarized the labor market. First, the GR was a job-killing recession, and job losses are typically concentrated among the low-skilled.[19] Second, the GR significantly impacted the long-term unemployed, few of whom were college graduates.[20] Third, the GR was a concentrated rather than a general recession. It had especially strong effects in some industries (e.g., construction), and these industries tended to have workers who were relatively low-skilled.[21] Also, the impact was especially strong in some localities (Yagan, 2016), and graduates are typically more mobile than non-graduates. These features suggest that in fact the GR probably polarized earnings by education level, leaving those with some college *relatively* better off.

Nevertheless, the GR may have reduced overall earnings (and so affected the net return to college). Yet, unlike prior recessions, worker productivity during the GR actually increased; hence its effect on wages was muted (Larrimore et al., 2013).[22] Over the period 2007 to 2011, wages were very stable, increasing by 0.3 percent in real terms, and patterns of wage adjustments were mixed, with evidence both of wage stickiness and wage flexibility (Freeman, 2013; Elsby et al., 2016). Thus, the GR did not reduce wages much. Furthermore, recessions typically hurt new hires the most (Rothstein, 2012; Oreopoulos, von Wachter, & Heisz, 2012), and the CAPSEE evidence mostly uses samples of those newly entering the labor market during the late 2000s. Graduates entering the labor market after the end of the recession might therefore be expected to have higher earnings than those in the CAPSEE samples. Even for those entering during the GR, however, Abel, Dietz, and Su (2014) find that college graduates were working in more skilled jobs than high school graduates and that their "overeducation" was temporary as they switched into more skilled occupations over time.

Decline in Skill-Biased Technological Change

As noted above, the conventional explanation for increasing returns to education in an economy with growing supply of educated workers is skill-biased technological change (or

[19] The national unemployment rate doubled during the GR: at the end of 2007 it was 5 percent; at its height in October 2009, it was over 10 percent. Also, unemployment grew rapidly and receded slowly. Yet, for workers with "some college," the overall job loss rate in 2007–09 was 4 percent, and this was fully offset by a job gain rate of 4 percent over the following two years (Carnevale, Jayasundera, & Cheah, 2012, Table 3).

[20] The pool of long-term unemployed expanded dramatically: the rate rose to a peak of 4.4 percent, a rate more than one percentage point higher than ever observed in the post-war period.

[21] The construction sector accounted for 40 percent of changes in the job-filling rate despite being less than 5 percent of total employment; recruitment and job-filling rates were very stable in the government sector (Davis, Faberman, & Haltiwanger, 2012). See also Carnevale, Jayasundera, & Cheah (2012) on industry-specific losses in jobs, especially in construction and manufacturing.

[22] This muted effect is also consistent with the job-loss evidence: rather than reduce wages, employers cut workers in an effort to reduce costs (Elsby, Shin, & Solon, 2016).

SBTC, see Goldin & Katz, 2008).[23] This explanation would fit with the positive returns summarized in Tables 1 and 2. However, recent investigations of the match between workers' skills and job tasks raise questions as to the strength of SBTC.

An important recent study by Beaudry, Green, and Sand (2016) contends that SBTC was a temporary phenomenon of the 1990s caused by substantial new investments in information technology (IT) and that since 2000 the returns to higher skills have been declining. In their framework, jobs have three types of task: cognitive/abstract, manual/services, and routine. In the 1990s, investment in IT temporarily boosted returns to performing cognitive tasks; this accounts for the positive SBTC and increasing returns. At the same time, the application of IT in the workplace sharply cut the return to performing routine tasks. Beaudry et al. (2016) find that today's college workers have the same task composition in terms of cognitive, manual, and routine task as college workers in 1980 and that it was only in the 1990s that college workers' cognitive skills were highly rewarded. This contention of skill downgrading is slightly different from the polarization argument discussed above. Unlike polarization, skills downgrading suggests that there are fewer cognitively demanding jobs.

