



Cost-Benefit Analysis of School Spending in Ohio

December 2023

Executive Summary

On June 30 of this year, the Ohio General Assembly passed the state’s budget bill for Fiscal Years 2024-25, and on July 3rd, the bill was signed into law.¹Part of this bill reformed Ohio’s education spending, increasing overall K-12 spending. All in all, the bill will increase per-pupil spending in Ohio by 11%.

The state is a major funder of public schools, and a change in per-pupil spending on this scale amounts to billions of dollars in new spending. In light of large investments states make on school spending, many wonder if the economic benefits of these investments outweigh the economic costs.

A change in educational spending will impact educational outcomes. Changes in educational resources, teacher quality, class sizes, curricular and extracurricular opportunities impact things like test scores, graduation, and educational attainment.

In this analysis, we apply the findings of a study done by C. Kirabo Jackson and Claire Mackevicius to Ohio’s school spending.²Accounting for how education impacts test scores, high school graduation, college matriculation, and social savings, we determine that an increase in spending from the current rate of Ohio K-12 spending towards one that more closely models that of Pennsylvania would, 95% of the time, create benefits between \$23 billion and \$90 billion. 100% of simulations saw positive benefits per student.

With a reduction in spending that models the current school spending plan for Indiana, 95% of the time Ohio would see a loss of between \$30 billion and \$120 billion. In this model as well, 100% of all simulations saw a loss in per student benefits. The largest of these impacts was the effect that changes in school spending had on eventual college attendance, and the lifetime earnings that stemmed from that increase in educational attainment.

When accounting for different income levels and distributing funding in a way that biases lower income schools, the increase in spending led to benefits being between \$22 billion and \$88 billion 95% of the time, while the plan that decreased spending led to losses between \$30 billion and \$120 billion 95% of the time.

1. “Overview of School Funding.” Ohio Department of Education, November 2023. <https://education.ohio.gov/Topics/Finance-and-Funding/Overview-of-School-Funding>.

2. “Per Pupil Spending by State 2023.” Wisevoter, June 15, 2023. <https://wisevoter.com/state-rankings/per-pupil-spending-by-state/>.

The Current State of School Spending

According to WiseVoter, Ohio is currently ranked 19th in the nation for its per-pupil K-12 spending,³ spending about \$13,500 per student. This puts them slightly above the national average of \$13,201 per student.

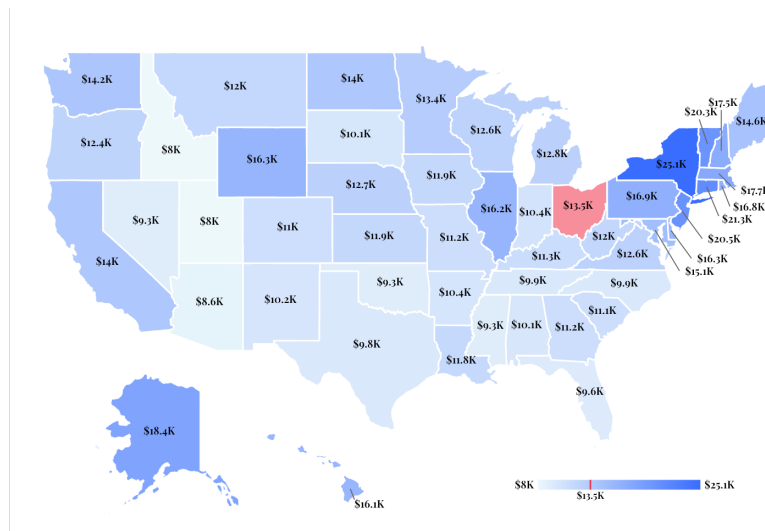


Figure 1: Average Per-Pupil Spending by State

Ohio’s school funding landscape has undergone significant changes recently, with a notable increase in state appropriations included in its most recent budget bill. The state’s biennium budget for fiscal years 2024 and 2025 allocates a total of \$12.97 billion for primary and secondary education, representing an 11.4 percent increase over the previous biennium.⁴ This marks the largest commitment of state appropriations for education in Ohio’s history, driven by this recent school funding reform package.

