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The Effect of a Dual Enrollment Tuition Subsidy for Students Eligible for Free/Reduced Price Meals: Evidence from CCR-CCA in Maryland

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If you have questions regarding this publication, please contact mlds.center@maryland.gov.

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Executive Summary

The College and Career Readiness and College Completion Act (CCR-CCA) of 2013 (Chapter 533, Senate Bill 740, 2013) passed the Maryland General Assembly in 2013 with the goal of improving college and career outcomes for Maryland students. One policy included in the legislation was a tuition cost reduction for select high school students who dually enroll in college courses. This study used data from the Maryland Longitudinal Data System (MLDS) to examine the effect of the cost reduction in tuition for dual enrollment on dual enrollment uptake, with a particular focus on low-income students who were eligible for free/reduced price meals (FARMS), as these students are under-represented in the dual enrollment population in Maryland. A difference-in-differences (DD) approach was used and, overall, dual enrollment increased over this period for all subgroups of students. Among students who were likely eligible for dual enrollment (i.e., students who graduated with a 3.0 or higher GPA), FARMS-eligible students, who saw larger tuition decreases after CCR-CCA, had larger increases in the rates of any dual enrollment (11^{th} or 12^{th} grades) and dual enrollment in 11^{th} grade. Policy implications and directions for future research are discussed.

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Introduction

The College and Career Readiness and College Completion Act (CCR-CCA) of 2013 (Chapter 533, Senate Bill 740, 2013) passed the Maryland General Assembly in 2013 with the goal of improving college and career outcomes for Maryland students. One policy included in the legislation was a tuition cost reduction for select high school students who dually enroll in college courses. Since the passage of the CCR-CCA, dual enrollment rates have steadily increased in Maryland. For example, between the 2010-2011 and 2018-2019 academic years, the rate of dual enrollment among Maryland public high school students increased from 1.7% to 5.8% (see Figure 1 below; MLDS Center, 2020). However, lower-income students are disproportionately underrepresented in dual enrollment. For example, in the 2017-2018 academic year, 37% of the population of Maryland public high school students were eligible for free/reduced price meals (FARMS), but only 23% of dually enrolled students were eligible for FARMS (see Figure 2; MLDS Center, 2019). To date, the impacts of the dual enrollment cost reduction have not been evaluated, so little is known about the returns on the State investment. The goal of this study was to examine the effect of the cost reduction in tuition for dual enrollment on dual enrollment uptake, with a particular focus on low-income students who were eligible for FARMS, as these students are under-represented in the dual enrollment population in Maryland.

Figure 1: Percent of Dually Enrolled Students by Year

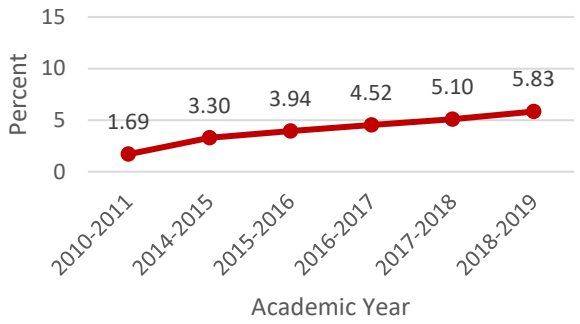
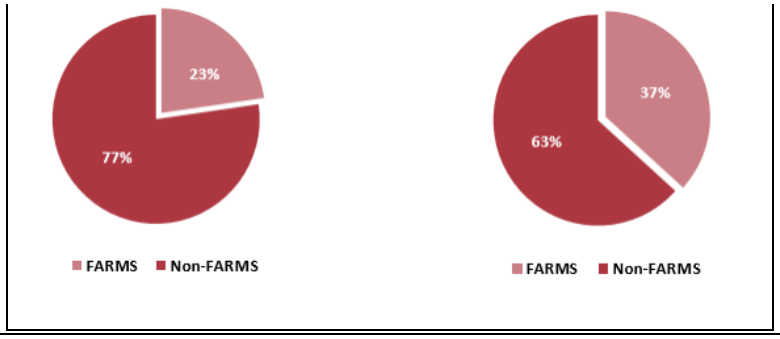


Figure 2: Percent of Dual Enrollment for FARMS and Non-FARMS Students



Background

Prior research highlights a positive return to individual students and society for postsecondary degree completion (Hout, 2012). For example, it is well-documented that wage returns (Baum et al., 2013; Melguizo & Wolniak, 2012) and returns from fringe benefits (e.g.,

paid vacation, sick leave, pension contributions; Baum et al., 2013; Williams & Swail, 2005) are greater, on average, for individuals who earn a college degree when compared to individuals who do not earn a college degree. Societal benefits are also realized through reduced rates of unemployment, increased tax revenues, reduced reliance on public assistance programs, and reductions in criminal activity and risky behaviors (Baum et al., 2013; Oreopoulos & Salvanes, 2011; Rouse, 2005; Williams & Swail, 2005; Wolfe & Haveman, 2002). The positive return to individual students and society is particularly strong for low-income students, who may not have attended college otherwise (Hout, 2012; Page & Scott-Clayton, 2016).

Given the positive nature of the individual and societal returns to postsecondary degree completion, public agencies invest significant funds in policies and programs that aim to increase college enrollment and degree attainment, particularly for low-income students, who are under-represented in the college-going population (Bailey & Dynarksi, 2011; Belley & Lochner, 2007). One such program is dual enrollment, which allows high school students to simultaneously enroll in college coursework. Recent experimental evidence from Tennessee suggests that dual-credit math coursework alters subsequent high school course taking and alters college selection, inducing some students to select four-year colleges instead of two-year colleges (Hemelt et al., 2020). Prior quasi-experimental[1] evaluations of dual enrollment show that dually enrolled students have increased rates of college enrollment and degree attainment, when compared to similar non-dually enrolled students (An, 2013; Cowan & Goldhaber, 2015; Giani et al., 2014; Grubb et al., 2017; Miller et al., 2018; Struhl & Vargas, 2012). A recent evaluation in Maryland indicated that dually enrolled students were more likely to enroll in college, persist in college, and earn a college degree, including associate, bachelor's, and certificate degrees, when compared to similar students who were not dually enrolled (Henneberger et al., 2018; 2020). Furthermore, the effects of dual enrollment on postsecondary outcomes were stronger for lower-income students, highlighting the potential for dual enrollment to break the cycle of intergenerational poverty and improve social mobility.