However, it is difficult to describe a clear linkage between education, workers' skills, job tasks and occupations, and ultimately, earnings. Workers have a range of skills that they can apply as the returns to each task change; firms can change the allocation of tasks or task composition of jobs in response to workers' skills. Accurate identification of changes in the returns to skills is therefore challenging (see the discussion in Autor & Handel, 2013). For example, Altonji, Kahn, and Speer (2014) perform a similar exercise to Beaudry et al. (2016). They find that the returns to abstract skills rose throughout the period from 1993 to 2011 and that the returns to routine tasks performed by the college-educated also rose. Castex and Dechter (2014, p. 686) find that the returns to cognitive skills did decline substantially between the NLSY79 and NLSY97 cohorts, yet the overall returns to schooling increased (see also Appendix Figure A1).

Looking simply at what workers do, there is strong evidence that college graduates perform significantly more complex tasks than high school graduates. College graduates spend less time on repetitive/physical tasks, spend more time on management and problem-solving, and use math skills more frequently. Also, the complexity of tasks appears to be increasing with the amount of college education (see Appendix Figure A6). Even if this correlation is weaker than in the 1990s, it still indicates much greater complexity of work tasks by those with some college.

Also, the mapping of education levels with occupations appears to be far from certain. Some studies project that the share of occupations requiring some college or an associate degree

[23] SBTC strictly refers to a change in the elasticity of substitution between skilled and unskilled labor. However, it may also include economic changes such as new high skill sectors and increased demand for more complex products.

will grow in the near future (Carnevale, Smith, & Strohl, 2013).[24] Notably, occupational mapping suggests that the U.S. workforce is grossly overqualified. Based on job requirements, Handel (2016) estimates that the U.S. economy has about the right number of workers with bachelor's degrees. But almost half of the persons with some college do not need any college to do their jobs; similarly, almost half of the persons with more than a bachelor's degree do not need that extra qualification. Overall, Handel estimates that 32 percent of the U.S. workforce is over-educated. Estimates of educational requirements using occupational mapping indicate an even greater mismatch between education and occupations (Gittleman, Monaco, & Nestoriak, 2016). In the context of positive returns to college (either trending upward or flat over time), the conclusion that one third of the U.S. workforce is over-educated seems incongruous.

More generally, some studies conclude that more education is valuable in the context of rapid and unpredictable technological change. Even as some technically challenging jobs may be eliminated because of artificial intelligence or other technologies, workers are more likely to find alternative, sometimes related work if they have a college education (Executive Office of the President, 2016).

Finally, Castex and Dechter (2014) propose an interesting counter-argument to the skills downgrading evidence. In a period of technological change, a college degree is a relatively weak signal of productivity: as the task requirements for jobs are in flux, skills learned in college may not be valuable.[25] However, as technology stabilizes (and colleges provide more vocationally relevant skills), a college degree becomes a better signal of productivity. Thus, the returns to a college degree might actually increase during a technology slowdown.

At least for current cohorts, a general conclusion is that earnings gains from college are not going to accelerate as they did in the 1990s. Yet these earnings gains are still very large.[26] Calculations by Avery and Turner (2012) show the present discounted value of a four-year college degree over high school net of tuition expressed in 2009 constant dollars. In 1965, this difference was for men (women) \$215,000 (\$120,000). By 1985, the difference was \$365,000 (\$265,000), and by 2009 it was \$580,000 (\$375,000). Thus, the relative gain over high school graduation approximately tripled over the last five decades (see also Oreopoulos & Petronijevic, 2013). Valletta (2016) uses Current Population Survey (CPS) data to estimate the returns to college graduates over the period 1980–2015. In 1980, a college graduate earned 34 percent more than a high school graduate. By 1990, this premium had increased to 57 percent, and by 2000 it had increased to 71 percent. After 2000, the premium slowed, and it hit a plateau of

[24] For example, Carnevale et al. (2016, p.17) define a high-skill occupation as one in which 50 percent or more of workers have at least a bachelor's degree. Thus, many high school graduates may be working in high-skill occupations.

