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Goodbye to Summer Vacation? The Effects of Summer Enrollment on College and Employment Outcomes

A CAPSEE Working Paper

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Abstract

Despite rich evidence on the benefit of summer enrollment at the K-12 level, the college completion literature has so far focused on college readiness, remediation, and financial aid, and has largely overlooked the potential benefits of taking summer courses among college students. Academic momentum theory suggests that summer enrollment may increase credit accumulation and retention and thus increase the rate of college completion. Using proximity to the closest four-year college as an instrumental variable (IV), I analyze public higher education data from an anonymous state to examine how enrolling in summer credits can impact college outcomes and the mechanisms by which it may do so. I find that summer enrollees in the sample had higher bachelor's degree completion rates than summer non-enrollees. Summer enrollees returned to college at a higher rate and completed more credits in the following fall without compromising their grade point averages. Students with lower first-term grade point averages benefitted more from summer enrollment. When summer enrollees reached the labor market, they had higher employment rates six years after initial enrollment. Conditional on employment, earnings were equivalent among summer enrollees and non-enrollees. These findings indicate that summer enrollment benefits students through retention, which leads to higher rates of completion and employment. They suggest that colleges may want to seek opportunities for increasing summer enrollment, and they have implications for the current method of Pell Grant allocation, which privileges the fall and spring terms over the summer term.

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1. Introduction

The United States now lags behind other nations in terms of college attainment. Between 1990 and today, the U.S. dropped from first to twelfth in the world ranking for four-year degree attainment among 25 to 34 year olds (Organisation for Economic Co-operation and Development [OECD], 2015). In 2013, the six-year bachelor's degree graduation rate for first-time, full-time undergraduate students who started college in fall 2007 was only 59 percent. Meanwhile, the strongly positive returns to higher education and the changing skill demands in the labor market have made the attainment of higher education a near necessity for acquiring a middle-class job (Carnevale, Smith, & Strohl, 2010; Levy & Murnane, 2012). As a result, policymakers and others are increasingly looking to graduate more individuals from college. In particular, the use of summer courses as a means to increase college completion rates has become attractive.

While summer has traditionally been a time of rest or employment, colleges and the media have increasingly encouraged students to shorten their vacations and other undertakings and engage in learning activities that might benefit them more in the long-term.[1] Despite the rich K-12 literature on summer learning loss, we know close to nothing about the effect of a long summer break on college students. Using Educational Longitudinal Survey (ELS) data, I found that the biggest leak in the college "pipeline" among students enrolled in a four-year college occurs after the summers. On average, the withdrawal rate among four-year college students who began college for the first time in 2004 is 6 percent each for the first summer and second summer after initial enrollment. Those rates double for nonselective institutions and among students with low socioeconomic status (SES). These disturbing statistics suggest the need for interventions designed to prevent after-summer enrollment loss.

Recently, more students are becoming aware of the potential benefit of summer coursework. According to ELS data, one in five four-year students enrolled in their first summer after initial college enrollment, and the percentage of students who did so peaks in the third summer. The effect of summer enrollment has been frequently discussed in the K-12 literature; however, very few studies have investigated the effect of summer enrollment in higher education settings. The voluntary nature of summer enrollment in college creates difficulty in investigating its effects on student outcomes, as summer enrollees are more likely to be highly motivated and may have better academic outcomes regardless of their summer attendance status.

This paper uses a state administrative dataset to exploit the exogenous variation in proximity to the closest four-year institution to examine the effect of summer enrollment on subsequent achievement. I found that enrolling in summer credits increased retention and credits accumulated in the following fall without comprising grades. Summer enrollees were also more likely to be employed after college.

The current paper contributes to the literature in a number of ways. First, despite the prevalence of summer enrollment and its potential benefits, there is little empirical evidence on

[1] http://www.foxbusiness.com/features/2011/03/25/college-students-summer-break.html

the effects of taking summer courses on academic outcomes. Only one study that I am aware of provides rigorous evidence on the potential impact of summer course enrollment on college outcomes (Attewell, Heil, & Reisel, 2012). The current paper not only examines descriptively the characteristics of summer enrollees and non-summer enrollees, it provides the first causal evidence on the impact of summer enrollment on college enrollment, grades, and degree attainment.

Second, I isolate the effect of summer enrollment by using distance from a four-year college as an instrumental variable (IV) for enrolling in summer coursework. Attewell et al.'s (2012) study intended to control for selection bias using a propensity score matching strategy, but such an approach may not be able to isolate the causal effect of summer enrollment. Summer enrollees may have similar pretreatment characteristics as other students that engage in activities that also increase academic momentum. I, therefore, exploit variation in proximity to a four-year college as an instrument, which isolates summer enrollment with no effect on enrollment patterns that affect college outcomes.

Third, I suggest and examine three potential mechanisms through which summer enrollment may affect future enrollment patterns, grade point average, and bachelor's degree completion. By estimating the impact of summer enrollment on grades in the following academic year, I examine whether summer enrollment may lead to learning gains. In addition, I explore the academic momentum hypothesis by examining enrollment patterns after summer enrollment. I also investigate whether summer enrollment can reduce time to degree completion.

Finally, previous studies using distance as an instrument have provided limited validity checks on the relationship between residence and SES (Carneiro, Meghir, & Parey, 2011; Carneiro & Heckman, 2002; Card 1995; Dee, 2004; Kane & Rouse, 1995; Long & Kurlaender, 2009; Xu & Jaggars, 2013). My analysis includes extensive correlation tests beyond the association between distance from a four-year institution and SES: these include tests concerning academic year and summer employment, earnings during college, credits earned, grades, and enrollment patterns. The findings show that while distance from a four-year institution can be related to many variables, this does not invalidate the IV used in the paper. Nonetheless, future research should be cautious in choosing distance from a four-year institution as an IV and should include thorough validity tests to satisfy the exclusion restriction assumption.

Section 2 of this paper reviews relevant literature on the effect of summer vacation and summer enrollment at the K-12 level and discusses how summer enrollment may influence college students. Section 3 presents the various mechanisms by which summer enrollment may impact academic and labor market outcomes. It further specifies the empirical method used for the analysis. Section 4 describes the data source and provides a statistical summary of the sample. Section 5 reports the findings, and section 6 concludes the paper.

2. Literature Review: How Summer Vacation Affects Learning

For a century, K-12 researchers have documented the “summer slide,” or summer learning loss, among students after a long summer break. A review of 39 studies found that typical learning loss is equivalent to approximately one month’s worth of skills or knowledge acquired in math and language arts combined (Cooper, Nye, Charlton, Lindsay, & Greathouse, 1996). The authors found that summer loss is much more profound in subjects that involve the acquisition of knowledge, such as spelling and math, than for other subjects or skill areas that are more conceptually based, such as reading. Furthermore, Alexander, Entwisle, and Olson (2007) showed that summer learning loss is cumulative over the course of multiple years and that cumulative learning loss widens the achievement gap by family socioeconomic (SES) level over time.

Despite the lack of summer slide literature at the college level, it is highly likely that college students are also subject to summer learning loss. Summer break for college students is typically longer than three months, which is longer than the summer break for students at the K-12 level. Without compulsory enrollment in the summer, learning loss may be higher among college students who do not engage in learning-based activities in the summer.

The net learning loss in various subject areas at the K-12 level seems to be dependent on students’ SES but not on students’ gender, ethnicity, or IQ. High-SES students tend to experience less learning loss; indeed, in some cases, high-SES students experience learning gains, especially in reading, compared to low-SES students (Alexander, Entwisle, & Olson, 2001; Cooper et al., 1996). The difference in learning loss has been attributed to differences in opportunities to access and read books over the summer (Alexander et al., 2001).

Similar to results found in K-12 settings, researchers have found strong and consistent achievement gaps in higher education between higher and lower SES students (Bailey & Dynarski, 2011; Bowen, Chingos, & McPherson, 2009). It is therefore plausible that summer learning loss disproportionally affects low-SES college students.

A parallel branch of literature addresses another concern of summer vacation, “summer melt,” which refers to the high percentage of students (10–40 percent) who fail to matriculate at the college they have been accepted to after the summer following their high school graduation (Castleman & Page, 2014; Daugherty, 2012; Matthews, Schooley, & Vosler, 2011). In particular, low-SES students are more susceptible to summer melt (Roderick, Nagaoka, Coca, & Moeller, 2008). In one study, Arnold, Fleming, DeAnda, Castleman, and Wartman (2009) found that up to one-third of low-income students who had been accepted to and paid deposits to college decided not to enroll at all.

