Senior Project

Department of Economics



The Expansion of the Ohio Educational Choice Scholarship and the Impact on Public School Performance

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In 2005, the Ohio Department of Education created the Ohio Educational Choice Scholarship Program, which allowed students from specific underperforming public schools to use tax dollars meant to be allocated to the building as a scholarship for private school tuition and fees. In 2023, this was expanded into the Ohio Educational Choice Expansion Scholarship Program, allowing students to use the tax dollars funded toward their public school as a scholarship to a private school, regardless of if the school was underperforming. Controversies arise between arguments for the support of the individual student versus the detriment of the students remaining at the public school. This paper examines the effect of implementing the Ohio EdChoice Expansion Scholarship Program and how it affected the performance of public schools. This is measured as the percentage of proficient students in third grade math and language arts, eighth grade math and language arts, high school Algebra and English II, and graduation rates of public high schools. This paper will use a two-way fixed effects differences-in-differences model to investigate this using school building level data from the Ohio Department of Education and US Census Bureau. The final results of this paper conclude that there is a significant difference between schools that were never subject to the Ohio EdChoice Scholarship Program prior to the expansion and schools that were subject, and that third grade math, eighth grade language arts, and high school English II can be attributed to the policy expansion.

Table of Contents

I. **Introduction** 3

II. **Literature Review** 5

III. **Theoretical Discussion** 8

IV. **Data** 10

V. **Methodology** 15

VI. **Results** 17

VII. **Conclusion** 25

I. Introduction

In 2005, the Ohio Department of Education (ODE) began the Ohio Educational Choice Scholarship, colloquially known as the Ohio EdChoice Scholarship. Schools that performed poorly in the prior academic year were placed on a list. Students that attended schools on the list were able to use a state scholarship to attend private schools in the area instead. The scholarship is funded out of the public tax dollars given to a school, instead going towards the student. In 2013 this scholarship was expanded to scale with a household's income, allowing students from financially disadvantaged families to afford higher-cost educational opportunities (*EdChoice Scholarship*, 2023).

In 2023, the ODE included a new option for the EdChoice Scholarship, known as the Ohio Educational Choice Expansion Scholarship. This would allow a student to take the tax dollars from their public school as a scholarship and use it as tuition and fees for another school, regardless of if it was private or public. In other words, a student may leave their public school for *any* other school, now transforming the school voucher into a universal school voucher. Even if a school provides a high-quality education for a student, they are still able to use the school voucher to leave (*EdChoice Expansion,* 2023).

The expansion has faced mixed reactions across the educational spectrum. Proponents of the scholarship like the Thomas B. Fordham Institute claim that allowing all students to utilize the scholarship helps in terms of sheer quantity of students able to attend private charter schools, especially nonwhite and poor students who would typically be unable to receive such an opportunity (Churchill, 2025). Opponents state that the scholarship is directly tied to the budget of a public school building. By allowing any student to leave regardless of performance harms

students in well-performing districts and funnels taxpayer dollars out of public institutions (Lier and Pruitt, 2024; Melvin, 2026).

This paper investigates the effect that the Ohio EdChoice Expansion Scholarship has on the percentage of proficient students in public schools, and is to determine whether allowing a new program like this to continue will have detrimental or positive effects on a student's education future. Research in this field has already deduced how private schools typically offer a more robust curriculum than public schools (Gross, 2018), and how the original Ohio EdChoice Scholarship in 2005 has improved educational standards massively across the board (Figlio and Karbownik, 2016). This paper's unique contribution is investigating how the expansion of school vouchers to a universal group compared to a selective subpopulation will affect the entire population.

The data used in this paper is from the Ohio Department of Education and the US Census Bureau. It examines the percentage of proficient students in seven different subjects between math and language arts in grade schools. The subjects used are grade 3 math, grade 3 language arts, grade 8 math, grade 8 language arts, high school level Algebra, high school level English II, and the graduation rates of high school buildings. The control variables used are the median income of the county the building is in, measured in the thousands; the population of the county the building is in, measured in the thousands; the percentage of male students in the building, the percentage of black students in the building; the percentage of Asian students in the building, the percentage of Latino students in the building, the percentage of multiracial students in the building, and the percentage of students with disabilities in the building.

To investigate this, the paper uses a two-way fixed effects differences-in-differences model. There are seven different linear and logarithmic models, each one using a different

subject previously listed. The two-way fixed effects of the model are measured at the building and academic year level. The differences-in-differences indicator variable tracks if a school was never subject to the Ohio EdChoice Scholarship and then was introduced to the Ohio EdChoice Expansion Scholarship. In other words, a school that never allowed their students to participate in the Ohio EdChoice Expansion Scholarship program is a part of the treatment group, whereas schools that did allow their students to participate are part of the control group.

The concluding results about this paper are that the Ohio EdChoice Expansion Scholarship more negatively affected schools that were already privy to the Ohio EdChoice Scholarship prior to 2023 in certain subjects. Grade 3 Math, Grade 8 Math, Grade 8 Language Arts, and Algebra all had a statistically significant positive coefficient. This means that schools that were never allowed to have their students use a school voucher from the program had an on-average higher percentage of proficient students in those subjects.

The remainder of the sections in this paper will be organized as follows: Section I will introduce the paper and the research question. Section II will provide the literature review of other papers regarding public and private school funding and impacts on quality of learning. Section III will include the theoretical discussion regarding economic theory as to why parents are open to moving their children between schools using provided programs. Section IV will include the data used. Section V will include the methodology behind the analysis. Section VI will include the results. Section VII will conclude the paper.

II. Literature Review

Parents have a variety of factors affecting the choice in where they may send their children for school. If these factors change partway through a child's education, parents may feel

inclined to swap between schools. Parents are typically satisfied with their student's education when there are sufficient educational materials, good attitudes of educators, appropriate and relatively small classroom sizes, and flexible approaches from the administration (Önder and Önder, 2022). However, when there are fewer resources available for families financially struggling, like free lunches, and a less rigorous and challenging curriculum, parents are less likely to send their children to those schools (Owens et al., 2016). Other limiting factors for families can include geography, as the choice can also be based on proximity to the household (Hastings et al., 2005; Trajkovski et. al, 2021) and transportation resources (Trajkovski et al., 2021).

Some factors of school choice are based on a family's economic standing, where a difference in institutions will not lead to a difference in academic achievement. For instance, around three quarters of a student's academic potential is derived from their socioeconomic status. A difference in academic programming will have little to no effect on their performance (Orfield and Wallace, 2008). Similarly, students who experience more negative psychosocial issues in school compared to their peers are typically lower-income students. Additionally, they are more likely to experience said issues when there is a higher proportion of middle- or higher-income classmates. Other immutable characteristics, like race, ethnicity, and sex, play a large factor in affecting how well a student may do in grade school and in postsecondary education (Deming et al., 2014; Riegle-Crumb and King, 2010).

Once parents have made their choice and sent their children to their respective schools, academic districts begin to compete in hopes of attracting or retaining students. Schools receive thousands of dollars from the state department of education for each pupil attending their institution (Howell and Miller, 1997). Because of that, even a few dozen students leaving a

school because of poor educational quality will result in a six-figure loss of operational budget for academic programming and expansion or refreshment of the current curriculum. From the other perspective, students enrolling into a school will grant them additional funds to continue to better their institution. When there is competition around public schools, most notably private institutions or charter schools, the administration will invest more into the quality of the curriculum, the quantity of resources available (Couch et al., 1993), and the support required in order to help students graduate (Dee, 1998).

The primary limiter between a private and public school is the financial cost for many families. Private schools have two requirements to entry: the academic potential to do well in a more rigorous setting, and the financial capacity to pay the associated tuition and fees. As a result, only high-income families are able to afford sending their children to private schools with better educational programs (Murnane et al., 2018). If students are able to pass the entrance exam given but are unable to pay the tuition and fees, then the barrier to entry is the financial aspect. This in turn hurts financially struggling students as they remain in public schools while higher-income students can attend private institutions, removing portions of the operational budget as they leave. Research has found that the funding grade school institutions receives are directly related to the performance of students (Căldăraru et al., 2018; Toma, 1996). As private enrollment rates increase over time, public performance scores will subsequently decrease (Marlow, 2007).