[25] There was no college course to teach Bill Gates how to write Microsoft code, for example.

[26] As summarized by Valletta (2016, pp. 12–13): "wage premiums [for college graduates] have sputtered. They remain *large* but … the factors *propelling earlier increases* in the returns to higher education have *dissipated*"(emphasis in italics added).

roughly 78 percent from 2010 through 2015. Notably, although stable, this plateau is much higher than in earlier decades: returns to college are high, they are just not growing higher.

It is worth placing the evolution of returns in the context of changes in who is participating in the labor market. This high plateau was reached despite a substantial increase in the education levels of the U.S. workforce (see Appendix Figure A7). Thus, the U.S. economy has absorbed many more educated workers while also maintaining very high labor market returns. Skill downgrading would have to be extreme in order for these gains to be eliminated.

5. Conclusion

Evidence from the CAPSEE studies and related research suggests a consensus. The returns to sub-baccalaureate college are positive. They are demonstrably incremental in amounts and quality. For associate degrees, they are robust across method, dataset, and time period. There is strong evidence that these degrees yield higher returns than certificates; the growth in completion of certificates is therefore unlikely to have the same economic effect as would promoting degree completion. There is some heterogeneity in returns, which is demonstrably evident for occupational versus transfer-oriented degrees and for programs in health fields versus other fields. Finally, these returns appear to be responsive to broader macroeconomic trends in the form of labor market polarization, the Great Recession, and skills downgrading. The consensus indicates that further investments in sub-baccalaureate college are valuable for students.

However, there are some areas of concern that may undermine the implications of this consensus. The price or cost of attending college may be increasing (Ma, Baum, Pender, & Welch, 2016). Relatedly, as students accumulate excess credits or take longer to complete their degrees, the realized cost of college goes up. Another concern is that—despite the high returns—completion rates at two-year colleges are low; we need to identify the constraints that are hindering students' from completion and so from securing a higher paid job. The final important concern is the extent to which there is growing heterogeneity in the returns to college. In a period in which students are bearing more of the costs of college, and in which firms are sorting their employees more precisely, this heterogeneity marks a greater risk for students who are now deciding on the optimal level of investment in college.

