



THE EARNINGS & EMPLOYMENT OF CERTIFICATE EARNERS IN KENTUCKY

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EXECUTIVE SUMMARY

This is the third in a series of reports on the postsecondary certificate environment in Kentucky, with a focus on the earnings and employment trajectories of certificate earners. In the previously released reports, *Certificates Awarded in Kentucky, 2005–2006 to 2018–2019*, and *Who Earns Certificates in Kentucky? 2005–2006 to 2018–2019*, we documented trends in sub-baccalaureate certificates granted by postsecondary institutions and examined the characteristics of certificate earners. Using similar data, the goal of this report is to inform policy decisions surrounding certificates by providing evidence about the earnings and employment trajectories of certificate earners in Kentucky. The rising popularity of certificate programs dictates inquiry into the value proposition of short-term certificates; in this report, we aim to add new information to improve our understanding of the costs and benefits of certificate programs, policy efforts, and human capital investments.

The focal group of this report is single certificate earners who have a record of employment prior to pursuing their certificates. By focusing on this group of students, we can compare their earnings and employment after completing their certificates to their earnings and employment before entering a certificate program. To facilitate comparisons, we provide similar comparisons for students who earned associate degrees and those who started, but did not complete, a sub-baccalaureate credential.

Key Takeaways

1. Nationally, sub-baccalaureate certificate granting has grown nearly 80% over the past 20 years, currently totaling about one million credentials per year. This growth has been particularly notable among public institutions, with the number of certificates granted annually up over 140% during this time period. Presently, public sector certificates account for about 70% of all certificates granted.
2. Kentucky provides an important context for studying short-term credentials given its prominence in policy debates and its rate of short-term credential seeking. Currently, Kentucky is a national leader in short-term certificate granting, with about two less-than-one-year certificates granted for every associate degree, about four times the national average.
3. Students who pursued certificates are different in important ways than those who earned associate degrees or those who never earned a sub-baccalaureate credential, including differences in their chosen fields of study and along gender, racial, ethnic, and age lines. Moreover, certificate earners have distinctive labor market experiences, with relatively low pre-enrollment earnings and employment rates as compared to other students in our sample, suggesting that certificate students have unique needs and reasons for pursuing postsecondary education. More broadly, it is important to recognize wide variation in labor market experiences and educational intentions among students in the sub-baccalaureate sector: such diversity necessitates an array of support structures and constrains policy and practice inferences from analyses of average outcomes.

4. Using an individual fixed effects model and a sample of students who have considerable earnings records prior to enrolling in a postsecondary program, we estimate how much certificate students' post-credential completion labor market experiences differ from their pre-enrollment labor market experiences, controlling for a robust set of observed characteristics. Students who earned certificates generally have higher average post-certificate wages and probabilities of being employed than when they entered the program. Overall, we estimate that students earn more per quarter (about 14% of the pre-enrollment average quarterly earnings), on average, after earning a certificate as compared to prior to entering the program. These increases in earnings after the receipt of award reflect higher employment rates and also higher rates of earnings growth. This is promising suggestive evidence of the value of such certificates; however, we urge caution in interpreting findings as irrefutable evidence of the causal effect of earning a certificate given analytical considerations discussed in the report.

5. There are notable differences in vocational outcomes across fields of study, length of certificates, and student demographics. Certificate earners who studied a STEM field experience the highest earnings increase (in both absolute and relative dollars compared to the average baseline value) after award receipts, followed by health professions and skilled trades. This is consistent with the fast-growing and higher-paid STEM labor market, as well as the evidence that relevant skills in health and trades are in high demand in the state. Earnings increases are largest among students who took a larger number of credits while earning their certificate: students who took 15 or more credits in their fields of study have earnings increases that are about twice as large as those who completed certificates with fewer credits (e.g., 1-6) related to their fields of study. Male students' earnings rise at a greater rate than those of female students. While this finding needs further investigation, this could be partly due to male and female students pursuing generally different fields in our data.

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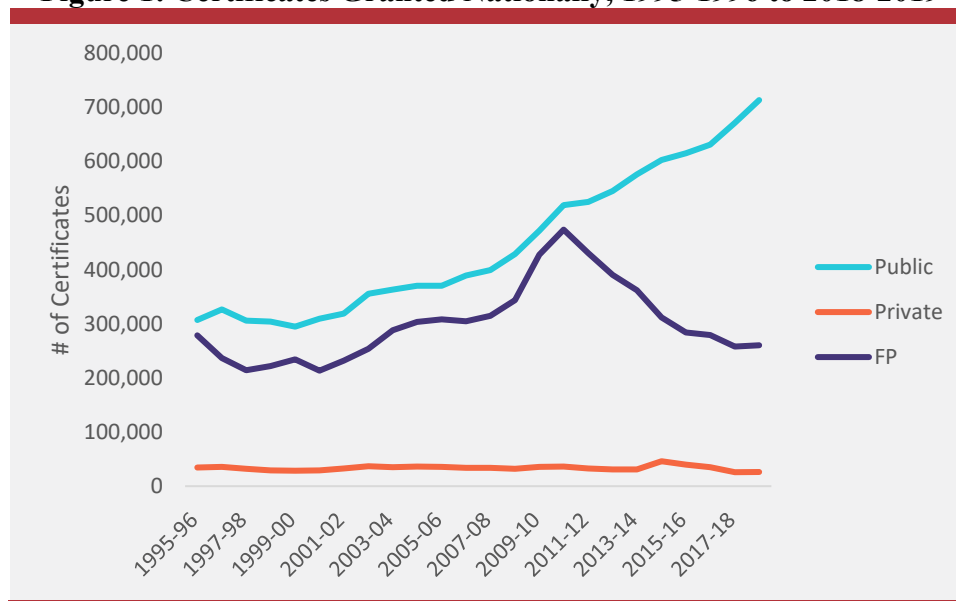
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1. INTRODUCTION AND CONTEXT

1.1. National

The number of sub-baccalaureate certificates in the United States has grown nearly 80% over the past 20 years, currently totaling about one million credentials per year. This growth has been particularly notable among public institutions, with the number of certificates granted annually up over 140%, as displayed in Figure 1. Presently, public sector certificates account for about 70% of all certificates granted nationally, which is up from about 55% from two decades earlier. For-profit institutions grant about a quarter of all certificates. Their share has significantly declined since a peak in the 2010-2011 academic year, following broader trends in the decline of the for-profit sector. Meanwhile, private nonprofit institutions grant less than 3% of all certificates, which is down from about 5% in the 2000-2001 academic year.

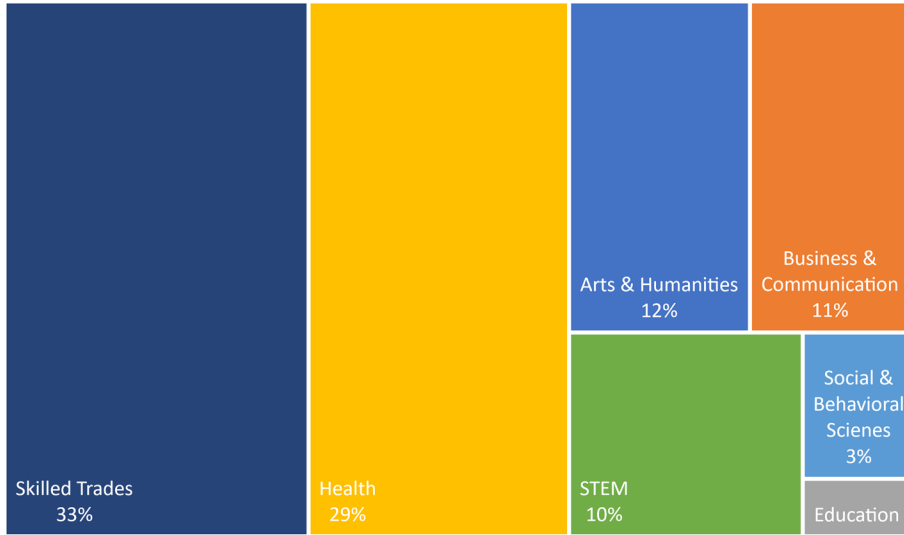
Figure 1: Certificates Granted Nationally, 1995-1996 to 2018-2019



Source: *Digest of Education Statistics 2020*, Table 318.40. Notes: This figure includes only postsecondary institutions that participate in Title IV federal financial aid programs. Certificate counts include both degree- and non-degree-granting institutions.

In Figure 2, we display fields of study certificate recipients pursued nationally in the 2018-2019 academic year. About a third of certificates were granted in skilled trade fields, including precision production, construction, mechanics, personal and culinary services, and law enforcement. These fields comprised less than 5% of bachelor's degrees. The second largest certificate category, health professions and related programs, accounted for about 29% of certificates, while certificates in STEM, business and communication, and arts and humanities comprised about another third of certificates collectively. Social and behavioral sciences and education made up about 4% of total certificates granted.

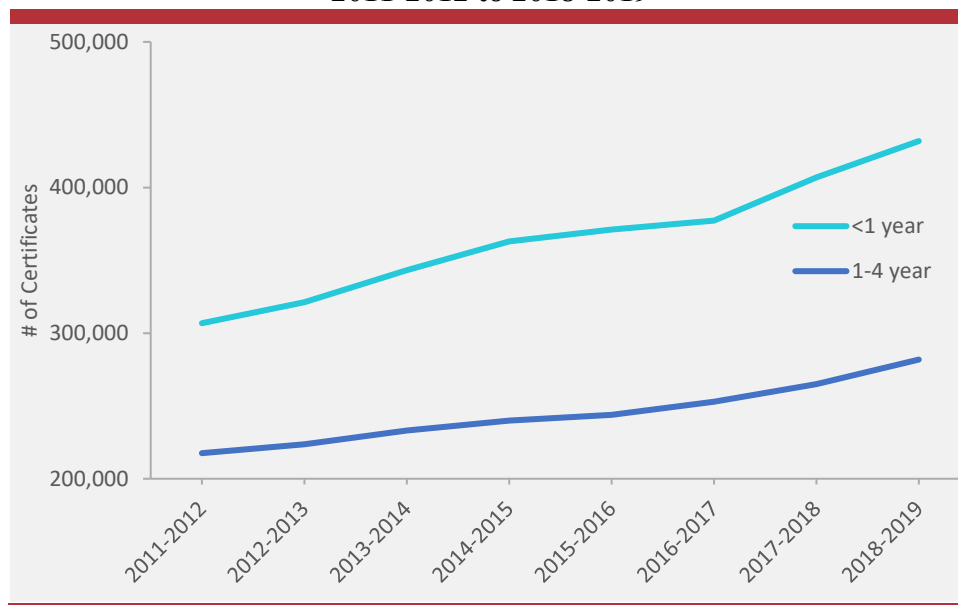
Figure 2: Certificates Granted Nationally by Fields, 2018-2019



Source: *Digest of Education Statistics 2020*, Table 320.10. Notes: This figure includes only postsecondary institutions that participate in Title IV federal financial aid programs. Certificate counts include both degree- and non-degree-granting institutions.

Of recent policy relevance is the proliferation of “short-term” certificates. Short-term certificates have been traditionally defined as programs with a duration of one year or less, or of at most 30 credits. The national trends are displayed in Figure 3. Since the 2011-2012 academic year, the number of <1-year certificates granted by public institutions has grown by about 125,000 certificates, or about 40%. This is faster than the growth of 1- to 4-year certificates, which have increased by about 64,000 certificates, or about 30%.

Figure 3: Certificates Granted by Public Institutions Nationally by Length, 2011-2012 to 2018-2019



Source: *Digest of Education Statistics 2012-2019*, Tables 320.10. Notes: This figure includes only postsecondary institutions that participate in Title IV federal financial aid programs. Certificate counts include both degree- and non-degree-granting institutions.

While short-term and stackable credentials are of acute interest to policymakers in the state of Kentucky, they are also the focus of increasing attention in several other states across the nation.¹ There are numerous federal policies for which understanding the value of short-term credentials is critically important, including how credentials are recognized in the 2014 Workforce Innovation and Opportunity Act and current debates about Pell Grant funding for short-term credential programs. In the latter policy debate, a key point of contention is whether short-term credentials pay off for students and thus merit Pell Grant funds for support.² There is also ample state-level interest in short-term credentials around the country. For example, as of 2016, at least 19 states have enacted legislation or appropriations that explicitly mention the stackable nature of credentials in two different domains: (1) requirements that postsecondary institutions offer stackable credits; and (2) financial incentives for pursuing stacking programs.³ As such, the results of this project have the potential to inform policymaking and programmatic initiatives in and beyond Kentucky.

1.2. Kentucky

Kentucky provides an important context for studying short-term credentials given its prominence in policy debates and its rate of short-term credential seeking. Historically, Kentucky has had the highest rate in the country of certificates awarded per capita (nearly twice the national average), public sector certificates awarded per capita (almost three times the national average), and less-than-one-year certificates awarded per capita. It is also ranked in the top three states for the number of sub-baccalaureate awards per capita and the ratio of certificates awarded compared to associate degrees (with almost twice as many certificates granted as associate degrees).⁴

In Figure 4 we show the trend in certificates granted by public 2-year colleges in Kentucky.⁵ From the 2005-2006 to 2018-2019 academic years, the number of certificates granted has doubled, from 12,901 certificates awarded in the 2005-2006 academic year to 27,144 certificates awarded in the 2018-2019 academic year. We include associate degrees granted in the figure for comparison. Certificate growth has outpaced the rapid expansion of associate degrees granted over this period, which increased 71% from 5,760 to 9,860. Although there was expansive growth in both

¹ According to U.S. Department of Labor (DOL), a stackable credential refers to a credential “when it is part of a sequence of credentials that can be accumulated over time to build up an individual’s qualifications and help them to move along a career pathway or up a career ladder to different and potentially higher-paying jobs.” See: *Career Pathways Toolkit: A Guide for System Development*, <https://lincs.ed.gov/professional-development/resource-collections/profile-841>.

² See: <https://www.insidehighered.com/news/2019/07/08/debate-over-proposed-expansion-pell-grants-short-term-job-training>.