My contribution to this field is researching the effect that a policy expansion would have when it is initially designed for underperforming public schools and is then expanded to all public schools. Prior research in the educational field has shown that private schools perform similarly, if not worse, to public schools once demographic differences like race and sex are

removed (Lubienski and Lubienski, 2006). It has also been shown how state intervention has played a role in improving different fields based around public policy (McQuillan, 2008). The contribution this paper would add to the field is the expansion of a public policy like the Ohio EdChoice Scholarship Program and its effects when expanded to include target groups that were not part of the initial program.

III. Theoretical Discussion

A relevant theory to the topic of this paper is the degree of market competition and its impact on the suppliers. When vouchers are provided to every student instead of a select few, the question for a parent now is primarily the perceived quality of the education being provided rather than both the quality and cost to obtain it. The economic argument of this paper is that by providing vouchers to students to lower the barrier to exit the public school system, we can expect to see the number of consumers decrease for public education and a follow-up decrease in public education quality.

It is first important to note the difference in reasons why a parent would consider moving their child between schools and the internal and external factors. Internal factors refer to personal characteristics that would not change if a student were to change between buildings. These can include the socioeconomic status of the family themselves, the race or sex of the child, or the familial structure. External factors refer to communal characteristics that are dependent on the location that a student is in and are privy to changing. These include the quality of educational and supporting resources, the socioeconomic status of classmates, and the proximity of the school to the household. Competing theories in the field discuss the external factors.

Prior research in this field has shown distinct competition in theories. If there is competition in educational opportunities, public schools will spend more in educational resources and curriculum development in order to provide higher quality for their students and improve graduation rates (Christensen et al., 2011; Couch et al., 1993; Dee, 1998). Because funding is based on the number of students attending an institution (Howell and Miller, 1997), public administrations will try new and innovative methods in order to attract and retain students. This is especially prevalent in school districts with a high median household income, as those schools would have the time and money to dedicate towards innovative programs that would retain their students, in contrast to schools that are already struggling for funding that would be unable to create a competitive edge compared to local private schools.

Opposing theories argue that a reduction in student numbers at public schools when private schools are available negatively affects the performance of those remaining (Marlow, 2007). Only affluent families are able to send their children to expensive private schools (Murnane et al., 2018). The reduction in budget due to fewer students can also be argued to a decrease in programs, curriculum innovation, and an overall lower operating budget. Additionally, higher-income families have the additional income to spend on tutors and extracurricular academic programs. Those students leaving their public schools would consequently decrease the percentage due to their already high academic achievement.

Although there are competing theories, my *prior expectation* is that an expectation to see a decrease in performance schools at public schools. I believe that the overall reduction in funding due to fewer students has an immediate impact on programs and hurts student scores before new and innovative advancements can be made. There is an expected negative correlation between the implementation of universal school vouchers and student performance scores.

IV. Data

The Ohio Department of Education (ODE) provides three of the datasets necessary for this analysis, and the United States Census Bureau provides the other datasets necessary for the control variables. These have all been aggregated into one primary dataset for simplicity.

The first is a historical list of all public schools that were valid for their students to receive an Ohio Educational Choice Scholarship, from the 2007-2008 academic year to the 2024-2025 academic year (ODE, 2025a). In the primary dataset, this has been marked as any building that has not been eligible for the scholarship with a value of 1 for *old_law* prior to 2023. The second is a composite of public-school building performance in Ohio in a variety of subjects from the 2015-2016 academic year to the 2024-2025 academic year. These denote the percentage of students who scored proficient or above in a given subject (ODE, 2025b). Prior to high school, students are tested in math and language arts from grade 3 through 8. In high school, students are tested on different individual subjects. This paper will consist of math proficiencies in grade 3, grade 8, and in Algebra at the high school level, along with language arts proficiencies in grade 3, grade 8, and English II at the high school level. This is to check if the Ohio EdChoice Expansion Scholarship had significantly different effects depending on the subject. Note that there is no data for the 2019-2020 academic year due to COVID-19, as state tests were cancelled and scores were not collected.

The third dataset is a composite list of all Ohio counties from the US Census Bureau from 2015-2024 and the median income for all families (US Census, 2026a). The fourth dataset is a composite list of all Ohio counties from the US Census Breau from 2015-2024 and the population total for each county (US Census, 2026b). These will be used for the balance of

regressors test to verify that there are no other possible variables explaining the policy impact. Note that there is no data for 2020 as well due to COVID-19.

The fifth dataset is a composite list of all Ohio public schools from the academic years of 2015-2016 to 2024-2025 and the demographic percentage of students who were male, black, Asian, Latino, multiracial, or had a disability (ODE, 2025c). These were used in conjunction with the fourth dataset to serve as control variables to verify that race and sex are not also variables that could explain the policy impact.

Table 1 represents the summary statistics for schools that allowed students to obtain an Ohio EdChoice scholarship, whereas Table 2 represents the summary statistics for those who never did. What's important to note is that both groups had minimums of zero for each of their proficiencies, noting that both groups have had poor academic years. This can be explained as academic buildings that joined the Ohio EdChoice Scholarship Program the following year after failing to reach state minimum standards. Across the groups, the percentages did not differ to more than fifteen percent.

Table 3 represents the balance of regressors test used to verify a lack of statistical significance between the groups. The table shows a lack of statistical significance between the population of the county a building is located in and the percentage of male students within a given school. However, the table also shows statistical significance between the median household income in thousands by county, the percentage of black students, the percentage of Asian students, the percentage of Latino students, the percentage of multiracial students, and the percentage of students with disabilities. This signifies that although some regressors had no significant difference between the control and treatment groups, there are clear differences

between the racial makeup of public schools subjected and not subjected to the Ohio EdChoice Scholarship program and should therefore consider the results with caution.

Table 4 represents the parallel trend test used to verify a consistent trend between the control and treatment groups prior to the treatment being applied. This parallel trend uses the third polynomial for the relative year. The $Treatment*Year^3$ variable is insignificant for Grade 3 Math, Grade 8 Language Arts, and English II. Each of the other models are significant to at least the 10% level, demonstrating how there were clear differences in the groups prior to the treatment. As such, we cannot claim that the policy impact from the expansion of the Ohio EdChoice Scholarship program was the catalyst for any change between the groups.

The data has some inconsistencies due to how it was collected and aggregated. Because all of the numbers have been pulled directly from the state-provided datasets, any change to calculating a proficient score between 2015 and 2024 will not be accurately reflected. Additionally, due to the outcome variables spanning kindergarten through high school and not every academic building servicing those grades, every school has data missing at some level. Buildings will have "NC" or "NR" to denote the data as either not collected or not reported. This can occur in elementary schools when recording graduation rates or middle schools for the percentage of proficient third grades in math, for instance. To account for this, "NC" and "NR" will be replaced with a null value for data analysis. This will allow for higher accuracy in displaying the differences in model sizes and potentially statistical significance.

Table 1. Summary Statistics for Control Group

Variable	Obs	Mean	Std Dev	Min	Max
Third Grade Math	11090	62.54	23.59	0.00	100.00
Third Grade Language Arts	11104	60.38	21.44	0.00	100.00
Eighth Grade Math	6435	48.26	25.50	0.00	100.00
Eighth Grade Language Arts	6468	49.85	21.71	0.00	100.00
High School Algebra	9154	65.84	29.85	0.00	100.00
High School English II	5518	61.78	18.98	0.00	100.00
Graduation Rate	5901	90.01	13.91	1.20	100.00

Sources: Data provided by the Ohio Department of Education, the US Census Bureau, and own calculations.

Table 2. Summary Statistics for Treatment Group

Variable	Obs	Mean	Std Dev	Min	Max
Third Grade Math	1451	70.76	18.99	0.00	100.00
Third Grade Language Arts	1453	70.74	17.85	0.00	100.00
Eighth Grade Math	1070	56.82	23.47	0.00	100.00
Eighth Grade Language Arts	1068	57.59	19.73	0.00	100.00
High School Algebra	1487	79.97	21.69	2.50	100.00
High School English II	810	72.81	14.17	0.00	98.90
Graduation Rate	813	95.13	6.52	45.60	100.00

Sources: Data provided by the Ohio Department of Education, the US Census Bureau, and own calculations.

