Public Education Funding Cuts and Enrollment Shift to Private Schools: Evidence from the Great Recession

Jiwon Park

Abstract: This paper examines whether funding for public schools affects private school enrollment. To examine causality, I utilize the fact that states with greater historical reliance on state appropriations and states without income tax experienced larger cuts for public K-12 education funding in the US after the Great Recession. These fiscal characteristics provide a plausiblely exogenous variation in public school funding. I find that a $1,000 reduction in per-pupil funding increases enrollment in private schools by 0.48 to 0.57 percentage points. I show further that the effect is strongest among high socioeconomic status students, suggesting an increase in education inequality.

Keywords: Private school, K-12 appropriations, Great Recession

JEL Classification: H61, H75, I21, I22, I28

Word Count: 13,109; 10,407 without figures and tables

Corresponding Author:
Jiwon Park
Korea Institute for International Economic Policy
370 Sicheong-daero,
Sejong-si, 30147, South Korea
Phone: +82-44-414-1324
Email: jpecon.373@gmail.com

Declarations of interest: none

Acknowledgment:
I am grateful to Leigh Linden, Richard Murphy, Stephen Trejo, Dean Spears, Sam Arenberg, Sungwon Lee, Seth Neller, Anjali Priya Verma, and the seminar participants of the University of Texas at Austin for their valuable comments and suggestions. Any errors are my own responsibility.

1 Introduction

Private schools, accounting for 9% or 4.7 million students of US primary and secondary education in the fall of 2019, serve as the principal alternative to traditional public schools (TPS) (National Center for Education Statistics, 2022). Despite their role in improving education by fostering educational diversity and competition (Dee, 1998; Hoxby, 1994), they are criticized for potentially exacerbating socioeconomic inequality (Davies, Zhang, and Zeng, 2005; Glomm and Ravikumar, 1992; Iyigun, 1999). Given their significance, understanding the factors influencing private education choice is essential. Critically, the competition between public and private schools for student enrollment suggests that local public school attributes, along with various other considerations such as religious affiliations and pedagogical methods, play a significant role in the decision-making process for private education (Goldring and Phillips, 2008).

This paper explores the impact of public education funding, one of the most important attributes of public schools, on private school enrollment within US K-12 education. Two primary channels through which public education funding may affect private school participation are explored. Firstly, public education funding, influencing academic quality, may shape school choice decisions (Blundell, Dearden, and Sibieta, 2010; Brasington and Hite, 2012; Jackson, 2018; Jackson and Mackevicius, 2021). Secondly, public education resources may substitute household investment in education, thus reduced public funding potentially leads to increased investment in private education (Houtenville and Conway, 2008; Kim, 2001; Yuan and Zhang, 2015). This nuanced relationship, despite its policy relevance, has received limited attention in the literature.

To address this gap, this study leverages the idiosyncratic characteristics of states following the Great Recession, which led to exogenous variation in public education funding cuts. In the

aftermath of the Great Recession, K-12 education funding experienced a substantial decline in many states, averaging $651 or 5.8% per pupil from 2008 to 2013, with lingering effects over subsequent years. To isolate changes in school funding from other concurrent elements, this study identifies two exogenous state characteristics. Firstly, states historically more reliant on state appropriations, rather than local or federal appropriations, for K-12 funding experienced deeper cuts during the Great Recession because state tax revenue is more volatile than local tax revenue and state governments are likely to crowd out education spending due to increasing demand for other safety net programs (Evans, Schwab, and Wagner, 2019; Jackson, Wigger, and Xiong, 2021; Moffitt, 2013). Secondly, seven states without an individual income tax saw their K-12 funding remain lower post-recession. These states, with a less diversified tax portfolio (Cornia and Nelson, 2010), showed increased revenue volatility following the recession (Jordan, Yan, and Hooshmand, 2017; Yan and Carr, 2019). These factors were established well before the recession, changed little over time, and are independent of several state characteristics relevant to the impacts of the Great Recession, providing conditions for an instrument that isolates the effects of K-12 funding cuts from broader recession effects.

Utilizing these sources of variation and the onset of the Great Recession in an event study framework, I instrument for state K-12 education appropriations per pupil. By employing a two-stage least squares (2SLS) model, I compare private school enrollment in regions with substantial funding cuts to those with smaller reductions. The 2SLS results suggest that a $1,000—approximately 8.9%—decrease in K-12 appropriations per pupil increases the private school enrollment rate of schoolchildren by 0.48-0.57 percentage points or 4.5-5.4 percent. with the estimated elasticity of -0.62 in the most preferred specification. This implies that, in response to a 5.8% funding cut, 182,290 students in the nation switched to private schools. My finding is consistent with previous studies finding elasticities ranging from -0.84 to -0.34

(Dinerstein and Smith, 2021; Goldhaber, 1999; Husted and Kenny, 2002; Mavisakalyan, 2011). The effect is most pronounced for middle to high-income students, particularly those living in high SES areas, who are likely to afford private schools and were less enrolled before the recession.

To further comprehend why students switch to private schools, the impact on spending categories and staff-to-student ratios is estimated. The results reveal that areas with larger budget cuts ended up with fewer teachers and instructional aides per student, and less generous salary and employee benefits for teachers, which are relevant measures of education quality (Card and Krueger, 1992). While I cannot directly connect these changes to an increase in private school attendance due to the instruments' limitations, Jackson, Wigger, and Xiong (2021) show that students' test scores had fallen in the same period, supporting that a decline in education quality is the most likely mechanism. Furthermore, the study demonstrates that other potential mechanisms, such as changes in school access and selective migration, cannot explain this shift to private schools.

This paper makes three contributions to existing literature. First, this is one of the few papers estimating the elasticity of the demand for private school enrollment with respect to public K-12 education funding. Due to the challenges of identification, few empirical papers examine the causal relationship between public K-12 funding and private school attendance. While Goldhaber (1999) and Mavisakalyan (2011) investigate this relationship, they rely on cross-sectional instrumental variables. This paper employs a tighter identification strategy using variation in funding across regions and over time, finding more robust results and larger elasticity. Another crucial identification strategy is school finance reforms (SFR), which create exogenous variation in school funding by benefiting relatively poor school districts. Dinerstein and Smith (2021) examine SFR in New York City, finding an increase in public school

funding raises public school enrollment and accelerates private school closures. The elasticity estimated in this paper is larger than mine; however, together with my work, it shows that the impact of public school funding on private school enrollment is somewhat symmetric.

Secondly, this paper presents evidence on how education funding cuts can deepen social gaps in educational attainment through school choice. Although public school spending plays a crucial role in reducing inequality (Johnson and Jackson, 2019), this paper complicates this role by revealing that high SES students can exacerbate educational inequality by switching to private schools in response to funding cuts. This paper also illuminates potential changes in student composition due to funding cuts, which could result in an overestimation of funding effects on student performance if not accounted for (Baron, 2019; Hyman, 2017; Jackson, Wigger, and Xiong, 2021; Kreisman and Steinberg, 2019; Lafortune, Rothstein, and Schanzenbach, 2018).

Thirdly, this paper contributes to the identification strategy of education spending cuts driven by the Great Recession initiated by Jackson, Wigger, and Xiong (2021). They examine how K-12 funding cuts after the Great Recession affected test scores and college enrollment by leveraging variation in funding cuts induced by historical reliance on state-appropriated funds. This paper enhances this approach by adding another source of variation—whether a state collects an individual income tax— and employs a conventional difference-in-differences strategy to improve the precision of the first-stage estimates. This is, to my knowledge, the first study to demonstrate that slower tax revenue recovery in no-income-tax states affected education funding stability and use income tax status to identify variation in public school funding.