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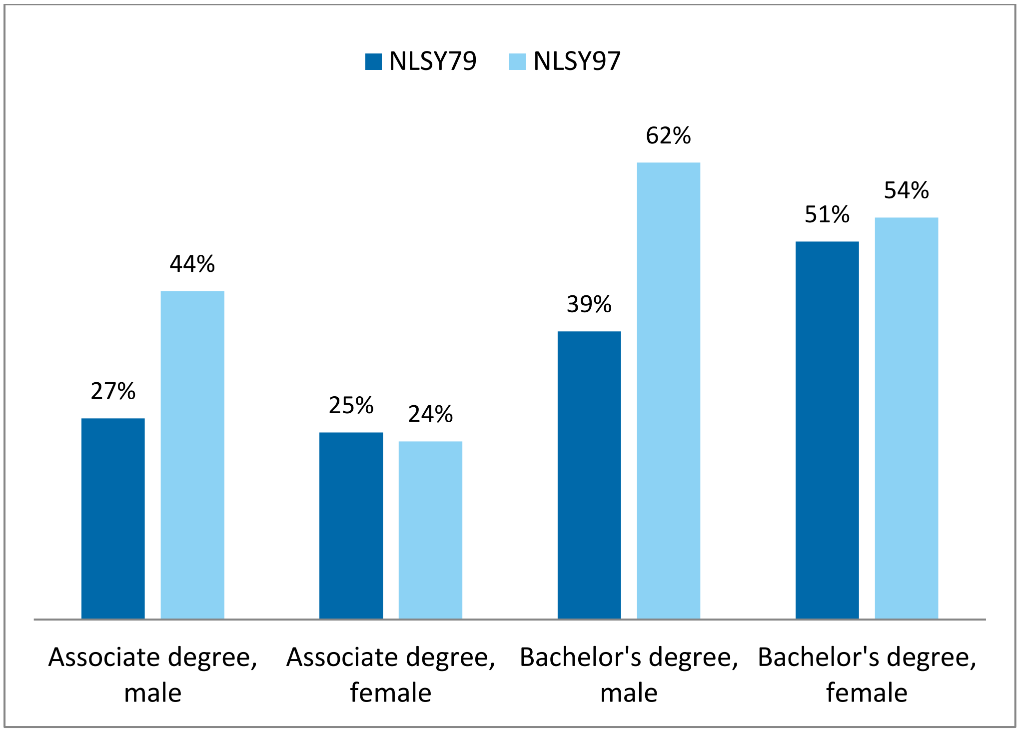
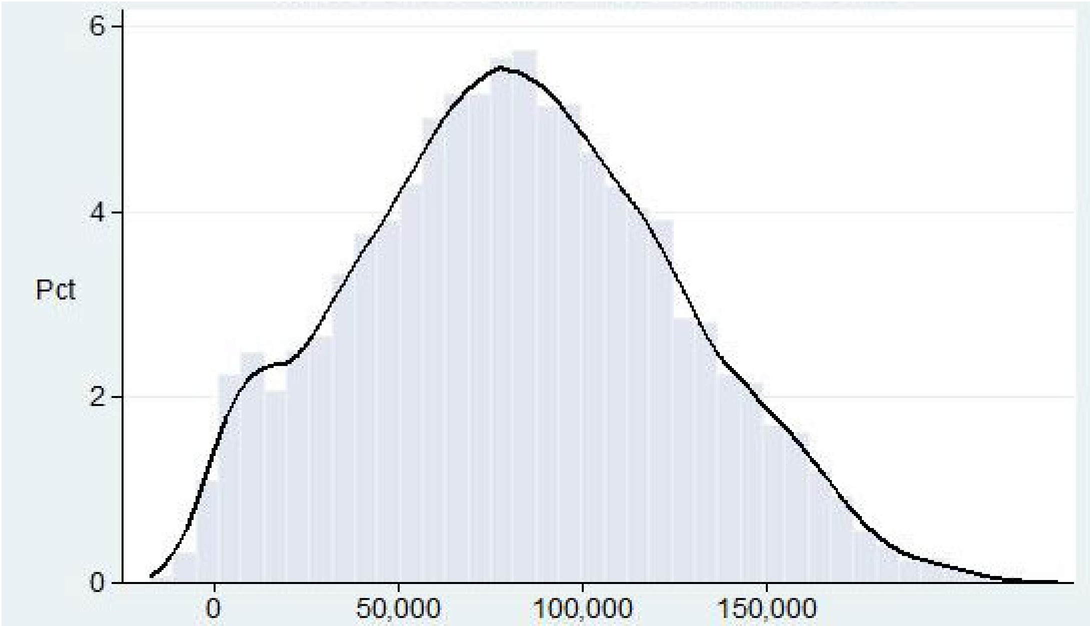
Appendix: Additional Figures and Tables