Table 3. Balance of Regressors Test

Regressors	Treatment	Control	Difference
Median Household Income in Thousands	58.82	57.26	1.56***
County Population in Thousands	368.90	366.20	2.62
Percentage of Male Students	44.17	44.38	-0.21
Percentage of Black Students	7.51	22.77	-15.26***
Percentage of Asian Students	1.80	1.37	0.43***
Percentage of Latino Students	4.23	6.67	-2.44***
Percentage of Multiracial Students	3.69	6.15	-2.46***
Percentage of Students with Disabilities	13.77	16.01	-2.24***

Sources: Data provided by the Ohio Department of Education, US Census Bureau and own calculations.

Notes: The table shows the pre-2023 average values of regressors for the treatment and control groups, as well as the difference. Differences that are statistically significant are identified with *, **, and ***, corresponding to 10%, 5%, and 1% significance levels, respectively.

Table 4. Parallel Trend Test

Regressors	Math 3	LA 3	Math 8	LA 8	Algebra	English II	Grad Rate
Treatment	0.3714***	0.2719***	0.7605***	0.5783***	0.4936***	0.4687***	0.0435
	(0.0990)	(0.0869)	(0.1289)	(0.0984)	(0.0869)	(0.0897)	(0.0591)
Year	0.3619***	0.2928***	0.6782***	0.1244***	0.4245***	0.0560	0.0077
	(0.0869)	(0.0449)	(0.1038)	(0.0146)	(0.0662)	(0.0560)	(0.0574)
Year2	0.1128***	0.0980***	0.2216***	0.0097***	0.1318***	0.0307	0.0087
	(0.0223)	(0.0116)	(0.0270)	(0.0146)	(0.0190)	(0.0144)	(0.0142)
Year3	0.0086***	0.0083***	0.0174***	0.0097***	0.0108***	0.0034	0.001
	(0.0016)	(0.0008)	(0.0020)	(0.0010)	(0.0014)	(0.0010)	(0.0011)
Treatment * Year	-0.0748	-0.0885**	-0.1580**	0.0409	-0.0729	0.0754	-0.0937
	(0.1079)	(0.0417)	(0.0661)	(0.0592)	(0.0498)	(0.0468)	(0.0607)
Treatment * Year2	-0.0269	-0.0256**	-0.0589***	0.0095	-0.0279*	0.0174	-0.0316*
	(0.0290)	(0.0116)	(0.0182)	(0.0145)	(0.0144)	(0.0009)	(0.0175)
Treatment * Year3	-0.0020	-0.0019*	-0.0046***	0.0008	-0.0025**	0.0011	-0.0027*
	(0.0022)	(0.0010)	(0.0014)	(0.0011)	(0.0011)	(0.0009)	(0.0014)
Control Variables Included?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sources: Data provided by the Ohio Department of Education, US Census Bureau and own calculations.

Notes: The table shows the pre-2023 average values of regressors for the treatment and control groups. Each model name in order represents third grade math, third grade language arts, eighth grade math, eighth grade language arts, high school algebra, high school English II, and graduation rates. Differences that are statistically significant are identified with *, **, and ***, corresponding to 10%, 5%, and 1% significance levels, respectively.

V. Methodology

My *prior expectation* was to see an overall decrease in the percentage of proficient students in public schools after the implementation of the Ohio Educational Choice Expansion Scholarship. Receiving a private education from the expanded program has become significantly cheaper. As a result, parents will opt for the significantly higher quality education from private schools in exchange for the lowered price point. Since the operational budget of public schools is tied to the number of pupils attending their institutions, students moving out of their public schools will result in a reduction in dollars to work with. This in turn increases the difficulty in improving and expanding current academic programs and reduces the quality of said programs moving forward.

This paper will use a two-way fixed effect difference-in-differences model to measure the change in the percentage of proficient students in public schools following the implementation of the Ohio EdChoice Expansion Scholarship. I will be using one different model to measure the scores at different levels of grade school.

$$Y_{bt} = \beta_0 + \beta_1 EdChoiceOptional + X_{bt} + Building_b + Year_t + \varepsilon_{bt} \quad (1)$$

$$\log(Y_{bt}) = \beta_0 + \beta_1 EdChoiceOptional + X_{bt} + Building_b + Year_t + \varepsilon_{bt} \quad (2)$$

Y_{bt} represents the percentage of each outcome variable in building of b and academic year of t. For grade 3 math, grade 3 language arts, grade 8 math, grade 8 language arts, Algebra, and English II, Y_{bt} represents the percentage of students proficient in each of those subjects at a given

building of b in an academic year of t. For the graduation rate, Y_{bt} represents the percentage of students who graduated from a given building of b in an academic year of t. $\beta_1 EdChoiceOptional$ is a binary variable measuring whether a school was ever listed as being eligible for the Ohio EdChoice Scholarship Program. $\beta_1 EdChoiceOptional$ was given to schools that were never listed as eligible for the Ohio EdChoice Scholarship Program, and not given to schools that were eligible for the scholarship at one point prior to the universal expansion.

X_{bt} represents the different control variables used in a county of b and year of t. The control variables used are the median household income by county in thousands, county population in thousands, percentage of male students, percentage of black students, percentage of Asian students, percentage of Latino students, percentage of multiracial students, and the percentage of students with disabilities. Because only the data collected by the ODE is at the building level and the data collected by the US Census is at the county level, control variables were assigned to the county the school was located in. Additionally, because the data collected by the ODE spans two years to represent the academic year, the data from the US Census is assigned based on the start of the academic year, because that is when parents are most likely to make the choice to switch schools for their child.

$Building_b$ represents the entity fixed effects of the model, such as the poverty rate for the state in a given year. $Year_t$ represents the time fixed effects of the model, such as the number of schools active in a given county. Lastly, ε_{bt} represents the white noise within the model.

It is important to note the limitations of the methodology concerning the control group and data used. Regarding the control group, it takes an extremely conservative estimate by assuming every school within the group has always been eligible for the Ohio EdChoice Expansion Scholarship program. In reality, this is untrue as school are able to move on and off

the eligibility list depending on the prior academic year's performance. It is assumed that all schools stayed on the list, as there were few deviations once a school became eligible for the universal school vouchers. Regarding the data used, to isolate the effect that the scholarship may have had on public school performance, the school buildings used were required to be operating from 2015 to 2025. If a public school opened or closed during that time period, they were excluded from the data. This is to prevent schools that were already failing and closing to be unfairly attributed to the pre-treatment groups without ever having an opportunity to have the treatment applied, or to prevent schools from opening in the post-treatment period and unable to measure their impact based on non-existent pre-treatment periods.

VI. Results

Table 5 represents the linear models of the effect of the Ohio EdChoice Expansion Scholarship Program on public school performance. The primary regressor of interest is the *Inclusion in the Expansion Program*. This details whether or not a building becoming included in the expanded scholarship program while not being involved in the original scholarship program affected the percentage of proficient students within the school compared to a building who did utilize the original scholarship program at some point.

The primary regressor is positive and significant at the 1% level for all models. Additionally, the values show that schools that were never subjected to the Ohio EdChoice Scholarship Program had a 16.13 percentage point increase in third grade math, 18.74 percentage point increase in eighth grade language arts, and 19.04 percentage point increase in high school English II compared to schools that utilized the scholarship prior to its expansion. Additionally, graduation rates were also 4.76 percentage points higher. The reason for the much smaller

increase can be attributed to high schools having a generally high graduation rate, regardless of their inclusion in the original program.

Table 6 represents the logarithmic models of the effect of the Ohio EdChoice Expansion Scholarship Program on public school performance. Due to the fact that the primary regressor is a percentage, Table 5 was used to check the veracity of the effect of Table 6's results. This table also does not include demographic data to test whether the racial and gender composition of a school affects the primary regressor. This is because a student participating in the scholarship program and leaving their public school will cause a shift in the racial and gender composition and could potentially be poor control variable.