The above studies hypothesized that low-income students’ plans are prone to change over the summer as many necessary steps need to be completed to finalize their initial college enrollment, including completing paper work and securing additional funding to meet the gap between financial aid and college cost. Without access to high-quality support and guidance, students are more likely to give up on college. Similarly, college students face many of these same hurdles in the summers after initial enrollment, which can often affect students' plans of reenrolling after summer breaks.

Research in behavioral economics suggests that net short-term costs weigh more heavily on an individual's decision-making process, even if the alternative investment would be more beneficial in the long term (Chabris, Laibson, Morris, Schuldt, & Taubinsky, 2008; Pallais, 2009). The returns to a four-year degree are much higher than those of a high school diploma, but students may weigh their short-term gains more heavily and decide to leave school after earning a full-time salary over the summer. In interviews with 600 young adults who were 22 to 30 years old, Johnson and Rochkind (2009) found that full-time employment is a major reason for not returning to college once having left for the summer. The tuition bills students receive over the summer for the following term may also trigger more financial anxiety over returning to school in the fall.

Summer bridge programs intending to combat the summer melt phenomenon aim to assist students in their transition from high school graduates to college students. These programs typically involve summer counseling and primarily target minority and low-SES students, who are most likely to change their plans after having accepted a college offer (Roderick et al., 2008). The literature on the efficacy of summer bridge programs is inconclusive, however. While one randomized control study on eight developmental summer bridge programs in Texas found no achievement effect on program participants (Barnett, Bork, Mayer, Pretlow, Wathington, & Weiss, 2012), two studies found a 14 percent increase in fall enrollment among students randomly assigned to receive proactive outreach from high school counselors addressing financial and information barriers (Castleman, Arnold, & Wartman, 2012; Castleman, Page, & Schooley, 2014).

At the college level, a few studies have found positive outcomes among activities that are aimed at generating "academic momentum" in college. One descriptive study found a strong correlation between summer enrollment and credit accumulation (McCormick & Carroll, 1999); another found a strong correlation between summer enrollment and degree completion (Adelman, 2006). Using a propensity score matching technique, Attewell, Heil, and Reisel (2012) also found that enrollment in college coursework in the summer after freshman year is associated with 7–16 percent higher bachelor's degree completion rate.

Together the summer bridge program literature and academic momentum literature suggest that participation in summer study may improve college students' academic outcomes.

3. Conceptual Framework: How Summer Enrollment Influences Outcomes

Based on the literature and common convention, there are four mechanisms by which enrollment in the summer can influence academic and labor market outcomes.

Summer Learning Effect

First, by remaining enrolled in coursework during the summer, students may be less prone to lose knowledge or skills acquired from the previous term and thus may have a higher GPA in the fall. Despite the lack of evidence for this at the college level, the evidence on K-12 summer school interventions appears positive if somewhat murky due to variation in program curriculum, participants' characteristics, and evaluation design. The gain in GPA as a result of participating in summer programs is between zero to a quarter of a standard deviation, on average, depending on the empirical rigor and program content of the studies (Cooper, Charlton, Valentine, Muhlenbruck, & Borman, 2000; Kim & Quinn, 2013; Lauer, Akia, Wilkerson, Apthorp, Snow, & Matin-Glenn, 2006). The most rigorous meta-analysis in summer school interventions (Kim & Quinn, 2013) reviewed 41 studies on summer reading programs that employed only experimental and quasi-experimental designs. The analysis showed that the average gain in GPA as a result of participating in a summer reading program is one-tenth of a standard deviation—the approximate mid-point of Cooper et al. (2000), Kim & Quinn (2013), and Lauer et al. (2006)—and the benefit is statistically larger for low-income students.

Academic Momentum Effect

Second, some evidence has been found that activities that increase academic momentum such as summer enrollment and full-time enrollment in the first college term can increase academic intensity (i.e., the number of credits enrolled in per term or per year) and improve college outcomes (Adelman, 1999, 2006; Attewell et al., 2012; Martin, Wilson, Liem, & Ginns, 2013). According to the academic momentum theory, early enrollment patterns may strongly influence students' subsequent progress and likelihood of completion (Tinto, 1987; Wittrock, 1974). Activities that increase academic momentum such as enrollment in summer courses, immediate entry into college after high school graduation, and full-time enrollment in the first term can improve the rate of college completion. Furthermore, according to these studies, academic intensity is more likely to influence the rate of college completion than sociodemographic backgrounds and high school achievement (Attewell et al., 2012).

Earlier Graduation/Reduced Cost Effect

The third mechanism relates to the cost of college and length of time to graduation (Tutors, 2015; Nelson, 2009). Taking advantage of the summer term can allow students to catch up on coursework needed to graduate on time or to take remediation courses. In addition, summer courses often have smaller class sizes, allowing each student more individualized attention and potentially higher learning gains. Finally, students may have the flexibility to take courses at a college closer to home with the option of transferring the credits later. As a result, summer enrollees are able to reduce the overall cost of their education by living at home over the summer.

Earnings Effect

The final mechanism relates to students' ability to accumulate working experience while enrolled in college. Since individuals with more working experience tend to earn more, summer enrollment may influence the hours worked during college and affect earnings after graduation in three ways. First, to offset the gap between financial aid and the cost of college, students may choose either to take out more student loans or to increase the number of hours worked during the academic year. If a student opts to work more hours over the course of the traditional academic year, the increased experience may positively affect future earnings by increasing students' work experience. Second, students who do not enroll in summer courses may work more because they have more time off. As a result, these two effects may offset each other. Finally, if summer enrollees have a higher completion rate than non-summer enrollees, they will on average receive higher returns to their college education.

4. Data and Summary Statistics

Data Description

The administrative data analyzed in this paper are from a higher education system in an anonymous southern state and include 16,000 bachelor's degree-seeking students who first enrolled in the fall of 2005, 2006, and 2007. The analysis focuses on students who were residents of the state, intending to seek bachelor's degrees, and who had transcript records and had earned credits in their first term. Based on these criteria, the final sample analyzed in this paper contains approximately 14,000 students followed until fall of 2013.

The student dataset contains demographic information such as age, race/ethnicity, gender, county, and high school code. Also included for each student is course-level information such as course names, grades earned, credits attempted, and credits earned for all college courses taken within the state's two- and four-year public systems, and information on major and degree attainment. Finally, the dataset includes high school transcripts which list courses taken, admission test scores, and each student's intentions for education after high school.

To explore returns to education, earnings data is merged from the Unemployment Insurance records, which include quarterly earnings adjusted to 2010 dollars and industry codes.

I also include county-level SES indicators at the time of college enrollment from the U.S. Bureau of Labor Statistics and the state's department of health. These indicators include county-level household income, per capita income, percentage of drinkers or smokers, proportion of mothers under 20 years old, percentage of residents without health insurance, and percentage of students receiving free or reduced-price lunch at schools.