There are several mechanisms through which dual enrollment could increase college enrollment and degree attainment, particularly for lower-income students. First, dual enrollment could allow students to obtain college-level credits early, reducing the credits required for a college degree and, correspondingly, the time required to complete the degree. Second dual enrollment courses are also often (though not exclusively) undertaken at community colleges, where per credit tuition and fees are generally lower than at four-year institutions. Further, tuition and fees for dual enrollment may be subsidized by state, local, or institutional funds, discounting the tuition rate directly paid by high school students. These financial mechanisms reduce the overall cost of a student's college degree, making college more affordable. Lastly, dual enrollment could also serve as an introduction to college for students with limited experience or information about postsecondary education, such as those who are low-income or first-generation college students.

[1] Experimental evidence from a lottery conducted with Early College programs, which combine high school and college to shorten the time a student is in school, shows positive impacts on college enrollment and degree attainment (Edmunds et al., 2017; 2020).

One form of states' investment in postsecondary education comes from providing financial aid or tuition subsidies (see Dynarksi & Scott-Clayton, 2013 for a review). However, much of the research examining the cost of college enrollment focuses on the price responsiveness of college enrollment after high school graduation. Prior research indicated that students' college enrollment and degree attainment was responsive to changes in cost that came through additional grant aid/subsidies. For example, Deming and Dynarski (2010) reviewed the literature on financial aid and concluded that about $1,000 of grant aid was associated with a 4-percentage point increase in college enrollment. Additionally, students' response to financial aid has been studied within the context of Pell Grant eligibility, and results show that student decisions are impacted by Pell Grant offers (Park & Scott-Clayton, 2018). Financial aid provided to increase STEM completion increased STEM college credit completion by 20-35% among students who were academically eligible, suggesting that aid availability impacts the academic choices of students in a large, public higher education system (Castleman et al., 2017). Additionally, more recent research has found positive effects of grant aid on college persistence, degree attainment, and wages after graduation (Bettinger et al., 2016; Castleman & Long, 2016).

More recent evidence from Promise programs, a place-based scholarship program that provides students with tuition subsidies for in-state college attendance, shows positive impacts of the subsidy on college enrollment outcomes (see Gandara & Li, 2020 and Swanson et al., 2016 for recent reviews of this research). For example, the first place-based promise program was implemented in Kalamazoo, Michigan and showed positive effects on college enrollment (Bartik et al., 2017). In Oregon, the Promise program increased college enrollment by 4-5 percentage points (Gurantz, 2019). In Buffalo, New York, students saw a 20% increase in college enrollment in the year after high school graduation as a result of the tuition subsidy (Bifulco et al., 2019). In El Dorado, Arkansas, college enrollment increased by 11-14 percentage points after implementation of the Promise program (McKenzie & Ritter, 2018; Swanson & Ritter, 2020). Swanson and Ritter (2020) reported larger enrollment effects for students of color and students with below-average GPAs, suggesting that student characteristics may impact students' response to policy changes. In Tennessee, an evaluation of the Promise program showed substantial impacts on college enrollment, with larger impacts for low-income students (Carruthers & Fox, 2016).

Comparatively little research has examined the cost structure and price responsiveness of college enrollment during high school (e.g., dual enrollment). A recent report by the National Center for Education Statistics (NCES, 2020) reported that 78% of schools with dual enrollment included funding provided by the school, local school system, or state. Forty-two percent of schools with dual enrollment included funding provided by the family or the student. Additionally, dual enrollment was funded by the school, district, or state at higher rates in schools in which 75% or more of students were eligible for FARMS, meaning that schools serving lower income students received higher levels of funding subsidies. Miller and colleagues (2018) examined the cost structure of dual enrollment in Texas and reported that the cost of dual enrollment for the community college, local school system, and student varied substantially across institutions.

The Current Study

The *College and Career Readiness and College Completion Act of 2013* was passed by the Maryland General Assembly to improve high school students' college and career readiness. The legislation included new mandates for dual enrollment, among other efforts to improve preparation[2]. As part of the mandate, local school systems (LSS) were required to form agreements with Maryland public postsecondary institutions to cover the tuition and fees for up to four courses for all students. Postsecondary institutions could not charge high school students for tuition and had to reduce their tuition by 25%. The LSS would cover the remaining 75% of the postsecondary tuition for the first four courses taken. The LSS could then charge 90% of the tuition back to the high school student, but this fee was waived for students who were eligible for free/reduced price meals (FARMS). This, effectively, offered a minimum discount on dual enrollment tuition to all students in Maryland high schools, and effectively set the tuition for FARMS-eligible students to zero (not including other costs of education besides tuition). In this way, the cost of dual enrollment was reduced for all students, but particularly reduced for students who were FARMS-eligible.

The current study used data from the Maryland Longitudinal Data System (MLDS) and applied a difference-in-differences (DD; Ashenfelter & Card, 1985; Card & Krueger, 1994) research design to estimate the causal effect of the dual enrollment subsidy included in the CCR-CCA legislation. The DD strategy depends on using non-FARMS students as a comparison group for FARMS students, who received the largest tuition subsidy[3] for dual enrollment as a result of the legislation. This research allows for students to differ in possibly unobservable ways, as long as those unobserved differences are time-invariant. This study contributes to the literature by producing quasi-experimental evidence of the causal effect of the tuition subsidy that accompanied CCR-CCA on dual enrollment uptake in Maryland, particularly for students who experienced greater tuition subsidies. This report is the first to isolate the effect of the cost of dual enrollment by using a change in tuition to estimate these effects. The current study answers the following research question:

> What is the effect of a dual enrollment subsidy on dual enrollment rates for students who were eligible for FARMS when compared to students who were not eligible for FARMS?