Figure A1: Earnings Gains over High School Graduates by Youth Cohorts



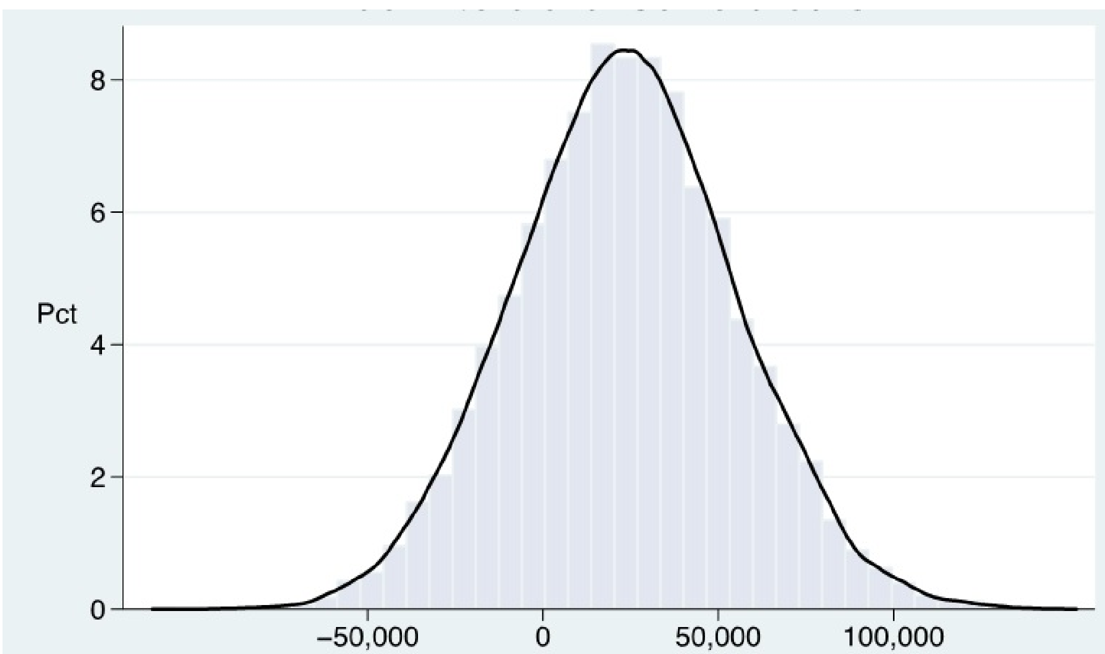
Note. Source: Castex and Dechter (2014, Table 4).

Figure A2: Net Present-Value Earnings Gain—Associate Degree Over Some Credits



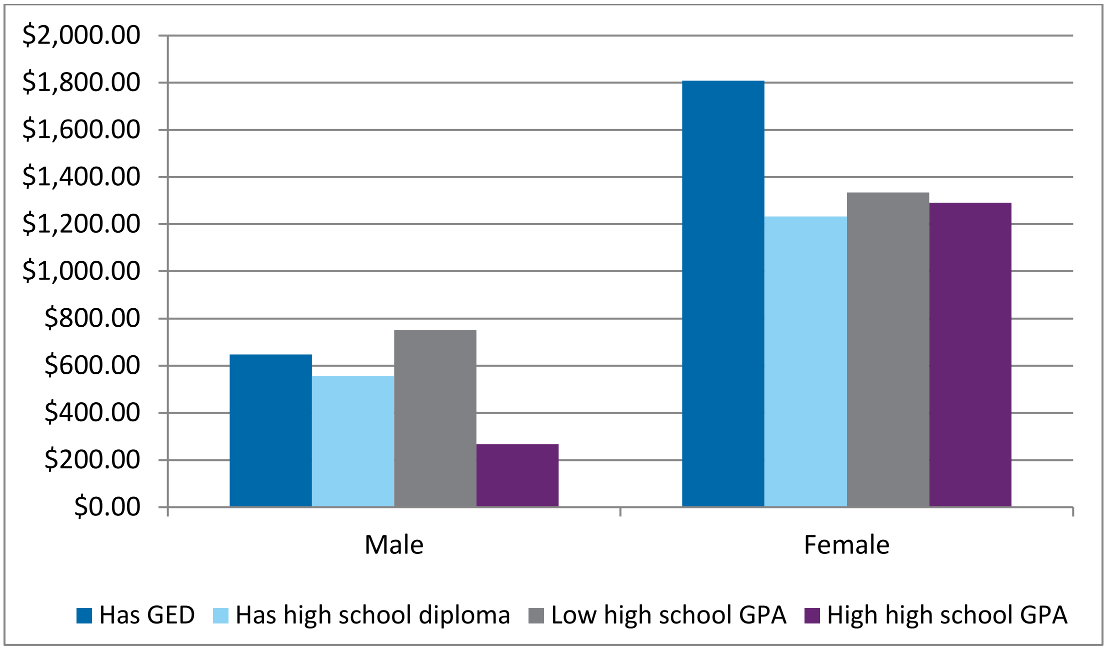
Source: Table A3. Notes: Monte Carlo simulation, 10000 trials; kernel density plot.