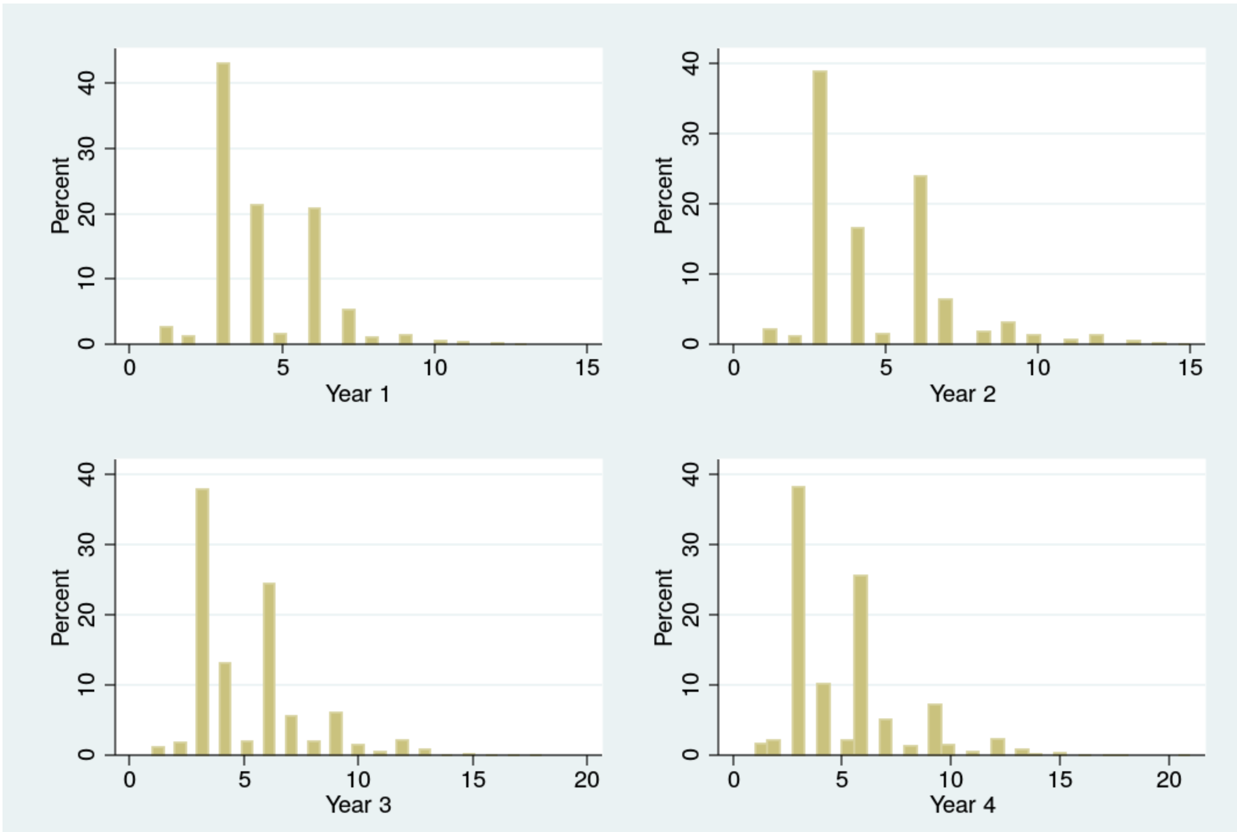
Summer Enrollment Statistics

I identify summer enrollment in terms of the credits enrolled in during summer. Internship credits are not counted as summer credits to isolate the effect of summer enrollment at a four-year college from other out-of-school activities. Over half of the students enrolled in at least one summer credit within five years of enrolling in college for the first time. Figure 1 displays the number of summer credits enrolled in among students who have enrolled in at least one credit for each particular summer. Summer credits enrolled in peaks at three credits and then again at six credits, indicating that summer enrollees typically take one to two courses during the summer.

Figure 2 presents descriptive data on the percentage of students ever enrolled in each summer and the average summer credits enrolled in by year. The dotted bars show that 12 percent of the students in the sample took any summer course in the summer after their first year at college. The percentage increases and peaks at the third summer at 26 percent. The dotted line indicates that the number of credits enrolled in by summer enrollees was about five credits. The solid bars and line show similar trends for college-level (i.e., non-remedial) courses, which may suggest that summer enrollees tended to take remedial courses in the first couple summers and took more advanced courses later on.

Figure 3 further breaks down the statistics by students' majors and CIP codes. The dark bars show that over 50 percent of the students majoring in math & science and engineering sciences enrolled in at least one summer course. In education & childcare, allied health, business & marketing, and transportation majors, close to 50 percent of the students did so. The light bars indicate the variation in number of summer credits students enrolled in. For example, math & science majors attempted approximately six credits, on average, while business & marketing majors and information science majors enrolled in only three summer credits, on average.

Figure 1: Summer Credit Enrollment in Each Year Among Students Enrolled in at Least One Summer Credit



Note. The graphs are based on students enrolled in at least one summer credit. The location of each bar on the x-axis indicates the number of credits enrolled in by students represented in that bar. The y-axis height of each bar indicates the proportion of students enrolled in that many credits in each year.

Figure 2: Percentage of Summer Enrollees and Credits Enrolled

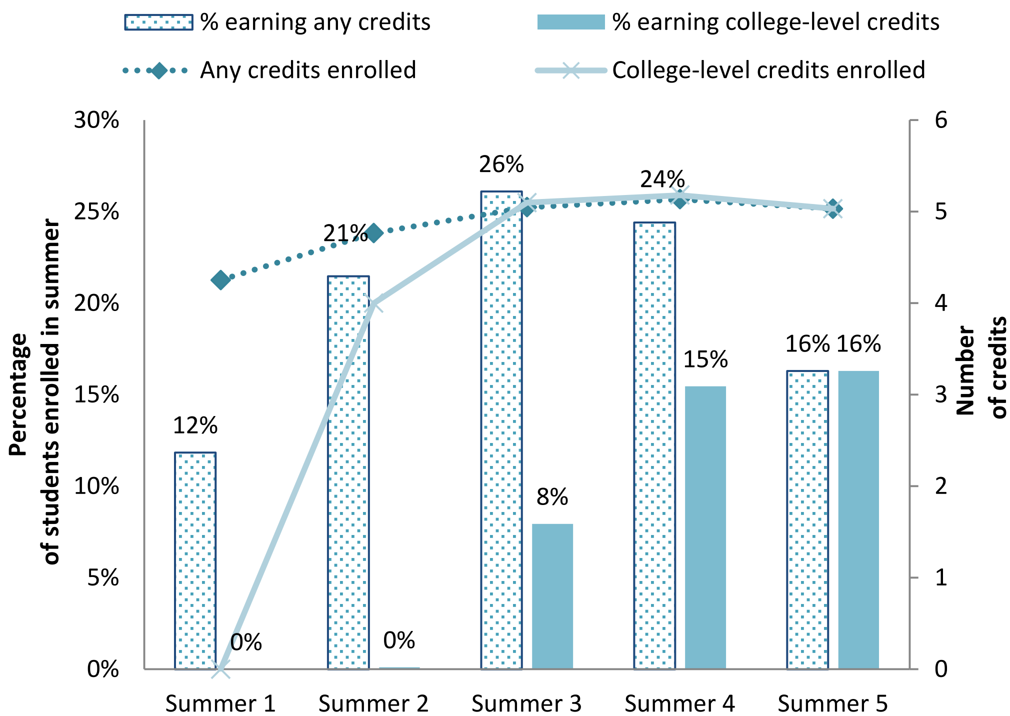
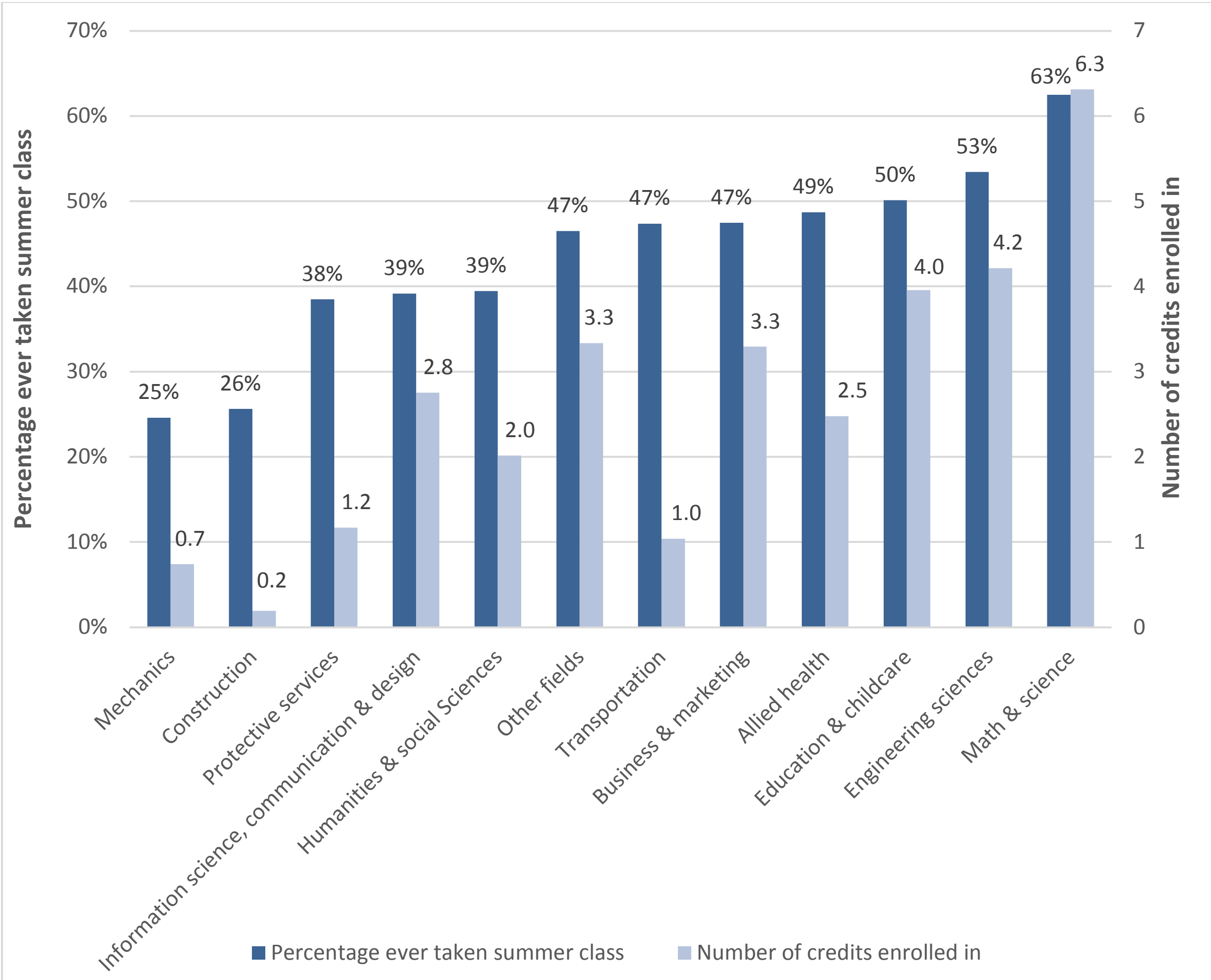