The primary regressor is again positive and significant at the 1% level. However, the effect of the primary regressor indicates a 38.54 percent increase for third grade math, a 65.60 percent increase for eighth grade language arts, and a 45.63 percent increase for high school English II. This demonstrates a significant difference between the schools never subjected to the program and how many of their students are proficient compared to schools that were subjected to the program. It is important to note that the control variable of *Percentage of Male Students* is also highly negative and statistically significant, which is most likely explaining the stark difference in values.

To test this further, Table 7 represents the logarithmic models of the effect of the Ohio EdChoice Expansion Scholarship Program on public school performance, now utilizing the racial, gender, and disabled composition of each school as well. This is to account for any effect that the inclusion of different racial groups or percent of students may have, assuming that the number of students leaving a school is negligible to the shift in its racial composition.

The primary regressor matches what Table 5 and Table 6 have confirmed; it is positive and statistically significant at the 1% level for third grade math and language arts, 5% statistically significant for eighth grade math and language arts, high school Algebra and English II, and 10% statistically significant for graduation rates. However, the effect has been drastically reduced. Instead, third grade math shows a 8.51 percent increase, eighth grade language arts shows a 19.75 percent increase, and high school English II shows an 11.24 percent increase. This can be explained from the newly introduced demographic control variables, which allow for the model to more accurately assess the effect of the policy expansion.

It is important to note that only third grade math, eighth grade language arts, and English II passed the parallel trend test, and so only those three models can be said to have their differences attributed to the policy expansion. All other models have an extenuating variable that did not allow them to pass the parallel trend test and should thus treat their results in Tables 5, 6, and 7 with caution.

Table 5: The Effect of the Ohio EdChoice Expansion Scholarship Program on Public School Performance

Regressors	Math 3	LA 3	Math 8	LA 8	Algebra	English II	Grad Rate
Inclusion in the Expansion Program	16.1296***	14.5421***	23.6809***	18.7381***	18.9632***	19.0402***	4.7600***
	(2.8907)	-3.0571	(3.0775)	(3.2633)	(2.8636)	(3.0376)	(1.2216)
Median Household Income in Thousands	-0.1023	-0.1301**	-0.1049	-0.1155	-0.1240	-0.0594	0.0532
	(0.0659)	-0.0569	(0.1320)	(0.0876)	(0.1048)	(0.0863)	(0.0682)
County Population in Thousands	-0.0003	-0.0002	0.0004	0.0003	-0.0009	-0.0002	-0.0022***
	(0.0005)	(0.0004)	(0.0012)	(0.0005)	(0.0027)	(0.0007)	(0.0006)
Percentage of Male Students	-22.2142***	-27.4891***	-18.8727*	-27.8073***	-19.6991***	-43.5819***	-19.9931***
	(4.9754)	(4.0799)	(6.8920)	(5.8148)	(3.9901)	(4.5115)	(5.8447)
Intercept	162.3835***	170.0602***	133.0887	163.4592***	148.3683***	228.4284***	163.5749***
	(20.2251)	(16.5046)	(27.2959)	(23.8054)	(16.8774)	(19.2538)	(23.1832)
Demographic Data Included?	No	No	No	No	No	No	No
Building and Year Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	8,932	8,945	4,938	4,959	6,768	3,930	4,314
Adjusted R-Square	0.2298	0.2109	0.2636	0.2928	0.0988	0.2497	0.0866
Overall Significance	232.23***	10,728.73***	8,979.00***	1,410.53***	243.09***	1,553.72***	91.29***

Sources: Data provided by the Ohio Department of Education, the US Census Bureau, and own calculations.

Notes: Each model name in order represents third grade math, third grade language arts, eighth grade math, eighth grade language arts, high school algebra, high school English II, and graduation rates. Robust standard errors are in parentheses. All models have clustered robust standard errors and are clustered to the building level. *, **, and *** respectively indicate 10%, 5%, and 1% significance levels. The reference group is Allen County in 2015 for all models. All models are linear.

Table 6: The Effect of the Ohio EdChoice Expansion Scholarship Program on Public School Performance

Regressors	Math 3	LA 3	Math 8	LA 8	Algebra	English II	Grad Rate
Inclusion in the Expansion Program	0.3260***	0.2729***	0.7292***	0.5044***	0.3977***	0.3759***	0.0559***
	(0.0816)	(0.0687)	(0.1097)	(0.1153)	(0.0750)	(0.0684)	(0.0151)
Median Household Income in Thousands	-0.0011	-0.0019*	-0.0016	-0.0026	-0.0048*	-0.0017	0.0020
	(0.0014)	(0.0010)	(0.0035)	(0.0024)	(0.0025)	(0.0016)	(0.0018)
County Population in Thousands	-0.0000	0.0000	-0.0000	0.0001**	-0.0000	0.0000***	-0.0000*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)
Percentage of Male Students	-0.5171***	-0.6211***	-0.6840***	-0.7993***	-0.6732***	-1.0654***	-0.3070**
	(0.1133)	(0.0994)	(0.2038)	(0.1762)	(0.1700)	(0.1409)	(0.1444)
Intercept	6.2938***	6.4506***	6.5765***	7.0448***	6.8847***	8.1930***	5.5707***
	(0.4599)	(0.3929)	(0.8247)	(0.7323)	(0.6667)	(0.5803)	(0.5794)
Demographic Data Included?	No	No	No	No	No	No	No
Building and Year Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	8,897	8,934	4,841	4,921	6,732	3,919	4,314
Adjusted R-Square	0.1943	0.1925	0.2621	0.2959	0.1154	0.2397	0.0584
Overall Significance	967.74***	685.63***	77.06***	2,668.60***	48.66***	5,335.80***	164.23***

Sources: Data provided by the Ohio Department of Education, the US Census Bureau, and own calculations.

Notes: Each model name in order represents third grade math, third grade language arts, eighth grade math, eighth grade language arts, high school algebra, high school English II, and graduation rates. Robust standard errors are in parentheses. All models have clustered robust standard errors and are clustered to the building level. *, **, and *** respectively indicate 10%, 5%, and 1% significance levels. The reference group is Allen County in 2015 for all models. All models are logarithmic.

Table 7: The Effect of the Ohio EdChoice Expansion Scholarship Program on Public School Performance

Regressors	Math 3	LA 3	Math 8	LA 8	Algebra	English II	Grad Rate
Inclusion in the Expansion Program	0.0817***	0.0589***	0.2395**	0.1802**	0.1910**	0.1065**	0.0327*
	(0.0240)	(0.0153)	(0.1034)	(0.0675)	(0.0789)	(0.0395)	(0.0176)
Median Household Income in Thousands	0.0001	-0.0020	0.0045	0.0026	-0.0034	-0.0006	0.0021
	(0.0021)	(0.0023)	(0.0036)	(0.0029)	(0.0022)	(0.0016)	(0.0034)
County Population in Thousands	-0.0000	0.0000**	0.0001**	0.0001***	0.0000	0.0000**	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Percentage of Male Students	-0.3986***	-0.3273**	0.0969	-0.4502	-0.0414	-0.6054**	-0.4718**
	(0.1204)	(0.1303)	(0.3660)	(0.2806)	(0.2518)	(0.2475)	(0.2047)
Percentage of Students with Disabilities	-0.0982*	-0.1174***	-0.4941***	-0.4303***	-0.2231	-0.3369***	-0.0084
	(0.0517)	(0.0387)	(0.1339)	(0.1138)	(0.1335)	(0.0843)	(0.0373)
Percentage of Black Students	-0.1656***	-0.1543***	-0.2429***	-0.1839***	-0.2062***	-0.1577***	-0.0225*
	(0.0244)	(0.0247)	(0.0281)	(0.0350)	(0.0340)	(0.0279)	(0.0123)
Percentage of Asian Students	0.0317**	0.0277	0.0448	0.0359	0.1314***	0.0328	-0.0055
	(0.0155)	(0.0180)	(0.0399)	(0.0254)	(0.0311)	(0.0221)	(0.0126)
Percentage of Latino Students	-0.1768***	-0.1878***	-0.1580***	-0.1986***	-0.0738	-0.1346***	-0.0402
	(0.0365)	(0.0325)	(0.0505)	(0.0481)	(0.0495)	(0.0341)	(0.0245)
Percentage of Multiracial Students	0.0699**	0.0791**	0.0667	0.1662***	0.2486***	0.1658**	0.0235
	(0.0335)	(0.0299)	(0.0624)	(0.0501)	(0.0795)	(0.0675)	(0.0313)
Intercept	6.5044***	6.1529***	5.0436***	6.8619***	4.9942***	7.3858***	6.3713***
	(0.4459)	(0.5162)	-1.3773	(0.9707)	(0.8975)	(0.7675)	(0.8188)
Demographic Data Included?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Building and Year Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	2,100	2,100	1,232	1,210	2,160	1,294	1,331
Adjusted R-Square	0.478	0.5417	0.5284	0.6549	0.3000	0.6699	0.0670
Overall Significance	2,197.71***	34,953.69***	6,079.47***	866.09***	276.40***	797.72***	389.00***

Sources: Data provided by the Ohio Department of Education, the US Census Bureau, and own calculations.