The remainder of this paper is organized as follows. Section 2 provides the background of K-12 education funding and sources of identifying variation in funding cuts following the

Great Recession. Section 3 describes the data sources, and Section 4 outlines the econometric model. Section 5 presents the results and potential mechanisms. Section 6 discusses the robustness of the results. The discussion and conclusion are in Section 7.

2 Background: K-12 Budget and the Great Recession

The business cycle introduces volatility into education funding as tax revenue experiences a decline during economic recessions, which is known to be the income effect. Simultaneously, governments face heightened demand for social safety net programs, such as unemployment benefits and cash assistance, crowding out appropriations for K-12 education. This complex interplay contributes to a decline in the growth rate of K-12 funding per pupil during and after economic downturns (Jackson, Wigger, and Xiong, 2021; Moffitt, 2013).[1] While most recessions undergo a modest dip in education funding growth, the Great Recession marked an unprecedented period of funding reduction. Nationally, education funding was cut by $651 or 5.8% per pupil from 2008 to 2013, marking the first decline in real education funding following the recession in the 1980s, and lasting for several subsequent years (Figure 1). The impact of this funding cut varied significantly across states; for example, Florida, facing the most substantial cut, reduced its funding by an extraordinary 28% over five years, significantly surpassing the national average (Figure 2).

While the Great Recession prompted some parents to withdraw children from private schools due to the household income shock (Ewert, 2013), the reduction in funding cuts may have increased private school demand. Figure 3 reflects these dynamics: overall private school enrollment declined post-recession (income effect), but less so in states with more significant funding cuts, suggesting a relative increase (substitution effect). To isolate this substitution

[1] Throughout this discussion, K-12 education appropriation refers to the amount of money allocated to K-12 education, not the realized spending.

effect and estimate the causal impact of public school funding, I leverage two state-level characteristics unrelated to the Great Recession.

Firstly, states relying more on state appropriations, rather than federal or local appropriations, for K-12 education before the recession faced deeper cuts, an identifying variation employed by Jackson, Wigger, and Xiong (2021) (JWX henceforward) to examine the impact of education spending on student achievement. This strategy uses variations in changes in education funding from state, local, and federal sources. Figure 4 illustrates the trend of K-12 funding per pupil by source, showing an immediate drop in state appropriations compensated by federal assistance, stabilizing total education funding for the initial two recession years, while local funding remained relatively stable.

The disparate trends in state and local education appropriations can be attributed to the distinct effects of income and crowding-out effects. State appropriations experienced substantial fluctuations because they are heavily reliant on income and sales taxes (66 percent in 2007 (US Census Bureau, 2020)), which are susceptible to the business cycle. Simultaneously, state governments encountered crowding-out effects during economic downturns as they are responsible for diverse welfare programs. In contrast, local education appropriations, predominantly funded by stable property taxes (72 percent (US Census Bureau, 2020)), underwent smaller income and crowding-out effects. Given that public K-12 education constitutes the most significant expenditure for local governments, the crowding-out effect at the local level was less pronounced than at the state level. The federal government provided substantial funding through the American Reinvestment and Recovery Act (ARRA) to offset state-level losses. However, a significant reduction in funding occurred once the funds were depleted (Evans, Schwab, and Wagner, 2019).[2]

[2]In contrast to federal funds that are predominantly earmarked for specific federal programs such as the National School Lunch Program and Title I, a considerable portion of ARRA funding was provided as discretionary appropriations for expedited recovery efforts.

The composition of K-12 funding in each state played a pivotal role in the magnitude of funding cuts due to these differing trends by funding sources. The state share ($S_s = \frac{State\ App_s}{Total\ App_s}$, referred to as the state share henceforth), representing the proportion of K-12 appropriations derived from state governments, serves as the identifying variation.[3] On average, the state share was 47 percent of total K-12 appropriations in School Year 2007-2008, ranging from 86 percent in Vermont to 27 percent in Nevada (See Appendix Figure A.2 and A.4). The variation in the state share is associated with the magnitude of funding cuts, as states with a higher state share experienced larger cuts, as illustrated in Figure 5.

The state share is determined by the particulars of the state's funding formula, shaped by multiple factors including state and local laws, tax rates and bases, government programs, and overall fiscal centralization (Alm, Buschman, and Sjoquist, 2011). Consequently, the education funding structure is a composite of various factors established years or decades before the Great Recession, presenting limited changes over time and little relevance to the recession itself.[4] Critically, a higher state share does not necessarily indicate a greater commitment to public education by a state, as there is no discernible correlation between the share and total K-12 appropriations per pupil before the recession (Panel B of Appendix Figure A.4).[5]

In addition to the education funding structure, the tax structure plays a crucial role in predicting the trend of tax revenue and funding for K-12 in each state post the Great Recession. Notably, I find that funding cuts for K-12 were more substantial in states that do not collect income tax. The decision of whether a state collects an income tax or not was made decades

[3] State appropriations here is the K-12 funding "distributed" by the state government. For example, Texas's recapture process (Robin Hood Plan) redistributes property tax revenues from wealthy to poor districts. While this fund is locally raised property tax, it is considered state appropriations in receiving districts because it is distributed by the state government. To address a potential problem arising from this, I exclude Texas from the sample in the robustness check, and the result does not change much. (See Appendix Table E.2.)

[4] See Section 4.2 for the formal tests.

[5] State share had been very stable during 2000-2007 (Panel A of Appendix Figure A.4). The correlation coefficient between state share in 2000 and 2007 is over 0.9. The correlation is weaker for the share in 1990 (0.6); however, the correlation between rankings is 0.75. In the robustness check, I use the share in 1990, 2000, and the five-year average of 2002-2006 instead of the share in 2006 and obtain very similar results (See Table 6).

ago, providing exogenous variation to the education budget cuts.[6] The seven states without an individual income tax are Alaska, Florida, Nevada, South Dakota, Texas, Washington, and Wyoming.[7]

Three factors contributed to a more pronounced decline in education funding in these seven states. Firstly, the absence of income tax makes it challenging for these states to diversify their tax revenue, impacting their tax portfolio volatility (Jordan, Yan, and Hooshmand, 2017; Yan and Carr, 2019). Secondly, these states tend to heavily rely on sales tax (Cornia and Nelson, 2010),[8] taking it longer to recover their tax revenues after the Great Recession (Alm and Sjoquist, 2014). Lastly, these states lack certain options to expedite the recovery of tax revenues. Typical approaches to raise tax revenue were making the income tax more progressive or revising the tax portfolio, options not available to states without income tax (Seegert, 2015). Consequently, states without income taxes experienced a more prolonged reduction in tax revenues post the Great Recession.[9] Figure 5 compares the trend of K-12 education funding in states with and without income tax relative to the fiscal year 2007. While education funding in other states recovered to the pre-recession level by 2014-15, it lagged in states without income tax. This study is the first, to my knowledge, to demonstrate the impact of having an income tax on education funding stability after the Great Recession.

[6]The state income tax status was predominantly determined during the early 20th century, with the first adoption occurring in 1901 in Hawaii. By 1976, 44 states had implemented state income tax. Following Alaska's repeal of its income tax in 1979, seven states presently do not have a state income tax (US Advisory Commission on Intergovernmental Relations, 1995).

[7]New Hampshire and Tennessee collect tax on dividend and interest income but not on labor income. In the robustness check, I include these two states as no-income tax states as well. The results remain consistent (See Table 6).

[8]This is not true for Alaska, which collects most of its tax revenue through natural resource taxes.