The increase in state funding is driven by a combination of factors, including a growing recognition of the importance of education for economic development and a desire to address equity concerns in school funding. The additional funding is expected to be used to support a variety of initiatives, such as increasing teacher salaries, reducing class sizes, and expanding early childhood education programs.

3. C. Kirabo Jackson and Claire Mackevicius. "What Impacts Can We Expect from School Spending Policy? Evidence from Evaluations in the U.S." *American Economic Journal: Applied Economics* 2023 http://works.bepress.com/c_kirabo_jackson/44/

4. "Overview of School Funding." Ohio Department of Education, November 2023. <https://education.ohio.gov/Topics/Finance-and-Funding/Overview-of-School-Funding>.

Policy Options

We selected two alternative plans for school spending that could be implemented, one of which represents an increase in school spending, and one of which represents a decrease from Ohio’s current spending rate.

We also analyzed what would happen if school spending was allocated differently based on community income. We designated three income groups, low income, middle income, and high income, where low income is defined as the bottom quintile of districts, high income is defined as the top quintile, and the middle income is the students in the middle three quintiles. We found that 15.1% of students attend the bottom quintile of districts, and 15.5% attend the highest, while 69.4% attend middle income districts.⁵

It is possible that by allocating greater resources to districts that are in higher need, different results could materialize. Within these two spending alternatives, we split them into two methods of distribution: one which evenly distributes the increase/decrease in school spending across all Ohio schools, and another that either allocates spending at a 3:9:1 ratio between low, middle, and high income students respectively, with the end goal being to increase per student spending at a 3:2:1 ratio, or de-allocate spending at a 1:2:3 ratio between those respective income levels. Ohio’s current rate serves as the “moderate” option. The goal is to best understand the impacts of raising or lowering current educational spending.

The two alternative states we chose to base the “high” and “low” spending plans on are Indiana and Pennsylvania, because they are geographically and demographically similar to Ohio.⁶

Status Quo (Ohio) Plan: \$13,650 median per K-12 pupil spending (no change in spending)

Low Spending (Indiana) Plan: \$10,100 median per K-12 pupil spending

5. “Ohio Education by the Numbers: 2023 Statistics, Charts, Tables & Maps: Thomas B. Fordham Institute Advancing Educational Excellence.” Ohio Education by the Numbers: 2023 Statistics, Charts, Tables & Maps: Thomas B. Fordham Institute Advancing Educational Excellence, 2022. <https://www.ohiobythenumbers.com/>.

6. “U.S. Census Bureau Quickfacts: United States.” U.S. Census Bureau QuickFacts, 2022. <https://www.census.gov/quickfacts/fact/table/US/PST045222>.

- **Alternative 1** – Cut spending equally across all K-12 schools
- **Alternative 2** – Cut spending at a 1:2:3 ratio between low, medium, and high income schools

High Spending (Pennsylvania) Plan: \$16,450 median per K-12 pupil spending

- **Alternative 3** – Increase spending equally across all K-12 schools
- **Alternative 4** – Increase spending at a 3:2:1 ratio between high, middle, and low income schools

Each of these plans are specific to public schools. We assume that these funds come from the state general fund. The lower and upper quintiles used for calculations are not based on the difference in medians, but rather calculated based on Pennsylvania and Indiana's actual lower and upper quintile.

Standing

For the purposes of this study, we will be estimating the benefits and costs of changing spending on Ohio's K-12 schools on the entire US population. This is because it is hard to isolate benefits to Ohio citizens, since often students leave the state after graduation to attend college, or leave the state after attending an Ohio college.

Impacts

For this analysis, we investigated the impacts that school spending had on test scores, high school graduation, college matriculation, and social spending. The Jackson-Mackevicius study makes income differentiations for test scores and educational attainment (college matriculation), but does not provide income-specific impacts for high school graduation. For factors that were differentiated by income, we assume there is a reasonable diminishing marginal return on spending. Essentially, the same

amount of money going to a school that is already receiving a relatively large amount of funding will have less benefit than that same amount of money going to a school with a relatively lower amount of funding. All of the numbers given in the impact section have a social discount rate of 7%.

Test Scores

Test scores are a key measurement when it comes to school spending, because virtually every student must take some sort of standardized test in their lifetime, meaning it provides a uniform metric for estimating achievement for students.