Figure 3: Summer Enrollment and Summer Credits Enrolled in by Field



Data Summary

Table 1 presents the descriptive summary of the sample. Summer enrollees are defined as individuals that have ever enrolled in a four-year college in the summer. Although this excludes students who enrolled in summer courses exclusively at two-year colleges, the effect of this phenomenon is minor because only one in every ten students enrolled in the summer at two-year colleges, with around one credit of enrollment on average.

The demographic characteristics of summer enrollees and non-summer enrollees look similar, and most mean differences are not statistically significant. The raw means, however, show that female and White students were slightly more likely to enroll in the summer, and that summer enrollees tended to live closer to a four-year institution. The county-level characteristics look almost identical among the two groups.

On average, summer enrollees accumulated 11.4 summer credits; 10.3 of those credits were from four-year colleges. Nine percent of their total credits earned were earned during the summer. Thirteen percent of the non-summer enrollees took at least one course at a two-year college over summer, yet the average number of credits enrolled in was very small over the five years.

Regarding academic ability, students who took classes in the summer were more likely than summer non-enrollees to have a higher grade point average (GPA) in high school and during the first year of college. Summer enrollees also had heavier course loads in the first year and higher credits earned by the junior and senior years in college than non-summer enrollees. Finally, summer enrollees also exhibited higher retention and completion rates.

Table 1: Data Summary

Characteristic	Summer Enrollees Mean	Summer Enrollees Standard Deviation	Non-summer Enrollees Mean	Non-summer Enrollees Standard Deviation
Demographic characteristics				
Female	55%	50%	51%	50%
White	74%	44%	71%	45%
Black	18%	38%	22%	42%
Hispanic	2%	15%	2%	15%
Other race/ethnicity	4%	18%	3%	17%
Age at enrollment	18.8	2.0	18.9	2.1
Distance to the closest four-year college	11.0	11.9	13.0	12.5
Lives in a metropolitan area	68%	47%	65%	48%
Entering year: 2005–06	36%	48%	35%	48%
Entering year: 2006–07	34%	48%	34%	47%
Entering year: 2007–08	29%	45%	32%	47%
County-level characteristics				
Household income	$32,416	$5,513	$32,308	$5,284
Percentage mothers with college degree	40%	9%	40%	9%
Percentage without insurance	17%	3%	17%	3%
Percentage smokers/drinkers	23%	3%	23%	4%
Percentage Black in school district	28%	26%	29%	26%
Percentage Hispanic in school district	6%	6%	5%	6%
Percentage other races in school district	2%	2%	2%	1%
Percentage receiving free/reduced lunch	56%	12%	56%	11%
Ever enrolled for summer credits (2- or 4-year)	100%	0%	13%	33%
Four-year credits enrolled in during summer	10.29	7.20	0.00	0.00
Two-year credits enrolled in during summer	1.17	3.01	0.85	2.71
Percent of credits earned during summer	9%	7%	1%	5%
High school GPA	3.12	0.69	2.97	0.67
GPA term 1	3.0	0.7	2.7	0.8
GPA year 1	3.0	0.6	2.7	0.7
Credits earned in term 1	13.0	3.0	11.2	4.1
Credits earned in year 1	26.9	6.5	20.4	9.3
Percent credits taken online	7%	10%	5%	11%
Percent credits at the lower level	66%	15%	78%	18%
Percent credits at the upper level	29%	14%	12%	16%
Enrolled in year 2	96%	19%	67%	47%
Enrolled in year 3	92%	26%	53%	50%
Enrolled in year 4	88%	32%	44%	50%
Enrolled in year 5	67%	47%	29%	45%
Highest degree earned in 2013				
Certificates	1%	9%	1%	12%
Associate degree	5%	22%	5%	22%
Bachelor's degree	63%	48%	23%	42%
Observations	7,590		7,289	

5. Empirical Methods

Ordinary Least Squares Model

To examine the impact of summer enrollment empirically, I first employ a basic ordinary least squares (OLS) model to explore the relationship between summer credits enrolled in and subsequent academic outcomes:

$$Y_i = \beta_1 Summer\ credits_i + \beta_2 X_i + \beta_3 Ability_i + \epsilon_i \qquad (1)$$

At the student level, Y_{it} is the outcome for individual i post-treatment, such as enrollment, credits earned, grades, bachelor's degree attainment, employment rate, or log earnings. β_1, the variable of interest, is the difference in academic outcomes attributable per credit to summer enrollment. I chose credits enrolled instead of a dummy variable of ever enrolling in a summer course to take into account variation in the number of summer credits earned. The effect of ever enrolling in summer coursework would be higher for those enrolled in more summer credits than for those who took fewer summer courses. Using summer credits enrolled eliminates that problem.

X_i is a set of demographic variables measured before the first summer after initial college enrollment, including age, race/ethnicity, gender, high school graduation year, resident tuition status, a dummy variable for living in the metropolitan area, initial college fixed effects, cohort fixed effects, major fixed effects, congressional district fixed effects, and a vector of county-level SES indicators. The county-level SES variables include the percentage of mothers with college degrees, percentage of population uninsured, percentage of smokers or drinkers, percentage of minorities in the school district, and percentage of students with free or reduced price lunch status in the school district. When using employment outcomes, I also control for the number of years worked to control for differences in students' employment experiences. $Ability_i$ includes effects attributable to high school grades, admission test scores, first term grades, and credits earned.

Eliminating Selection Bias With Instrumental Variable Strategy

The OLS estimates from equation (1) may be biased if students with certain characteristics tend to enroll in the summer. If students with higher academic ability are more likely to take summer courses, they may have more successful outcomes regardless of whether or not they enroll in summer coursework. To eliminate the selection bias, the main analysis uses the instrumental variable (IV) approach. The most common instrument in studying the effect of enrollment in a certain type of institution or course is geographical variation (Card 1995; Carneiro & Heckman, 2002; Dee, 2004; Kane & Rouse, 1995; Long & Kurlaender, 2009; Xu & Jaggars, 2013).

Instead of using actual summer credits in equation (1), the IV approach will first predict the number of summer credits enrolled in based on the proximity to the closest four-year college and other confounders in the two-stage least square estimation:

$$Summer\ credits_i = \sigma Distance_i + \beta_4 X_i + \beta_5 Ability_i + \epsilon_i \quad (2)$$

$Distance_i$ is the geodetic distance, the shortest curve along the surface of the earth, from high school location to the closest four-year college in miles. I choose the proximity to any four-year institution instead of an individual's initial institution of college enrollment. Despite the fact that over 70 percent of students attend the college closest to home during the traditional academic year, many students do not and may choose to enroll in an institution closer to home during the summer. The distance to the closest four-year institution will be able to capture both groups of students.