[9]This is not applicable to five states with no general sales tax (Alaska, Delaware, Montana, Oregon, and New Hampshire) as they were diversifying their tax revenues through excise taxes and license fees. Their reliance on income tax is comparable to states with sales tax, ranging from 5 to 40 percent, except for Oregon. See Appendix Table A.1.

3 Data

3.1 Private School Enrollment and Individual Characteristics

I utilize data from the 2000 Census and the 2001-2018 American Community Survey (ACS) sourced from the Integrated Public Use Microdata Series (IPUMS) (Ruggles et al., 2023) to gather information on private school enrollment.[10] Both the Census and ACS inquire whether respondents are enrolled in a private school when they are enrolled in school. In addition to private school enrollment status, the datasets also contain rich information on individual, parental, and household characteristics. I restrict my sample to children between the ages of 6 and 17 years (equivalent to grades 1 to 12) to ensure they are school-aged.[11] Washington DC is excluded from the primary sample due to its unique status, where the state share is zero by definition, making it an outlier. The final sample comprises 9,793,777 children.

3.2 K-12 Education Appropriations and Expenditures

I collect financial data for all school districts in the US spanning the 1999-2018 school years from the Common Core of Data (CCD), obtained from the National Center for Education Statistics (NCES). The CCD offers comprehensive data on school financing, including funding sources (state, local, and federal government), expenditures in various categories, as well as directory information such as school type, address, enrollment, and staffing. To ensure a focus on K-12 education, I utilize district-level data and aggregate it to the state level, excluding districts exclusive to special education, vocational schools, and adult education. Additionally, to address the potential noise in the district-level data, I follow Lafortune, Rothstein, and

[10] Due to the onset of the Covid-19 pandemic in 2020, I have restricted my study period to the school year up to 2018/2019. Consequently, the sample is limited to the 2018 calendar year.

[11] Excluding five-year-olds addresses variations in public funding for pre-kindergarten, and excluding eighteen-year-olds accounts for individuals who may have completed their schooling.

Schanzenbach (2018) by excluding certain suspicious school districts.[12] As the Census and ACS lack information on the survey month, I compute a weighted average of the subsequent two school years to construct education finance data at the calendar year level.

3.3 Additional Datasets

State-level spending on various sectors, utilized to assess the validity of the empirical strategy, is sourced from the 2000-2018 state expenditure report by the National Association of State Budget Officiers (NASBO). The state revenues from various sources are derived from the Annual Survey of State and Local Government Finances by US Census Bureau, retrieved from the Urban Institute. State-level spending on unemployment insurance benefits is directly coming from the official unemployment insurance budget data (US Department of Labor). Additionally, for further analysis on private school attendance, I incorporate the 1999-2017 Private School Universe Survey (PSS) from the NCES , a biennial survey containing all private K-12 schools in the US.[13]

3.4 Summary Statistics

In Table 1, I show the summary statistics in the pre-and post-recession period. About 10.34 percent of the total children were enrolled in private school (as opposed to in public school or not enrolled at all) in the pre-Great Recession period. This number has decreased by 0.42 percentage points after the Great Recession, suggesting that the income effect dominates the substitution effect. The average inflation-adjusted total revenue per pupil is about $11,225

[12]The suspicious school districts include: (1) district-year observations with fewer than 100 enrollees, (2) singleton districts, (3) district-year observations where enrollment exceeds twice the average district enrollment, (4) district-year observations with membership that fluctuates by more than 25% and less than 75% compared to the previous year, (5) district-year observations with membership deviating by less than 30% or more than 30% from the district's constant growth rate, (6) district-year observations where total appropriations per pupil fall below 20% or exceed 500% of the state average.

[13]Refer to Appendix Section G for detailed analysis.

before the recession. The funding is larger after the recession despite the cut because of an increasing trend from 2000 to 2007.

In the next columns, I divide states into two groups based on their state shares, using the median (0.54) as the threshold. While there was a decrease in private school enrollment in both groups, the decline was larger in low-share states (0.26 versus 0.51 percentage points), implying a relative increase in high-share states. Similarly, when comparing states with and without income taxes, the trend was similar, with a smaller decline in private school enrollment in states without income taxes. In Panel B, consistent with these patterns, states with low state shares and no income tax recovered their education appropriations more quickly.

Panel C compares the major covariates before and after the Recession, revealing minimal disparity. Although most covariates are balanced, some differences persist. For instance, states without income tax exhibit economic disparities, characterized by lower average household income and a higher proportion of Hispanic residents. However, these covariates are controlled for in the estimation, and additional robustness checks in Section 6 and Appendix Section E confirm that the results are not influenced by these confounding factors.

4 Econometric Model and Validity

4.1 Estimation Equations

My empirical strategy leverages the Great Recession as a natural experiment that generated an exogenous variation in education funding as I explained in Section 2 to address endogeneity between local public education funding and private school enrollment. I estimate the following system of equations using two-stage least squares (2SLS):

$$Private_{ist} = \beta A\hat{p}p_{st} + \pi_1 X_{ist} + \rho_1 C_{st} + \mu_{1s} + \theta_{1t} + \varepsilon_{1ist}, \quad (1)$$

$$App_{st} = \sum_{t \neq 2007} [\gamma_{1t} S_s \times I_t + \gamma_{2t} NT_s \times I_t] + \pi_2 X_{ist} + \rho_2 C_{st} + \mu_{2s} + \theta_{2t} + \varepsilon_{2ist}, \quad (2)$$

where $Private_{ist}$ is an indicator of whether individual i in state s in calendar year t is in a private school and App_{st} is the total K-12 appropriations per pupil in thousands (in 2010 dollars).[14][15] I include a vector of student and household level controls (X_{ist}). C_{st} is the state-level Bartik predictors of states' unemployment and income, following JWX. I also include the baseline state characteristics (in 2000) interacted with the time trend in some specifications. State fixed effects (μ) absorb the time-invariant differences across states, and year fixed effects (θ) control for any common national shocks specific to given years.

I instrument for App_{st} by combining S_s, the share of total K-12 funding coming from state-appropriated funds in the school year 2007-2008 ($\frac{State\ App_{s,2006}}{Total\ App_{s,2006}}$), and NT_s, the indicator for having no state income tax, with the year dummies (I_t) in an event study setting. I take 2007 as the base year, as the Bureau of Economic Analysis states the Great Recession officially started in December of 2007, so all coefficients can be interpreted as changes relative to 2007. This framework helps me extract the exogenous variation in education funding cuts from additional shocks induced by the Great Recession. Because funding did not decline until 2010 and slowly recovered until 2016 (Figure 1), I prefer an event study model that has more flexibility than the traditional difference-in-differences model (DiD). In Appendix Table E.3, I show that my results are robust to using alternative instruments such as traditional DiD and using only one source of variation. The standard errors are clustered at the state level,

[14] "Not in private school" means children in public schools and not in school at all, including homeschoolers and dropouts. I include all of the school-aged sample to avoid the impact of "leaving the education system". Excluding these students does not make much difference. See Appendix Section E.2.

[15] I use levels instead of logs to avoid the assumption that a one-dollar increase in revenue has a stronger impact on low-spending states than on high-spending states. The results using logs are available in the Appendix Table A.2.

and the regressions are weighted using sample weights of the Census and ACS in both of the regressions.

My identification strategy using the variation in the reliance on the state government owes JWX's work. The most important difference is that instead of using the change in the slope of education expenditure induced by the Great Recession ($S_s \times Post_t \times t$), I utilize the change in the level, which is a more conventional DiD strategy, and add NT_s as another source of variation. By doing so, I can improve the first stage F-statistics without assuming a specific functional form as JWX do. I argue that my specification complements their work by using traditional DiD and making it easier to interpret the compliers. For the discussions of compliers, see Appendix Section B.)