[2] These policies included standardized testing for high school students, college and career counseling in middle and high school, statewide transfer agreements for general education between community colleges and four-year public institutions, and standardization of credits required to graduate from college.

[3] The MLDS does not contain information on which students received the dual enrollment subsidy, but all students were eligible post-legislation. The methodology used in this report does not rely on that distinction to draw causal conclusions. Collecting information identifying the specific students receiving a subsidy would help to further draw causal conclusions about the effect of the legislation on dual enrollment outcomes.

Methods

Sample Selection

The data used for this report are from the Maryland Longitudinal Data System[4] (MLDS), which contains linked longitudinal data from State agencies. Data for this report came from two partner agencies. The Maryland State Department of Education (MSDE) provides data for public preK-12 students and schools. The Maryland Higher Education Commission (MHEC) provides data for Maryland public and private college students and colleges. College enrollment data are supplemented through data that are obtained through the National Student Clearinghouse (NSC) for students who were in a Maryland public high school for the 12th grade. For part of the timeframe examined in this study, MHEC only collected college enrollment data on students that were enrolled in fall terms. Data on enrollment for spring terms were derived from NSC records to supplement MHEC data from this period.

This report responds to the Maryland Longitudinal Data System Center (MLDSC) Research Agenda questions*:*

- *Are Maryland students prepared to enter postsecondary institutions and complete their programs in a timely manner?*
- *What percentage of Maryland high school exiters go on to enroll in Maryland postsecondary education?*
- *Which financial aid programs are most effective in improving access and success (i.e., retention and graduation) for Maryland students?*

This report focuses on 12th grade high school students in Maryland public high schools in the 2007-2008 through the 2016-2017 academic years. CCR-CCA was passed in 2013, and the changes in dual enrollment tuition were immediately introduced in the following academic year (2014). Therefore, all students[5] beginning in the 2014 academic year were "treated" by the legislative changes, and all students prior to 2014 were not "treated" by the legislative changes. This report includes data from 534,702 12th grade students (approximately 62,000 12th grade students per cohort).

Descriptive analyses showed that the average FARMS-eligible student was less likely to be academically eligible to enroll in dual enrollment programs. An observed variable that can help determine eligibility for dual enrollment is having a 3.0 grade point average (GPA) or higher at high school graduation. On average, under 20% of FARMS-eligible students earned a 3.0 or higher GPA by graduation, while the same rate for non-FARMS students was 44%. To ensure that we were making comparisons among students who were eligible for dual enrollment, the sample was further limited to students who graduated with a 3.0 or higher

[4] For more information on the sources and data elements included in the MLDS, see https://mldscenter.maryland.gov/.

[5] Although all students beginning in the 2014 academic year were "treated," there is no direct indication for which students received tuition assistance.

GPA. Approximately 22,000 students per 12th grade cohort graduated with a 3.0 or higher, and the final sample size for the current study was just under 200,000 students.

Measures

Dual Enrollment. This report uses several measures of dual enrollment to examine the effect of CCR-CCA on dual enrollment and the extent to which a student dual enrolls while in high school. Education Article § 18-14A-01, Annotated Code of Maryland defines a dually enrolled student as a student who is enrolled in both secondary school and an institution of higher education in Maryland, including both cases where students access college courses in conjunction with their local high school or on their own. This report uses the same method of defining dual enrollment described in Henneberger and colleagues (2018).

A student is determined to be dually enrolled if s/he has enrollment in a secondary school and an overlapping enrollment in an institution of higher education[6] (see Henneberger et al., 2018; 2020). An indicator, equal to 1 if a student ever dual enrolls in their 11th or 12th grade years of high school was used as the main indicator of whether a student ever dual enrolls[7]. Two other measures were created to provide an indication of dual enrollment "intensity" (i.e., to provide an indication of the amount of dual enrollment taken). One measure is an indicator of whether a student dual enrolls in their 11th grade year. Most dual enrollment occurs in a student's 12th grade year, so 11th grade year dual enrollment might provide a measure of intensity. The second measure of intensity is the number of semesters in which a student dual enrolls.

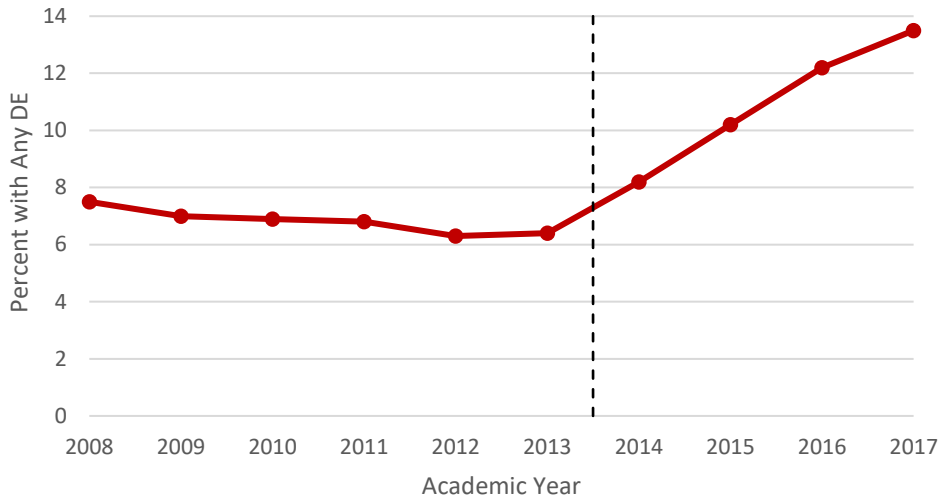
As a preliminary step, descriptive trends in each measure of dual enrollment were examined over time. These changes have also been discussed in recent dual enrollment reports published by the MLDS Center (see MLDS Center, 2019; 2020).[8] Figures 3a, 3b, and 3c show the changes in the dual enrollment intensity measures before and after the passage of the CCR-CCA. Figure 3a shows the percentage of students who dual enrolled at any point in their 11th or 12th grade years of high school. Prior to the 2014 cohort, the first after the CCR-CCA passage, Maryland high school 12th grade students were dual enrolling at a rate of just under 7%, which had remained nearly constant since 2008. After the passage of CCR-CCA, the series begins to increase at a rapid pace such that around 13.5% of students were dually enrolled in 2017, representing a doubling of the rate of dual enrollment over this time period. Between 2013 (the year prior to CCR-CCA implementation) and 2017, the number of students who were dually enrolled increased from 4,105 to 8,072.