Our estimate of the benefits of test scores are on the conservative side, because it is difficult to isolate the monetization of test scores. Many studies that implicate increases in lifetime earnings or other benefits link the fact that higher test scores correlate with an increased likelihood of graduation or college attendance. Outside of college acceptance/attendance, the benefit that comes from higher test scores isn't usually the value of the test score, but instead the improved level of human capital that the test score represents, which is far more difficult to measure. Therefore, our benefits that accrue from higher test scores independent of high school graduation and college attendance are correlated. Because of this, and the fact that to avoid double counting benefits, we only looked at the test score impacts for students who both did not graduate and did not attend college, the estimates are on the conservative side.

According to the available research, a one standard deviation increase of test scores tends to increase earnings by 12%.⁷ Applying this scale to the increases in standard deviations based off of an increase in spending, and using the average lifetime earnings of \$1,700,000 for an Ohio high school student who does not go on to attend college,⁸ the plan for an increase in spending contributes to an additional \$2 billion in benefits, whereas the decrease leads to an estimated \$2.6 billion in losses. When the spending distribution accounts for income, the benefits and costs are \$2.1 billion and \$2.6 billion respectively.

7. Watts, Tyler W. "Academic Achievement and Economic Attainment: Reexamining Associations between Test Scores and Long-Run Earnings." *AERA Open* 6, no. 2 (2020): 233285842092898. <https://doi.org/10.1177/2332858420928985>.

8. "The College Payoff: More Education Doesn't Always Mean More Earnings." CEW Georgetown, May 16, 2022. <https://cew.georgetown.edu/cew-reports/collegepayoff2021/>.

High School Graduation

Graduation from high school is a large factor in determining one's earnings in the labor market over their lifetime. According to the Alliance for Excellent Education, just graduating from high school increases lifetime earnings by \$322,000 compared to those who do not graduate.⁹ This number distinctly refers to “terminal high school graduates” – students who graduate high school but do not go on to attend college. This keeps this benefit independent of our college matriculation impact calculations. Based on an 89% high school graduation rate in the state of Ohio,¹⁰ and the fact that 51% of those 89% don't attend college,¹¹ we estimate that the increase in spending would create a benefit of \$9.3 billion and our plan that reduces spending would lead to a loss of about \$11 billion

College Matriculation

Economic benefits that accrue as a result of an increased attendance of college is far and away the largest impact that an increase in K-12 spending contributes to. Based on the estimate of a 2.8% increase in college attendance per \$1,000 dollar increase estimated in the Jackson-Mackevicius study, as well as factoring in diminishing marginal returns on this spending for different income levels, we deduced that for the plans that provided a uniform increase and decrease in spending creates an average benefit and cost of \$18 billion and \$23 billion respectively. When the increases and decreases in funding are distributed according to income levels of students, these benefits and losses are \$19 billion and \$23 billion respectively.

These lifetime earning calculations are based on the estimate that the average associate's degree holder earns \$400,000 more than just a high school graduate, a bachelor's degree \$1,200,000 more, a masters \$1,600,000 more, and a doctoral

9. Romero, Jessie. “The Dropout Dilemma.” Federal Reserve Bank of Richmond, 2014. https://www.richmondfed.org/publications/research/econ_focus/2014/q3/feature1.

10. Siddens, Stephanie. “Ohio School Report Cards Show Achievement Results Moving in the Right ...” School and District Results 2021-2022, 2023. <https://education.ohio.gov/getattachment/Topics/Data/Report-Card-Resources/Annual-Reports-and-Information/21-22>.

11. “Ohio Education by the Numbers: 2023 Statistics, Charts, Tables & Maps: Thomas B. Fordham Institute Advancing Educational Excellence.” Ohio Education by the Numbers: 2023 Statistics, Charts, Tables & Maps: Thomas B. Fordham Institute Advancing Educational Excellence, 2022. <https://www.ohiobythenumbers.com/>.

degree \$2,400,000 more.¹² It also accounts for the distribution of degree achievement, where of students who complete college, 23.9% earn associate's degrees, 53.5% earn bachelor's degrees, 17.8% earn master's degrees, and 4.8% earn doctorate or professional degrees.¹³ It also accounts for the amount of students that graduate Ohio high schools, and whether or not they stay in Ohio or attend college outside of Ohio,¹⁴ due to the difference in average graduation rates between Ohio college and the national average (57.3% compared to 62.3% nationally).^{15,16} Further, this uses the high end estimate of the difference between low and high income differences in college matriculation rates per \$1,000 of spending of $.055\sigma$ from the Jackson/Mackevicius study.