4.2 Validity of the Empirical Strategy

The crucial identifying assumption of my empirical strategy is that the instruments should not affect private school attendance through channels other than the change in appropriations for public K-12 education (exclusion restriction). This assumption is fundamentally unprovable because I cannot show my instruments are unrelated to any potential confounding factors or it is impossible to show my instruments are independent of the error term ε_{1ist}. Nevertheless, in this subsection, I provide evidence that my instrumental variables are uncorrelated with important individual and regional characteristics. In particular, I demonstrate that my instruments are independent of the characteristics closely relevant to the income effects of the Great Recession, the most concerning confounding factor, showing they can separate the substitution effect caused by cuts for education funding from the overall impact of the Great Recession. In addition, I also show whether the change in education funding is associated with changes in the regional demographic characteristics and other spending categories

that may affect private school attendance.

In Table 2, I show the 2SLS results of 18 potential confounders. In Panel A, I use the main sample to test individual-level characteristics. Five variables, whether the household head is employed, total household income (in $1,000), whether the household is under 150% of the poverty line, and indicators for minority and foreign-born are not associated with the total education funding per pupil. I find that ownership of a dwelling is positively associated with education funding. Reassuringly, the point estimate of 0.65 percentage points is very small compared to the average of 69.5 percent before the Great Recession. Other important characteristics such as employment of household head and total household income have little relation to K-12 appropriations per pupil.

Next, I test state-level covariates in Panel B, including the median house value and the number of children. Median house value is an important characteristic as the Recession started from the collapse of the housing market, and reassuringly, it is not associated with education funding. The number of children in all categories has little to do with the funding, except for the total number of children, indicating that a $1,000 decline in funding is associated with an increase of 4% of children in the state. Because I use *per-pupil* funding, the total number of children is considered in the model. Nevertheless, some may concern selective migration as a confounding factor, which is considered in Appendix Section D.

Lastly in Panel C, I conduct tests to examine whether other state-level spending categories were associated with state K-12 funding and, indirectly, affected private school enrollment.[16] Since the identification strategy relies on the fact that total tax revenue was lower in no-income-tax states, total expenditure increases when education funding increases. However, the point estimate is small because total expenditure includes transfers from the federal government, which compensate for the loss from the state government. Spending on other cat-

[16] Years 2002 and 2004 are excluded from the regressions because state-wise expenditure data is not available.

egories shows little association with total K-12 appropriations per pupil. Interestingly, higher education spending per capita is also not correlated, indicating that K-12 and higher education funding are determined by different mechanisms. Overall, the placebo tests support that my instruments can remove the income effects of the Great Recession and focus on the variation in education funding.

4.3 First Stage and Reduced-Form Results

In this subsection, I present the results of the first stage and reduced-form regressions to validate the relevance of the instrumental variables outlined in Equation 2. Figure 6 displays the coefficients of the state share and the no-income-tax indicator interacted with year dummies, along with 95% confidence intervals. All estimates are relative to the base year of 2007. The regression incorporates individual and household controls as well as Bartik predictions of state-level unemployment and income, constituting the preferred specification.[17]

Panel (a) presents the first-stage results. Per-pupil public education appropriations are scaled to thousands of 2010 dollars for the estimation. The results indicate that the identifying variation strongly predicts the extent of funding cuts. Coefficients are generally larger for the state share due to differing scales; the state share ranges continuously from zero to one, while the no-income-tax indicator is binary. To be specific, in 2013, a ten percentage point increase in the state share corresponds to a decrease of $624 per pupil in the education budget. Given the pre-recession average appropriations per pupil of approximately $11,225, this represents a 5.6% decline, signifying a substantial impact. Notably, the funding cuts induced by the Great Recession persisted even after 2013, when the economy rebounded to pre-recession levels. Likewise, the coefficients on the no-income tax indicator also present a strong decline in per-

[17] Alternative specifications are available in Appendix Figure A.6; however, they exhibit no significant differences.

pupil appropriations. In 2013, the K-12 education funding per pupil was lower by $1,446 or 12.9% in no-income-tax states. A sustained decline in per-pupil appropriations is observed for the coefficients on the no-income-tax indicator, lasting up to 10 years post-recession.

Panel (b) illustrates the association of the instrumental variables with private school attendance (the reduced form). I multiply the coefficients and standard errors by 100 to represent changes in private school enrollment in percentage points. Both instrumental variables exhibit a positive association with private school enrollment, persisting for 10 years post-recession, consistent with Panel (a). Specifically, a ten percentage point increase in the state share in 2013 corresponds to a 0.332 percentage point (or 3.2%) rise in private school attendance. Although the estimates for 2016 and 2018 are statistically insignificant, the sustained effect on private school enrollment is evident, mirroring the trends observed in Panel (a). This prolonged effect is particularly pronounced for the no-income-tax indicator, with point estimates indicating an increase in private school enrollment up to 2018. For instance, in 2013, private school enrollment in no-income-tax states increased by 0.83 percentage points compared to income-tax states relative to 2007. This consistent rise in private school enrollment aligns with the suggestive relationship depicted in Figure 3.

The parallel trends assumption in the event study model asserts that the trends of the treatment and control groups are similar in the absence of treatment. The insignificance of pre-treatment estimators in the event study model suggests parallel trends, as observed in Panels (a) and (b). However, concerns may arise regarding potential differential pre-existing trends (pre-trends), particularly in earlier years for the first stage (for S_s) and later years in the pre-period for the reduced form (for NT_s). The consistent direction of post-treatment estimators heightens concerns about violating the parallel trends assumption. To address this, in Appendix Section C, I employ the robust estimator proposed by Rambachan and Roth

(2023) (implemented through the Stata package honestdid) to accommodate potential violations of the parallel pre-trends assumption. As shown in Appendix Figure C.2, even when parallel trends are somewhat violated, the average treatment effects in the post-periods (DiD estimator) remain statistically significant. Hence, I argue that pre-trends do not substantially confound my main results.

5 Results

5.1 Main Results

I begin by estimating the main model presented in Equations 1 and 2 in Table 3, where the outcome variable is the indicator for private school attendance. All specifications include the year and state fixed effects and the full set of dummies of children's age. In columns 1 to 5, the coefficients are consistent and robust to the inclusion of controls, falling within the small range of -0.397 to -0.611 percentage points. When I control for individual demographic and household characteristics, respectively, the point estimates increase in magnitude by 0.075 percentage points (columns 2 and 3). The jumps in point estimates are happening because of the high correlation between private school attendance and individual and household characteristics, indicating the importance of the inclusion of covariates. In column 4, my preferred specification, I add the Bartik prediction of the state unemployment rate and average income. In column 5, I add the linear trends of baseline state characteristics, where the point estimate increased by 0.05 percentage points.[18] The magnitude of the impact is much larger (more negative) in 2SLS regressions than OLS result (*-0.166 to -0.266*, see the Appendix Table A.2.),

[18]Despite the change in point estimates, I choose column 4 as my preferred specification for the individual-level analysis to save the computational power. In particular, the addition of state characteristics trend generates a multicollinearity problem when dividing the sample in the heterogeneity analysis in Section 5.3 and Appendix Section F.

which means that the appropriations per pupil are endogenous and the OLS estimate is biased toward zero.