[6] This method excludes any type of summer enrollment.

[7] Some students dual enroll in 9th and 10th grade, so the measure of intensity used in this study may be understated. Additionally, some local school systems only allow dual enrollment in 12th grade, making it impossible for students to have dually enrolled in 11th grade.

[8] The MLDS Center Dual Enrollment reports can be found at https://mldscenter.maryland.gov/CenterReports.html

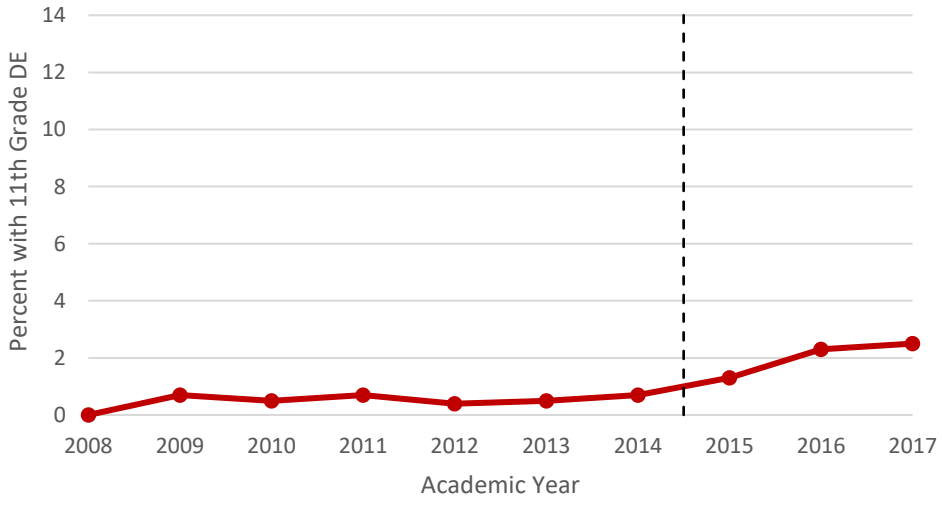
Figure 3a: Percentage of 12th Grade High School Students Who Ever Dual Enrolled Over Time



Note. This chart shows the percentage of students who dual enrolled at any point in their 11th or 12th grade years of high school.

In addition to the overall level of any dual enrollment, other measures of dual enrollment intensity also increased after the passage of the CCR-CCA. Figure 3b shows the same time series but focusing on the rate at which students dual enroll in their 11th grade year of high school. Since the 2014 high school cohort would have only been affected by the CCR-CCA in their 12th grade year, this graph treats the 2015 cohort as the first

Figure 3b: Percentage of Students Who Dual Enrolled in the 11th Grade Year Over Time

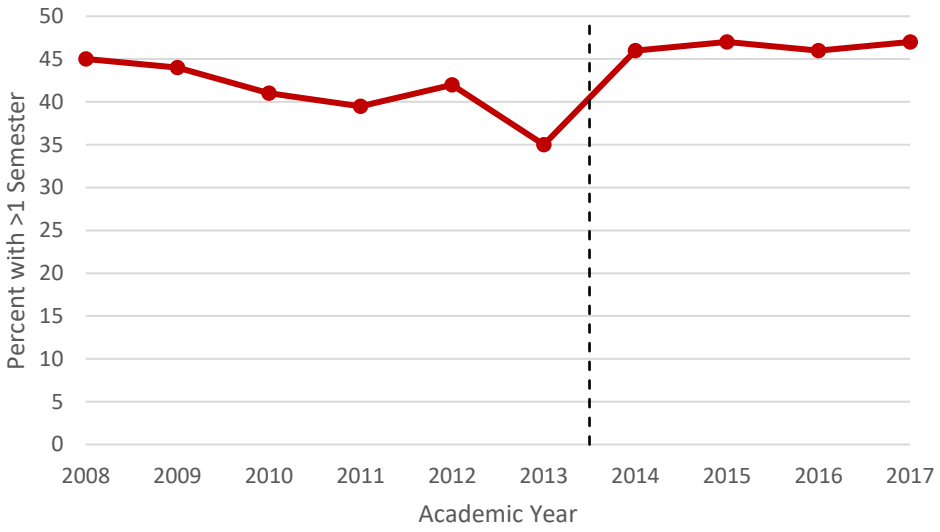


Note: Since the 2014 high school cohort would have only been affected by the CCR-CCA in their 12th grade year, this graph treats the 2015 cohort as the first cohort that could have been affected by the legislation in their 11th grade year.

cohort that could have been affected by the legislation in their 11th grade year. Prior to 2015, dual enrollment in a student's 11th grade year was very low (0.38%). In 2016, this rate had increased to 2.33%.

Similarly, Figure 3c shows that the rate of dual enrolling in more than one semester among students who ever dual enroll, which had been steadily falling over time, increased from less than 35% of dual enrolling students in 2013 to 45% in 2017.

Figure 3c: Percentage of Students Who Dual Enrolled in More than One Semester Over Time



Eligibility for Free/Reduced Price Meals[9] (FARMS). The only available measure of students' household socioeconomic background comes from data collected in accordance with the National School Lunch Program, an income-based eligibility program that provides low-income students with improved access to meals at school. Students with household incomes at or below 130% of the federal poverty level were eligible for free meals, while students with

[9] The Maryland Longitudinal Data System (MLDS) Center uses student-level data on free and reduced-price meals (FARMS) eligibility under the National School Lunch Program (NSLP) as a proxy for poverty. Students are eligible for free or reduced-price meals based on annual household income or the student's status as a migrant student, homeless student, or student in foster care. The National School Lunch Program (NSLP) is administered by the United States Department of Agriculture (USDA). More information can be found on Maryland's Office of School & Community Nutrition Programs website at http://www.marylandpublicschools.org/programs/SchoolandCommunityNutrition/Pages/default.aspx. Using FARMS eligibility as a proxy for poverty may not correctly identify students experiencing poverty and treats all students as experiencing the same level of poverty. Using FARMS participation as a proxy for student poverty has several known limitations and data is only reported on student eligibility at a point in time.

household incomes between 130% and 185% of the federal poverty level were eligible for reduced-priced meals. The free and reduced-price meals (FARMS) indicator associated with each school enrollment record in the MLDS data does not distinguish between eligibility for free meals and eligibility for reduced-price meals, which means that this variable merely indicates that the student's household income was below 185% of the poverty line at that particular point in time.