Figure A3: Net Present-Value Earnings Gain—Certificate Over Some Credits



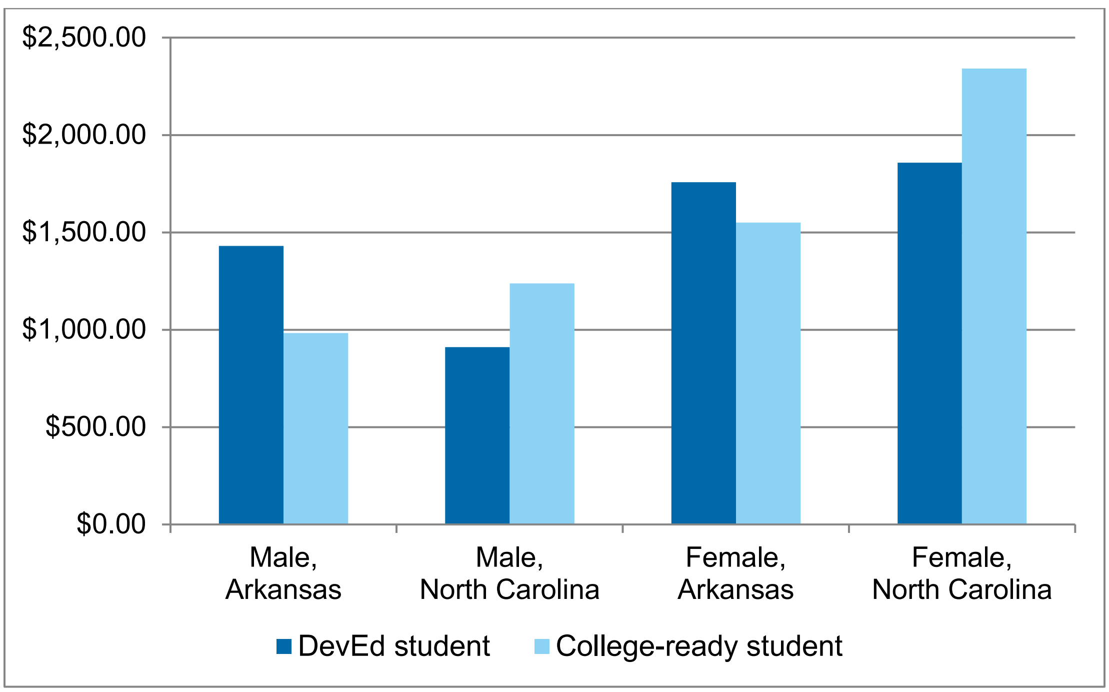
Source: Table A3. Notes: Monte Carlo simulation, 10000 trials; kernel density plot.