In the preferred specification, the point estimate suggests that for every $1,000 reduction in public education appropriations per pupil in the state, private school enrollment increases by 0.567 percentage points. This represents an 8.9% decrease in public school appropriations and a 5.5% increase in private school enrollment, given the pre-period means ($11,225 and 10.34%). This indicates the elasticity of the demand for private schools with respect to public school funding is -0.62(= 5.5%/8.9%) meaning that a 1% decrease in public education funding would increase private school enrollment by 0.62%. Using this elasticity, it can be calculated that roughly 2,637 students in the median state or 182,290 students nationwide switched to private schools in response to a 5.8% funding cut, which was the average decrease from 2008 to 2013.[19]

5.2 Comparison to Existing Literature

In this subsection, I compare the elasticity estimated in this paper (-0.62) to existing estimates. Using a structural model, Goldhaber (1999) suggests an elasticity of -0.5.[20] A more recent study by Mavisakalyan (2011), a cross-country study with 80 countries, shows an elasticity of -0.34, about half of mine.[21] While they investigate different periods and regions, the cross-sectional instrumental variables used in these papers may not completely rule out reverse causality and omitted variables, generating a smaller elasticity. Thus, I would expect estimates

[19] Before the recession, the private school enrollment was 10.34%. The number of school-aged children in a median state and nationwide was 688,907 and 49,025,736, respectively, in 2007. Thus, 2,561 = (-0.62) × (-5.8%) × 688,907 × 10.34%, and 182,290 = (-0.62) × (-5.97%) × 49,025,736 × 10.34%.

[20] His estimate shows that a $1,000 (in 1983 dollars) increase in public school expenditure per pupil decreases private school enrollment by 1.5 percentage points in the school district. Average private school enrollment is 4.64% in his sample, New York State in 1981, and the instructional funding per pupil is $1,565.

[21] The point estimate indicates that a one percentage point increase in public education spending relative to the country's GDP decreases private school enrollment by -8.5%. Education spending accounts for 4.0% of US GDP in 2016 (Snyder, de Brey, and Dillow, 2019), so a one percentage point increase corresponds to a 25% increase in education spending. The estimated elasticity is -0.34 (=-8.5%/25%).

to be biased toward zero, consistent with the results of my OLS estimation.

A couple of papers examine the relationship between funding and private school attendance using school finance reform (SFR) as an identification strategy. Husted and Kenny (2002) utilize SFR started in 1970s, finding elasticity of -0.5.[22] Dinerstein and Smith (2021)'s recent work using the SFR in New York City presents that an increase in public school funding through financial reform reduces private school attendance with an estimated elasticity of -0.84.

My elasticity estimates, ranging from -0.43 to -0.79, align closely with those found in previous studies. However, unlike most of these studies—particularly those leveraging SFR—I focus on the Great Recession-induced funding cuts for public education, an extreme case of funding changes. Although my approach allows for testing the impact of massive funding cuts, its use as identification raises questions about the generalizability of my results to more typical funding changes. While my findings appear to be consistent with the literature, at least direction-wise, their wider applicability remains unclear. Nevertheless, this study presents a compelling case study that highlights the significance of investigating negative shocks that follow major economic downturns, as they can have lasting effects on the education market.

5.3 Heterogeneity in Effect

Private school preferences are known to be correlated with household demographics and socioeconomic status (SES), as noted in studies by Brunner, Imazeki, and Ross (2010) and Long and Toma (1988). I begin by examining heterogeneity by children's age, recognizing that preferences for private schools may vary across different age groups due to factors such as accessibility to private schools, parental beliefs about critical educational stages (age), and previous

[22] They find a 100% increase in state-level public education funding decreases private school enrollment by 5 percentage points. The private school enrollment in their sample is 10% and the estimated elasticity is -0.5.

experiences in public schools (Goldring and Phillips, 2008). In columns 1 and 2 of Panel A of Table 4, I separately estimate the impact of K-12 appropriations on private school enrollment for elementary/middle and high school-aged students. The estimate is larger for younger students by 0.128 percentage points, although the two coefficients are not statistically different from each other.

Next, I consider race. While racial variation in private school enrollment is well-documented, whether a particular racial group is more responsive to public school spending is less clear. In Panel B of Table 4, I examine heterogeneity by five race and ethnicity categories. I find significant effects for all races except Asians. The point estimates for US-born children, Whites, and Asians are similar to the baseline result, although the estimate for Asians is not significant due to the small sample size. Considering the low baseline mean of Black and Hispanic students' private school attendance, the elasticity is high for them; the estimated elasticities of White, Black, and Hispanic students are -0.49, -0.84, and -1.40, respectively. A rough calculation suggests that 101,311, 19,271, and 44,029 White, Black, and Hispanic students were enrolled in private schools in the country in response to a -5.8% funding cut from 2008 to 2013, respectively.[23]

The larger point estimates and elasticity for Blacks and Hispanics are interesting, suggesting that this is not solely a White effect. While this is surprising, previous literature suggests that Hispanics have as strong a preference for private schools as their White peers. Fairlie (2002) demonstrates that an increase in the Black population in a neighborhood prompts Hispanic students to transfer to private schools, and this "Latino Flight" is no weaker than "White Flight." Thus, Hispanic students may have a strong preference for private schools, leading them to opt for private schools when facing funding cuts. My results also indicate

[23]The total number of White, Black, and Hispanic school-aged children before the Great Recession is 28,540,928, 7,063,334, and 9,546,335, respectively. 101,311=(-0.49)×(-5.8%)×28,540,928×12.49%. Numbers for Blacks and Hispanics can be calculated similarly.

that Black students may be as responsive as White peers when facing a funding cut in public schools. The point estimate for Black is smaller than the main effect, although not statistically different from the baseline result. The preference for private schools among African American students is not extensively documented; however, some studies suggest that African American students also choose private over public schools under situations like increasing immigrant population (Murray, 2016). Additionally, a recent survey shows that African American parents express support for private school vouchers more than the national average (Ekins, 2019), implying that the preference for private schools among Black parents is not lower than that of their counterparts.

In Panel C, I divide the sample by household income percentile and separately estimate the impact of K-12 funding. Household income percentile thresholds are defined by the national income percentile each year. The results demonstrate evident heterogeneity in response to budget cuts across income groups. The point estimate is small and insignificant for columns 1 and 5, the richest and poorest households, likely because a large proportion of households in these groups always and never enroll in private schools, respectively. The point estimates in these groups are statistically different from the other three groups. Although not statistically different, it is noteworthy that the point estimate is the largest in the middle-income group (75-50th percentile) compared to the richer group (90-75th), whose private school enrollment rates are already high.

Public school advocates criticize the government for reducing education funding because public schools may reduce inequality (Johnson and Jackson, 2019). The results in Table 4 suggest that relatively affluent students can mitigate the adverse effects of funding cuts by switching to private schools, and given this, cuts in public education funding may have a broader impact on intergenerational mobility than expected. In other words, while the adverse effects

of funding cuts on remaining students may be partially mitigated by high SES students leaving for private schools (Akyol, 2016), inequality in student outcomes may increase both by directly affecting remaining students in public schools and by inducing some students to opt for private schools.

Extensive research has explored the relationship between regional characteristics and private school attendance, indicating that private school enrollment is influenced by factors such as the poverty rate (Winkler and Rounds, 1996), the proportion of minorities (Fairlie, 2002; Fairlie and Resch, 2002; Li, 2009), and the immigrant population (Betts and Fairlie, 2003; Cascio and Lewis, 2012; Murray, 2016). In Appendix Table F.1, I further examine the heterogeneity by regional characteristics and household income. The findings are consistent with Table 4, presenting that households living in high SES areas, especially those with higher income, are more likely to switch to private schools in response to the funding shock.