Social Spending

When students graduate from high school, they are less likely to draw support from government programs, such as welfare. They also are less likely to be incarcerated, reducing costs to society based on a reduction in crime. Holistically, every additional high school graduate, over the course of their lifetime, saves about \$127,000 in social spending.¹⁷ Based on the increase in high school graduates that would come from an increase in Ohio's spending on education, we would see a benefit of \$12.5 billion. On the other hand, a decrease in education modeling Indiana's spending would lead to an estimated loss of \$15 billion.

Table 1: Benefits and Costs (Millions)

Category	Indiana Plan 1	Pennsylvania Plan 1	Indiana Plan 2	Pennsylvania Plan 2
MEBT (.24)	\$1,100	-\$1,400	\$1,100	-\$1,400
Test Scores	-\$2,600	\$2,000	-\$2,500	\$2,100
High School Grad.	-\$11,000	\$9,300	-\$11,000	\$9,300
College Matric.	-\$23,000	\$18,000	-\$19,000	\$23,000
Social Savings	-\$15,000	\$13,000	-\$15,000	\$13,000
Total	-\$50,500	\$40,900	-\$46,400	\$46,000

Results

This analysis shows the large magnitude of benefits and costs that result from these changes in spending. Granted, the change in spending is significant, so these large outcomes are to be expected.

The largest contributor to benefits and costs is the change based off of college matriculation. These results indicate that there would be a large increase in overall economic output with an increase in K-12 school spending in Ohio, and an equally large decrease in economic output if per student spending went the other way.

Aside from the burden of taxation, there doesn't seem to be any inherent trade-offs within the education space – that is, there is no compromise between test scores, high school graduation, or college attendance – they all move in the same direction as the spending. As a result, it could make sense for policy makers to favor these increases in education spending for the monetary benefits it creates. It should also be noted that spending policies that distributed spending according to income needs (Indiana

12. “The College Payoff: More Education Doesn’t Always Mean More Earnings.” CEW Georgetown, May 16, 2022. <https://cew.georgetown.edu/cew-reports/collegepayoff2021/>.

13. “Most Current Digest Tables - National Center for Education Statistics.” Digest of education statistics-most current Digest Tables, 2021. https://nces.ed.gov/programs/digest/current_tables.asp.

14. “Number of First-Time Degree/Certificate-Seeking Undergraduate Students Enrolled, Residence, and Migration at Title IV Institutions, by State or Jurisdiction: Fall 2020.” Ipedes, 2021. <https://nces.ed.gov/ipeds/Search?query=residence&query2=residence&resultType=all&page=1&>

15. “Graduation Rate Comparison between Ohio Colleges.” College Tuition Compare, 2023. <https://www.collegetuitioncompare.com/compare/tables/?state=OH&factor=graduation-rate>.

16. “Completing College - National and State Reports.” National Student Clearinghouse Research Center, November 29, 2022. <https://nscresearchcenter.org/completing-college/>.

17. Levin, Henry M, Clive Belfield, Peter Muennig, and Cecilia Rouse. “The Costs and Benefits of an Excellent Education for All of America’s Children.” Academic Commons, January 1, 1970. <https://academiccommons.columbia.edu/doi/10.7916/D8CF9QG9>.

plan 2 and Pennsylvania plan 2) were favorable compared to the ones that distributed changes in spending uniformly, meaning it may be worth considering this method of spending distribution for both equity and efficiency reasons.

Sensitivity Analysis

To better understand the range of possible outcomes, we performed two types of sensitivity analysis: a Monte Carlo simulation with 10,000 replications varying the inputs to our model in each step, and a best-case/worst-case comparison.