Notes: Each model name in order represents third grade math, third grade language arts, eighth grade math, eighth grade language arts, high school algebra, high school English II, and graduation rates. Robust standard errors are in parentheses. All models have clustered robust standard errors and are clustered to the building level. *, **, and *** respectively indicate 10%, 5%, and 1% significance levels. The reference group is white students in Allen County in 2015 for all models. All models are logarithmic.

VII. Conclusion

There is a statistically significant impact to show that the Ohio EdChoice Expansion Scholarship program was more beneficial for schools that were never eligible for the original Ohio EdChoice Scholarship program in comparison to schools that were eligible at some point from 2015 to 2023. Furthermore, Table 4 and Table 7 in conjunction show that the stark differences between the treatment and control group in third grade math, eighth grade language arts, and high school English II can be safely attested to the expansion of the educational policy. However, while third grade language arts, eighth grade math, high school Algebra, and graduation rates were positive and statistically significant, they failed the parallel trend test and cannot have the differences between the groups post-treatment attributed to the policy expansion.

My *prior expectation* was incorrect, as the policy expansion did increase the overall number of proficient students in public schools. This can be explained via the increasing competition between public schools and private schools. As private schools decrease in cost thanks to universal school vouchers being introduced, public schools begin to lose the competitive advantage granted to them. This in turn requires schools to invest time, money, and resources back into their educational programs to create a new competitive advantage that encourages parents to keep their children in public school. The difference is in the schools between the treatment and control groups: Schools in the treatment group had money and resources to invest back into their schools. This caused parents to reconsider moving their children between schools. However, schools in the control group had fewer resources and less money available, not allowing them to create the competitive advantage required to retain their student population.

It is important to note the limited range that the current data has when discussing educational policy. Since the policy expansion occurred in the summer of 2023, there have only been two years of post-treatment data available for use. As a result, schools and families may not have fully adjusted to the opportunities the Ohio EdChoice Expansion Scholarship Program provides. This is especially more prevalent for schools in the treatment group, which are made up of communities that never had access to the Ohio EdChoice Scholarship prior to 2023. Were this to be investigated in five years, there would also realistically be a stronger difference in graduation rates as the scholarship program begins to affect students who transitioned to a private four-year high school.

Lawmakers need to consider whether the current outflow of students from public schools into private schools is worth the detrimental effects for the remaining public students, especially as the cost of the program has increased from $130 million to almost $500 million since the expansion (Henry, 2025). If they decide that there are currently too many students leaving the public school system and the cost has become uncontrollably high, they may wish to revert the expansion policy and grandfather in those who have already utilized the scholarship program to stem the student population loss from public schools. However, if they decide that cost is not the concern and that it is a beneficial program, lawmakers may wish to divert more funding towards underperforming schools that are losing their students. This is to ensure that students in those schools are not receiving a worse education due to the actions of their peers.

Ultimately, the Ohio Educational Choice Scholarship Expansion Program has had a significant impact on public school performances. For those in third grade math, eighth grade language arts, and high school English II, there are clear differences between the control and treatment groups that can be attributed to the policy expansion. These differences position

students from schools that never offered the original Ohio EdChoice scholarship in a better position than students from schools that did offer the scholarship. For those in third grade language arts, eighth grade math, high school Algebra, and the graduation rates of high schools, there is a stark difference that cannot currently be attributed to the policy expansion.

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Appendix A: Equation for Table 6 and Table 7 Results