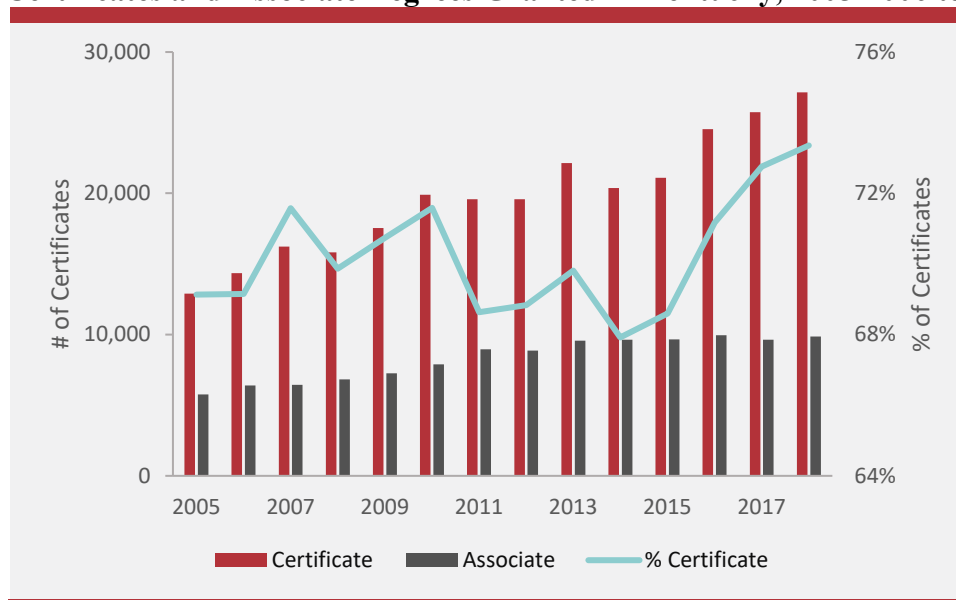
³ See: National Skill Coalition, <https://www.nationalskillscoalition.org/resources/publications/file/Stackable-Credential-Scan-2.pdf>. Examples of prominent state programs are the Virginia FastForward Credentialing Program and the Minnesota ReConnect Program & Pathways to Prosperity.

⁴ Data from the 2007-2008 school year (see *Certificates Count: An Analysis of Sub-baccalaureate Certificates* by Complete College America, 2010).

⁵ See Appendix 1 for a description of the data we use in this report.

certificates and associate degrees, the relatively faster growth of certificates awarded has led to the growth in the certificate share of total awards at public institutions from 69% to 73%. Differential trends are prominent in recent years: associate degree awards remained relatively flat from 2013 to 2018, while certificates awarded grew by almost a third. In the last few years, over 2.5 certificates have been awarded for each associate degree.

Figure 4: Certificates and Associate Degrees Granted in Kentucky, 2005-2006 to 2018-2019



Source: Author calculations based on KPEDS Degree Data in the Kentucky Longitudinal Data System. Notes: This figure represents the number and percentage of certificates conferred between the 2005-2006 and 2018-2019 academic years. Calculations are based on the number of certificates in proportion to the total number of credentials by year.

Nearly all sub-baccalaureate certificates granted in the state of Kentucky come from the 2-year public sector. However, in recent years, the 4-year public sector has granted more certificates; for example, institutions in the 4-year public sector were responsible for about 2% of all certificates granted in 2017. This represents a small portion of all certificates granted, so we focus the discussion in this report on the 2-year sector. However, it is worth keeping an eye on certificate production in the 4-year sector in the future, especially given the apparent high student demand for these programs and various incentives for institutions to offer shorter-term programs.

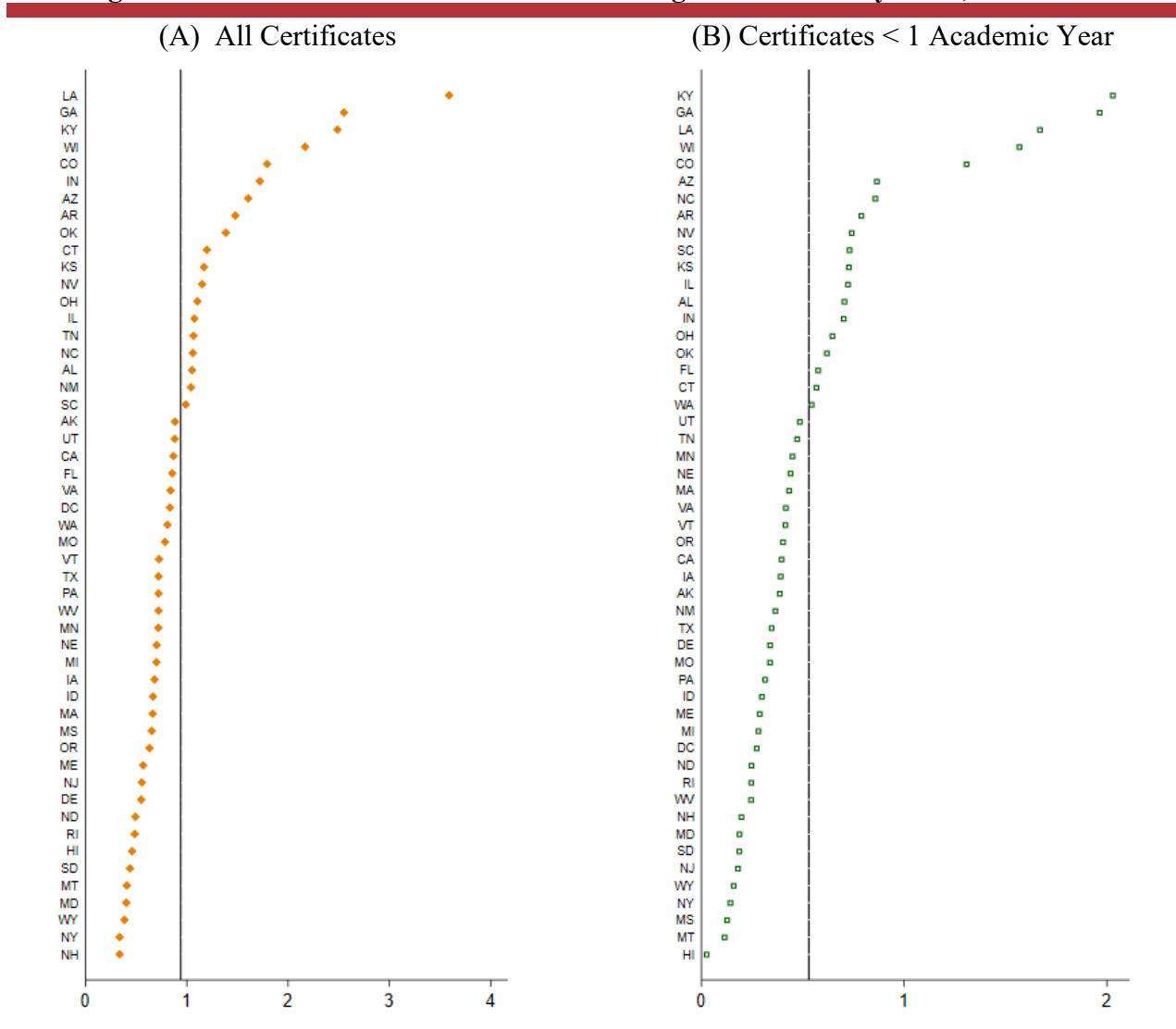
There have been recent, high-profile examples of policies that may have affected supply and demand for short-term credentials. In the state’s recently enacted performance-based funding system, institutions are awarded funding for granting short-term credentials and are given extra credit for granting credentials to low-income students and underrepresented minority students. This has created an incentive for institutions to offer a greater number of programs where students can complete with fewer credits. Additionally, starting in 2016, state officials introduced the Work Ready Kentucky Scholarship program, thereby boosting the availability and generosity of scholarships for students pursuing certificates and diplomas in “high demand” workforce sectors.⁶

⁶ See: <https://www.lanereport.com/103233/2018/07/bevin-expands-work-ready-kentucky-scholarship-to-include-associates-degrees-and-high-school-dual-credit-courses/>.

Policy efforts like these, and the general popularity of certificate programs, necessitate inquiry into the value proposition of short-term certificates.

We show the ratio of certificates to associate degrees granted by state for the 2018-2019 academic year in Figure 5. Panel (A) includes all certificates, regardless of length. The national average is about one, which means that about one certificate is granted for every associate degree. About 19 states have ratios higher than the average, with Kentucky ranking third in the nation with 2.5 certificates granted for every associate degree. Panel (B) shows only certificates with the program length of less than one year. We observe that Kentucky leads the nation with about two less-than-one-year certificates granted for every associate degree, as compared to the national average of about 0.5.

Figure 5: Ratios of Certificates to Associate Degrees Granted by State, 2018-2019



Source: U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS).

2. WHAT RESEARCH TELLS US ABOUT THE BENEFITS OF SHORT-TERM CREDENTIALS

Much of the earliest estimates of labor market returns on certificates rely on national survey data (e.g., Bailey, Kienzl, and Marcotte 2004; Grubb 1995, 2002; Hollenbeck 1993; Kerckhoff and Bell 1998; Marcotte et al. 2005; Marcotte 2019; Surette 1997). In these studies, researchers often compare the earnings of students with certificates to the earnings of those with no education beyond a high school diploma. Findings regarding economic returns on certificates are inconsistent. These inconsistencies may reflect limitations noted by the researchers: for example, national surveys often contain limited information on student characteristics, backgrounds, and educational pathways. This leads to the concern that unobserved differences between the groups might affect both certificate earning and future income, resulting in biased estimations of returns on certificates. Another issue is that national surveys typically collect information on students' income shortly after they finished postsecondary education and therefore do not give an insight into outcomes as students advance in their careers. Other concerns are related to the limited ability of researchers to use national data to precisely estimate differential returns on certificates by fields of study or certificate types, or related to state-specific trends that drive differences in estimated returns across states.

As state and college administrative data combined with earnings and employment records become available in several states, studies have started using these data to examine the impact of short-term certificates on earnings. Unlike national survey data, these state-level datasets include more detailed information about students, certificates, and educational contexts. Researchers have used this information to investigate returns on different types of certificates in states like California (Bahr 2014; Stevens, Kurlaender, and Grosz 2019), Kentucky (Jepsen, Troske, and Coomes 2014), Michigan (Bahr et al. 2015), North Carolina (Liu, Belfield, and Trimble 2015; Xu and Trimble 2016), Ohio (Bettinger and Soliz 2016; Minaya and Scott-Clayton 2021), Tennessee (Carruthers and Sanford 2018), Virginia (Xu and Trimble 2016), and Washington (Dadgar and Trimble 2015).

We summarize the results of these studies in Table 1. Many of the studies compare students' earnings gains derived from the acquisition of short-term certificates to the earnings gains of those who drop out of college without completing their program. These earnings datasets contain information on students over a longer period of time as compared to studies using national surveys, which allows researchers to better control for systematic differences between treatment and control groups in their estimations that are stable over time. Nevertheless, studies using this approach are still subject to biases to the extent that unobserved or dynamic factors can drive earnings gains rather than certificates.

In general, most of these studies find small and positive returns on certificates. Belfield and Bailey (2017) summarize the findings on the returns on certificates across statewide analyses and conclude that a certificate is associated with \$2,120 of earnings increase per annum for males and \$2,960 for females in 2014 dollars. These positive returns are mostly found in career and technical education (CTE) fields, which include areas like engineering, information technology, and health (Bahr 2014; Stevens et al. 2019). Bahr (2014) documents a positive earnings effect in CTE fields in California but does not find positive returns for non-CTE fields. Likewise, Carruthers and Sanford (2018) find that Tennessee's state-run technology centers yield positive and significant earnings gains. Xu and Trimble (2016) find that certificates in the health sector are associated with

positive returns in Virginia and North Carolina. They also provide evidence of substantial variation in returns on certificates across different programs within a particular field of study. For instance, they find that the long-term certificate program in dental assisting is associated with high earnings returns across both states. However, both the long-term and short-term certificate programs in medical office administration in North Carolina produce insignificant returns while both certificate programs in health sciences in Virginia are associated with negative returns. All these programs fall under the single field of health that has generally shown positive returns in most studies. As these authors argue, their findings suggest that averaged effects calculated from a broad field comprised of a wide range of distinct programs do not show important differences in returns on certificates across programs in the same field. For the other sectors, researchers have found inconsistent results across fields and states. This variation across states suggests that the differential impacts of certificates depend on local labor markets and economies.

Research also demonstrates substantial differences in returns across the intersection of fields of study and gender. Dadgar and Trimble (2015) find positive earnings effects of short-term certificates in construction, and business and marketing for women and in protective services for men. Xu and Trimble (2016) find that short-term certificates in protective services are associated with positive returns in North Carolina but negative returns in Virginia. They also find positive returns in mechanics, repair, and welding in Virginia but not North Carolina. The existence of such heterogeneity indicates that aggregating returns across states, fields of study, and gender may mask significant variations in these aspects.

Of more recent interest has been the benefits of certificates depending on their length, typically measured in years or credits. There are challenges in accurately measuring the length of a program, including decisions on whether to count credits completed that are not directly related to the certificate field of study and general difficulties in tracking educational intentions and all credits taken and earned over time and across institutions. (See our earlier report *Certificates Awarded in Kentucky, 2005–2006 to 2018–2019* for an extended discussion based on the Kentucky context.) Commonly, policymakers and researchers distinguish between short-term certificates (which require less than one year of full-time study) and long-term certificates (which typically take one year or more of full-time study to complete but less time compared to associate degrees).⁷ Within each category, the number of credit hours required for completion vary substantially across programs and states (Belfield and Bailey 2017). Previous studies have generally shown higher returns on certificates that require more credits (Belfield and Bailey 2017). However, the effects of program length can be confounded by variations in fields of study and gender participation rates across different program lengths.

⁷ These long-term certificates are called “diplomas” in states like Kentucky, North Carolina, and Virginia.

Table 1: Summary of Results from Selected Studies Related to Returns on Short-Term Certificates

Authors	Geography	Sub-Baccalaureate Credential Examined	Cohorts Included	Earnings Years	Heterogeneity Analysis	Earnings Gains for Certificates	Fields in which <i>Short-Term Certificates</i> Yield Positive Earnings Gains
Bahr (2014)	California	Low-credit awards (< 6 credits), short-term certificates (6–29 credits), long-term certificates (> 29 credits), and associate degrees (> 59 credits)	2002-2006	2002-2012	Fields of study	Low-credit awards: 11%↑. Short-term certificates: 13%↑. Long-term certificates: 17%↑.	Biological Sciences; Business & Management; Health; Family & Consumer Sciences; Public & Protective Services; Commercial Services.
Bahr, Dynarski, Jacob, Kreisman, Sosa, and Wiederspan (2015)	Michigan	Short-term certificates (< 15 credit hours), long-term certificates (≥ 15 credit hours), and associate degrees	2003, 2004	1998-2011	Gender, fields of study	Short-term certificates: no significant impacts for both males and females. Long-term certificates: 14%↑ for females; no significant impacts for males.	None.
Bettinger and Soliz (2016)	Ohio	Short-term certificates (less than one year of full-time study), long-term certificates (at least one year of study, but less than two years), and associate degrees	1998, 1999, 2000	1998-2000	Gender, fields of study	Short-term certificates: 51%↑ for males in all colleges; no significant impacts for females. Long-term certificates: 24%↑ for females in all colleges; no significant impacts for males.	Computer and Information Sciences and Support; Homeland Security, Law Enforcement, Firefighting; Social Sciences.
Carruthers and Sanford (2018)	Tennessee	Short-term certificates (one or two trimesters), diplomas (one to two years), and associate degrees	2004-2008	2001-2012	Industrial choices	Short-term certificates: \$166-292↑ in quarterly earnings (or 3-5%↑ of pre-enrollment average earnings). Diplomas: \$707-1034↑ in quarterly earnings (or 13-19%↑ of pre-enrollment average earnings).	NA.