High School Grade Point Average (GPA). An indicator for whether a student graduated with a 3.0 GPA or higher was used from the MSDE's data on high school completion. Many dual enrollment agreements between a LSS and a community college[10] require a minimum GPA to be enrolled in a community college course. For example, Montgomery Community College requires a 2.75 GPA for students who have completed their sophomore year of high school, and a 2.5 for students who have completed their junior year[11]. The indicator of 3.0 GPA or higher was used to identify students who would be more likely to be eligible for dual enrollment programs.

Demographic Characteristics. Measures of gender, race, and ethnicity were used as control variables in the estimating equations.

Analyses

This report uses several methods to estimate the effect of the CCR-CCA on dual enrollment in Maryland. The first uses an event study descriptive approach, or a "pre-post" design, in which the simple change in dual enrollment after the implementation of the legislation is compared to the levels prior to the legislation. The implementation of the dual enrollment portions of the legislation began in the 2014 academic year[12], facilitating the event study analysis. The CCR-CCA was a wide-ranging legislation that affected multiple parts of higher education in Maryland, but, as described in the prior section, the dual enrollment tuition portions of the legislation were the first to be immediately implemented.

Several strong assumptions would be required to interpret the event study as a causal effect of the dual enrollment tuition reduction portions of the CCR-CCA. Firstly, the assumption must be made that there are no contemporary changes in the outcome variables beginning in the 2014 academic year. In addition to other outside forces that could change dual enrollment or college enrollment in 2014 or after, to interpret the event study estimate as the effect of the tuition reduction would also require that there are no other dual enrollment changes in 2013. For example, the passage of the legislation could have increased salience of existing dual enrollment programs, making students more aware of their existence. Also, high school

[10] The 3.0 GPA measure is used as a crude proxy. The GPA requirements for dual enrollment vary across local school systems in Maryland. The current method may identify some students as "likely eligible" for dual enrollment when not officially eligible and may identify some students as ineligible when they were actually eligible.

[11] See https://www.montgomerycollege.edu/high-school-students/dual-enrollment/eligibility-requirements.html.

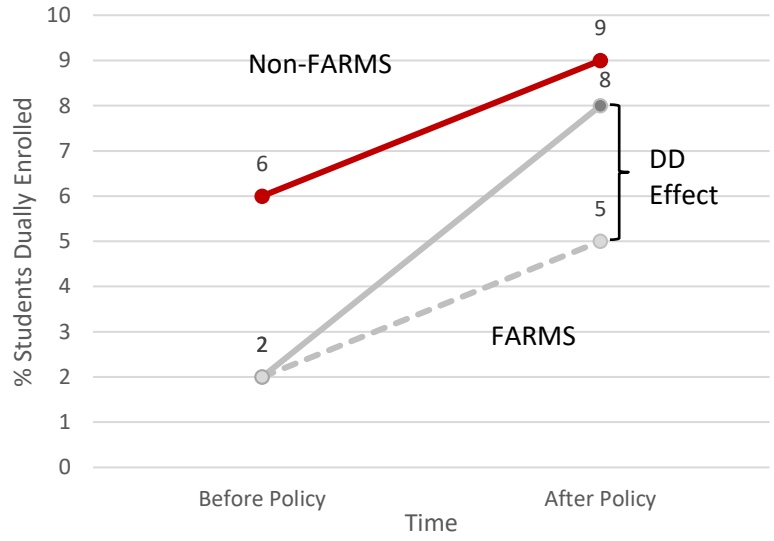
[12] Although all LSS were able to implement in 2014, whether a LSS implemented the tuition subsidy immediately is unknown.

counselors may have been more likely to recommend a community college course after the passage of the legislation, which, while resulting in an increase in dual enrollment due to the CCR-CCA, would not be as a result of the tuition change but instead due to changes in counseling behavior.

As an approach that relaxes these assumptions, this study also uses a difference-in-differences (DD) approach, a popular empirical approach broadly used in empirical social science research (see seminal works, including Ashenfelter & Card, 1985; Card & Krueger, 1994; also see more recent work that has formalized important approaches to inference using the DD method, including Bertrand et al., 2004; Donald & Lang, 2007). This approach measures the difference between a "treated" group and a "control" group, before and after the policy, with the assumption that absent of the policy, the "treated" and "control" groups would maintain the same relationship. Pre-trends in the treated and control groups were examined visually to test the parallel trends assumption necessary for the DD analysis. Inherent to this approach is the assumption that all changes that may impact the two groups differentially can be attributed to the policy implementation itself, with no additional differential changes between groups.