Figure A4: Quarterly Earnings Gains for Associate Degree Holders Over Non-Completers by Level of High School Preparation



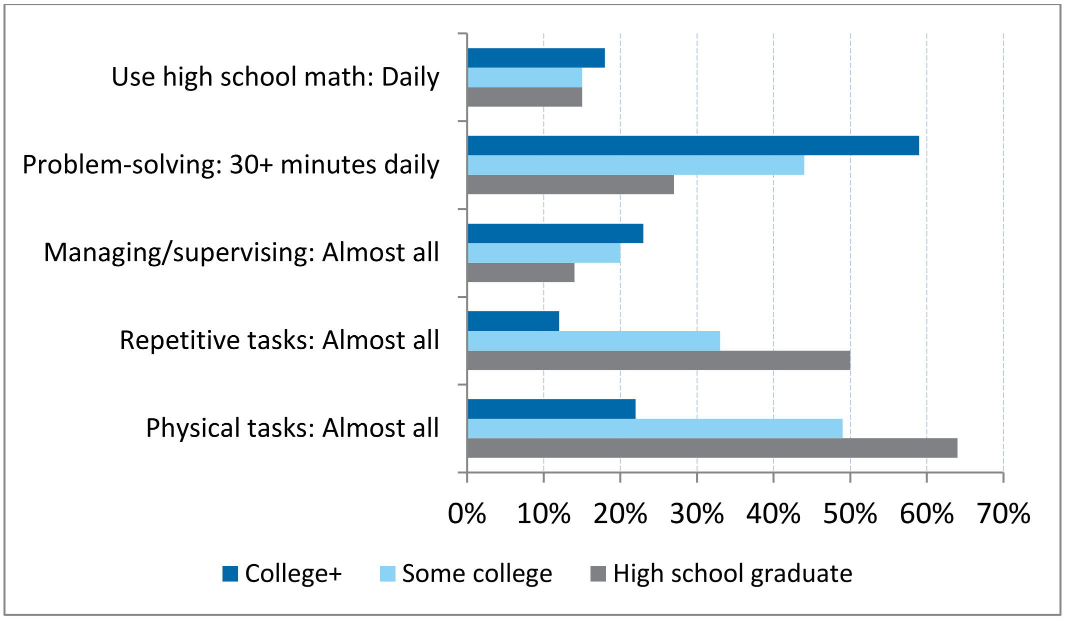
Note. Source: Direct calculations from Liu et al. (2015).

Figure A5: Quarterly Earnings Gaps—Associate Degree Over Non-Completers by College Readiness



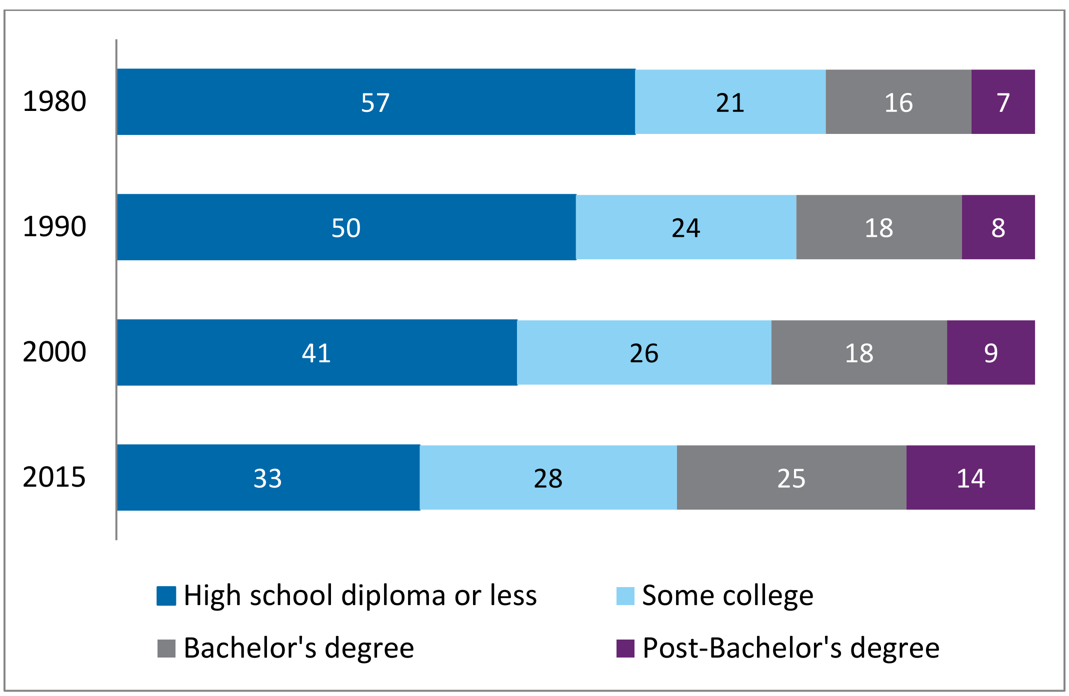
Note. Source: Liu et al. (2015) and Belfield (2014).