High school location is a proxy for the home address. The rationale behind the IV is that students are more likely to take a summer course if they are close to a four-year institution assuming that proximity to four-year institution does not affect enrollment in non-summer terms.

In order for the IV estimation to be valid internally, the IV should (1) be related to the exogenous variable, (2) be as good as random, and (3) have no impact on any outcomes except through the exogenous variable. Section 5 will show the first stage results on testing the strength of the IV. The main concerns surround the last two assumptions since there is no foolproof way to properly test them. The endogeneity of the distance IV may be an issue if individuals who place a higher value on education choose to live closer to a postsecondary campus (Card, 1995; Long & Kurlaender, 2009; Rouse, 1995; Xu & Jaggars, 2014). Particular to this study, it is also important that the IV does not correlate with non-summer enrollment and grades. Otherwise, the IV would no longer be random and would instead be directly correlated with academic or labor market outcomes.

Another potential problem is that high-quality job opportunities may be more available in areas closer to four-year campuses (Miller, 2007). Universities with less desirable labor market conditions within their surrounding neighborhoods may encourage students who cannot otherwise secure a summer job to enroll in summer coursework non-randomly. On the other hand, if the job opportunities are better around the four-year institutions, students may be distracted from enrollment and have lower academic performance (Ehrenberg & Sherman, 1987; Scott-Clayton, 2011; Stinebrickner & Stinebrickner, 2003).

Miller (2007) found that the distance-based IV estimates become non-significant after including county-level median household earnings to absorb the variations in job opportunities geographically. Other than including county-level average household income and many pretreatment variables on ability and SES, I also conduct a series of falsification tests to examine the correlation between distance and SES, employment, and enrollment in and out of summer.

The four studies mentioned above also examined the differences in perception of distance across the country. The same amount of travelling time, for example, may be interpreted differently in urban, rural, and suburban settings. Regardless, this concern is minimal in the context of this study, which focuses on students in one state. The average distance to the closest four-year institution in the state reviewed is 14.5 miles, and 90 percent of the students are within 37 miles of a college. The perception of distance as a concern is unlikely to arise within such small ranges of distance. Furthermore, I include rich geographical controls such as institutional fixed effects, congressional district fixed effects, metropolitan area fixed effects, and county-level socioeconomic indicators throughout the analysis to avoid any urban/rural and county-specific variations.

5. Results

This section presents the results of summer enrollment effects on various academic outcomes, describes the mechanisms of the effects, and provides proof of the validity of the IV. Both the OLS and IV estimations indicate that students were more likely to complete a bachelor's degree if they enrolled in courses over the summer. Further analysis suggests that summer enrollment increased bachelor's degree completion rates as a result of increasing course enrollment in the fall rather than through improving students' GPAs. These results lend support to the academic momentum theory. I find no evidence that summer enrollees completed a bachelor's degree earlier than non-summer enrollees. Finally, summer enrollees were more likely to be employed in the sixth and seventh year after initial college enrollment, yet those who were employed had similar earnings to non-summer enrollees who were employed.

First Stage and Reduced Form Statistics

I first present the first stage and reduced form statistics of the IV. The first stage results in Table 2 support the hypothesis in the Methods section that individuals living closer to a four-year institution are more likely to enroll in summer coursework. Column 2 shows that being one mile closer to a four-year institution increases the number of summer enrollment credits by 0.04 when controlling for all confounders available. The coefficient is statistically significant at the 99 percent confidence level. The F-statistics test also indicates distance is a strong IV for summer enrollment (Stevens, 2007).

Columns 3 and 4 present the reduced form results when using distance directly to predict academic outcomes. The IV has a small and negative relationship to both bachelor's degree attainment and time to degree for degree holders. Column 4 also shows that distance does not correlate with log earnings at the sixth year from college entry. Similar results are found using fifth and seventh year earnings.

Table 2: First Stage and Reduced Form Results

	(1)[a]	(2)	(3)	(4)	(5)
	First Stage		Reduced Form		
Characteristic	Summer Credits Enrolled In	Summer Credits Enrolled In	Bachelor's Degree	Time to Degree (Degree Holders Only)	Log Earnings of 6th Year From College Entry
		F-Stat: 15.1			
Distance to closest 4-year institution	–0.030*** [0.009]	–0.037*** [0.009]	–0.001** [0.000]	–0.002* [0.001]	-0.000 [0.001]
Female		0.352*** [0.133]	0.020** [0.008]	–0.139*** [0.018]	-0.094*** [0.029]
2006–2007 cohort		0.292 [0.609]	0.202*** [0.029]	0.150 [0.103]	0.235** [0.105]
2007–2008 cohort		0.172 [0.505]	0.120*** [0.027]		
Black		1.522*** [0.273]	0.009 [0.012]	0.076** [0.033]	-0.137*** [0.044]
Hispanic		0.478 [0.451]	0.006 [0.024]	0.119* [0.069]	-0.010 [0.077]
Other race/ethnicity		0.454 [0.322]	-0.003 [0.025]	0.030 [0.054]	-0.089 [0.087]
Age at enrollment		0.035 [0.080]	-0.004 [0.004]	–0.025* [0.014]	0.016 [0.016]
High school GPA		0.316*** [0.092]	0.028*** [0.006]	–0.035*** [0.010]	0.021 [0.023]
Admission test scores		–0.390*** [0.095]	0.055*** [0.004]	–0.133*** [0.012]	-0.029 [0.020]
First-term GPA		0.443*** [0.086]	0.172*** [0.006]	–0.252*** [0.018]	0.176*** [0.023]
First-term credits earned		0.296*** [0.020]	0.032*** [0.001]	–0.059*** [0.004]	0.027*** [0.005]
Observations	14,267	14,267	14,267	6,374	7,200
R^2	0.002	0.061	0.315	0.256	0.065

Note. Robust standard errors are shown in brackets; sample includes all beginning four-year students from fall 2005 to fall 2008 who intend to earn a bachelor's degree, are residents of the state, and are enrolled full-time; covariates in all regressions include the above variables, geographic controls (congressional district fixed effects), county fixed effects, major fixed effects, and initial four-year college fixed effects.

[a] Column 1 shows the baseline results without any covariates.

*** $p < .01$. ** $p < .05$. * $p < .1$.

The Effect on Degree Attainment and Time to Degree

The OLS and IV estimates are shown in Table 3. Panel A uses bachelor's degree attainment as the outcome. The OLS estimate for each summer credit enrolled in during the first five years of college is on average 1.6 percent. If the marginal benefit of each summer credit remains constant, a summer course load of 3 to 4 credits will increase the completion rate by 4.8 to 6.4 percent. Table 1 shows that summer enrollees on average accumulated 10 summer credits at the four-year level over their first five years of college, which thus yields a 16 percent higher bachelor's completion rate.

The IV estimate in Table 3, row 1 is 2.6 percent. It may be surprising that the IV results are higher than the OLS results given that the summary statistics show that summer enrollees tend to have stronger academic backgrounds. One would expect the selection bias of OLS estimation to be positive. However, because the IV estimates measure the local average treatment effect, the estimates are only valid for students that are affected by distance. While both OLS and IV methods measure students that are sensitive to distance, the OLS estimates also calculate the average treatment effect based on the always-takers and never-takers who choose whether or not to enroll in summer coursework regardless of proximity to college. The positive estimates reflect the fact that the effects of the compliers are much more positive than the sum of the selection bias and effects of the non-compliers (Card, 1995).

Since labor economists have traditionally found very different academic results between men and women, rows 3 to 6 display the heterogeneous effects by gender. While the coefficients are generally similar to those in the pooled gender regression, the standard error of the IV regression for men is so large that the coefficient is no longer statistically significant. There are three explanations for the lack of a significant effect. First, summer courses may only improve bachelor's degree attainment among women. Second, the sample size of men alone may be too small for the IV to be strong enough to generate a statistically significant result. Finally, the earnings data may just be too noisy or too early to give precise estimates of the effect of summer enrollment.