Table 1 (continued)

Authors	Geography	Sub-Baccalaureate Credential Examined	Cohorts Included	Earnings Years	Heterogeneity Analysis	Earnings Gains for Certificates	Fields in which <i>Short-Term Certificates</i> Yield Positive Earnings Gains
Dadgar and Trimble (2015)	Washington	Short-term certificates (less than one year of full-time study), long-term certificates (at least one year of study), and associate degrees	2001	2001-2009	Gender, fields of study	Short-term certificates: 3%↓ for females; no significant impacts for males. Long-term certificates: 16%↑ for females; no significant impacts for males.	For females: Construction; Business and Marketing. For males: Protective Services.
Jepsen, Troske, and Coomes (2014)	Kentucky	Certificates (one or two semesters of course work), diplomas (more than one year of study), and associate degrees	2002, 2003	2000-2008	Gender, fields of study	Certificates: \$297↑ in quarterly earnings (or 5%↑ of average earnings) for males; \$299↑ in quarterly earnings (or 7%↑ of average earnings) for females. Diplomas: \$1,265↑ in quarterly earnings (or 21%↑ of average earnings) for males; \$1,914↑ in quarterly earnings (or 45%↑ of average earnings) for females.	For females: Health; Services. For males: Vocational.
Liu, Belfield, and Trimble (2015)	North Carolina	Certificates (12-18 semester-hour credits), diplomas (36-48 semester-hour credits), and associate degrees	2002	1996-2012	Gender, fields of study	Certificates: \$279↓ in quarterly earnings for males; \$347↓ in quarterly earnings for females. Diplomas: \$545↓ in quarterly earnings for males; \$1,680↑ in quarterly earnings for females.	For females: Protective Services. For males: Protective Services.
Minaya and Scott-Clayton (2021)	Ohio	Short-term certificates (less than one year of study), long-term certificates (at least one year of study), and associate degrees	2001, 2002, 2003	2000-2013	Gender, fields of study	Short-term certificates: \$395↑ in quarterly earnings for males; \$404↑ in quarterly earnings for females. Long-term certificates: \$1,003↑ in quarterly earnings for males; \$1,871↑ in quarterly earnings for females.	For females: Health. For males: None.

Table 1 (continued)

Authors	Geography	Sub-Baccalaureate Credential Examined	Cohorts Included	Earnings Years	Heterogeneity Analysis	Earnings Gains for Certificates	Fields in which <i>Short-Term Certificates</i> Yield Positive Earnings Gains
Stevens, Kurlaender, and Grosz (2019)	California	6-17 credit certificates, 18-29 credit certificates, 30-59 credit certificates, and associate degrees	Earning a credential between 2003 and 2007	1992-2012	Gender, fields of study	<p>6-17 credit certificates: 12% to 18%[↑] across different fields of study for females; 10% to 20%[↑] across different fields of study for males.</p> <p>18-29 credit certificates: 13% to 31%[↑] across different fields of study for females; 3% to 38%[↑] across different fields of study for males.</p> <p>30-59 credit certificates: 15% to 56%[↑] across different fields of study for females; 7% to 37%[↑] across different fields of study for males.</p>	<p>6-17 credit certificates: For females: Health; Business/Management; Family/Consumer; Engineering/Industrial; Commercial Services.</p> <p>For males: Health; Public/Protective; Business/Management; Engineering/Industrial; Information Technology.</p> <p>18-29 credit certificates: For females: Health; Public/Protective; Business/Management; Family/Consumer; Fine/Applied Arts; Commercial Services.</p> <p>For males: Health; Public/Protective; Business/Management; Engineering/Industrial; Agriculture/Natural Resources.</p>
Xu and Trimble (2016)	North Carolina, Virginia	Short-term certificates (less than one year of full-time study), long-term certificates (at least one year of study), and associate degrees	North Carolina: 2006, 2007; Virginia: 2006, 2007, 2008	North Carolina: 2005-2012; Virginia: 2005-2013	Fields of study, state	<p>Short-term certificates: North Carolina: \$278[↑] in quarterly earnings; Virginia: \$153[↑] in quarterly earnings.</p> <p>Long-term certificates: North Carolina: \$953[↑] in quarterly earnings; Virginia: \$200[↑] in quarterly earnings.</p>	<p>North Carolina: Construction; Humanities and Social Sciences; Protective Services.</p> <p>Virginia: Allied Health; Humanities and Social Sciences; Mechanics, Repair, and Welding; Transportation.</p>

Notes: This table includes studies that examine labor market returns on short-term certificates. In the “Earnings Gains for Certificates” column, since some studies report estimated coefficients of the impacts on *log* earnings, we convert the changes in earnings from log points to percentage points for the purpose of comparison. To be specific, the percent change in earnings is equal to: $e^{\text{change in log earnings}} - 1$.

3. DATA

The data we use in this report primarily come from administrative postsecondary system records for the state of Kentucky, including information for all students (both full-time and part-time) who attended one of 16 community colleges with more than 70 locations across the state. The focal group of this report is certificate earners who have a record of employment prior to pursuing their certificates. This group makes up a notable proportion of certificate earners. Focus on this group of students enables us to compare earnings and employment after certificate completion to their earnings and employment prior to entering a certificate program. To ensure sufficient data on students' pre- and post-college earnings, we restrict cohorts to those who entered a Kentucky community college from the 2010-2011 through 2015-2016 academic years. We exclude students who have no UI wage records during the analytic time frame. We focus on students of working age (ages 20-60) at the time of first enrollment who have no known records of attendance at a four-year college or university in the state.⁸ Our focus is on students who pursued and eventually earned one sub-baccalaureate credential (either a certificate or an associate degree) during the analytical time frame.⁹ See Appendix 1 for a detailed discussion of the data in this report.

The sample restrictions we impose for the analysis—including only students with robust pre-enrollment work histories and students earning a single sub-baccalaureate credential and no other credentials—are common in similar analyses in other contexts because of their benefits for analytical tractability. However, this means that the findings from this report may not cleanly extrapolate to other common types of students, such as those without substantial work histories or those who earned multiple credentials. Further work is needed to understand the likely unique experiences of these students, and we aim to extend our analyses in these directions in future studies.

We merge postsecondary records with administrative quarterly earnings and employment records from the state Unemployment Insurance (UI) program, ranging from the third quarter of calendar year 2008 to the second quarter of calendar year 2019. Administrative UI records are from covered jobs as reported by Kentucky employers in the state UI program. This includes most workers; however, consistent with limitations that affect all studies using state administrative UI data, those who are not working, those who work only out of state, and those who work in jobs not subject to UI reporting requirements (e.g., federal employment and self-employment) do not have earnings records for that quarter in the data. We do not consider students' earnings and employment records in the years before they turned 18 years old and after they turned 65 years old. We adjust all earnings to 2019 dollars using the consumer price index to account for inflation.

In the sections that follow, we present three outcomes that reflect labor market experiences: employment rate and two different measures of earnings.¹⁰ We use multiple earnings measures to

⁸ In future work, we will examine potential differences in returns among students of different age profiles.

⁹ Note that in the data we cannot observe whether students obtained a different degree or credential in a college system outside Kentucky.

¹⁰ Another way to examine labor market outcomes related to educational programs is to compare annual earnings against a benchmark (e.g., the average earnings of high school graduates or the federal poverty line). For brevity, we do not examine such a standard, but plan to in future work.

provide a fuller picture of labor market experiences given the UI data limitations discussed above. The first earnings measure we use is earnings for all quarters in the data. This includes both earnings records for quarters during which individuals are employed and zeros for quarters during which individuals do not have earnings records in our data. Individuals without an earnings record in a quarter could mean that: the person is not working in that quarter; they have moved out of state or are working in an uncovered job; or the data have an administrative error. Under the first measure, we code all missing earnings records as if the person were not working (i.e., with earnings equal to zero and no employment). The second measure of earnings only includes records for quarters when the individuals are employed. In this measure we specifically count earnings only among those with positive earnings in the data and drop student-quarter observations that have zero or missing earnings.

In Table 2, we present summary statistics for our analytical sample of 100,458 students. Columns 1 and 2 consist of information on our focal group of students: those who earned a certificate. For comparison, we provide information on associate degree earners in columns 3 and 4, and on students who pursued coursework in sub-baccalaureate programs but never earned a credential during the analytic time frame in columns 5 and 6. In this report, we define length of certificates based on earned credits that are in the same field of study as the certificate.¹¹ Among certificate earners, about two-thirds earned an award with six credits or fewer related to their fields of study. Certificate earners enrolled in school for fewer quarters (6.2 quarters) on average than associate degree earners (10 quarters) but longer than non-completers (3.6 quarters). The proportion of certificate and associate degree earners who received a Pell Grant is around 76%, which is slightly higher than—but largely similar to—non-completers.

Among the four main major fields (in our context, business and communication, health professions, STEM, and skilled trades), certificate students are more likely to enroll in health-related programs than programs in other fields.¹² Across the various demographic groups, there are slight differences in the distributions of age at first enrollment and underrepresented minority status

¹¹ See our earlier report *Certificates Awarded in Kentucky, 2005–2006 to 2018–2019* for an extended discussion related to the Kentucky context. Understanding the number of credits completed is a complex task because of data limitations and student behavior. There is currently no way in the data to clearly identify which credits earned are counted for each credential; rather the data only list courses taken by students and credits earned for each course. In our calculation of credits per certificate for this report, we consider the total number of credits completed related to the field of the certificate. A different way to do this would have been to consider all credits a student takes, regardless of whether they are related to their primary field of study (see: *Certificates Awarded in Kentucky, 2005–2006 to 2018–2019*). We consider a course to match the field of the certificate if they both have the same two-digit Classification of Instructional Programs (“CIP”) code. This approach helps us to understand the patterns of the number of credits that students have earned as they complete certificates and allows us to distinguish between credits accrued that are directly related to the certificate and those that do not share the same field. We include only college-level courses passed with a letter grade of “A” through “D” or a passing grade of “P.”

¹² This is an example of where some of the data restrictions of this report lead to differences relative to other reports that we have produced on the full sample of certificate earners. For example, in the report *Certificates Awarded in Kentucky, 2005–2006 to 2018–2019*, we show that skilled trades are the most popular certificates earned in Kentucky in recent years. However, because skill trade certificates are often combined with other credentials, we do not analyze many of these students here but will do so in future work. In addition, this report focuses on students whose first enrollment year is between the 2010-2011 and 2015-2016 academic years. As such, students who have ever earned a credential prior to the 2010-2011 academic year are excluded from the analytical sample of this report.

(URM; in this report we follow Kentucky Council on Postsecondary Education convention and define URM as a student who identifies as Hispanic or Latino, American Indian or Alaska Native, Black or African American, Native Hawaiian or Other Pacific Islander, or Two or more Races). The largest difference is that the proportion of female students is lower among non-completers (about 50%) than among certificate and associate degree earners (about 70%). Table 2 also displays information on labor market performance prior to students' initial enrollment. The average probability of being employed ranges from 54% to 57% across groups. Certificate earners have lower average quarterly earnings than associate degree earners and non-completers during pre-enrollment periods.¹³ Notably, non-completers have the highest baseline earnings and employment levels in our sample.

These demographic and pre-enrollment earnings and employment trends indicate that students who completed certificates in our sample differ in important ways from those who earned associate degrees and those who enrolled but did not complete a sub-baccalaureate credential. We attempt to account for as many of these differences as possible in our analysis to estimate the extent to which observed post-credential completion labor market outcomes could be attributed to the certificate receipt. However, many relevant factors are not recorded in the data, which makes simple comparisons of labor market outcomes across groups likely to be biased. We take further steps to account for some potential confounders in the econometric analysis in Section 5 and in our forthcoming research paper.

¹³ In this table, we calculate average quarterly earnings prior to students' initial enrollment based on earnings information from all pre-enrollment quarters, whereas the baseline earnings presented in Section 4 are only based on earnings records two years prior to the initial enrollment.

Table 2: Summary Statistics for the Analytical Sample

	Certificate Earners		Associate Degree Earners		Non-Completers	
	Mean (1)	SD (2)	Mean (3)	SD (4)	Mean (5)	SD (6)
Certificate Length						
0-3 Credits	0.485	0.500	NA	NA	NA	NA
>3-6 Credits	0.187	0.390	NA	NA	NA	NA
>6-15 Credits	0.168	0.374	NA	NA	NA	NA
>15 Credits	0.160	0.367	NA	NA	NA	NA
Number of Quarters Enrolled	6.151	4.476	9.982	4.315	3.612	3.102
Ever Receiving Pell Grant	0.758	0.428	0.769	0.422	0.733	0.443
Major Fields						
Business and Communication	0.030	0.172	0.068	0.251	0.081	0.273
Health	0.451	0.498	0.331	0.471	0.165	0.371
STEM	0.041	0.197	0.036	0.187	0.058	0.234
Skilled Trades	0.112	0.315	0.058	0.234	0.116	0.321
Other Fields	0.367	0.482	0.507	0.500	0.580	0.494
Demographic Characteristics						
Age at First Enrollment	32.318	9.718	32.028	8.829	32.688	10.370
Female	0.737	0.440	0.682	0.466	0.493	0.500
Underrepresented Minority (URM)	0.181	0.385	0.138	0.345	0.203	0.402
Pre-Enrollment Labor Market Outcomes						
Average Quarterly Earnings (in 2019 Dollars)	3007	3601	3987	4585	4392	5982
Average Quarterly Earnings if Employed (in 2019 Dollars)	4768	3851	6110	4733	6215	6242
Probability of Being Employed	0.540	0.369	0.567	0.393	0.572	0.368
Number of Students	7559		3930		88969	

Note: Columns 1-4 present summary statistics for students who have earned either a certificate (columns 1 and 2) or an associate degree (columns 3 and 4). Columns 5 and 6 present summary statistics for students who pursued coursework in sub-baccalaureate programs but never earned the credential during the analytical time frame. Major fields are categorized into five groups following definitions from the Kentucky Center for Statistics (KYSTATS): business and communication, health, STEM, skilled trades, and other fields. Information on major fields for credential earners is obtained from degree records and enrollment records for non-completers. Race and ethnicity are categorized into two groups following definitions from the Kentucky Council on Postsecondary Education (CPE): underrepresented minority (URM) and non-URM. Average quarterly earnings prior to students' initial enrollment are calculated based on earnings information in all pre-enrollment quarters.