The results presented in Appendix Table F.1 alongside Table 4 indicate that reductions in public education funding could exacerbate educational disparities as high SES students may choose to enroll in private schools in response to budget cuts. Moreover, these findings highlight the possibility of change in student composition in public schools. Many studies examining the impact of school finance often overlook this potential compositional shift, which could introduce bias into their results.

5.4 Possible Mechanism: Impact on School Expenditures

A subsequent critical question is whether students switch to private schools because of a decline in (observable) quality of public schools. A literature review by Jackson (2018) and Jackson and Mackevicius (2021) point out that the causal effects of school funding on student outcomes are overwhelmingly supported by recent quasi-experimental works. In particular,

Jackson, Wigger, and Xiong (2021)'s research studying the same period with a similar specification also finds a negative impact of school funding cuts on students' academic performance through cuts in actual spending. To test whether my specification results in the same conclusion, I estimate the impact on outcomes that are related to the real quality of education, similar to Jackson, Wigger, and Xiong (2021)'s analysis.

In Panel A of Table 5, I investigate the spending categories that were primarily affected by the funding cuts. I regress the level of spending per pupil in each category—namely, expenditure on instruction, student and teacher support, capital, noninstructional, and general and school administration. The results indicate that instructional spending, which is closely linked to education quality, decreases by $526 with a $1,000 reduction in total appropriations per pupil. Given that a $1,000 reduction corresponds to an 8.9% decline in total funding, this suggests that school funding cuts directly translate to reductions in instructional spending at a one-to-one ratio. Similar reductions are observed in expenditure on support activities. However, there is a small and statistically insignificant impact on capital and noninstructional expenditure. This does not imply that there were no cuts in capital investment; rather, it suggests that school districts with relatively small funding reductions also reduced capital spending to safeguard other expenditures, especially anticipating prolonged funding constraints. This result for capital expenditure is inconsistent with the findings of JWX, which observe a significant impact on capital spending reduction during the same period. The discrepancy likely arises from the use of different LATEs between the studies. Additionally, Baron (2019) found that an increase in property spending did not significantly improve student achievement compared to instructional expenditure, underscoring the critical importance of instructional spending in shaping education quality.

The last column of Panel A presents the outcome for a critical expenditure category: pub-

lic spending on private school tuition and direct private school program support. The estimations indicate that a $1,000 decrease in overall funding leads to a $30.9 reduction in private school funding. Although this estimate is statistically significant, it is reassuring that the point estimate is small, and the observed effect opposes my primary finding. This implies that an increase in spending on private school programs cannot be the main factor driving private school enrollment during this period. However, it's possible that the spending itself has somehow influenced private school enrollment. In Appendix Table E.6, I verify whether these findings remain robust after including private school program indicators and public spending on private school programs.

In Panel B, I examine expenditure per teacher, a crucial attribute linked to education quality (Card and Krueger, 1992). Although spending per teacher may not be directly relevant to students, greater financial incentives can draw in talented educators from other regions or sectors, and deter competent teachers from exiting the profession, improving education quality. In Column 1, a $1,000 drop in K-12 appropriations per pupil corresponds to a statistically significant $1,524 (or 2.2%) reduction in real average teacher salary (computed as total instructional salary expenditure divided by the number of teachers). Column 2 reveals a similar impact on employee benefits for teachers, amounting to about $4,092 (or 17.6%). This finding is plausible as reducing teacher salaries might be challenging, inducing school districts to instead trim less notable employee benefits to achieve cost savings. Column 3 assesses the effect on staff support per teacher, producing a minor and statistically insignificant estimate.

Panel C investigates whether the budget cuts led to a decrease in the number of staff per 100 students. Overall, the effect on staff numbers was modest. The number of teachers reduced by 0.073 per 100 students (equivalent to a 1.2% reduction), while instructional aides experienced a more substantial decline of 0.115 (or 7.8%). This pattern aligns with that ob-

served in Panel B, where difficulties in cutting the number of teachers, due to factors such as teacher unions or regulations on minimum class sizes, might lead to a preference for letting go of support staff. For other staff categories, the effect is only statistically significant for library staff, albeit very small. Guidance counselors, student support staff, and school and general administrative staff, showed minimal effects since their baseline numbers were relatively low, affording limited scope for reduction.

Table 5 underscores an overall decline in education quality in terms of spending. However, it remains uncertain whether this change was readily noticeable to local residents. The reduction in staff numbers may not have been significant enough to be immediately perceived, and parents may not have been fully informed about the details of education expenditure in their local school districts. While directly measuring the parental awareness of this quality decline is challenging, I offer some anecdotal evidence that the budget cuts were perceptible. For instance, a report by American Federation of Teachers (2018) outlines various issues faced by many school districts, such as overcrowded classrooms, outdated textbooks, malfunctioning buses, and deteriorating infrastructure like leaky roofs. Critical staff positions, including nurses and guidance counselors, were also eliminated, while elective offerings were slashed, the school year was shortened, and, in more extreme cases, some districts resorted to a four-day school week. The media, both local and national, heavily covered the funding cuts, amplifying public awareness of the issue. Although these pieces of evidence are not definitive, it is plausible that parents were aware of the impending cuts to some extent.

Other potential mechanisms, such as a change in the school supply and the introduction of private school support programs, are explored in Appendix Section D, yielding insignificant results. When considered alongside the findings from JWX, the transition to private schools is attributed to a decline in public education quality rather than changes in access to private

schools.

6 Robustness Checks

In this section, I provide several robustness checks to assess the sensitivity of my result. In column 1 of Table 6, I aggregate the data to the state-year level, and the level of variation used in this paper, and run the regression only with state-level controls. The regression is weighted with the school-aged children's population in 2000. The point estimate is slightly smaller but similar to column 1 of Table 3. In column 2, I introduce a state-specific linear time trend term ($\eta_s \times t$). This term explicitly controls for any effects through differential trends across states and addresses potential pre-trend issues in education funding. The point estimate in column 2 is comparable to the preferred specification, although less precise, suggesting that differential trends cannot explain the main finding. This is further supported by the analysis in Appendix Section C.

In column 3, I exclude charter-only districts from the sample when constructing the state-level financial data, and column 4 additionally excludes districts with any charter schools. The point estimate increases by 0.073 when excluding charter schools, suggesting that funding for traditional public schools (TPS) is a stronger predictor for private schools compared to all public and private schools. However, the point estimates are not statistically different. Excluding districts with any charter schools slightly changes the sample because some states do not have an independent charter district. In column 5, I use a smaller geographical unit called Consistent Public Use Microdata Area (CPUMA).[24] The funding at the CPUMA level results in an increase of 0.12 percentage points in the point estimates, because it better reflects

[24] PUMA is the smallest geographic unit that the Census discloses in their microdata files. The boundary of ACS PUMA changed in 2012. CPUMA combines contiguous PUMAs to make the boundary consistent from 2000. To match the school district to CPUMA, I identify the CPUMA of the school district offices and then aggregate the data to the CPUMA level. When there is no school district office in a CPUMA, I use the average of the contingent PUMAs.

the actual funding shock that students face.

Columns 6-9 utilize alternative definitions of state share and no-income tax. In columns 6-8, I use state share defined in 2000, 1990, and a five-year average, respectively, and the estimates are robust to these alternative definitions. In column 9, I include New Hampshire and Tennessee as the no-income-tax states as well because these two states do not collect tax on labor income. The point estimates increase by 0.04-0.1 percentage points, but the differences are not statistically significant.