Table 3: The Effect of Summer Credit Enrollment on Degree Attainment

	Sample	Method	Summer Credits Enrolled In	Standard Error	Observations	R^2
Panel A: Bachelor's degree attainment						
1	All	IV	0.026**	[0.010]	14,267	0.352
2	All	OLS	0.016***	[0.001]	14,267	0.370
3	Women	IV	0.025**	[0.010]	7,601	0.361
4	Women	OLS	0.017***	[0.001]	7,601	0.375
5	Men	IV	0.023	[0.019]	6,666	0.359
6	Men	OLS	0.016***	[0.001]	6,666	0.370
Panel C: Bachelor's degree attainment after 4 years						
7	All	IV	0.025***	[0.009]	14,267	0.094
8	All	OLS	0.014***	[0.001]	14,267	0.126
Panel C: Bachelor's degree attainment after 5 years						
9	All	IV	0.012*	[0.006]	14,267	0.046
10	All	OLS	0.006***	[0.000]	14,267	0.074
Panel D: Bachelor's degree attainment after 6 years						
11	All	IV	-0.002	[0.002]	14,267	0.017
12	All	OLS	0.001***	[0.000]	14,267	0.042

Note. Robust standard errors are shown in brackets; sample includes all beginning four-year students from fall 2005 to fall 2008 who intend to earn a bachelor's degree in the public sector, are residents of the state, and are enrolled full-time; covariates in all regressions include demographic characteristics (gender, race, and age at enrollment), geographic controls (congressional district fixed effects, a dummy for being in a metropolitan area), initial four-year controls (first term GPA, first-term credit earned, initial four-year schools fixed effects), and county-level SES indicators (percentage of drinkers/smokers, percentage without health insurance, household income, mothers with college degrees, percent of White/Asian/Black/Hispanic students in the school district, free or reduced price lunch status).

*** p < .01. ** p < .05. * p < .1

The Per-Credit-Enrolled-In Effect of Summer Enrollment on Time to Degree, Subsequent Fall Enrollment, Credits Earned, and GPA

This section aims to explain the mechanisms by which summer enrollment improves bachelor's degree completion. First, practitioners have long promoted summer enrollment as a way for students to speed up time to graduation, yet no rigorous evidence exists to support to this claim. Second, according to the academic momentum theory, summer enrollment may encourage students to return in the fall, as attending classes would have become the norm. Additionally, the literature on summer learning loss predicts that summer enrollment has a positive effect on learning outcomes. To test these theories, I explore students' subsequent enrollment, credits earned, and GPA outcomes after having enrolled in summer coursework.

Time to bachelor's degree completion. Some students may be encouraged to enroll in summer courses to complete a bachelor's degree more quickly. Table 3 Panels B, C, and D look at the effect of summer credits on bachelor's degree completion after four, five, and six years respectively. Since the completion effect is much stronger in earlier years, these panels indicate that summer credits may help students to graduate early.

Enrollment. To examine the application of the academic momentum theory, Table 4 presents the IV results on the impact of summer enrollment credits on student retention rate in the following fall. Instead of examining cumulative summer credits as in Table 3, the endogenous variable here is the number of summer credits earned in the summer term indicated. The coefficients show the gain in the enrollment rate in the following fall term in relation to each credit earned in the summer indicated. Panel A shows that enrolling in summer credits has a positive and statistically significant effect on enrollment in the following fall. The enrollment gain is between 17 percent and 24 percent for the pooled sample and is the strongest for the second summer after initial enrollment. The gender subgroup analysis is consistent as well, yet the effect seems to be stronger for men.

Course load and college-level credits earned. Other than its effect on subsequent fall enrollment, taking summer courses can also impact academic momentum as a result of taking heavier course loads. Table 5 shows strong support for this hypothesis. Each summer credit enrolled in correlates to an increase of 1.8 to 3.1 credits earned in the fall, with the largest effect seen in the second summer after initial enrollment.

Panel B presents similar results among women. As the sample size of men is 13 percent smaller than that of women, Panel C shows more insignificant results among men than women. Yet men seem to benefit more from summer credits than women

One of the indicators of college success is the number of college-level credits earned. Table 6 estimates the impact of enrolling in summer credits on the number of college-level credits earned in the next fall term. We see that most of the credit gains in Table 5 are from taking college-level credits as opposed to taking remedial credits. Panels B and C of Table 6 show the results of the sub-group analysis for students with different prior achievement levels. The estimates show that while students with various levels of first-term GPAs experienced gains in college-level credits by virtue of earning summer credits, higher gains occurred among individuals with low first-term performance.

Table 4: IV Results on the Effect of Enrolling in One Summer Credit on Enrollment in the Following Fall

Summer Year	Coefficients	Standard Error	Observations	R^2
Panel A: Entire sample				
Summer 1	0.165**	[0.082]	14,267	
Summer 2	0.239**	[0.118]	14,267	
Summer 3	0.141**	[0.069]	14,245	
Summer 4	0.172***	[0.055]	11,352	
Panel B: Women				
Summer 1	0.172**	[0.082]	7,601	
Summer 2	0.181*	[0.096]	7,601	
Summer 3	0.084	[0.077]	7,587	0.197
Summer 4	0.119**	[0.055]	5,828	0.124
Panel C: Men				
Summer 1	0.130	[0.137]	6,666	0.121
Summer 2	0.371	[0.281]	6,666	
Summer 3	0.216**	[0.109]	6,658	
Summer 4	0.280*	[0.157]	5,524	

Note. Robust standard errors are shown in brackets; sample includes all beginning four-year students from fall 2005 to fall 2008 who intend to earn a bachelor's degree in the public sector, are residents of the state, and are enrolled full-time; covariates in all regressions include demographic characteristics (gender, race, and age at enrollment), geographic controls (congressional district fixed effects, a dummy for being in a metropolitan area), initial four-year controls (first term GPA, first-term credit earned, initial four-year schools fixed effects), and county-level SES indicators (percentage of drinkers/smokers, percentage without health insurance, household income, mothers with college degrees, percent of White/Asian/Black/Hispanic students in the school district, free or reduced price lunch status).

*** $p < .01$. ** $p < .05$. * $p < .1$.

Table 5: IV Results on the Effect of Enrolling in Summer Credits on Credits Earned in the Following Fall

Summer Year	Additional Credits Enrolled In	Standard Error	Observations	R^2
Panel A: Entire sample				
Summer 1	2.071**	[1.028]	14,267	0.209
Summer 2	3.129*	[1.615]	14,267	
Summer 3	1.789*	[0.947]	14,245	0.123
Summer 4	2.213***	[0.581]	11,352	
Panel B: Women				
Summer 1	2.006**	[1.006]	7,601	0.197
Summer 2	1.761	[1.112]	7,601	0.093
Summer 3	1.421	[1.084]	7,587	0.213
Summer 4	1.635**	[0.655]	5,828	0.081
Panel C: Men				
Summer 1	1.913	[1.828]	6,666	0.270
Summer 2	6.603	[4.911]	6,666	
Summer 3	2.181*	[1.313]	6,658	0.016
Summer 4	3.317	[2.150]	5,524	

Note. Robust standard errors are shown in brackets; sample includes all beginning four-year students from fall 2005 to fall 2008 who intend to earn a bachelor's degree in the public sector, are residents of the state, and are enrolled full-time; covariates in all regressions include demographic characteristics (gender, race, and age at enrollment), geographic controls (congressional district fixed effects, a dummy for being in a metropolitan area), initial four-year controls (first term GPA, first-term credit earned, initial four-year schools fixed effects), and county-level SES indicators (percentage of drinkers/smokers, percentage without health insurance, household income, mothers with college degrees, percent of White/Asian/Black/Hispanic students in the school district, free or reduced price lunch status).