4. DESCRIPTIVE EARNINGS AND EMPLOYMENT TRAJECTORIES

In this section, we begin by presenting descriptive trends of earnings and employment from eight quarters prior to a student's entrance into a certificate program to 20 quarters after the initial enrollment. We then compare average earnings and employment in the eight quarters prior to certificate program enrollment to those in the eight quarters after completing the certificate program. For the sake of comparison, we provide information for the following three groups: (1) certificate earners; (2) associate degree earners; and (3) those who started sub-baccalaureate programs but did not observably complete a credential.

It is important to stress that the descriptive statistics and trends presented here are not definitive evidence of the "effect" of earning a certificate on labor market outcomes. The descriptive differences of earnings and employment in pre-enrollment periods compared to post-completion periods could be driven by factors other than certificate receipts. For example, highly motivated students may be more likely to pursue a certificate, and motivation itself could increase productivity and cause higher earnings and probabilities of employment after students earn the certificate. Similarly, student characteristics, such as family background, ability, and work ethic, could affect the differences in earnings and employment from pre-enrollment to post-degree completion. Different circumstances and motivations for pursuing postsecondary study can also affect interpretation of these trends. As we discuss below, we observe lower employment rates for many students right before entering their chosen program. Therefore, we present these trends to provide background context. However, the research design employed in the next section gets us closer to a potentially cleaner effect of the certificate programs (though those results are also subject to certain types of biases and require consideration of certain assumptions, which we will discuss in detail in the next section).

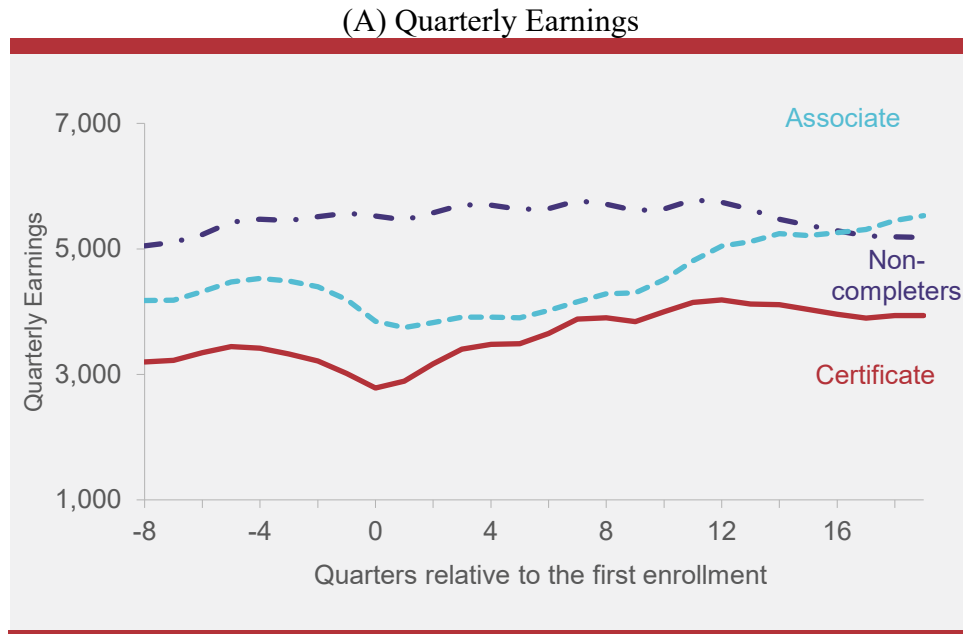
4.1. Overall

In Figure 6, we present earnings and employment trends before and after the first enrollment among certificate earners, associate degree earners, and credential non-completers. In Panel A, we see average quarterly earnings decrease among certificate earners (as represented by the solid red line) by about 20% in the year prior to the initial enrollment. This dip appears to be both a function of lower employment rates (which also fall by nearly 10% the year before entering the program) as shown in Panel B, and a decline in earnings among those employed as shown in Panel C. This suggests weakened labor market conditions may be contributing to students' decisions to return to school to pursue a certificate (this is commonly called an "Ashenfelter dip." See: Ashenfelter 1978; Ashenfelter and Card 1985).

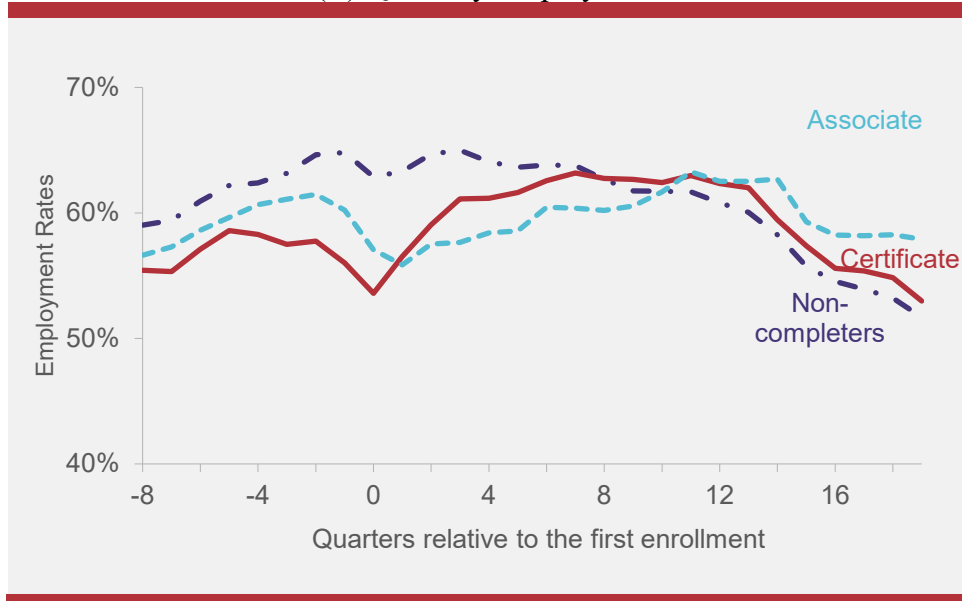
After initial enrollment, some of the early quarters correspond to periods when students are taking courses, depending on how long they stayed enrolled. Moreover, there is a mix of students who worked and did not work while completing their programs. Starting about two quarters after enrollment, quarterly earnings gradually increase to their peak about three years after first enrollment. Panels B and C show that these increases in overall earnings reflect both increases in employment and earnings among those employed.

For comparison in these figures, we also display the earnings and employment patterns for associate degree earners and students who enrolled but did not earn credentials. There is a similar, though less dramatic, pre-enrollment decline among associate degree earners, but this dip is less evident among those who did not earn a credential. This could reflect distinct motivations for pursuing different types of programs and different skills or goals among those who complete versus those who do not. During the post-enrollment periods, earnings and employment generally are higher for both certificate and associate degree earners as compared to pre-enrollment, though their trajectories follow somewhat different patterns. Among non-completers, such increases are milder, and we also observe an average decline towards the end of our analytical period. Throughout the whole period, the average quarterly earnings of certificate earners remain lower than those of non-completers and associate degree earners.

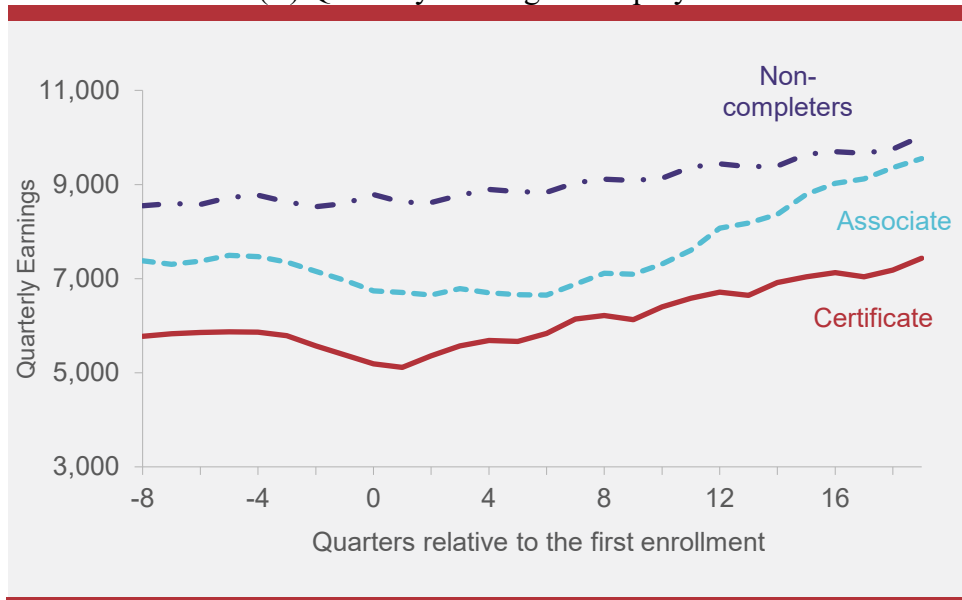
Figure 6: Earnings and Employment Trajectories



(B) Quarterly Employment



(C) Quarterly Earnings if Employed



Source: Author calculations based on administrative data from the Kentucky Longitudinal Data System. Notes: Each quarter is measured relative to the initial program enrollment (“0” on the horizontal axis indicates the first enrollment quarter). Earnings are adjusted to 2019 dollars using the consumer price index to account for inflation. Panel A includes all earnings (i.e., quarters with zero or missing earnings are included), whereas Panel C only includes earnings for quarters when the individual is employed.

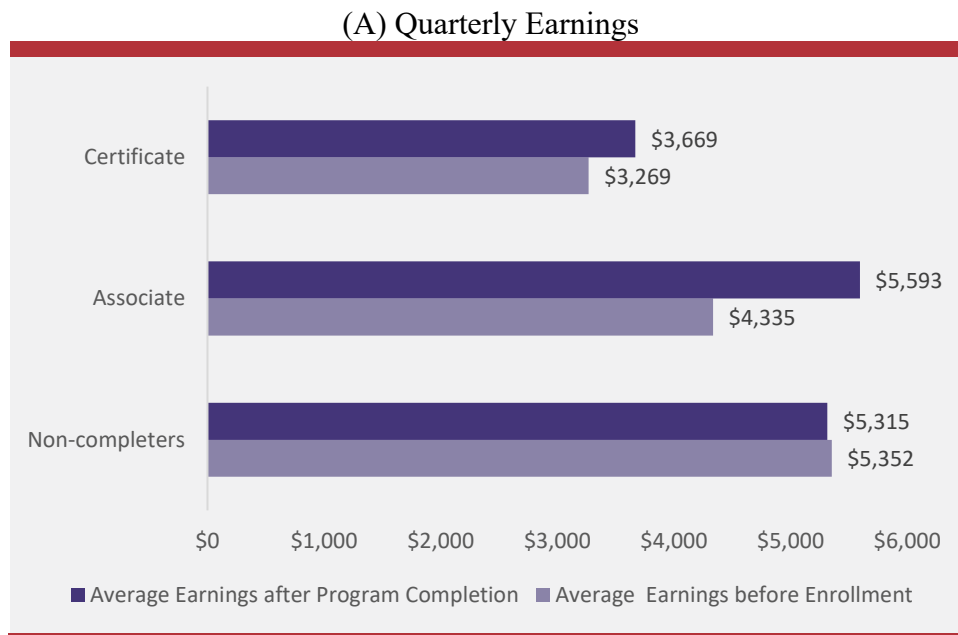
To provide a clearer sense of the magnitude of earnings and employment differences pre- to post-enrollment, we present average quarterly earnings and employment rates among certificate earners, associate degree earners, and non-completers in Figure 7. We calculate baseline earnings and

employment as the average quarterly earnings and employment during the eight quarters prior to students' initial entry into a sub-baccalaureate program. We also calculate post-completion earnings and employment as the average among the eight quarters following program completion. For non-completers' post-completion earnings and employment, we use averages from the eight quarters after their last enrollment instead of program completion.

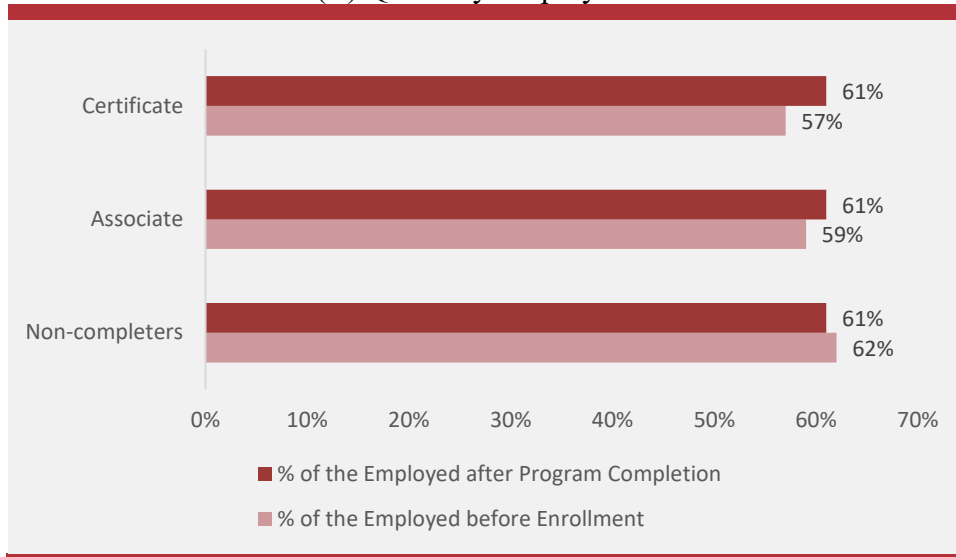
Certificate earners' average baseline quarterly earnings and employment are around \$3,269 and 57%, respectively, which is lower than those of associate degree earners (\$4,335, 59%) and non-completers (\$5,352, 62%). Post-completion earnings and employment are generally higher than baseline earnings for certificate and associate degree earners. On average, certificate earners' earnings are about \$400 more per quarter in the two years after completing the program compared to the two years before entering, while employment is four percentage points higher. The comparable differences among associate degree earners are \$1,258 and two percentage points, respectively. Associate degrees typically take around two years to complete, whereas certificate programs are typically shorter in duration. Comparatively, average post-completion earnings and employment rates are quite similar pre-enrollment and post-program for non-completers.

We reiterate here that these are descriptive trends and should not be interpreted as conclusive evidence of the causal effect of earning a certificate.