In the Online Appendix, I provide several additional robustness checks and consider other potential confounding factors. I first examine whether the effect is robust to the inclusion of other state characteristics such as political affiliation, teachers' union presence, and religiosity (Table E.1). I further the sensitivity of the results by exploring alternative samples (Table E.2), utilizing alternative instruments (Table E.3), using lagged funding variables (Table E.4), considering selective migration (Table E.5) or school supply and school choice policies (Table E.6). Across all these checks, the results remain robust, supporting the main findings of the study.

7 Discussion and Conclusion

Private schools serve a significant portion of K-12 students and play a pivotal role in enhancing education quality by offering an alternative and fostering competition. Parents often select private schools under the belief that they are better resourced than public schools. Given this context, a shock to public school funding might influence parental decisions regarding enrolling their children in private schools. Understanding the sensitivity of students to public school funding is crucial for policymakers when deciding on K-12 funding, which is among the largest government expenditures.

By utilizing education funding cuts followed by the Great Recession, I establish solid evidence that private school enrollment reacts to public education resources in K-12 education. To separate the impact of the funding cuts from the recession, I exploit two plausibly exogenous sources of variation: the share of state-appropriated funds for K-12 education and a no-state-income-tax indicator. I combine these with the timing of the recession in an event study framework, using the event study interaction terms as the instruments for the state-level K-12 appropriations per pupil.

The funding cuts triggered by the two instrumental variables have lasted for a decade after the recession's onset, allowing room for a long-lasting change in private school enrollment. I discover that a $1,000 decrease in the public education budget per pupil raises private school enrollment by 0.567 percentage points, implying an elasticity of -0.62. A reduction in public schools' perceived quality, as indicated by instructional spending per pupil, the student-staff ratio, and spending per teacher, appears to be a probable mechanism. Furthermore, the impact of funding cuts is focused on high- to middle-income households. My heterogeneity findings shed light on how public school funding can exacerbate inequality through school choice and changes in student composition within public schools.

Lastly, the funding cut studied here provides a critical lesson on addressing economic crises. In the event of an excessive shock such as the Great Recession, it may take years for schools to fully recover their funding, leading to a long-term shift in public and private school enrollment patterns. The adverse effects could be worsened by complex situations arising from recessions, such as an actual disruption in public education, potentially leading to a learning gap between public and private schools. Thus, as public education is crucial in addressing inequality, policy interventions must secure education funding during recessions.

References

Akyol, Metin. 2016. "Do Educational Vouchers Reduce Inequality and Inefficiency in Education?" *Economics of Education Review*, 55: 149–167.

Alm, James and David L Sjoquist. 2014. "State Government Revenue Recovery from the Great Recession." *State and Local Government Review*, 46(3): 164–172.

Alm, James, Robert D Buschman, and David L Sjoquist. 2011. "Citizen "Trust" as an Explanation of State Education Funding to Local School Districts." *Publius: The Journal of Federalism*, 41(4): 636–661.

American Federation of Teachers. 2018. "A Decade of Neglect." American Federation of Teachers, AFL-CIO, Washington, DC.

Baron, E Jason. 2019. "School Spending and Student Outcomes: Evidence from Revenue Limit Elections in Wisconsin."

Betts, Julian R and Robert W Fairlie. 2003. "Does Immigration Induce 'Native Flight' from Public Schools into Private Schools?" *Journal of Public Economics*, 87(5-6): 987–1012.

Blundell, Richard, Lorraine Dearden, and Luke Sibieta. 2010. "The demand for private schooling in England: The impact of proce and quality." *IFS Working Paper*.

Brasington, David M and Diane Hite. 2012. "School Choice and Perceived School Quality." *Economics Letters*, 116(3): 451–453.

Brunner, Eric J, Jennifer Imazeki, and Stephen L Ross. 2010. "Universal Vouchers and Racial and Ethnic Segregation." *Review of Economics and Statistics*, 92(4): 912–927.

Card, David and Alan B. Krueger. 1992. "Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States." *Journal of Political Economy*, 100(1): 1–40.

Cascio, Elizabeth U and Ethan G Lewis. 2012. "Cracks in the melting pot: Immigration, school choice, and segregation." *American Economic Journal: Economic Policy*, 4(3): 91–117.

Cornia, Gary C and Ray D Nelson. 2010. "State Tax Revenue Growth and Volatility." *Federal Reserve Bank of St. Louis Regional Economic Development*, 6(1): 23–58.

Davies, James B, Jie Zhang, and Jinli Zeng. 2005. "Intergenerational Mobility under Private vs . Public Education." *Scandinavian Journal of Economics*, 107(3): 399–417.

Dee, Thomas S. 1998. "Competition and the quality of public schools." *Economics of Education Review*, 17(4): 419–427.

Dinerstein, Michael and Troy D. Smith. 2021. "Quantifying the Supply Response of Private Schools to Public Policies." *American Economic Review*, 111(10): 3376–3417.

Ekins, Emily. 2019. "Poll: 58Private School." *https://www.cato.org/blog/poll-58-americans-favor-vouchers-k-12-private-school*. (Accessed 2023-09-01).

Evans, William N., Robert M. Schwab, and Kathryn L. Wagner. 2019. *The great recession and public education*. Vol. 14.

Ewert, Stephanie. 2013. "The Decline in Private School Enrollment." *SEHSD Working Paper*, FY12-117.

Fairlie, Robert W. 2002. "Private schools and "Latino flight" from black schoolchildren." *Demography*, 39(4): 655–674.

Fairlie, Robert W and Alexandra M Resch. 2002. "Is There "White Flight" into Private Schools ? Evidence from the National Educational Longitudinal Survey." *The Review of Economics and Statistics*, 84(1): 21–33.

Glomm, Gerhard and B. Ravikumar. 1992. "Public versus Private Investmetn in Human Capital: Endogenous Growth and Income Inequality." *Journal of Political Economy*, 100(4): 818–834.

Goldhaber, Dan. 1999. "An endogenous model of public school expenditures and private school enrollment." *Journal of Urban Economics*, 46(1): 106–128.

Goldring, Ellen B and Kristie J R Phillips. 2008. "Parent preferences and parent choices: The public-private decision about school choice." *Journal of Education Policy*, 23(3): 209–230.

Hamilton, James. "GDP-Based Recession Indicator Index [JHGDPBRINDX]." Federal Reserve Bank of St. Louis Economic Data. *https://fred.stlouisfed.org/series/JHGDPBRINDX*. (Accessed 2020-01-31).

Houtenville, Andrew J and Karen Smith Conway. 2008. "Parental Effort, School Resources, and Student Achievement." *Journal of Human Resources*, 43(2): 437–453.

Hoxby, Caroline Minter. 1994. "Do Private Schools Provide Competition for Public Schools?" *NBER Working Paper*.

Husted, Thomas A. and Lawrence W. Kenny. 2002. "The Legacy of Serrano: The Impact of Mandated Equal Spending on Private School Enrollment." *Southern Economic Journal*, 68(3): 566.

Hyman, Joshua. 2017. "Does money matter in the long run? Effects of school spending on educational attainment." *American Economic Journal: Economic Policy*, 9(4): 256–280.

Iyigun, Murat F. 1999. "Public education and intergenerational economic mobility." *International Economic Review*, 40(3): 697–710.

Jackson, C. Kirabo. 2018. "Does school spending matter? The new literature on an old question." *Confronting inequality: How policies and practices shape children's opportunities.*, 165–186.

Jackson, C. Kirabo and Claire Mackevicius. 2021. "The distribution of school spending impacts." *NBER Working Paper*.