A graphical approach provides the simplest explanation of the DD approach (see Figure 4). The comparison of FARMS-eligible students versus non-FARMS-eligible students is used for the example. The graph represents a trend line of the percentage of each student group who were dually enrolled before and after the policy. The DD method uses the "control" group, in this case, the non-FARMS students, as a counterfactual for what would have happened to FARMS-eligible students in the absence of the policy. To make this concrete, assume that non-FARMS students dual enrolled at a rate of 6% in the period before the policy, and FARMS-eligible students did so at 2%. The main assumption of the method is that, without the policy change, this 4-percentage point difference would remain. This is true even if there was a trend in dual enrollment in the control group, as the FARMS-eligible students would be assumed to follow the same trend. Therefore, if there was a general increase in dual enrollment for non-FARMS students over time, it is assumed that FARMS-eligible students would see a similar increase after the policy. This is represented by the dashed line in Figure 3. However, if the policy were to have a significant effect, we may see something like the solid trend line for FARMS-eligible students, in which the increase in dual enrollment is larger than what we would have predicted. In the Figure 4 example, the percentage of FARMS-eligible students dual enrolling increased to 8% after the policy, 3-percentage points higher than what we would have predicted with our assumptions (shown by

Figure 4: Illustration of the Difference-in-Differences

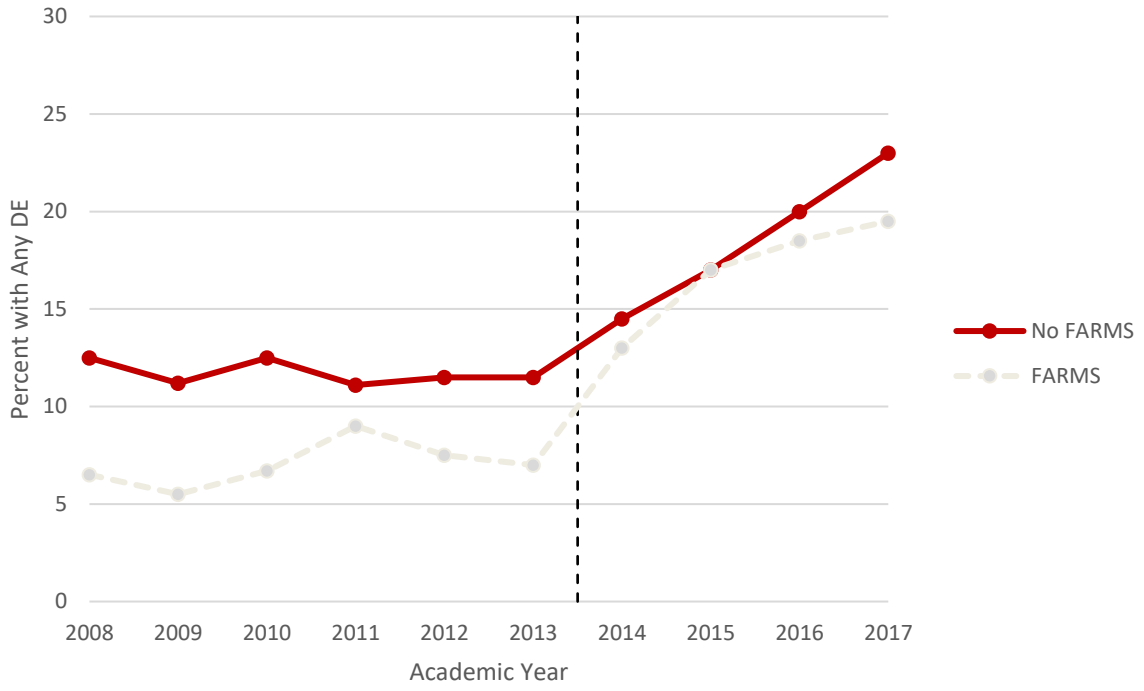


the dashed line). This 3-percentage point gain would be the estimate of the effect of the policy's additional tuition subsidy on dual enrollment for FARMS-eligible students.

Findings

Focusing on the population of students who were likely eligible for dual enrollment (i.e., had a high school GPA of 3.0 or higher), Figure 5 shows the descriptive trends in the rates of change in dual enrollment for FARMS-eligible and non-FARMS-eligible students. Both FARMS-eligible and non-FARMS students saw increases in the rate of dual enrollment, but the changes in dual enrollment were even larger for FARMS-eligible students. Non-FARMS students increased from just under 12% of students having any dual enrollment in the 2013 cohort to 22% of students by the 2017 cohort. The similar change in FARMS-eligible students over the same period was from 7.5% to just under 20%. Though, on average there remains a small gap between FARMS-eligible and non-FARMS students after CCR-CCA, in the 2015 cohort, the rates of dual enrollment for the two groups equalized.

Figure 5: Percent of Students with Any Dual Enrollment Over Time, FARMS Compared to Non-FARMS



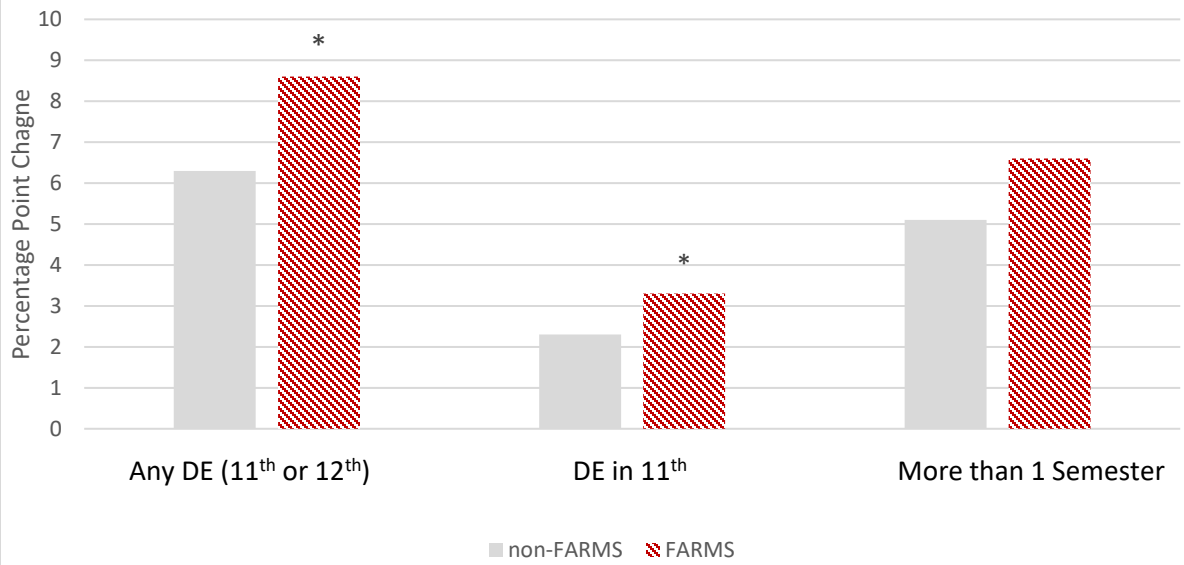
Note. Any DE = Dual enrollment in 11th or 12th grades, focusing on the population of students who were likely eligible for dual enrollment (i.e., had a high school GPA of 3.0 or higher).