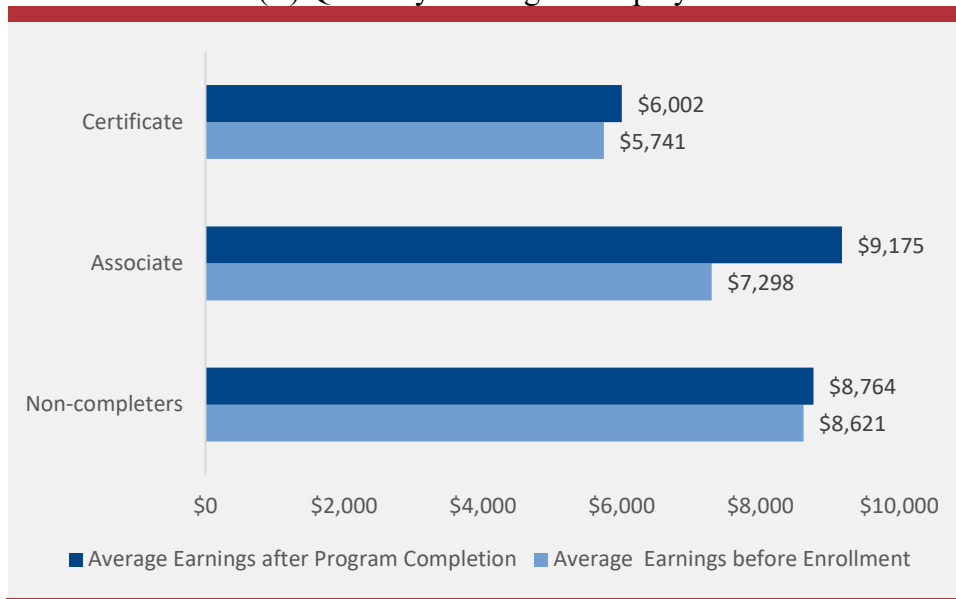
Figure 7: Earnings and Employment Prior to Enrollment versus Post-Completion



(B) Quarterly Employment



(C) Quarterly Earnings if Employed



Source: Author calculations based on administrative data from the Kentucky Longitudinal Data System. Notes: Baseline earnings and employment are average quarterly earnings and employment during the eight quarters prior to initial enrollment. Post-completion earnings and employment are averages during the eight quarters after program completion. For those with no credentials, we use averages from the eight quarters after their last enrollment. Earnings are adjusted to 2019 dollars using the consumer price index to account for inflation.

4.2. Subgroups

In this section, we discuss descriptive earnings and employment trajectories *among certificate earners only* for various subgroups of interest. For brevity in the main text, we display graphs akin

to Figure 6 for subgroups in Appendix 2. A summary of comparisons is provided for certificate earners' average quarterly earnings and employment rates during the eight quarters prior to initial entry versus average quarterly earnings and employment rates during the eight quarters after certificate completion across subgroups in Figures 8 and 9.

4.2.1. By Gender

In general, male certificate earners' average quarterly earnings are higher than those of female certificate earners (See Appendix Figure A2.1). Students who identify as male have higher earnings during the quarters prior to enrollment than students who identify as female, even though their employment rates are not substantially different from each other. As shown in Figures 8 and 9, average quarterly earnings among certificate earners who identify as male are 8% higher than their baseline earnings. Among females, this increase is almost twice as large, at around 16%. Post-certificate employment rates are similar to pre-enrollment rates for male certificate earners (60% compared to 59%) but are five percentage points higher among female certificate earners (61% compared to 56%).

4.2.2. Race and Ethnicity

Following direction from the Kentucky Council on Postsecondary Education (CPE), we categorize certificate earners based on their identification as one of two racial/ethnic categories: URM or non-URM, where URM is defined as a student who identifies as Hispanic or Latino, American Indian or Alaska Native, Black or African American, Native Hawaiian or Other Pacific Islander, or Two or more Races. In general, we find earnings and employment rates follow similar trends among URM and non-URM students (See Appendix Figure A2.2). Average quarterly earnings and employment rates shift downwards prior to enrollment but gradually increase after enrollment and peak around the 12th quarter, which is followed by a gradual decline between the 16th and 20th quarters. These trends are less pronounced for employment rates. Overall, average quarterly earnings for both URM and non-URM students do not significantly differ in both periods. Non-URM students' post-completion average quarterly earnings are 13% higher than their baseline earnings whereas URM students have earnings that are about 10% higher than the baseline. Non-URM students also generally have a higher employment rate compared to URM students in both periods.

4.2.3. Fields of Study

We group fields of study into four general categories: STEM, health professions, business and communication, and skilled trades (including construction, mechanic and repair technologies, and precision production), with the remainder of fields falling into the "other" category. See Appendix 3 for our classification scheme.

During the pre- and post-entry periods, the highest average quarterly earnings are from STEM fields, followed by business and skilled trades (See Appendix Figure A2.3). Average quarterly earnings and employment rates do not ostensibly fall to any drastic degree before entry into a STEM certificate program, but students who earned certificates in this field appear to have greater earnings growth after enrollment compared to the other fields, thereby widening the existing

earnings gaps with the other fields. In comparison, earnings and employment rates in business remain relatively flat throughout the whole periods. The average quarterly earnings of business certificate earners are lower than those of STEM certificate earners, even though employment rates in STEM and business fields mostly remain at similar levels. This suggests higher quarterly earnings in STEM are driven by higher wages in STEM fields. Meanwhile, health professions and skilled trades certificate earners show a substantial drop in pre-entry earnings and employment, which may mean students pursuing these fields have divergent career paths and motivations for pursuing a certificate. After entry, they experience an upward trend in earnings and employment rates and end the period higher than before they started. In comparison, the earnings and employment rates for other fields remain relatively stable during these pre- and post-entry periods.

Additionally, STEM certificate earners have the highest post-completion earnings relative to the baseline (22%), followed by skilled trades (18%), health professions (17%), business (7%), and *other* fields (4%) (See Figure 8). Across the fields, all see higher employment rates in the post-completion period, with the most pronounced increase occurring among those who earned a health professions certificate (See Figure 9).

4.2.4. Pell Grant Status

Pell Grant students experience a steeper decrease in average quarterly earnings and employment rates prior to entry than non-Pell Grant students, a trend that is followed by a steady improvement in earnings until the 12th quarter (See Appendix Figure A2.4). Non-Pell Grant students experience a mild decrease in quarterly earnings prior to entry, which could be explained by the growth in employment rates among non-Pell students during this period. Right after entry, there is a steep increase in their employment rates, followed by a gradual decline during the post-entry period. This decline in their employment rates is reflected in slower growth in quarterly earnings among non-Pell Grant certificate earners compared to Pell Grant certificate earners during the post-enrollment period. Throughout the whole period, the average quarterly earnings of non-Pell Grant certificate earners remain higher than that of Pell Grant certificate earners.

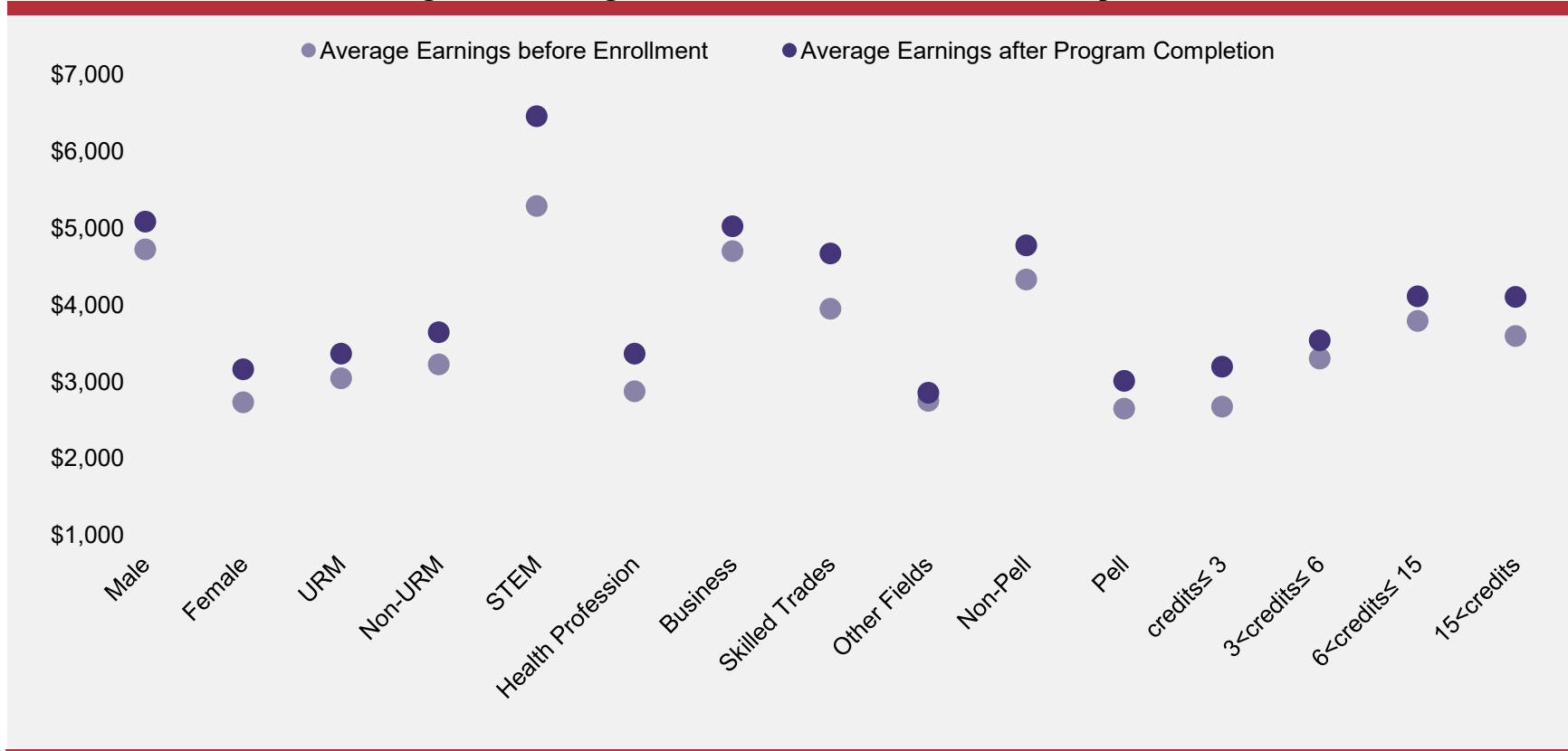
While Pell Grant certificate earners' average baseline earnings are lower than those of non-Pell Grant certificate earners, their post- to pre-certificate earnings growth rate (14%) is higher than their non-Pell Grant counterparts (10%) (See Figure 8). Part of the explanation for the relatively large percentage increase, however, is that Pell Grant certificate students' baseline earnings are quite low. Pell Grant certificate earners' employment rates are higher than those of non-Pell during the pre-enrollment and post-completion period (See Figure 9).

4.2.5. Certificate Length

There are data limitations to our understanding of the required length of certificate programs, whether in terms of credits or time in classroom (see our prior report *Certificates Awarded in Kentucky, 2005–2006 to 2018–2019* for a lengthier discussion). For the purpose of this report, we calculate certificate length by counting the number of credits completed *related to the field of the certificate*. We consider a course to match the field of the certificate if they both have the same two-digit Classification of Instructional Programs (“CIP”) code.

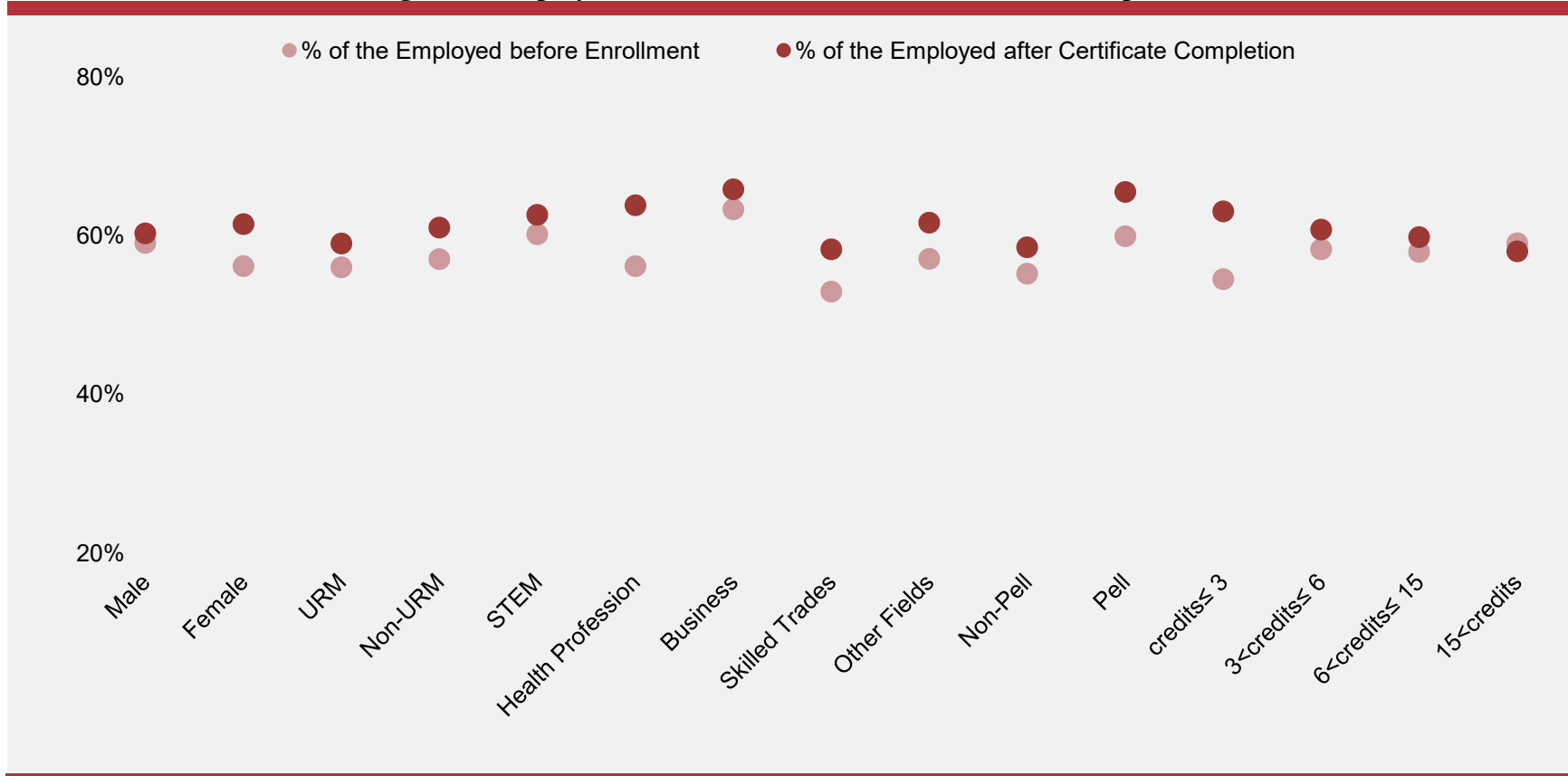
Earnings and employment rates generally follow similar trends regardless of certificate length (See Appendix Figure A2.5). Somewhat of an exception are those who completed certificates with more than 15 credits. This group experiences a steeper drop prior to entry, but during the post-entry period, their earnings and enrollment rates climb faster than the other groups and they end the period with higher earnings and employment rates compared to the other groups. This group may have been more likely to enroll full-time, which might have lowered their employment rates and earnings more substantially compared to the other groups during the quarters before and after enrollment. On average, certificates completed with a higher number of credits have higher average quarterly earnings during the post-completion period, but these certificates also have higher baseline earnings.