*** $p < .01$. ** $p < .05$. * $p < .1$.

Table 6: IV Results on the Effect of Enrolling in Summer Credits on College-Level Credits Earned in the Following Fall

Summer Year	Additional Credits Earned	Standard Error	Observations	R^2
Panel A: All sample				
Summer 1	2.071**	[1.028]	14,267	0.209
Summer 2	3.135*	[1.617]	14,267	
Summer 3	1.777*	[0.942]	14,245	0.128
Summer 4	2.203***	[0.581]	11,352	
Panel B: First-term GPA below median				
Summer 1	5.141	[4.775]	7,113	
Summer 2	4.067	[2.815]	7,113	
Summer 3	3.021*	[1.572]	7,111	
Summer 4	2.920***	[0.994]	6,576	
Panel C: First-term GPA at or above median				
Summer 1	1.076*	[0.626]	7,154	0.292
Summer 2	2.363*	[1.321]	7,154	
Summer 3	1.124	[0.912]	7,134	0.195
Summer 4	1.498*	[0.858]	4,776	0.037

Note. Robust standard errors are shown in brackets; sample includes all beginning four-year students from fall 2005 to fall 2008 who intend to earn a bachelor's degree in the public sector, are residents of the state, and are enrolled full-time; covariates in all regressions include demographic characteristics (gender, race, and age at enrollment), geographic controls (congressional district fixed effects, a dummy for being in a metropolitan area), initial four-year controls (first term GPA, first-term credit earned, initial four-year schools fixed effects), and county-level SES indicators (percentage of drinkers/smokers, percentage without health insurance, household income, mothers with college degrees, percent of White/Asian/Black/Hispanic students in the school district, free or reduced price lunch status).

*** $p < .01$. ** $p < .05$. * $p < .1$

Grade point averages. To evaluate the summer learning gain of enrolling summer credits, Table 7 shows the effect of enrolling in one summer credit on GPA in the following fall term. None of the estimates in Panels A through C are statistically different from zero. The K-12 literature found a positive effect on achievement scores among summer school enrollees; however, results for postsecondary education may be different because all K-12 students must take a similar number of courses each term while postsecondary students are able to choose how many credits to take each term.

Regardless, the results are encouraging. Even though Tables 4 and 5 found that earning summer credit increased course load and retention for students who might otherwise have dropped out, Table 7 suggests that summer enrollees performed just as well under these circumstances.

Table 7: IV Results of Enrolling in One Summer Credit on GPA in the Following Fall

Summer Year	Change in GPA	Standard Error	Observations	R^2
Panel A: All sample				
Summer 1	0.022	[0.084]	11,130	0.392
Summer 2	0.026	[0.093]	10,000	0.294
Summer 3	0.04	[0.111]	9,165	0.241
Summer 4	–0.07	[0.175]	5,959	0.088
Panel B: Women				
Summer 1	–0.022	[0.097]	6,026	0.406
Summer 2	–0.049	[0.095]	5,445	0.288
Summer 3	0.028	[0.127]	4,965	0.26
Summer 4	–0.083	[0.158]	3,204	0.056
Panel C: Men				
Summer 1	0.09	[0.133]	5,104	0.331
Summer 2	0.17	[0.271]	4,555	
Summer 3	0.007	[0.204]	4,200	0.249
Summer 4	–0.141	[0.488]	2,755	

Note. Robust standard errors are shown in brackets; sample includes all beginning four-year students from fall 2005 to fall 2008 who intend to earn a bachelor's degree in the public sector, are residents of the state, and are enrolled full-time; covariates in all regressions include demographic characteristics (gender, race, and age at enrollment), geographic controls (congressional district fixed effects, a dummy for being in a metropolitan area), initial four-year controls (first term GPA, first-term credit earned, initial four-year schools fixed effects), and county-level SES indicators (percentage of drinkers/smokers, percentage without health insurance, household income, mothers with college degrees, percent of White/Asian/Black/Hispanic students in the school district, free or reduced price lunch status).

*** $p < .01$. ** $p < .05$. * $p < .1$.

From Summer Enrollment to Employment

While the previous section shows that summer enrollment can lead to better college outcomes, this section examines whether the gains from summer enrollment carry over to the labor market. On the one hand, summer enrollees may have less work experience due to having less time available to work; on the other hand, summer enrollees may need to work more hours to pay for the summer tuition. Furthermore, summer enrollees graduate and start accumulating post-graduation work experience earlier than those who graduate later, and post-graduation work experience is valued more in the labor market than job experience in college. Without knowing the reason behind a student's decision to work, it is hard to fathom which mechanism is stronger, on average.

Table 8 presents the IV per-credit-enrolled-in effect of summer enrollment on an individual's future employment and earnings. Panel A shows that each summer credit enrolled in corresponds to a 1.3 and a 1.9 percent higher chance of employment in the sixth and seventh year after initial college enrollment, respectively. The magnitude of gain in employment is similar to that for bachelor's degree completion (0.026, see Table 3). These results are consistent with previous findings of higher retention and bachelor's degree completion rates among students who take summer courses. The estimate for the fifth year is not statistically significant. It is possible that students may still be completing their studies in that year.

Panel B displays the results when using log earnings of the fifth, sixth, and seventh year after initial enrollment conditional on employment. None of these results are statistically significant or significantly different from zero. Given the higher standard error, it is possible that the sample size is too small to produce precise IV estimates. I therefore pool the earnings data from the fifth, sixth, and seventh year in Panel C, clustering the standard errors at the student level. The pooled results do not indicate any earning effect of summer credits conditional on employment.

Table 8: IV Results of Enrolling in One Summer Credit on Employment Outcomes

	Change in Employment	Standard Error	Observations	R^2
Panel A: Employment				
Year 5	-0.014	[0.009]	13,983	0.236
Year 6	0.019**	[0.009]	14,267	0.401
Year 7	0.013*	[0.008]	14,267	0.578
Panel B: Log earnings of individual years				
Year 5	-0.017	[0.031]	10,510	0.064
Year 6	0.005	[0.035]	7,200	0.065
Year 7	-0.025	[0.057]	3,613	0.047
Panel C: Log total earnings of year 5 to 7				
All	-0.035	[0.030]	11,198	0.192
Women	-0.030	[0.026]	6,063	0.225
Men	-0.035	[0.072]	5,135	0.188
Panel D: Pooled log earnings of year 5 to 7				
All	-0.015	[0.026]	21,323	0.071
Women	-0.001	[0.023]	11,562	0.091
Men	-0.055	[0.090]	9,761	

Note. Robust standard errors are shown in brackets; sample includes all beginning four-year students from fall 2005 to fall 2008 who intend to earn a bachelor's degree in the public sector, are residents of the state, and are enrolled full-time; covariates in all regressions include year of work experience, demographic characteristics (gender, race, and age at enrollment), geographic controls (congressional district fixed effects, a dummy for being in a metropolitan area), initial four-year controls (first term GPA, first-term credit earned, initial four-year schools fixed effects), and county-level SES indicators (percentage of drinkers/smokers, percentage without health insurance, household income, mothers with college degrees, percent of White/Asian/Black/Hispanic students in the school district, free or reduced price lunch status); regressions in panel D pool earnings from the fifth, sixth, and seventh year from all individuals with, robust standard errors are clustered at the student level, work experience is controlled and equals to the year worked up till the year of the outcome measured.

*** $p < .01$. ** $p < .05$. * $p < .1$

Validity Tests

The empirical methods section outlines some of the major concerns about the validity of using distance as an instrumental variable (IV) for college enrollment, namely: (1) motivated individuals or affluent families may tend to live nearer to four-year college campuses, and (2) better and/or more job opportunities may exist in regions around four-year institutions. Both concerns could undermine the assumption that distance as an IV should be as good as random and that it should not affect outcomes other than via the endogenous variable.

If high-SES students tend to live closer to four-year campuses, they may have better outcomes regardless of their summer enrollment status. This concern is more significant in the setting where people are making enrollment decisions—especially when choosing between types of institutions (four-year versus two-year institutions) and between transfer paths (e.g., enrolling directly at a four-year institution versus transferring from a two-year institution into a baccalaureate program). Conditional on enrollment at a four-year university, this potential problem is minimized.

Nonetheless, Table 9 presents empirical tests of the relationship between proximity to a four-year institution and SES of the neighborhood. Rows 1 to 3 show that distance has no correlation with SES indicators such as average household income, percent of smokers, and percent of low-income students in the county of residence. The results are the same using other SES indicators included in the regressions.

Table 9: Validity Tests

	Characteristic	Distance	Standard Error	Observations	R^2
1	Household income	14.394	[13.209]	14,267	0.875
2	Percentage of smokers	–0.000	[0.000]	14,267	0.312
3	Percentage of students with free/reduced price status in school district	–0.000	[0.000]	14,267	0.863
4	Worked in term 1 and 2 (two-year students)	–0.000	[0.001]	9,116	0.054

Note. Robust standard errors are shown in brackets; sample includes all beginning four-year students from fall 2005 to fall 2008 who intend to earn a bachelor's degree in the public sector, are residents of the state, and are enrolled full-time; covariates in all regressions include demographic characteristics (gender, race, and age at enrollment), geographic controls (congressional district fixed effects, a dummy for being in a metropolitan area), initial four-year controls (first term GPA, first-term credit earned, initial four-year schools fixed effects), and county-level SES indicators (percentage of drinkers/smokers, percentage without health insurance, household income, mothers with college degrees, percent of White/Asian/Black/Hispanic students in the school district, free or reduced price lunch status).