Figure A6: Task Performance: Employed Workers



Note. Source: Autor and Handel (2013, Table 1).

Figure A7: Employment Shares



Note. Source: Valletta (2016, Table 1).

Table A1: Lifetime Present-Value Earnings Gain from Bachelor's Degree Over High School Graduation

Study	Net of College Costs	Source Dataset	Present Value at Age 18 in 2014 Dollars
Agan (2013)	Yes	NLSY79	$243,700
Webber (2014) [d]	Yes	NLSY79, ACS	$492,400
Avery and Turner (2012)	Yes	CPS2009	$462,000
Barrow & Malamud (2015) [b]	Yes	CPS 2013	$434,900
Barrow & Rouse (2005) [b]	Yes	CPS 2004	$629,400
Kim, Tamborini, & Sakamoto (2015) [a]	No	SIPP, IRS merge 1990–2008	$321,100
Tamborini, Kim, & Sakamoto (2015) [a]	No	SIPP, IRS merge 1990–2008	$266,100
Herschbein & Kearney (2014)	No	ACS 2009–12	$610,000
Mitchell (2014) [c]	No	SIPP 2008	$354,300
Average ($N = 9$)			$423,800

Note. Median earnings unless otherwise specified. Discount rate of 3 percent. Studies excluded because of lack of harmonization: Daly and Bengali (2014); Abel, Dietz, and Su (2014); Day & Newburger (2002); Carnevale et al. (2011); Trostel (2010). Studies excluded because derived from other studies: Autor (2014).

[a] Adjusted from discount rate of 4 percent.

[b] Mean earnings.

[c] Males only, up to age 47.

[d] Discount rate of 3.5 percent; full-year full-time males.

Table A2: Earnings Gains from Community College Relative to High School Graduation

Community College Education (CCE)	Percentage Gain in Earnings (CCE Over HS Graduate) Male	Female
Associate degree (average across 17 studies)[a]	13%	21%
Vocational certificate (average across 2 studies)[b]	8%	22%

[a] Belfield and Bailey (2011, Table 1).

[b] Belfield and Bailey (2011, Table 2).

Table A3: Present-Value Net Returns: Parameter Values for Monte Carlo Simulations

Parameter	Mean	SD	Minimum	Maximum
Associate degree model				
Credits (extra)	46.2	14.3	10.0	60.0
Quarters in college (extra)	10.0	2.0	2.3	17.6
Price per credit	$257	$92	75	500
Lost earnings per quarter	$360	$99	$190	$530
Earnings gain per quarter	$1,479	$628	$290	$2,770
Growth in earnings gain per quarter	0.015	0.010	-0.025	0.052
Certificate model				
Credits (extra)	20.0	4.9	10.0	40.0
Quarters in college (extra)	6.0	2.0	0	13.6
Price per credit	$257	$92	75	500
Lost earnings per quarter	$360	$99	$190	$530
Earnings gain per quarter	$616	$629	-$1,701	$2,872
Growth in earnings gain per quarter	-0.015	0.010	-0.055	0.022

Note. Simulation from 10,000 draws.