Figure 8: Earnings Prior to Enrollment versus Post-Completion



Source: Author calculations based on administrative data from the Kentucky Longitudinal Data System. Notes: This figure represents average quarterly earnings with quarters that have zero earnings included. Average earnings before enrollment are average quarterly earnings during the eight quarters prior to initial entry. Post-completion earnings are average quarterly earnings during the eight quarters after certificate completion. Earnings are adjusted to 2019 dollars using consumer price index to account for inflation. Quarters with no reported UI earnings are assigned with values of zero earnings.

Figure 9: Employment Prior to Enrollment versus Post-Completion



Source: Author calculations based on administrative data from the Kentucky Longitudinal Data System. Notes: This figure represents average quarterly employment rates. Percentage of the employment rates before enrollment are average quarterly employment rates during the eight quarters prior to initial entry. Post-completion employment rates are average quarterly employment rates during the eight quarters after certificate completion.

5. STUDENT FIXED EFFECT ESTIMATES

5.1. Design

Given the previously discussed challenges with inference that arise from simple averages or descriptive trends presented in the earlier section, we take further steps to mitigate these biases. The primary research design we use in this report is an individual fixed effects model. Because we are focusing on a sample of students who have considerable earnings records prior to enrolling in a postsecondary program, we use each student’s pre-enrollment labor market experiences as a counterfactual for their observed post-graduation labor market experiences. This “within-student” comparison accounts for stable unobserved individual factors that may be correlated with program choice or credential completion and labor market outcomes.

To more formally explore whether completing sub-baccalaureate credentials improves award recipients’ earnings, we estimate the following equation:

$$Y_{it} = \alpha + \beta Certificate_{it} + \theta X_{it} + \tau_t + \eta_i + \varepsilon_{it}, \quad (1)$$

where i and t index individuals and quarters, respectively. As for outcome variables Y_{it} , we separately estimate quarterly earnings, employment status, and log quarterly earnings for individual i in quarter t . We also estimate this equation separately for each subgroup of interest, for instance, by gender, length of certificates, fields of study, and race/ethnicity.

Our main parameter of interest is β , the estimated coefficient on the $Certificate_{it}$ variable. $Certificate_{it}$ is a dichotomous variable equal to one if the student has earned a certificate at the beginning of quarter t and zero otherwise. Students who did not earn a certificate have a value of zero in all periods for this variable. Because we include student fixed effects (as discussed later), we can interpret β as the “within-student” change in labor market performance from before receiving the award to after. Put another way, students’ own pre-credential earnings serve as a counterfactual as we estimate earnings and employment benefits of completing a certificate relative to earnings and employment in the absence of an award receipt.

We include the following control variables in the X -vector:

- An indicator equal to one if the student has earned an associate degree at the beginning of quarter t and zero otherwise.
- An indicator for contemporaneous enrollment equal to one if the individual attended a community college and zero otherwise in quarter t . This variable accounts for opportunity cost (in terms of earnings and employment) while students were enrolled.
- Indicators for students’ enrolled major fields of study, all interacted with time trends. Major fields are categorized into five groups: business and communication, health, STEM, trade, and other fields. See Appendix 3 for this classification scheme.

- Indicators for the four quarters prior to initial enrollment. These variables account for potential pre-enrollment dips in earnings (e.g., so-called “Ashenfelter Dips”). Results are robust to alternative constructions of these controls.
- Age fixed effects (i.e., indicators for each level of ages).
- Age at first enrollment in a community college interacted with time trends.
- Indicators for race and ethnicity all interacted with time trends. Race and ethnicity are categorized into two groups: URM and non-URM.
- Entry cohort indicators (i.e., the academic year when a student first entered college in our data) all interacted with time trends.

We include two sets of fixed effects. First, we include calendar year-quarter indicators, τ_t , to control for nation-wide macroeconomic shocks that impact all individuals in the same quarter. We also include student fixed effects, η_i , to control for time-invariant individual characteristics, such as ability, motivation, and efforts that would affect both labor market performance and credential completion.

In addition to students who earned a certificate during our sample period, we also include students who earned an associate degree and those who pursued but never completed a sub-baccalaureate credential during the analytical time frame in our estimation. These students serve as a comparison to our certificate group of interest and are helpful in our efforts to estimate the general relationship between labor market outcomes and factors like age, demographics, and enrollment status.

Our approach addresses some of the potential biases arising from naïve comparisons of post-completion relative to pre-enrollment earnings and employment. It takes into consideration factors like observed and unobserved student-level characteristics and macroeconomic conditions that can affect students’ labor market performance and decisions to pursue and complete certificates. However, a caveat to the current estimation strategy is that there are still potential biases that remain. This is because other group-specific, time-varying confounding factors that we cannot observe in our data could contribute to both educational decisions and labor market experiences. For instance, we include the comparison group as students pursuing a sub-baccalaureate credential without completing. Our estimates are thus prone to be biased if the labor market performance between treatment and control groups does not follow a similar trajectory over time in the absence of the certificate receipt, given all other factors fixed. This may be due to some group-specific time trends that are not fully captured in the current estimation. In future research, we will construct a matched comparison group using the above-mentioned control group to better match trends of earnings and employment prior to the first enrollment.

5.2. Results

In Table 3, we present the estimates of parameter β from Equation (1) for quarterly earnings (Panel A), probability of being employed (Panel B), and log quarterly earnings (Panel C). Estimated returns on certificates are about \$420 per quarter on average for the full sample. It is important to

consider certificate estimates in both absolute terms and also in relation to pre-enrollment labor market experiences. The magnitude of this effect is about 14% relative to the pre-enrollment mean. The estimate among male students (\$657 per quarter) is about twice as large as that of female students (\$328 per quarter). However, the average baseline earnings are about \$4,200 for males and \$2,600 for females. This suggests that males have a similar, though slightly higher, rate of increases in earnings (16%) relative to the baseline average, compared to females (13%). In Panel B, we show that employment rises by seven percentage points for certificate earners (or about 13% relative to the pre-enrollment average employment rate). The impact on employment is similar between female and male students. Panel C displays that attaining a certificate precedes a 4% increase in quarterly earnings for the whole sample. However, female students experience a slightly higher growth rate (5%) than male students (3%). Overall, we find that the increase in earnings after award receipts is not only driven by gains in the extensive margin (i.e., higher rates of employment), but is also due to higher gains in the intensive margin (i.e., higher growth rates of earnings) among certificate earners.

Table 3: Individual Fixed Effects Estimates of Economic Returns on Certificates

	Full Sample (1)	Females (2)	Males (3)
<i>Panel A: Quarterly Earnings</i>			
Certificate	419.63*** (45.05)	328.18*** (45.02)	656.60*** (115.47)
Pre-Enrollment Earnings	3,007	2,573	4,218
Observations	4,298,852	2,230,818	2,068,034
<i>Panel B: Employment</i>			
Certificate	0.07*** (0.00)	0.07*** (0.01)	0.07*** (0.01)
Pre-Enrollment Employment	0.54	0.54	0.55
Observations	4,298,852	2,230,818	2,068,034
<i>Panel C: Log Earnings</i>			
Certificate	0.04*** (0.01)	0.05*** (0.01)	0.03* (0.02)
Pre-Enrollment Earnings (if Employed)	4,768	4,048	6,718
Observations	2,512,979	1,264,458	1,248,521

Note: Average baseline labor market outcomes are presented in Panel A (pre-enrollment earnings), Panel B (pre-enrollment employment), and Panel C (pre-enrollment earnings conditional on being employed). Each regression model controls for: individual fixed effects; year-quarter fixed effects; an indicator equal to one if the student has earned an associate degree at the beginning of quarter t and zero otherwise; an indicator equal to one if enrolled in a community college; indicators for students' enrolled major fields interacted with time trends; indicators equal to one for the first, second, third, or fourth quarter prior to the initial enrollment (i.e., the "Ashenfelter Dips"); age fixed effects; age at first enrollment in a community college interacted with time trends; indicators for race and ethnicity interacted with time trends; and entry cohort indicators interacted with time trends. Standard errors reported in parentheses are clustered at the individual level. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In Table 4, we display estimated returns on certificates by certificate length. Specifically, certificates are categorized into four groups by number of credits that were earned directly related to the field of study of the certificate (see prior discussions in Section 3): certificates with 0-3

credits, 3-6 credits, 6-15 credits, and more than 15 credits. Results from Panel A indicate that certificates with more required credits yield higher earnings benefits overall for the full sample, ranging from \$314 per quarter (or 10% of average baseline earnings) for certificates with 0-3 credits required to \$965 per quarter (or 32% of average baseline earnings) for certificates with more than 15 credits required (column 1). Similar patterns are observed for female (column 2) and male (column 3) subsamples, even though some coefficients are less precisely estimated with larger standard errors. On average, male students experience greater gains after earning certain type of certificates than female students, which is consistent with our findings from Table 3. Results from Panel B suggest that students earning certificates with more required credits have higher probabilities of being employed after award receipts for the full sample and female subsample. Males have similar gains in employment across different certificate lengths. Gains in earnings are mainly driven by gains in overall employment rates. As shown in Panel B, the probabilities of being employed rise by five to ten percentage points across different types of certificates for both the full sample and female and male subgroups. Panel C suggests that students who earned certificates with more than 15 credits have higher growth in earnings (13% increase) as compared to other certificate types.

In Table 5, we show estimates across major fields of study. Certificate earners majoring in STEM experience notable earnings increases after award receipts (\$935 per quarter, or 23% of average baseline earnings). This is driven by both higher probabilities of employment (a six percentage-point increase in the rate) and higher earnings growth (a nine percent increase in earnings). Students who earned certificates in health professions and skilled trades also have relatively large quarterly earnings increases of about \$498 per quarter on average (or 17% of average baseline earnings) for health and about \$451 per quarter (or 12% of average baseline earnings) for trades. We see higher employment rates and earnings growth rates for health-related majors, but only employment increases for trades-related majors. These observed findings are consistent with fast-growing and higher-paid STEM-related occupation trends and the high demand for relevant skills in health and trades, as healthcare and construction trades are identified as two of five employment sectors in critical need of skilled workers.

Table 4: Estimated Returns on Certificates by Certificate Length

	Full Sample (1)	Females (2)	Males (3)
Panel A: Quarterly Earnings			
Certificate: 0-3 credits	313.95*** (58.59)	233.16*** (57.69)	575.46*** (181.09)
Certificate: 3-6 credits	299.77*** (100.07)	227.98** (90.74)	522.38* (274.51)
Certificate: 6-15 credits	391.42*** (116.34)	268.42** (129.58)	598.97** (238.92)
Certificate: More than 15 credits	965.49*** (127.72)	971.69*** (139.71)	976.89*** (246.67)
Pre-Enrollment Earnings	3,007	2,573	4,218
Observations	4,298,852	2,230,818	2,068,034
Panel B: Employment			
Certificate: 0-3 credits	0.06*** (0.01)	0.06*** (0.01)	0.08*** (0.01)
Certificate: 3-6 credits	0.06*** (0.01)	0.05*** (0.01)	0.06*** (0.02)
Certificate: 6-15 credits	0.07*** (0.01)	0.07*** (0.01)	0.05*** (0.02)
Certificate: More than 15 credits	0.09*** (0.01)	0.10*** (0.02)	0.07*** (0.02)
Pre-Enrollment Employment	0.54	0.54	0.55
Observations	4,298,852	2,230,818	2,068,034
Panel C: Log Earnings			
Certificate: 0-3 credits	0.04*** (0.01)	0.05*** (0.01)	0.02 (0.03)
Certificate: 3-6 credits	0.01 (0.02)	0.02 (0.02)	-0.01 (0.04)
Certificate: 6-15 credits	0.02 (0.02)	0.01 (0.03)	0.03 (0.04)
Certificate: More than 15 credits	0.13*** (0.02)	0.15*** (0.03)	0.09** (0.04)
Pre-Enrollment Earnings (if Employed)	4,768	4,048	6,718
Observations	2,512,979	1,264,458	1,248,521

Note: Average baseline labor market outcomes are presented in Panel A (pre-enrollment earnings), Panel B (pre-enrollment employment), and Panel C (pre-enrollment earnings conditional on being employed). Each regression model controls for: individual fixed effects; year-quarter fixed effects; an indicator equal to one if the student has earned an associate degree at the beginning of quarter t and zero otherwise; an indicator equal to one if enrolled in a community college; indicators for students' enrolled major fields interacted with time trends; indicators equal to one for the first, second, third, or fourth quarter prior to the initial enrollment (i.e., the "Ashenfelter Dips"); age fixed effects; age at first enrollment in a community college interacted with time trends; indicators for race and ethnicity interacted with time trends; and entry cohort indicators interacted with time trends. Standard errors reported in parentheses are clustered at the individual level. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Heterogeneity in Estimated Returns on Certificates by Major Fields

	Business	Health	STEM	Trades	Other Fields
	(1)	(2)	(3)	(4)	(5)
Panel A: Quarterly Earnings					
Certificate	308.29 (318.54)	497.73*** (62.60)	935.36*** (279.93)	451.31*** (161.66)	286.06*** (71.71)
Pre-Enrollment Earnings	3,827	2,867	4,108	3,655	2,791
Observations	330,142	834,720	239,400	484,382	2,410,208
Panel B: Employment					
Certificate	0.04 (0.03)	0.07*** (0.01)	0.06** (0.02)	0.04*** (0.01)	0.07*** (0.01)
Pre-Enrollment Employment	0.61	0.55	0.54	0.55	0.52
Observations	330,142	834,720	239,400	484,382	2,410,208
Panel C: Log Earnings					
Certificate	0.04 (0.05)	0.08*** (0.01)	0.09** (0.04)	0.01 (0.03)	0.01 (0.02)
Pre-Enrollment Earnings (if Employed)	5,421	4,455	6,702	5,502	4,641
Observations	186,400	480,218	132,749	259,152	1,454,460

Note: Average baseline labor market outcomes are presented in Panel A (pre-enrollment earnings), Panel B (pre-enrollment employment), and Panel C (pre-enrollment earnings conditional on being employed). Each regression model controls for: individual fixed effects; year-quarter fixed effects; an indicator equal to one if the student has earned an associate degree at the beginning of quarter t and zero otherwise; an indicator equal to one if enrolled in a community college; indicators for students' enrolled major fields interacted with time trends; indicators equal to one for the first, second, third, or fourth quarter prior to the initial enrollment (i.e., the "Ashenfelter Dips"); age fixed effects; age at first enrollment in a community college interacted with time trends; indicators for race and ethnicity interacted with time trends; and entry cohort indicators interacted with time trends. Standard errors reported in parentheses are clustered at the individual level. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In Table 6, we display the heterogeneity by race and ethnicity. We categorize race and ethnicity into two groups: URM and non-URM. Overall, quarterly earnings of non-URM students increase by about \$460 per quarter on average (15% of average baseline earnings), while earnings of URM students only increase by about \$200 per quarter (7% of average baseline earnings). The gains in employment are also higher among non-URM students (a seven percentage-point increase) than URM students (a five percentage-point increase). The earnings grow faster at the rate of 5% among non-URM students. However, we do not observe a statistically significant growth rate among URM students.