Within each trial of the Monte Carlo Simulation, we randomized the following variables:

- Marginal excess tax burden – we assumed that the probability of a given tax burden is uniformly distributed between a conservative estimate of .06 and a high estimate of .43
- Change in test scores per \$1,000 dollars spent – based on the Jackson/Mackevicius study, our boundaries for the change in test scores is between .021 and .043 standard deviations
- Change in college matriculation rate per \$1,000 spent – again, based on the findings of the Jackson/Mackevicius study, we randomized between the values of .9% and 5.51% change in college matriculation
- Difference between low and high income college matriculation rate – the disparity between the rate at which low and high income students varied across studies outlined in the meta-analysis, despite the same amount of spending being applied. Sometimes, spending was just as effective at pushing high income students to college as it was low income, whereas in other scenarios, spending towards low income schools had a much greater impact. As a result, we also decided to account for this variation, setting the boundaries for this difference to be between 0 and .55 standard deviations
- Change in high school graduation per \$1,000 – our boundaries for a change in high school graduation per \$1,000 spent were .07 and 3.99% based on the same Jackson/Mackevicius study

- Discount Rate – Our discount rates were randomized uniformly between .030 and .070

For the best-case/worst-case, we set each parameter to its maximum or minimum dependent on the plan we were testing

Table 2: Monte Carlo and Best/Worst Case Results (in Millions)

	Indiana Plan 1	Pennsylvania Plan 1	Indiana Plan 2	Pennsylvania Plan 2
5th Percentile	-\$30,000	\$23,000	-\$29,000	\$23,000
95th Percentile	-\$119,000	\$90,000	-\$119,000	\$87,000
Mean	-\$68,000	\$51,000	-\$68,000	\$50,000
% of positive/ negative results	100	100	100	100
Best possible outcome	-\$12,000	\$136,000	-\$12,000	\$131,000
Worst possible outcome	-\$184,000	\$9,000	-\$185,000	\$10,000

It is significant to note that 100% of these Monte Carlo trials produced a net cost in the case of a decrease in spending, and 100% produced a net benefit in the case of an increase in spending. This is likely a product of the large changes in spending, and might not necessarily hold for a smaller change.

Further, the difference between the benefits and costs of the plans that distribute spending according to income versus the ones that do not is much less pronounced across the 10,000 monte carlo trials than in the initial results that were calculated. This could indicate that the significance of the distribution in spending is smaller than initially thought, or it could be a result of the assumptions made to construct the model in the first place. However, given the definitive economic benefits of increasing spending, and the definitive negative economic impacts of decreasing spending, committing to either plan is most likely going to result in economic impacts that reflect in that same direction.

Appendix A: Estimating Diminishing Marginal Returns to Education Spending

To create a curve to estimate the diminishing marginal return of school spending, we took three points from the Jackson/Mackevicius study that related to educational attainment based on schools that were low, median, and high income, where “low” and “high” income are designated based on the bottom and top quintile of school spending.

Top quintile: \$16,477.82

Median: \$13,654.53

Bottom Quintile: \$11,673.22

Then, we calculated the increase in school spending as a percentage of total school spending. For low, median, and high income areas, this was 8.5666%, 7.3236%, 6.0688% respectively. Next, we took the average increase in educational attainment (measured in standard deviations) and divided that by the relative percent increase in spending to find the number of standard deviations increase in attainment per % increase in educational attainment for each income level.

Measurement	Per Student \$	Average increase in educational attainment	% increase in school spending	Increase in educational attainment per % increase in spending
Top Quintile	16,477.82	.0238	6.0688%	.0039217
Median	13,654.53	.0573	7.3236%	.0078240
Bottom Quintile	11,673.22	.0791	8.5666%	.0092335

From there, we plugged in points of the form (x,y), where x is the amount of spending at a school, and y is the increase in standard deviations per % increase in spending at that level of school spending.

Exponential Regression:

$$Y = .0838230885 * .9998172763^x$$

$$R^2 = .94377$$

This regression is not going to be perfect, as it is calculated based on only three points. However, the three points calculated (bottom quintile, median, and top quintile) are somewhat close to the actual values of school spending that we are analyzing for Indiana, Ohio, and Pennsylvania: \$10,250, \$13,500, and \$16,900, which allows it to serve the purpose of our modeling.

Plugging in our own values for x in the exponential regression, for example, the estimated increase in σ 's per % increase in spending would be $.01288\sigma$, $.00711\sigma$, and $.00382\sigma$ for each of the income levels respectively.