Summary: Limiting to students who were likely eligible for dual enrollment (i.e., students who graduated with a 3.0 or higher GPA), both FARMS-eligible and non-FARMS

students saw increases in the rate of dual enrollment, but the changes in dual enrollment were even larger for FARMS-eligible students.

Figure 6 and Table 1 show the estimated total change in dual enrollment after the CCR-CCA for non-FARMS and FARMS-eligible students, for students who were likely eligible for dual enrollment (i.e., students who graduated with a 3.0 or higher GPA). This figure corresponds to the estimates provided in Table 1, which shows the DD estimates of the differential effects for FARMS-eligible students. The grey bars represent the estimates from the first row of Table 1, the estimated increase for non-FARMS students, while the red patterned bars represent the sum of rows 1 and 3 for FARMS-eligible students, or the total increase after CCR-CCA for FARMS-eligible students. The significance stars in the chart indicate whether the difference between FARMS-eligible and non-FARMS students was statistically significant at $p < 0.05$. In Table 1, each number can be interpreted as the percentage point change in the likelihood of the outcome variable. The first row indicates the change for non-FARMS students, the second is the average difference between FARMS-eligible and non-FARMS students over the whole time period, and the third row is the differential effect for a FARMS-eligible student relative to a non-FARMS-eligible student. A significant effect in the third row indicates a statistically significant difference between FARMS-eligible and non-FARMS-eligible students.

Figure 6: Estimated Total Changes in Dual Enrollment FARMS-Eligible Students Compared to Non-FARMS-Eligible Students, 3.0 GPA or Higher



Note. * indicates a significant difference at the $p < 0.01$ level. FARMS = eligibility for free/reduced price meals; DE = Dual enrollment.

FARMS-eligible students saw an increase in the rate of any dual enrollment (11th or 12th grade) of 8.6 percentage points, a significant 2.3 percentage points larger effect ($p < 0.01$) when

compared to non-FARMS students. FARMS-eligible students also saw a significant 1 percentage point larger increase in the rate of dual enrolling in 11th grade ($p < 0.01$). FARMS-eligible students also had a larger increase in the rate of dual enrolling in more than one semester among students who dual enrolled, but this effect is only marginally significant ($p < 0.10$).

Table 1: Estimated Changes in Dual Enrollment for FARMS-Eligible Students Compared to Non-FARMS Students, 3.0 GPA or Higher

	Dependent Variable		
	Any DE in 11th or 12th Grades	DE in 11th Grade	DE in More than 1 Semester
	(1)	(2)	(3)
Post CCR-CCA	0.063***	0.023***	0.051***
	(0.02)	(0.00)	(0.02)
FARMS	-0.047***	-0.006***	-0.067***
	(0.01)	(0.00)	(0.01)
Post x FARMS	0.023***	0.010***	0.015*
	(0.01)	(0.00)	(0.01)
Dependent Mean	0.112	0.007	0.424
Observations (N)	222,884	222,884	31,378

Notes. FARMS = eligibility for free/reduced price meals (1 = student was eligible); DE = dual enrollment. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

Summary: Limiting to students who were likely eligible for dual enrollment (i.e., students who graduated with a 3.0 or higher GPA), FARMS-eligible students saw a significantly larger increase in dual enrollment after CCR-CCA.

Summary of Findings

This report estimated the effect of one component of the CCR-CCA, dual enrollment tuition subsidies, on dual enrollment using a difference-in-differences (DD) approach. Overall, dual enrollment increased over this period for all subgroups of students. Among students who were likely eligible for dual enrollment (i.e., students who graduated with a 3.0 or higher GPA), FARMS-eligible students, who saw larger tuition decreases after CCR-CCA, had larger increases in the rates of any dual enrollment (11th or 12th grades) and dual enrollment in 11th grade.

Discussion

The current study used data from the MLDS and applied a DD research design to estimate the causal effect of the dual enrollment subsidy included in the CCR-CCA legislation. The strategy used non-FARMS students as a comparison group for FARMS-eligible students, who received the largest tuition subsidy for dual enrollment as a result of the legislation. This report is the first to isolate the effect of the cost of dual enrollment by using a change in tuition, resulting from CCR-CCA, to estimate these effects.

This report found that the legislation providing a dual enrollment subsidy in Maryland was successful in increasing dual enrollment, particularly for FARMS-eligible students, who saw the largest decrease in tuition as a result of the legislation. This finding is consistent with recent research showing positive effects of tuition subsidies resulting from Promise programs on subsequent college enrollment (Gandara & Li, 2020; Swanson et al., 2016). The findings are also consistent with a study conducted in Tennessee that showed larger impacts of the Promise program on college enrollment for lower income students (Carruthers & Fox, 2016).

Miller et al. (2018) suggested that the cost of dual enrollment may be an impediment to students' participation, and the current report provides evidence that students who saw larger changes in dual enrollment costs dual enrolled at disproportionately higher rates post-legislation than students who saw smaller changes in cost. Prior literature examines tuition subsidies within the context of college enrollment after high school graduation (Dynarski & Scott-Clayton, 2013), making the current study unique in that it examines effects on college enrollment while in high school. The results indicate that a tuition subsidy provided to high school students draws a similar student response as tuition subsidies offered after high school graduation, particularly for lower income students.

There are several important limitations to consider when interpreting the results of the current study. Difference-in-differences (DD) analysis relies on the assumption that there is nothing concurrent with the policy implementation that affects FARMS-eligible students or students who saw larger decreases in price that differentially affects these students in comparison to other students. This requires that the other aspects of the CCR-CCA did not differentially affect these student groups. It may be the case that increases in counseling or increased information about dual enrollment, for example, was responsible for increases in dual enrollment among FARMS-eligible students. Additionally, due to limitations of MLDS data, the study relied on eligibility for FARMS as an indicator to identify lower-income students, which has known limitations (see Domina et al., 2018). Future research using more precise measures of student disadvantage and family income would help to clarify the effects of policies providing tuition subsidies for low income students. Finally, the current study did not examine differences in the effects by LSS. Eligibility for dual enrollment, dual enrollment course offerings, timing of policy implementation, and cost of living differences may relate to variation in the effects examined by LSS in Maryland (see P-20, 2018).