$$\ln(A) - \ln(B) = C$$

$$\ln(\frac{A}{B}) = C$$

$$log_e(\frac{A}{B}) = \ln(\frac{A}{B})$$

$$log_e\left(\frac{A}{B}\right) = C$$

$$e^C = \frac{A}{B}$$

Appendix B: SAS Codes

```
/* Full dataset used for the analysis of the Ohio EdChoice Scholarship */

proc import datafile="/home/u64117791/MySAS/Spring2026/DjordjeJovicic - ECON496
        v3.xlsx"
        out=school_data
        dbms=xlsx
        replace;
        sheet="Full_Data_Final";
        getnames=yes;
run;



/* Cleaned data to convert everything to a number variable */

data school_data;
        set work.school_data;
        grade_3_math = input(math_3_grade,5.);
        log_grade_3_math=log(grade_3_math);
        grade_3_reading = input(reading_3_grade,5.);
```

```
log_grade_3_reading=log(grade_3_reading);

grade_8_math = input(math_8_grade,5.);

log_grade_8_math=log(grade_8_math);

grade_8_reading = input(reading_8_grade,5.);

log_grade_8_reading=log(grade_8_reading);

grade_algebra = input(math_algebra,5.);

log_algebra=log(grade_algebra);

grade_english_ii = input(reading_english_2,5.);

log_english_ii = log(grade_english_ii);

log_grad_rate = log(grad_rate);

log_male_pct = log(male_pct);

log_disability_pct = log(disability_pct);

log_white_pct = log(white_pct);

log_black_pct = log(black_pct);

log_asian_pct = log(asian_pct);

log_latino_pct = log(latino_pct);

log_multi_pct = log(multi_pct);

DID = old_law * treatment;
```

```
        relative_year = academic_year-2023;
        relative_year_2 = relative_year*relative_year;
        relative_year_3 = relative_year_2*relative_year;
        TY = old_law * relative_year;
        TY_2 = old_law * relative_year_2;
        TY_3 = old_law * relative_year_3;
        drop math_3_grade math_8_grade math_algebra
                reading_3_grade reading_8_grade reading_english_2
                helper U V;
        if building_id = "" then delete;
        if grade_3_math > 100 then delete;
        if grade_3_reading > 100 then delete;
        if grade_8_math > 100 then delete;
        if grade_8_reading > 100 then delete;
        if grade_algebra > 100 then delete;
        if grade_english_ii > 100 then delete;
        if grad_rate > 100 then delete;
run;
```

```
proc sort data=school_data;
	by DID;
run;

ods excel file="/home/u64117791/MySAS/Spring2026/SummaryStats.xlsx";
/* Summary Stats Table */
proc means data=school_data nolabels;
	var grade_3_math grade_3_reading grade_8_math grade_8_reading grade_algebra
	grade_english_ii grad_rate;
	by DID;
run;
ods excel close;

ods excel file="/home/u64117791/MySAS/Spring2026/BalanceOfRegressors.xlsx";
/* Balance of Regressors Test */
proc ttest data=school_data;
	where academic_year<2023;
```

```
	var median_income population male_pct black_pct asian_pct latino_pct multi_pct
	disability_pct;
	class old_law;
run;
ods excel close;


/* Parallel Trend Test*/
proc surveyreg data=school_data plots=none;
	class building_county academic_year / ref=first;
	cluster building_county;
	model log_grade_3_math = DID TY TY_2 TY_3 old_law relative_year relative_year_2
	relative_year_3
			median_income population log_male_pct
			building_county academic_year / solution adjrsq;
	where academic_year<2023;
run;


proc surveyreg data=school_data plots=none;
	class building_county academic_year / ref=first;
```

```
        cluster building_county;
        model log_grade_3_reading = DID TY TY_2 TY_3 old_law relative_year
        relative_year_2 relative_year_3
                        median_income population log_male_pct
                        building_county academic_year / solution adjrsq;
        where academic_year<2023;
run;

proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
        cluster building_county;
        model log_grade_8_math = DID TY TY_2 TY_3 old_law relative_year relative_year_2
        relative_year_3
                        median_income population log_male_pct
                        building_county academic_year / solution adjrsq;
        where academic_year<2023;
run;

proc surveyreg data=school_data plots=none;
```

```
        class building_county academic_year / ref=first;
        cluster building_county;
        model log_grade_8_reading = DID TY TY_2 TY_3 old_law relative_year
        relative_year_2 relative_year_3
                        median_income population log_male_pct
                        building_county academic_year / solution adjrsq;
        where academic_year<2023;
run;


proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
        cluster building_county;
        model log_algebra = DID TY TY_2 TY_3 old_law relative_year relative_year_2
        relative_year_3
                        median_income population log_male_pct
                        building_county academic_year / solution adjrsq;
        where academic_year<2023;
run;
```

```
proc surveyreg data=school_data plots=none;
	class building_county academic_year / ref=first;
	cluster building_county;
	model log_english_ii = DID TY TY_2 TY_3 old_law relative_year relative_year_2
	relative_year_3
			median_income population log_male_pct
			building_county academic_year / solution adjrsq;
	where academic_year<2023;
run;


proc surveyreg data=school_data plots=none;
	class building_county academic_year / ref=first;
	cluster building_county;
	model log_grad_rate = DID TY TY_2 TY_3 old_law relative_year relative_year_2
	relative_year_3
			median_income population log_male_pct
			building_county academic_year / solution adjrsq;
	where academic_year<2023;
run;
```

```
/* Model 1: Testing based on the regressor of interest.
(percentage of proficient students in subject x / graduation rate)*/
/* Grade 3 Math */
ods output ParameterEstimates=PEModel1 DataSummary=ObsModel1
        FitStatistics=AdjRsqModel1 Effects=OverallSigModel1;
proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
        cluster building_county;
        model grade_3_math = DID median_income population log_male_pct building_county
        academic_year / solution adjrsq;
run;

/* Grade 3 Language Arts */
ods output ParameterEstimates=PEModel2 DataSummary=ObsModel2
        FitStatistics=AdjRsqModel2 Effects=OverallSigModel2;
proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
        cluster building_county;
```

```
        model grade_3_reading = DID median_income population log_male_pct building_county
        academic_year / solution adjrsq;
run;

ods output ParameterEstimates=PEModel3 DataSummary=ObsModel3
        FitStatistics=AdjRsqModel3 Effects=OverallSigModel3;
/* Grade 8 Math */
proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
        cluster building_county;
        model grade_8_math = DID median_income population log_male_pct building_county
        academic_year / solution adjrsq;
run;

ods output ParameterEstimates=PEModel4 DataSummary=ObsModel4
        FitStatistics=AdjRsqModel4 Effects=OverallSigModel4;
/* Grade 8 Reading */
proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
```

```
        cluster building_county;
        model grade_8_reading = DID median_income population log_male_pct building_county
        academic_year / solution adjrsq;
run;

ods output ParameterEstimates=PEModel5 DataSummary=ObsModel5
        FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
/* Algebra */
proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
        cluster building_county;
        model grade_algebra = DID median_income population log_male_pct building_county
        academic_year / solution adjrsq;
run;

ods output ParameterEstimates=PEModel6 DataSummary=ObsModel6
        FitStatistics=AdjRsqModel6 Effects=OverallSigModel6;
/* English II */
proc surveyreg data=school_data plots=none;
```

```
	class building_county academic_year / ref=first;
	cluster building_county;
	model grade_english_ii = DID median_income population log_male_pct building_county
	academic_year / solution adjrsq;
run;

ods output ParameterEstimates=PEModel7 DataSummary=ObsModel7
	FitStatistics=AdjRsqModel7 Effects=OverallSigModel7;
/* Graduation Rate */
proc surveyreg data=school_data plots=none;
	class building_county academic_year / ref=first;
	cluster building_county;
	model grad_rate = DID median_income population log_male_pct building_county
	academic_year / solution adjrsq;
run;

/* Parameter estimates into a new table*/
data PE_Table_Raw;
	length Model $10;
```

```
length Parameter $30;

set PEModel1-PEModel7 indsname=M;



if M="WORK.PEMODEL1" then Model="Model1";

        else if M="WORK.PEMODEL2" then Model="Model2";

        else if M="WORK.PEMODEL3" then Model="Model3";

        else if M="WORK.PEMODEL4" then Model="Model4";

        else if M="WORK.PEMODEL5" then Model="Model5";

        else if M="WORK.PEMODEL6" then Model="Model6";

        else if M="WORK.PEMODEL7" then Model="Model7";



where (Estimate ne 0) and

        (substr(Parameter,1,15) ne "building_county ") and

        (substr(Parameter,1,13) ne "academic_year ");



length Star $3;

if Probt le 0.01 then Star="***";

        else if Probt le 0.05 then Star="**";
```

```
        else if Probt le 0.1 then Star="*";
        else Star="";
if Model="Model1" then do
        EditedResults=cats(put(Estimate,comma16.4),Star);
        output;
        EditedResults=cats("(",put(StdErr,comma16.4),")");
        output;
end;
if Model="Model2" then do
        EditedResults=cats(put(Estimate,comma16.4),Star);
        output;
        EditedResults=cats("(",put(StdErr,comma16.4),")");
        output;
end;
if Model="Model3" then do
        EditedResults=cats(put(Estimate,comma16.4),Star);
        output;
        EditedResults=cats("(",put(StdErr,comma16.4),")");
```

```
        output;
end;
if Model="Model4" then do
        EditedResults=cats(put(Estimate,comma16.4),Star);