*** $p < .01$. ** $p < .05$. * $p < .1$.

In addition, Panel A of Table 10 shows the association between academic outcomes and distance over time. If students with higher academic motivation, resources, or academic ability live closer to four-year institutions, one should see a positive relationship between distance and GPA or credits earned in all years. First, no correlation is shown between distance and GPA. Second, distance is shown only to relate to credits earned in a way that is consistent with the summer enrollment analysis. Distance has no effect on credits earned during the academic year in the first year, but it does correlate with credits earned through the positive effect summer enrollment has on credits earned and on subsequent fall enrollment.

Table 10: Per-Mile Effect of Distance on Academic and Employment Outcomes by Year

Panel A: Academic Outcomes

Academic Year	Credits Earned in Summer		Credits Earned in Academic Year		Enrollment in Fall		GPA	
Year 1	–0.005***	[0.002]	–0.004	[0.004]	NA	NA	–0.000	[0.000]
Year 2	–0.006**	[0.003]	–0.019*	[0.011]	–0.001**	[0.000]	–0.000	[0.001]
Year 3	–0.008***	[0.003]	–0.027**	[0.012]	–0.001***	[0.000]	–0.000	[0.001]
Year 4	–0.007***	[0.003]	–0.035***	[0.013]	–0.001**	[0.001]	–0.000	[0.001]

Panel B: Employment Outcomes

Academic Year	Employment During Academic Year		Earnings During Academic Year		Employment During Summer		Earnings in Summer	
Year 1	–0.003***	[0.001]	–0.003**	[0.001]	–0.002***	[0.001]	–0.001	[0.001]
Year 2	–0.001**	[0.001]	–0.006***	[0.002]	–0.002***	[0.000]	0.001	[0.001]
Year 3	–0.001***	[0.000]	–0.001	[0.002]	–0.001**	[0.001]	0.000	[0.001]
Year 4	–0.001	[0.000]	–0.000	[0.001]	–0.001	[0.000]	0.001	[0.001]

Note. Robust standard errors are shown in brackets; sample includes all beginning four-year students from fall 2005 to fall 2008 who intend to earn a bachelor's degree in the public sector, are residents of the state, and are enrolled full-time; covariates in all regressions include demographic characteristics (gender, race, and age at enrollment), geographic controls (congressional district fixed effects, a dummy for being in a metropolitan area), initial four-year controls (first term GPA, first-term credit earned, initial four-year schools fixed effects), and county-level SES indicators (percentage of drinkers/smokers, percentage without health insurance, household income, mothers with college degrees, percent of White/Asian/Black/Hispanic students in the school district, free or reduced price lunch status).

*** $p < .01$. ** $p < .05$. * $p < .1$.

The second concern over the validity of the IV surrounds the relationship between four-year institutions and their neighboring labor market conditions. Row 4 of Table 9 shows that proximity to four-year institutions does not increase employment among two-year college students and therefore the job opportunities in proximity to four-year institutions are likely similar to those in neighborhoods farther away from the campuses.

Panel B of Table 10 also provides the details of the relationship between distance and employment for four-year college students over time. If distance correlates with job opportunities, one should see strong, negative, and statistically significant relationships with all labor market outcomes over all years since job opportunities do not usually fluctuate in the short term. The results in Panel B of Table 10 are inconsistent with this concern as only half of the coefficients are statistically significant. Proximity to four-year colleges therefore does not correlate with job opportunities for students in four-year colleges.

Panel B also shows that distance does not affect earnings during the summer. It shows statistically significant but economically insignificant correlations between employment and distance during fall and spring terms in the early years. It indicates that students work 0.1–0.3 percentage points more and earn 0.3–0.6 percentage points more over the academic year if they live one mile closer to a four-year institution.

Though the correlation is very small, the fact that an association exists in the early years but not the latter years suggests that individuals adjust their work patterns in response to summer enrollment as opposed to the availability of job opportunities. Three observations support this statement. First, as mentioned above, distance does not have a consistent relationship throughout all years and all outcomes.

Second, the strongest correlation between distance and employment occurs around the same time as when distance most strongly correlates with summer credits, which means that distance only affects employment through its effect on summer credits. Panel A in Table 10 shows that the effect of distance on summer credits earned is cumulative and strongest for the first summer. Given that individuals with past summer enrollment experience are more likely to enroll in summer credits, the additional effect of distance on summer credits earned in the latter years is much smaller than that in the first year. In addition, the strongest effect of distance on employment occurs during the first two years, which corresponds to the strongest effect of distance on summer credits. Anticipating the tuition in the summer, students may work more all year round. Though students may work more hours to pay for summer tuition, the increase in credit loads may make it difficult to do so in later years. Because distance does not directly relate to employment outcomes through SES or job opportunities, the IV has not violated the exclusion restrictive assumption.

Table 10 shows the complex relationship between distance to a four-year college and employment and enrollment outcomes. This validity test may serve as a caution to researchers considering the use of distance as an IV and illustrates the need to thoroughly check for any correlations between distance and relevant variables, in this case, SES, academic outcomes, and employment outcomes.

6. Conclusion

Despite the widespread practice of summer enrollment at the college level, researchers have rarely looked into its causal effect on college and employment outcomes. The K-12 literature has generally found encouraging results among students who engage in academic activities in the summer. At the college level, academic momentum theory predicts that summer enrollment may increase academic intensity, thus helping students to graduate and graduate quickly. Using a state administrative dataset and proximity to the closest four-year college as an instrumental variable, this paper found evidence that is consistent with academic momentum theory and which may help explain the mechanism by which summer enrollment serves to increase bachelor's degree completion rates.

The summary statistics show that summer enrollees are more likely than non-enrollees to be academically prepared, highlighting the importance of causal inference when examining summer enrollment. The IV results indicate that, on average, for each summer credit a student enrolls in, there is a 2.6 percent increase in the likelihood of completing a bachelor's degree. Further analysis shows that the increase in the bachelor's degree completion rate among summer enrollees is caused by an increase in the rate of enrollment and credits earned in the following fall semester. Despite taking more credits, summer enrollees in the sample had similar GPAs and time to degree completion as non-summer enrollees. Encouragingly, the gains in credits were higher among summer enrollees with lower first-term GPAs.

Given the current emphasis on bachelor's degree completion among analysts, policymakers, and others, these results are informative and promising. The literature on college completion has so far largely overlooked the role of summer enrollment in fueling academic momentum and subsequent enrollment. The results of the current study support the notion that institutions should more fully utilize their buildings in the summer to provide courses and should encourage students to participate in summer coursework. Academic advisors should consider counseling students to spend the summer break in an academically productive way. Given the risk of academic momentum loss, students should perhaps work less and instead take at least one course in the summer or participate in a field-related internship.

Three barriers undermine the ability or desire of college students to take summer courses. The first is the lack of summer financial aid. Currently, the federal Pell Grant is allocated only for the fall and spring semesters—students may only use the Pell Grant for summer courses if they have aid left over from the fall and spring academic terms, which rarely happens. Having access to financial aid through the summer for low-SES students could be beneficial in increasing summer enrollment and thereby improving graduation rates. Indeed, this paper provides empirical support for bringing back year-round Pell Grants. It is worth noting that randomized control trials using financial incentives to encourage summer enrollment could be used to evaluate the benefit of summer enrollment.

The second barrier to summer course participation is the status quo perception of summer break or summer vacation. The academic calendar has incorporated a summer break for a long time. In order to convince college personnel and students about the merits of summer coursework, academic advisors and others will need to change norms concerning the role of the summer term in student academic progression. Relatedly, the third barrier concerns the appeal of summer employment among students. Many college students work at summer jobs, but these are often not conducive to their academic goals. While a full-time wage may be attractive to students, institutions and advisors may need to help students weigh the benefits of working full-time against the potential benefits of taking summer coursework in terms of improved college outcomes.

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