Table 6: Heterogeneity in Estimated Returns on Certificates by Race and Ethnicity

	URM (1)	Non-URM (2)
<i>Panel A: Quarterly Earnings</i>		
Certificate	198.07** (97.94)	462.08*** (50.48)
Pre-Enrollment Earnings	2,730	3,068
Observations	847,906	3,450,946
<i>Panel B: Employment</i>		
Certificate	0.05*** (0.01)	0.07*** (0.01)
Pre-Enrollment Employment	0.51	0.55
Observations	847,906	3,450,946
<i>Panel C: Log Earnings</i>		
Certificate	0.01 (0.02)	0.05*** (0.01)
Pre-Enrollment Earnings (if Employed)	4,667	4,791
Observations	460,154	2,052,825

Note: Average baseline labor market outcomes are presented in Panel A (pre-enrollment earnings), Panel B (pre-enrollment employment), and Panel C (pre-enrollment earnings conditional on being employed). Each regression model controls for: individual fixed effects; year-quarter fixed effects; an indicator equal to one if the student has earned an associate degree at the beginning of quarter t and zero otherwise; an indicator equal to one if enrolled in a community college; indicators for students' enrolled major fields interacted with time trends; indicators equal to one for the first, second, third, or fourth quarter prior to the initial enrollment (i.e., the "Ashenfelter Dips"); age fixed effects; age at first enrollment in a community college interacted with time trends; indicators for race and ethnicity interacted with time trends; and entry cohort indicators interacted with time trends. Standard errors reported in parentheses are clustered at the individual level. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6. BRIEF CONCLUDING THOUGHTS

In this report, we present evidence on the earnings and employment of certificate earners in Kentucky. While there is variation across fields of study, student demographics, and program length, students who earn certificates generally have higher post-certificate wages and employment than when they entered the program. This is promising, suggestive evidence of the value of such certificates; however, because of analytical considerations, we urge caution in

interpreting findings from this report as irrefutable evidence of the causal effect of earning a certificate.

There is still more to do in order to more precisely isolate the earnings and employment benefits of certificate programs, including refining the proper comparison groups and further controlling for relevant factors that could affect both certificate completion and labor market outcomes. For example, we know that students' locations matter for both access to postsecondary programs and job markets, and because pre-entry labor market experiences differ among student groups, it is important to dive further into the distinct demographic and labor market experiences of students who choose different types of programs. A related need is to better understand if and how students make human capital investment decisions among education and training options offered through higher education institutions versus workforce training.

Further, there is still much work to do to dive deeper into different subgroups, especially related to program length. These analyses are particularly critical for policy discussions about public and private funding of certificates. There are also ample opportunities to better understand the intersections between different subgroups. For example, prior research suggests that certain fields of study have differential returns across gender. In addition, in future work we plan to push further to analyze students not directly examined here, including those who did not have a work record prior to pursuing a certificate and those who earned multiple credentials in their educational pathways.

Finally, it is critical to compare estimated benefits of completing programs against costs borne by individuals (including opportunity costs) and the state (including state scholarship programs and tuition subsidies). Thus, while the evidence presented in this report represents valuable progress in this line of inquiry, continued work is needed to understand the return on investment more comprehensively for individuals, taxpayers, and the state.

APPENDIX 1: DATA

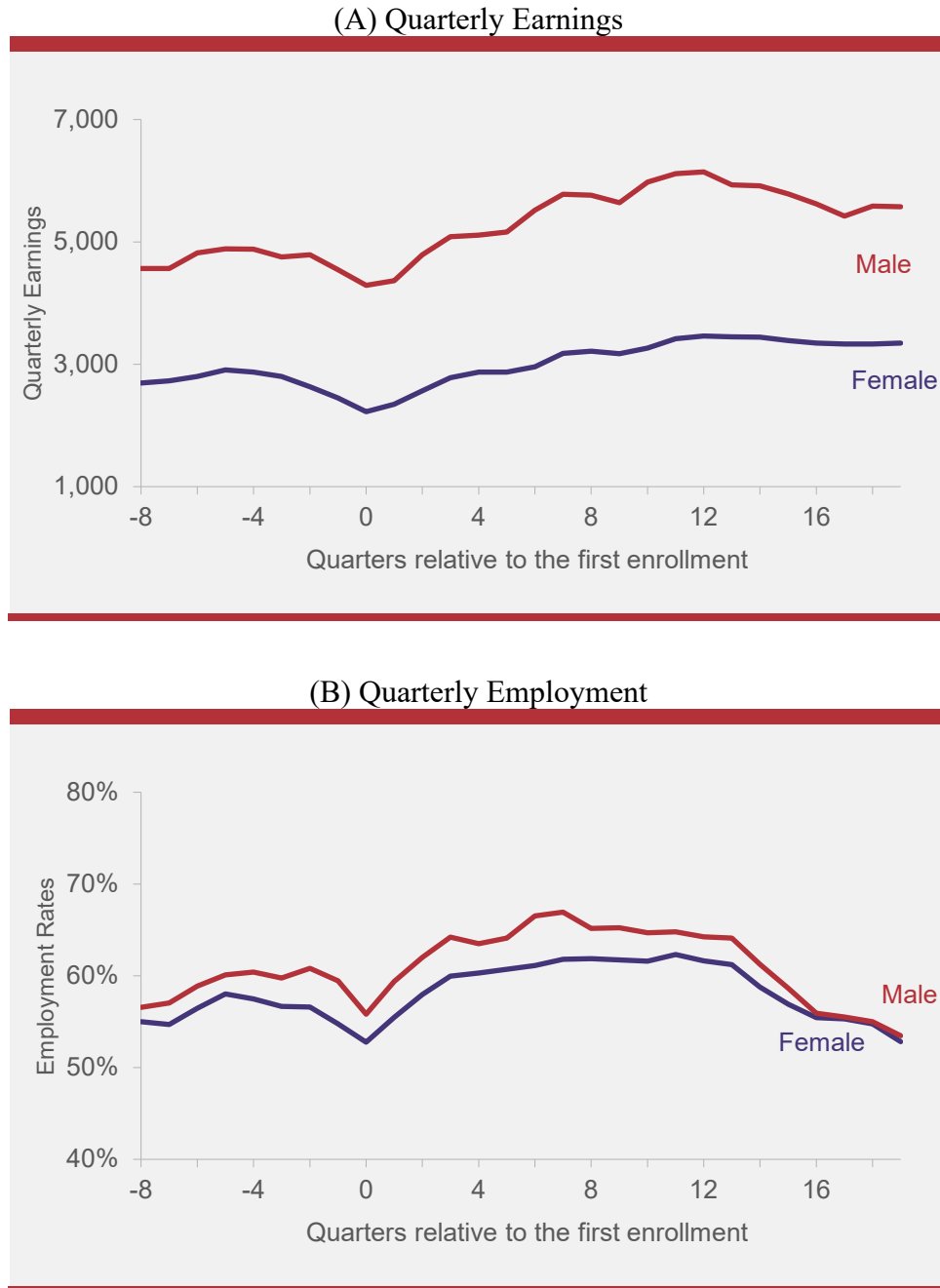
To conduct this study, we use administrative Kentucky Postsecondary Education Data System (KPEDS) data provided by the Kentucky Council of Postsecondary Education to the Kentucky Center for Statistics (KYSTATS). KPEDS is part of the broader Kentucky Longitudinal Data System (KLDS). The KLDS data contain individual-level records from the state agencies that oversee K-12 education, postsecondary education, and the Unemployment Insurance (UI) system. The primary data sets used in the project are KPEDS records that include data on postsecondary institutions attended, courses taken, credits attempted and earned, majors, and credentials completed for eight public four-year institutions and 16 community colleges with more than 70 locations between the 2008–2009 and 2019–2020 academic years.

We draw data from *KPEDS_Enrollments*, *KPEDS_CourseEnrollment*, *KPEDS_Degree*, *KPEDS_FinancialAid*, *KPEDS_Institution*, and *MasterPerson*. They provide information on enrollment records, course-taking records, credential attainment, financial aid, institution-related information, and student-level demographics, respectively. Using these six data files, we construct a student-level data file that consists of all individuals who earned certificates or associate degrees through public postsecondary education programs in the Kentucky Community and Technical College System between the 2008-2009 and 2019-2020 academic years. We then merge the postsecondary education data with quarterly earnings and employment records from the state UI program that is available from the third quarter of calendar year 2008 to the second quarter of calendar year 2019. Administrative UI records are from covered jobs as reported by employers in Kentucky to the state UI program. This includes most workers, but those who do not work, who work only out of state, or who work in jobs not subject to UI reporting requirements (for example, federal employment and self-employment) in every quarter during the analysis period will not be included in our analytical sample.

Sample Restrictions: We restrict our analytical sample to students who entered a Kentucky community college from the 2010-2011 through 2015-2016 academic years to ensure sufficient data on students' pre- and post-college earnings. We exclude students who have no UI wage records during the analytic time frame. We focus on students of working age (age 20-60) at the time of first enrollment, with no known records of attendance at a four-year college or university in the state. We limit the treatment group to students who pursued and eventually earned one sub-baccalaureate credential (either a certificate or an associate degree). We place no restrictions on the first term of enrollment; this suggests that some students may have earned the credential within a couple of quarters while others have spent longer periods of time. We do not consider students' earnings and employment records in the years before they turned 18 years old and after 65 years old. All earnings are adjusted to 2019 dollars using consumer price index to account for inflation.