Policy Implications

CCR-CCA included legislative changes aimed at increasing college access by reducing individual costs for dual enrollment through a tuition subsidy. This report provides evidence that the passage of the CCR-CCA increased dual enrollment in Maryland. Specifically, it provides evidence that the provision within CCR-CCA that reduced tuition was responsible for at least some of the increases in dual enrollment, particularly for lower-income (i.e., FARMS-eligible) students. Prior to CCR-CCA the cost of dual enrolling may have been a barrier that prevented students from dual enrolling. Among students likely eligible to dual enroll, the larger decrease in tuition for FARMS-eligible students seems to have reduced the gap between the dual enrollment rates of FARMS-eligible and non-FARMS students, suggesting a positive benefit of policies that provide tuition subsidies for dual enrollment, particularly for lower-income

students. Additional policies aimed at reducing non-tuition-related costs and curriculum structure could be explored to further help reduce gaps in dual enrollment. For example, policies that reduce the time and money necessary to travel to local colleges for coursework by bringing college teachers to the high school to teach dual enrollment courses may help to eliminate some of the non-tuition-related costs as well as minimize scheduling conflicts that might deter participation when there is not sufficient time to travel to and from the high school and college campuses. Students who otherwise may dual enroll may not due to scheduling conflicts, for both curricular and extracurricular activities. However, if the goal of dual enrollment is to ease the transition to a college campus, the approach of bringing a college teacher to the high school may be counter to that goal.

A key next step for policy will be determining whether the effects of the tuition subsidy on dual enrollment extend to passing dual enrollment courses, enrolling in college, attaining a degree, and/or being successful in the labor market in the long-term. These positive outcomes are critical for the return on investment to the State's initial tuition subsidy. Additionally, one must ask whether there were any unintended consequences as a result of the policy implementation and the increase in dual enrollment for FARMS-eligible students. For example, the tuition subsidy may have increased dual enrollment, but what if early enrollment reduced the motivation for FARMS-eligible students to continue in college? Additional research on the nuanced outcomes subsequent to increased dual enrollment would help to further clarify the costs and benefits of the policy.

Future Research

A key area for future research will be examining whether the tuition subsidy for dual enrollment provided by CCR-CCA helped to increase college enrollment after high school and subsequent college degree attainment, enrollment in non-degree college programs or apprenticeship programs, and success in the labor market. The current study took initial steps to examine the effects on college enrollment in the year following high school, but the trends in college enrollment over time violated assumptions of the DD estimation strategy (see appendix for details). Future research considering alternative approaches could help to examine longer term effects on post-high school outcomes. Additionally, a key interest for policymakers is whether dual enrollment reduces the amount of time a student spends to obtain a college degree. Future research could examine whether the increase in dual enrollment resulting from the tuition subsidy provided by CCR-CCA reduced the time to degree for students, with a particular focus on whether time to degree differs for students who were FARMS-eligible when compared to non-FARMS students. Another key area for future research includes examining the cost-benefits of dual enrollment to determine whether the cost of implementing the program plus the cost of the tuition subsidy realizes positive returns to the State in terms of students' college enrollment and subsequent workforce involvement. Although tuition was free as a result of the subsidy, there may be additional costs to the student (e.g., books; gas to travel to the college) that may deter dual enrollment for lower-income students. Further examination of the costs and benefits to students and the State would help to further understanding the effects of providing a dual enrollment subsidy. Additionally, the policy restriction subsidizing up

to four dual enrollment courses could be further examined to see how many dual enrollment courses students take and whether FARMS-eligible students might benefit from taking additional dual enrollment courses.

Conclusion

This report used a difference-in-differences (DD) estimation strategy to estimate the effect of a tuition subsidy for dual enrollment, passed as part of CCR-CCA legislation in Maryland. The results indicated that FARMS-eligible students, who saw their tuition reduced to zero after the implementation of the CCR-CCA, saw larger increases in dual enrollment when compared to non-FARMS eligible students, when looking among students who were likely eligible to dual enroll (i.e., students who graduated with a 3.0 or higher GPA). This report contributes to the literature by isolating the effect of a change in the cost of dual enrollment and provides positive support for states' investments in tuition subsidies to increase rates of dual enrollment, particularly for lower-income students, who traditionally have lower rates of dual enrollment and subsequent college enrollment.

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Appendix

The effects of the CCR-CCA dual enrollment tuition subsidy on enrollment in college immediately after high school were also examined in the current study using the same estimation strategy. If the result of the effect on dual enrollment was an increase in dual enrollment due to the tuition subsidy, then this increase can be used to estimate the effect of dual enrollment on college enrollment (provided the result was strong enough to provide a valid and reliable statistical test). Any change in dual enrollment after 2014 could be attributed to the tuition subsidy, so a change in college enrollment would thus be considered a change in college enrollment due to the dual enrollment caused by the subsidy.

To meet the assumptions of the DD strategy, trends in the types of college enrollment prior to 2014 (pre-legislation) were examined to determine whether changes in college enrollment after 2014 (post-legislation) could be treated as products of the dual enrollment subsidy included in the legislation. Findings revealed that four-year college enrollment after high school remained mostly constant over the 2009-2013 cohorts, with a slight decrease between 2008 and 2009. After 2014, the first cohort to be affected by the CCR-CCA, the rate of four-year enrollment began to increase. Two-year college enrollment increased between 2008 and the 2009 cohorts, then remained on a slight upward trend between 2009 and 2013. Beginning in 2014, the rate of two-year enrollment began to decrease. The presence of descriptive trends prior to the legislation makes it difficult to examine subsequent college enrollment after high school as a product of dual enrollment resulting from the CCR-CCA legislation.