        output;
        EditedResults=cats("(",put(StdErr,comma16.4),")");
        output;
end;
if Model="Model5" then do
        EditedResults=cats(put(Estimate,comma16.4),Star);
        output;
        EditedResults=cats("(",put(StdErr,comma16.4),")");
        output;
end;
if Model="Model6" then do
        EditedResults=cats(put(Estimate,comma16.4),Star);
        output;
        EditedResults=cats("(",put(StdErr,comma16.4),")");
```

```
        output;
    end;
    if Model="Model7" then do
        EditedResults=cats(put(Estimate,comma16.4),Star);
        output;
        EditedResults=cats("(",put(StdErr,comma16.4),")");
        output;
    end;

    keep Model Parameter EditedResults;
run;

/* Sort by model, then parameter */
proc sort data=PE_Table_Raw out=PE_Table;
    by Model Parameter;
run;

/* Separate the columns into new tables based on the model */
```

```
data Model1Results (rename=(EditedResults=Model1))
        Model2Results (rename=(EditedResults=Model2))
        Model3Results (rename=(EditedResults=Model3))
        Model4Results (rename=(EditedResults=Model4))
        Model5Results (rename=(EditedResults=Model5))
        Model6Results (rename=(EditedResults=Model6))
        Model7Results (rename=(EditedResults=Model7));
        set PE_Table;
        if Model="Model1" then output Model1Results;
                else if Model="Model2" then output Model2Results;
                else if Model="Model3" then output Model3Results;
                else if Model="Model4" then output Model4Results;
                else if Model="Model5" then output Model5Results;
                else if Model="Model6" then output Model6Results;
                else if Model="Model7" then output Model7Results;
        drop Model;
run;
```

```
/* Final results, no extra statistics */

data Results_Table_Raw;

	merge Model1Results Model2Results Model3Results Model4Results Model5Results
	Model6Results Model7Results;

	by Parameter;



	length Order 3;

	if Parameter="DID" then Order=1;

		else if Parameter="median_income" then Order=2;

		else if Parameter="population" then Order=3;

		else if Parameter="log_male_pct" then Order=4;

		else if Parameter="Intercept" then Order=5;

		else Order=6;



	if mod(_n_,2)=1 then Regressors=Parameter;

run;



proc sort data=Results_Table_Raw out=Results_Table(drop=Order Parameter);

	by Order;
```

```
run;


/* Extra statistics */

/* Number of observations */

data NumofObs;

        merge ObsModel1 (rename=(nValue1=NVModel1) drop=cValue1)

                ObsModel2 (rename=(nValue1=NVModel2) drop=cValue1)

                ObsModel3 (rename=(nValue1=NVModel3) drop=cValue1)

                ObsModel4 (rename=(nValue1=NVModel4) drop=cValue1)

                ObsModel5 (rename=(nValue1=NVModel5) drop=cValue1)

                ObsModel6 (rename=(nValue1=NVModel6) drop=cValue1)

                ObsModel7 (rename=(nValue1=NVModel7) drop=cValue1);

        where Label1="Number of Observations";

        Model1=put(NVModel1,comma16.);

        Model2=put(NVModel2,comma16.);

        Model3=put(NVModel3,comma16.);

        Model4=put(NVModel4,comma16.);

        Model5=put(NVModel5,comma16.);
```

```
        Model6=put(NVModel6,comma16.);
        Model7=put(NVModel7,comma16.);
        keep Label1 Model1-Model7;
run;

/* Adjusted R-square*/
data AdjRsq;
        merge AdjRsqModel1 (rename=(cValue1=Model1))
                AdjRsqModel2 (rename=(cValue1=Model2))
                AdjRsqModel3 (rename=(cValue1=Model3))
                AdjRsqModel4 (rename=(cValue1=Model4))
                AdjRsqModel5 (rename=(cValue1=Model5))
                AdjRsqModel6 (rename=(cValue1=Model6))
                AdjRsqModel7 (rename=(cValue1=Model7));
        where Label1="Adjusted R-Square";
        keep Label1 Model1-Model7;
run;
```

```
/* Overall significance */

data OSM1 (rename=(EditedValue=Model1))

        OSM2 (rename=(EditedValue=Model2))

        OSM3 (rename=(EditedValue=Model3))

        OSM4 (rename=(EditedValue=Model4))

        OSM5 (rename=(EditedValue=Model5))

        OSM6 (rename=(EditedValue=Model6))

        OSM7 (rename=(EditedValue=Model7));

        set OverallSigModel1-OverallSigModel7 indsname=M;

        ThisIsM=M;

        where Effect="Model";

        Label1="Overall Significance";



        length Star $3;

        if Probf le 0.01 then Star="***";

                else if Probf le 0.05 then Star="**";

                else if Probf le 0.1 then Star="*";

                else Star="";
```

```
        EditedValue=cats(put(fvalue,comma20.2),star);


        if M="WORK.OVERALLSIGMODEL1" then output OSM1;
                else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
                else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
                else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
                else if M="WORK.OVERALLSIGMODEL5" then output OSM5;
                else if M="WORK.OVERALLSIGMODEL6" then output OSM6;
                else if M="WORK.OVERALLSIGMODEL7" then output OSM7;

        keep Label1 EditedValue;
run;


data OverallSig;
        merge OSM1-OSM7;
run;
```

```
/* All extra statistics */

data ExtraStats;

        set NumofObs AdjRsq OverallSig;

        rename Label1=Regressors;

run;



/* Lines for controls */

data ExtraInfo;

        length Regressors Model1 Model2 Model3 Model4 Model5 Model6 Model7 $50;



        Regressors="Demographic Data Included?";

        Model1="No";

        Model2="No";

        Model3="No";

        Model4="No";

        Model5="No";

        Model6="No";

        Model7="No";
```

```
        output;


        Regressors="Building and Year Fixed Effects?";
        Model1="Yes";
        Model2="Yes";
        Model3="Yes";
        Model4="Yes";
        Model5="Yes";
        Model6="Yes";
        Model7="Yes";
        output;


run;


/* Formatting variable names */
proc format;
        value $VariableName (default=60)
                "DID"="Inclusion in the Expansion Program"
```

```
        "median_income"="Median Household Income"
        "log_male_pct"="Male Students"
        "population"="County Population";
run;

/* Combine all tables into the final results */
data Results_Table;
    set Results_Table ExtraInfo ExtraStats;
run;

/* Final table */
ods excel file="/home/u64117791/MySAS/Spring2026/FinalTable.xlsx"
    options(Embedded_Titles="ON" Embedded_Footnotes="ON");
title "Table 5: The Effect of the Ohio EdChoice Expansion Scholarship Program on Public
    School Performance";
footnote1 j=l "Sources: Data provided by the Ohio Department of Education, the US Census
    Bureau, and own calculations.";
footnote2 j=l "Notes: Each model name in order represents third grade math, third grade
    language arts,
```

```
                eighth grade math, eighth grade language arts, high school algebra, high
        school English II,
                and graduation rates. Robust standard errors are in parentheses.
                All models have clustered robust standard errors and are clustered to the
        building level.
                *, **, and *** respectively indicate 10%, 5%, and 1% significance
        levels.
                The reference group is Allen County in 2015 for all models.
                All models are linear.";
proc print data=Results_Table noobs;
        var Regressors;
        var Model1-Model7 / style(header)={just=center} style(data)={just=center
        tagattr="type:String"};
        format Regressors $VariableName.;
run;
ods excel close;
/* Model 2: Testing based on the regressor of interest.
(percentage of proficient students in subject x / graduation rate)*/
/* Grade 3 Math */
```

```
ods output ParameterEstimates=PEModel1 DataSummary=ObsModel1
        FitStatistics=AdjRsqModel1 Effects=OverallSigModel1;
proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
        cluster building_county;
        model log_grade_3_math = DID median_income population log_male_pct
        building_county academic_year / solution adjrsq;
run;

/* Grade 3 Language Arts */
ods output ParameterEstimates=PEModel2 DataSummary=ObsModel2
        FitStatistics=AdjRsqModel2 Effects=OverallSigModel2;
proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
        cluster building_county;
        model log_grade_3_reading = DID median_income population log_male_pct
        building_county academic_year / solution adjrsq;
run;
```

```
ods output ParameterEstimates=PEModel3 DataSummary=ObsModel3
        FitStatistics=AdjRsqModel3 Effects=OverallSigModel3;
/* Grade 8 Math */
proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
        cluster building_county;
        model log_grade_8_math = DID median_income population log_male_pct
        building_county academic_year / solution adjrsq;
run;


ods output ParameterEstimates=PEModel4 DataSummary=ObsModel4
        FitStatistics=AdjRsqModel4 Effects=OverallSigModel4;
/* Grade 8 Reading */
proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
        cluster building_county;
        model log_grade_8_reading = DID median_income population log_male_pct
        building_county academic_year / solution adjrsq;
run;
```

```
ods output ParameterEstimates=PEModel5 DataSummary=ObsModel5
        FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
/* Algebra */
proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
        cluster building_county;
        model log_algebra = DID median_income population log_male_pct building_county
        academic_year / solution adjrsq;
run;

ods output ParameterEstimates=PEModel6 DataSummary=ObsModel6
        FitStatistics=AdjRsqModel6 Effects=OverallSigModel6;
/* English II */
proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
        cluster building_county;
        model log_english_ii = DID median_income population log_male_pct building_county
        academic_year / solution adjrsq;
```

```
run;

ods output ParameterEstimates=PEModel7 DataSummary=ObsModel7
        FitStatistics=AdjRsqModel7 Effects=OverallSigModel7;
/* Graduation Rate */
proc surveyreg data=school_data plots=none;
        class building_county academic_year / ref=first;
        cluster building_county;
        model log_grad_rate = DID median_income population log_male_pct building_county
        academic_year / solution adjrsq;
run;

/* Parameter estimates into a new table*/
data PE_Table_Raw;
        length Model $10;
        length Parameter $30;
        set PEModel1-PEModel7 indsname=M;

        if M="WORK.PEMODEL1" then Model="Model1";
```

```
        else if M="WORK.PEMODEL2" then Model="Model2";

        else if M="WORK.PEMODEL3" then Model="Model3";

        else if M="WORK.PEMODEL4" then Model="Model4";

        else if M="WORK.PEMODEL5" then Model="Model5";

        else if M="WORK.PEMODEL6" then Model="Model6";

        else if M="WORK.PEMODEL7" then Model="Model7";


where (Estimate ne 0) and

        (substr(Parameter,1,15) ne "building_county ") and

        (substr(Parameter,1,13) ne "academic_year ");


length Star $3;

if Probt le 0.01 then Star="***";

        else if Probt le 0.05 then Star="**";

        else if Probt le 0.1 then Star="*";

        else Star="";

if Model="Model1" then do

        EditedResults=cats(put(Estimate,comma16.4),Star);
```

```
        output;
        EditedResults=cats("(",put(StdErr,comma16.4),")");
        output;
end;
if Model="Model2" then do
        EditedResults=cats(put(Estimate,comma16.4),Star);
        output;
        EditedResults=cats("(",put(StdErr,comma16.4),")");
        output;
end;
if Model="Model3" then do
        EditedResults=cats(put(Estimate,comma16.4),Star);
        output;
        EditedResults=cats("(",put(StdErr,comma16.4),")");
        output;
end;
if Model="Model4" then do
        EditedResults=cats(put(Estimate,comma16.4),Star);
```

```
        output;
        EditedResults=cats("(",put(StdErr,comma16.4),")");
        output;
end;
if Model="Model5" then do
        EditedResults=cats(put(Estimate,comma16.4),Star);
        output;
        EditedResults=cats("(",put(StdErr,comma16.4),")");
        output;
end;
if Model="Model6" then do
        EditedResults=cats(put(Estimate,comma16.4),Star);
        output;
        EditedResults=cats("(",put(StdErr,comma16.4),")");
        output;
end;
if Model="Model7" then do
        EditedResults=cats(put(Estimate,comma16.4),Star);
```

```
            output;
            EditedResults=cats("(",put(StdErr,comma16.4),")");
            output;
        end;

        keep Model Parameter EditedResults;
run;

/* Sort by model, then parameter */
proc sort data=PE_Table_Raw out=PE_Table;
        by Model Parameter;
run;

/* Separate the columns into new tables based on the model */
data Model1Results (rename=(EditedResults=Model1))
         Model2Results (rename=(EditedResults=Model2))
         Model3Results (rename=(EditedResults=Model3))
         Model4Results (rename=(EditedResults=Model4))
```

```
        Model5Results (rename=(EditedResults=Model5))
        Model6Results (rename=(EditedResults=Model6))
        Model7Results (rename=(EditedResults=Model7));
        set PE_Table;
        if Model="Model1" then output Model1Results;
                else if Model="Model2" then output Model2Results;
                else if Model="Model3" then output Model3Results;
                else if Model="Model4" then output Model4Results;
                else if Model="Model5" then output Model5Results;
                else if Model="Model6" then output Model6Results;
                else if Model="Model7" then output Model7Results;
        drop Model;
run;

/* Final results, no extra statistics */
data Results_Table_Raw;
        merge Model1Results Model2Results Model3Results Model4Results Model5Results
        Model6Results Model7Results;
        by Parameter;
```

```
	length Order 3;
	if Parameter="DID" then Order=1;
		else if Parameter="median_income" then Order=2;
		else if Parameter="population" then Order=3;
		else if Parameter="log_male_pct" then Order=4;
		else if Parameter="log_white_pct" then Order=5;
		else if Parameter="Intercept" then Order=6;
		else Order=7;

	if mod(_n_,2)=1 then Regressors=Parameter;
run;

proc sort data=Results_Table_Raw out=Results_Table(drop=Order Parameter);
	by Order;
run;

/* Extra statistics */
```

```
/* Number of observations */

data NumofObs;

        merge ObsModel1 (rename=(nValue1=NVModel1) drop=cValue1)

                ObsModel2 (rename=(nValue1=NVModel2) drop=cValue1)

                ObsModel3 (rename=(nValue1=NVModel3) drop=cValue1)

                ObsModel4 (rename=(nValue1=NVModel4) drop=cValue1)

                ObsModel5 (rename=(nValue1=NVModel5) drop=cValue1)

                ObsModel6 (rename=(nValue1=NVModel6) drop=cValue1)

                ObsModel7 (rename=(nValue1=NVModel7) drop=cValue1);

        where Label1="Number of Observations";

        Model1=put(NVModel1,comma16.);

        Model2=put(NVModel2,comma16.);

        Model3=put(NVModel3,comma16.);

        Model4=put(NVModel4,comma16.);

        Model5=put(NVModel5,comma16.);

        Model6=put(NVModel6,comma16.);

        Model7=put(NVModel7,comma16.);

        keep Label1 Model1-Model7;
```

```
run;


/* Adjusted R-square*/
data AdjRsq;
        merge AdjRsqModel1 (rename=(cValue1=Model1))
                AdjRsqModel2 (rename=(cValue1=Model2))
                AdjRsqModel3 (rename=(cValue1=Model3))
                AdjRsqModel4 (rename=(cValue1=Model4))
                AdjRsqModel5 (rename=(cValue1=Model5))
                AdjRsqModel6 (rename=(cValue1=Model6))
                AdjRsqModel7 (rename=(cValue1=Model7));
        where Label1="Adjusted R-Square";
        keep Label1 Model1-Model7;
run;


/* Overall significance */
data OSM1 (rename=(EditedValue=Model1))
         OSM2 (rename=(EditedValue=Model2))
```

```
OSM3 (rename=(EditedValue=Model3))

OSM4 (rename=(EditedValue=Model4))

OSM5 (rename=(EditedValue=Model5))

OSM6 (rename=(EditedValue=Model6))

OSM7 (rename=(EditedValue=Model7));

set OverallSigModel1-OverallSigModel7 indsname=M;

ThisIsM=M;

where Effect="Model";

Label1="Overall Significance";



length Star $3;

if Probf le 0.01 then Star="***";

        else if Probf le 0.05 then Star="**";

        else if Probf le 0.1 then Star="*";

        else Star="";



EditedValue=cats(put(fvalue,comma20.2),star);
```

```
        if M="WORK.OVERALLSIGMODEL1" then output OSM1;
                else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
                else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
                else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
                else if M="WORK.OVERALLSIGMODEL5" then output OSM5;
                else if M="WORK.OVERALLSIGMODEL6" then output OSM6;
                else if M="WORK.OVERALLSIGMODEL7" then output OSM7;

        keep Label1 EditedValue;
run;

data OverallSig;
        merge OSM1-OSM7;
run;

/* All extra statistics */
data ExtraStats;
        set NumofObs AdjRsq OverallSig;
```

```
        rename Label1=Regressors;
run;

/* Lines for controls */
data ExtraInfo;
        length Regressors Model1 Model2 Model3 Model4 Model5 Model6 Model7 $35;

        Regressors="Demographic Data Included?";
        Model1="No";
        Model2="No";
        Model3="No";
        Model4="No";
        Model5="No";
        Model6="No";
        Model7="No";
        output;

        Regressors="Building and Year Fixed Effects?";
```

```
        Model1="Yes";
        Model2="Yes";
        Model3="Yes";
        Model4="Yes";
        Model5="Yes";
        Model6="Yes";
        Model7="Yes";
        output;

run;

/* Formatting variable names */
proc format;
        value $VariableName (default=60)
                "DID"="Inclusion in the Expansion Program"
                "median_income"="Median Household Income"
                "log_male_pct"="Male Students"
                "log_white_pct"="White Students"
```

```
                "population"="County Population";
run;

/* Combine all tables into the final results */
data Results_Table;
        set Results_Table ExtraInfo ExtraStats;
run;

/* Final table */
ods excel file="/home/u64117791/MySAS/Spring2026/FinalTable.xlsx"
        options(Embedded_Titles="ON" Embedded_Footnotes="ON");
title "Table 5: The Effect of the Ohio EdChoice Expansion Scholarship Program on Public
        School Performance";
footnote1 j=l "Sources: Data provided by the Ohio Department of Education, the US Census
        Bureau, and own calculations.";
footnote2 j=l "Notes: Each model name in order represents third grade math, third grade
        language arts,
                        eighth grade math, eighth grade language arts, high school algebra, high
        school English II,
```

```
                and graduation rates. Robust standard errors are in parentheses.

                All models have clustered robust standard errors and are clustered to the
        building level.

                *, **, and *** respectively indicate 10%, 5%, and 1% significance
        levels.

                The reference group is Allen County in 2015 for all models.

                All models are logarithmic.";
proc print data=Results_Table noobs;
        var Regressors;
        var Model1-Model7 / style(header)={just=center} style(data)={just=center
        tagattr="type:String"};
        format Regressors $VariableName.;
run;
ods excel close;
```