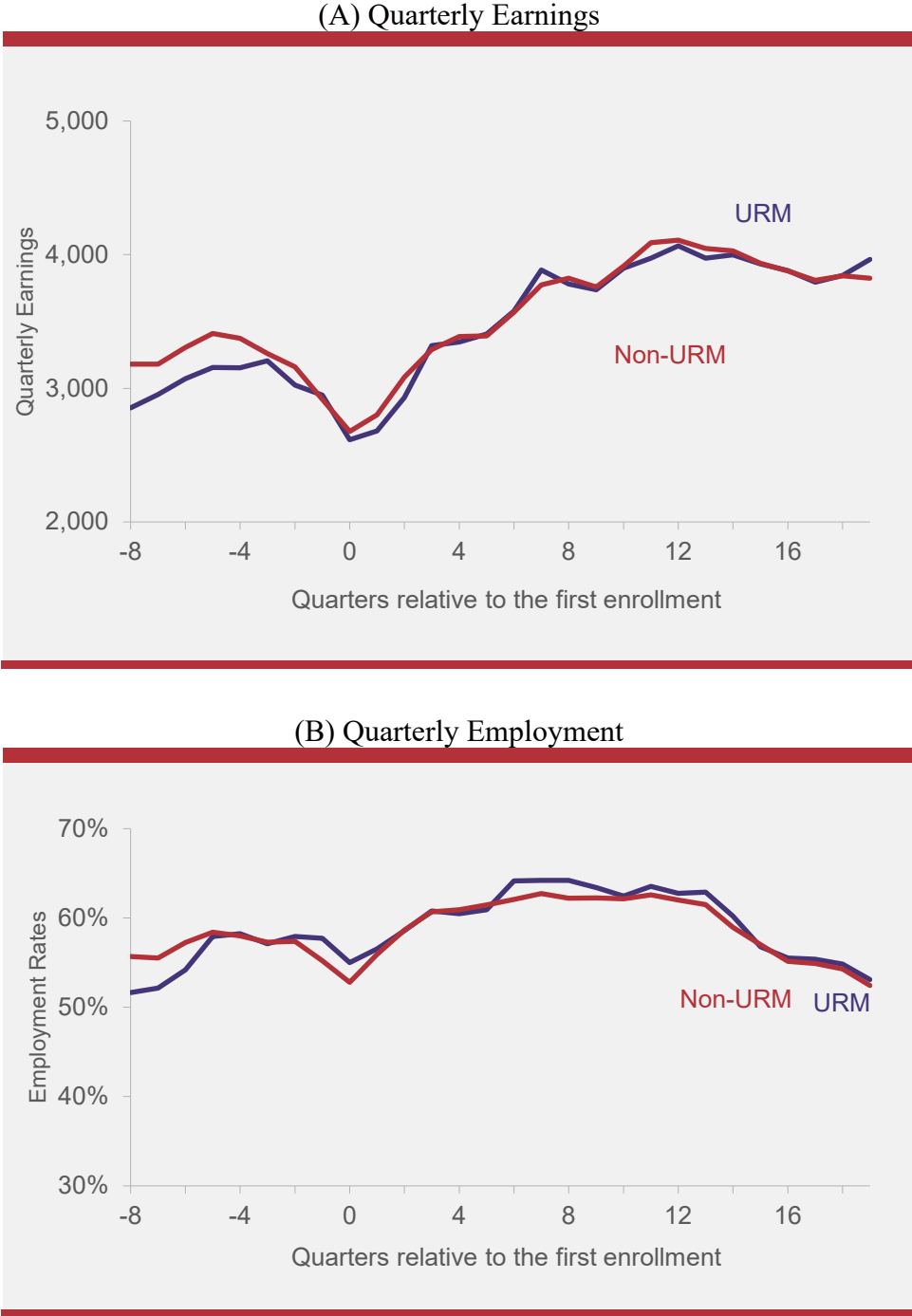
APPENDIX 2: SUPPLEMENTARY FIGURES

Figure A2.1. Earnings and Employment Trajectories by Gender



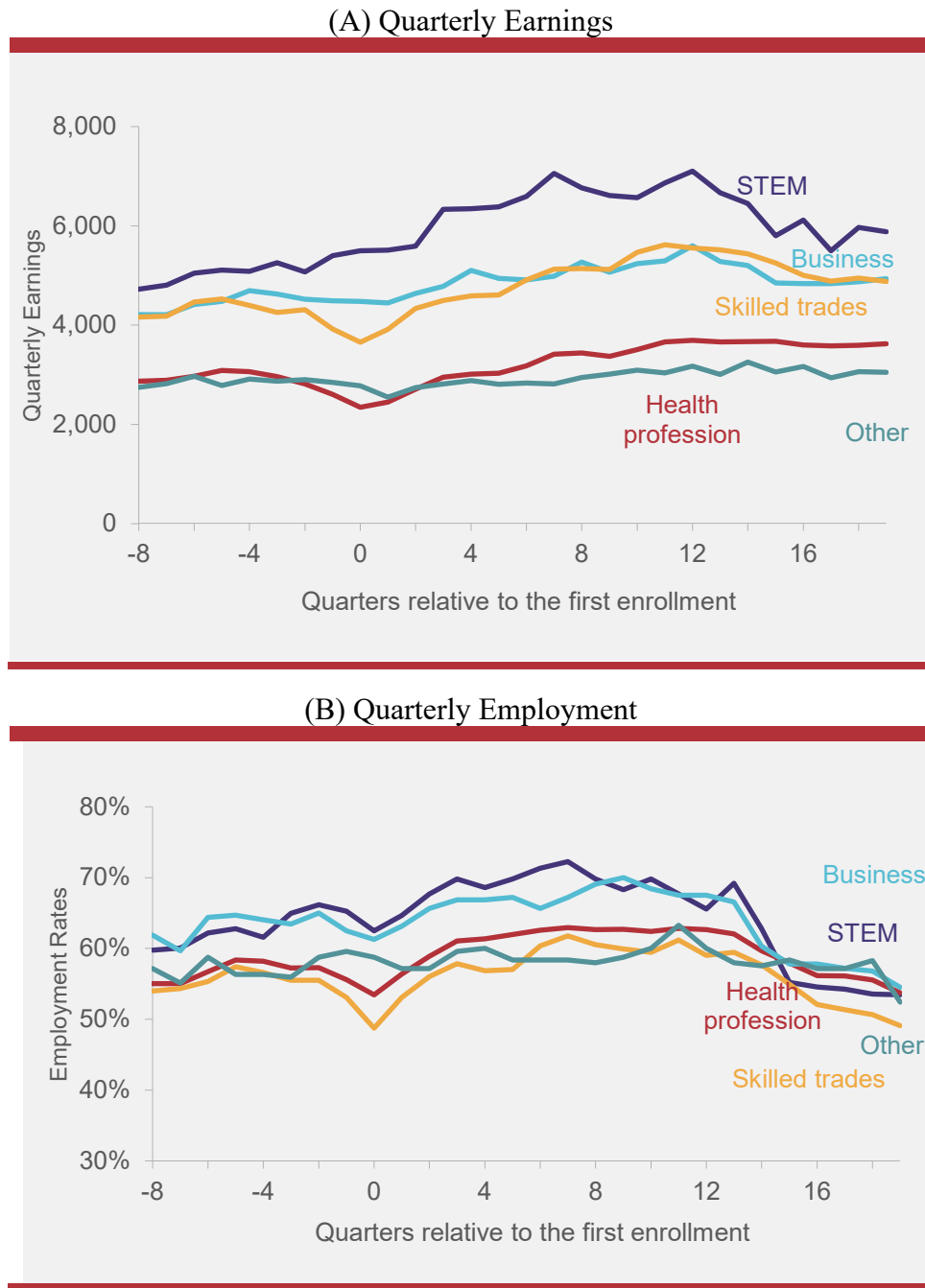
Source: Author calculations based on administrative data from the Kentucky Longitudinal Data System. Notes: Each quarter is measured relative to the initial program enrollment (“0” on the horizontal axis indicates the first enrollment quarter). Earnings are adjusted to 2019 dollars using consumer price index to account for inflation. Quarters with no reported UI records are assigned with values of zero earnings.

Figure A2.2. Earnings and Employment Trajectories by Race and Ethnicity



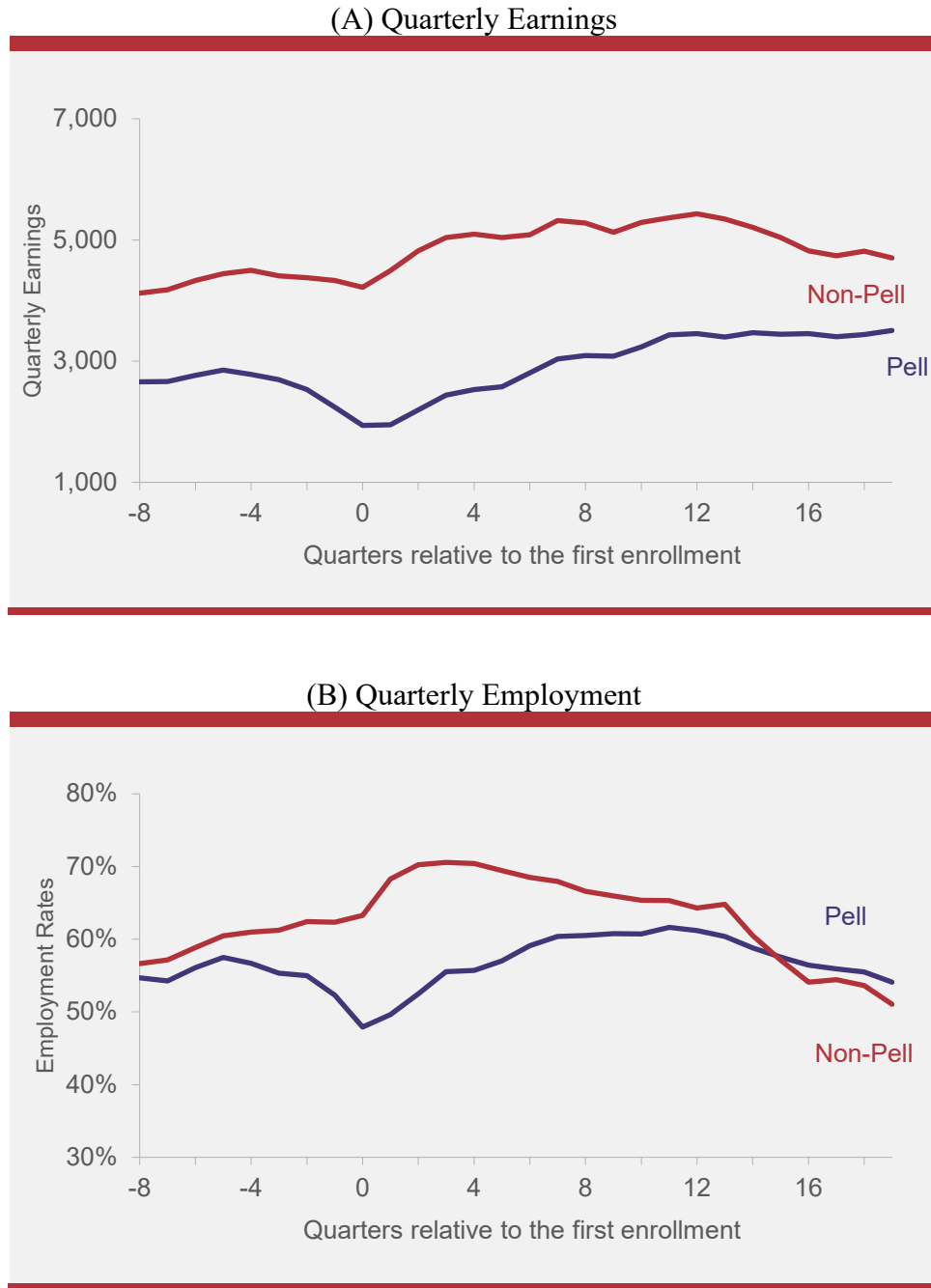
Source: Author calculations based on administrative data from the Kentucky Longitudinal Data System. Notes: Each quarter is measured relative to the initial program enrollment (“0” on the horizontal axis indicates the first enrollment quarter). Earnings are adjusted to 2019 dollars using consumer price index to account for inflation. Quarters with no reported UI records are assigned with values of zero earnings.

Figure A2.3. Earnings and Employment Trajectories by Fields of Study



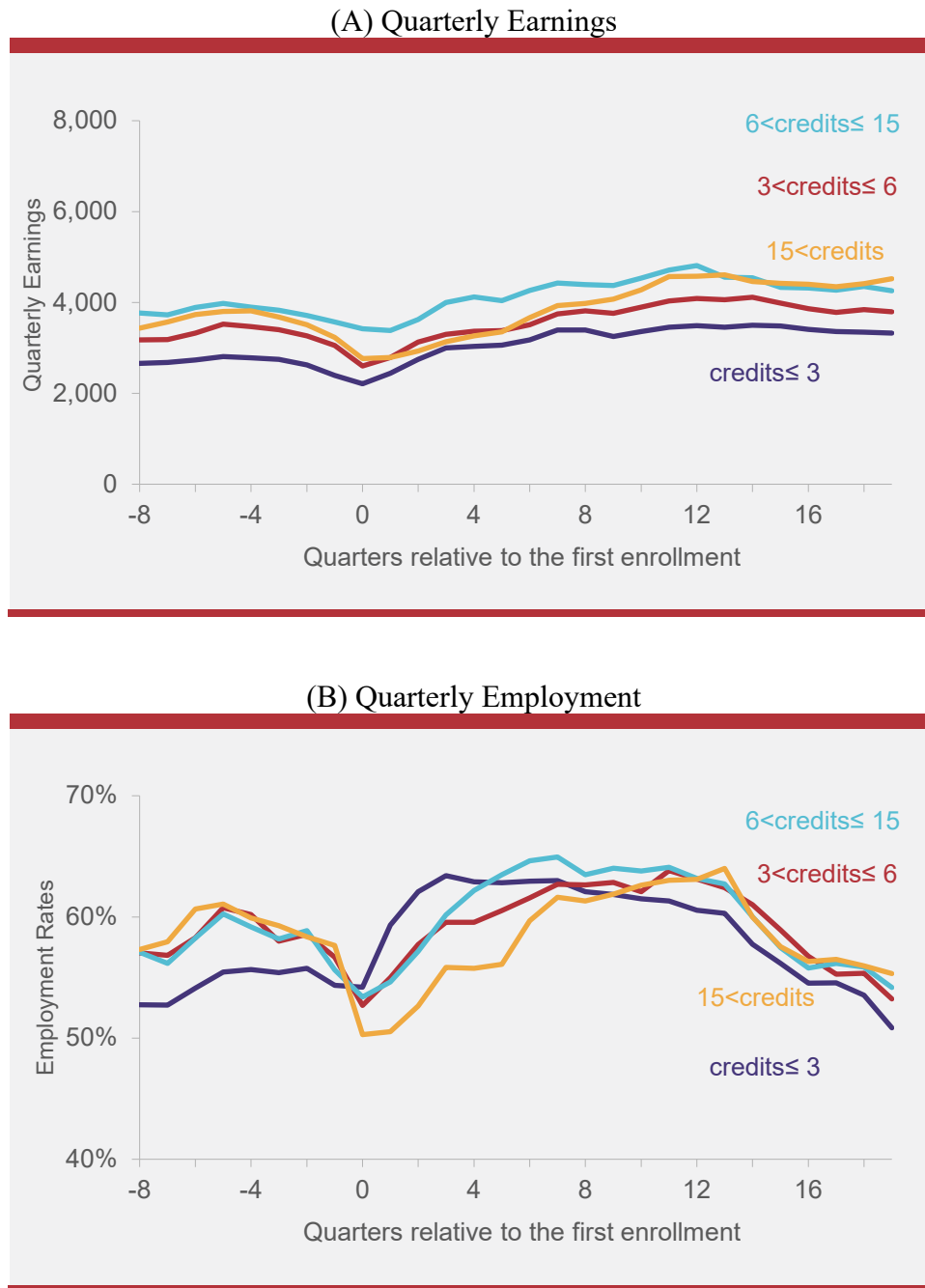
Source: Author calculations based on administrative data from the Kentucky Longitudinal Data System. Notes: Each quarter is measured relative to the initial program enrollment (“0” on the horizontal axis indicates the first enrollment quarter). Earnings are adjusted to 2019 dollars using consumer price index to account for inflation. Quarters with no reported UI records are assigned with values of zero earnings.

Figure A2.4. Earnings and Employment Trajectories by Pell Grant Status



Source: Author calculations based on administrative data from the Kentucky Longitudinal Data System. Notes: Each quarter is measured relative to the initial program enrollment (“0” on the horizontal axis indicates the first enrollment quarter). Earnings are adjusted to 2019 dollars using consumer price index to account for inflation. Quarters with no reported UI records are assigned with values of zero earnings.

Figure A2.5. Earnings and Employment Trajectories by Certificate Length



Source: Author calculations based on administrative data from the Kentucky Longitudinal Data System. Notes: Each quarter is measured relative to the initial program enrollment (“0” on the horizontal axis indicates the first enrollment quarter). Earnings are adjusted to 2019 dollars using consumer price index to account for inflation. Quarters with no reported UI records are assigned with values of zero earnings.

APPENDIX 3: MAJOR FIELD CLASSIFICATION

Classification of Academic Majors into Major Groups

Category	2-Digit CIP Code	Fields
Business and Communication	09	Communication, Journalism, & Related Programs
	10	Communications Technologies/Technicians & Support Services
	52	Business, Management, Marketing, & Related Support Services
Health	51	Health Professions & Related Programs
STEM	01	Agriculture, Agriculture Operations, & Related Sciences
	03	Natural Resources & Conservation
	04	Architecture & Related Services
	11	Computer & Information Sciences & Support Services
	14	Engineering
	15	Engineering Technologies & Engineering-Related Fields
	26	Biological & Biomedical Sciences
	27	Mathematics & Statistics
	28	Military Science, Leadership & Operational Art
	40	Physical Sciences
Skilled Trades	41	Science Technologies/Technicians
	12	Personal & Culinary Services
	33	Citizenship Activities
	43	Homeland Security, Law Enforcement, Firefighting & Related Protective Services
	46	Construction Trades
	47	Mechanic & Repair Technologies/Technicians
	48	Precision Production
49	Transportation & Materials Moving	
Others	05	Area, Ethnic, Cultural, Gender, & Group Studies
	13	Education
	16	Foreign Languages, Literatures, & Linguistics
	19	Family & Consumer Sciences/Human Sciences
	22	Legal Professions & Studies
	23	English Language & Literature/Letters
	24	Liberal Arts & Sciences, General Studies & Humanities
	25	Library Science
	30	Multi/Interdisciplinary Studies
	31	Parks, Recreation, Leisure, & Fitness Studies
	38	Philosophy & Religious Studies
	39	Theology & Religious Vocations
	42	Psychology
	44	Public Administration & Social Service Professions
45	Social Sciences	
50	Visual & Performing Arts	
54	History	

Note: We follow Kentucky Center for Statistics and use their classification of major fields. See https://kystats.ky.gov/Content/Reports/2020_PostsecondaryFeedbackReportTechnicalNotes.pdf, page 14.

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