Jackson, C. Kirabo, Cora Wigger, and Heyu Xiong. 2021. "Do School Spending Cuts Matter? Evidence from the Great Recession." *American Economic Journal: Economic Policy*, 13(2): 304–335.

Johnson, Rucker C and C Kirabo Jackson. 2019. "Reducing Inequality through Dynamic Complementarity: Evidence from Head Start and Public School Spending." *American Economic Journal: Economic Policy*, 11(4): 310–349.

Jordan, Meagan M, Wenli Yan, and Somayeh Hooshmand. 2017. "The Role of State Revenue Structure in the Occurrence and Magnitude of Negative Revenue Variance." *American Review of Public Administration*, 47(4): 469–478.

Kim, Hong Kyun. 2001. "Is there a crowding-out effect between school expenditure and mother's child care time?" *Economics of Education Review*, 20(1): 71–80.

Kreisman, Daniel and Matthew P Steinberg. 2019. "The effect of increased funding on student achievement : Evidence from Texas's small district adjustment." *Journal of Public Economics*, 176: 118–141.

Lafortune, Julien, Jesse Rothstein, and Diane Whitmore Schanzenbach. 2018. "School finance reform and the distribution of student achievement." *American Economic Journal: Applied Economics*, 10(2): 1–26.

Li, Mingliang. 2009. "Is there "white flight" into private schools? New evidence from High School and Beyond." *Economics of Education Review*, 28(3): 382–392.

Long, James E and Eugenia F Toma. 1988. "The Determinants of Private School Attendance , 1970-1980." *Review of Economics and Statistics*, 70(2): 351–357.

Mavisakalyan, Astghik. 2011. "Immigration, Public Education Spending, and Private Schooling." *Southern Economic Journal*, 78(2): 397–423.

Moffitt, Robert A. 2013. "The Great Recession and the Social Safety Net." *Annals of the American Academy of Political and Social Science*, 650(1): 143–166.

Murray, Thomas J. 2016. "Public or private? The influence of immigration on native schooling choices in the United States." *Economics of Education Review*, 53: 268–283.

National Association of State Budget Officiers. "Archive of State Expenditure Report." [dataset]. *https://www.nasbo.org/reports-data/state-expenditure-report/state-expenditure-archives*. (Accessed 2023-01-17).

National Center for Education Statistics. 2022. "Private School Enrollment." [dataset], U.S. Department of Education. *https://nces.ed.gov/programs/coe/indicator/cgc/private-school-enrollment*. (Accessed 2024-01-15).

National Center for Education Statistics. "Common Core of Data LEA Universe Surveys 2000-2019." [dataset], U.S. Department of Education. *https: //nces.ed.gov/ccd/pubagency.asp*. (Accessed 2023-02-15).

National Center for Education Statistics. "Private School Universe Survey (PSS)." [dataset], U.S. Department of Education. *https://nces.ed.gov/surveys/pss/*. (Accessed 2023-02-15).

Rambachan, Ashesh and Jonathan Roth. 2023. "A More Credible Approach to Parallel Trends." *Review of Economic Studies*, 90(5): 2555–2591.

Ruggles, Steven, Sarah Flood, Matthew Sobek, Daniel Backman, Annie Chen, Grace Cooper, Stephanie Richards, Renae Rogers, and Megan Schouweiler. 2023. "PUMS USA: Version 14.0." [dataset]. Minneapolis, MN: IPUMS, 2020. *https://doi.org/10.18128/D010.V14.0*. (Accessed 2023-01-05).

Seegert, Nathan. 2015. "The Performance of State Tax Portfolios During and After the Great Recession." *National Tax Journal*, 68(4): 901–918.

Snyder, Thomas D., Cristobal de Brey, and Sally A. Dillow. 2019. "Digest of Education Statistics 2018 (NCES 2020-009)." National Center for Education Statistics, U.S. Department of Education., Washington, DC.

US Advisory Commission on Intergovernmental Relations. 1995. "Significant Features of Fiscal Federalism: Volume 1, Budget Processess and Tax Systems." Washington, DC.

US Census Bureau. 2020. "Annual Survey of State and Local Government Finances, 1977-2017." [dataset]. compiled by the Urban Institute via State and Local Finance Data: Exploring the Census of Governments. *https://state-local-finance-data.taxpolicycenter.org*. (Accessed 2020-04-12).

US Department of Labor. 2020. "Unemployment Insurance Data." Washington, DC. Accessed Mar 02, 2020. *https://oui.doleta.gov/unemploy/DataDashboard.asp*.

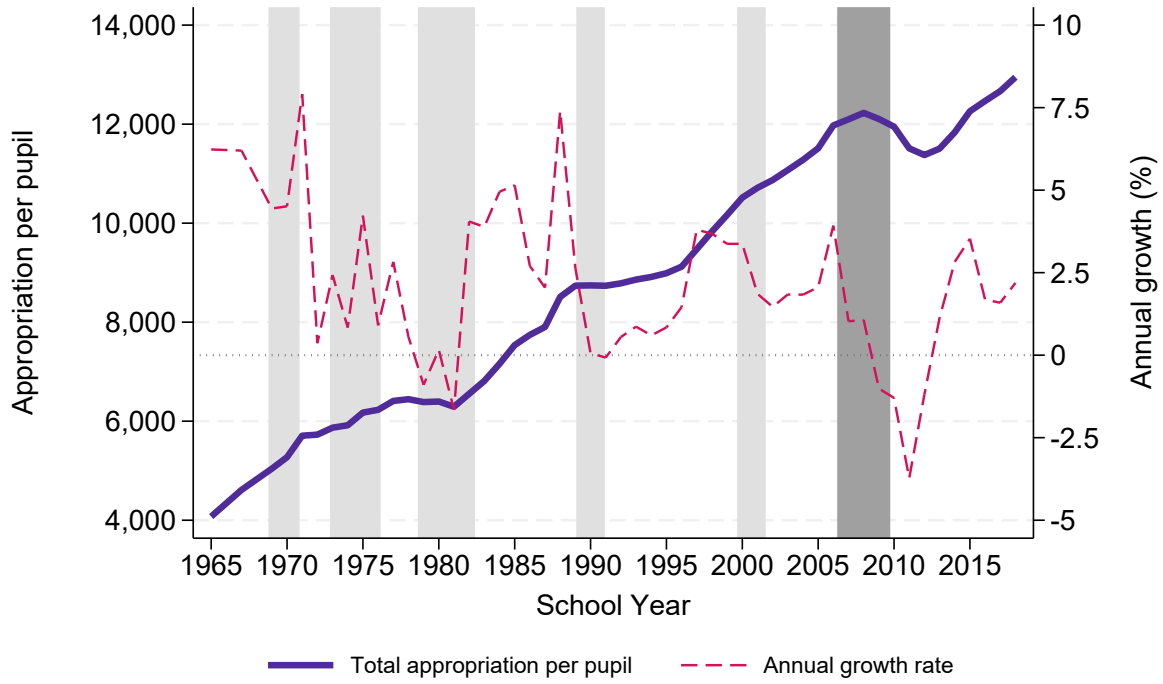
Winkler, Donald R and Taryn Rounds. 1996. "Municipal and private sector response to decentralization and school choice." *Economics of Education Review*, 15(4 SPEC. ISS.): 365–376.

Yan, Wenli and Douglas A Carr. 2019. "Impacts of Revenue Diversification and Revenue Elasticity on State Fiscal Health." *Public Finance and Management*, 19(2): 151–174.

Yuan, Cheng and Lei Zhang. 2015. "Public education spending and private substitution in urban China." *Journal of Development Economics*, 115: 124–139.

Figures

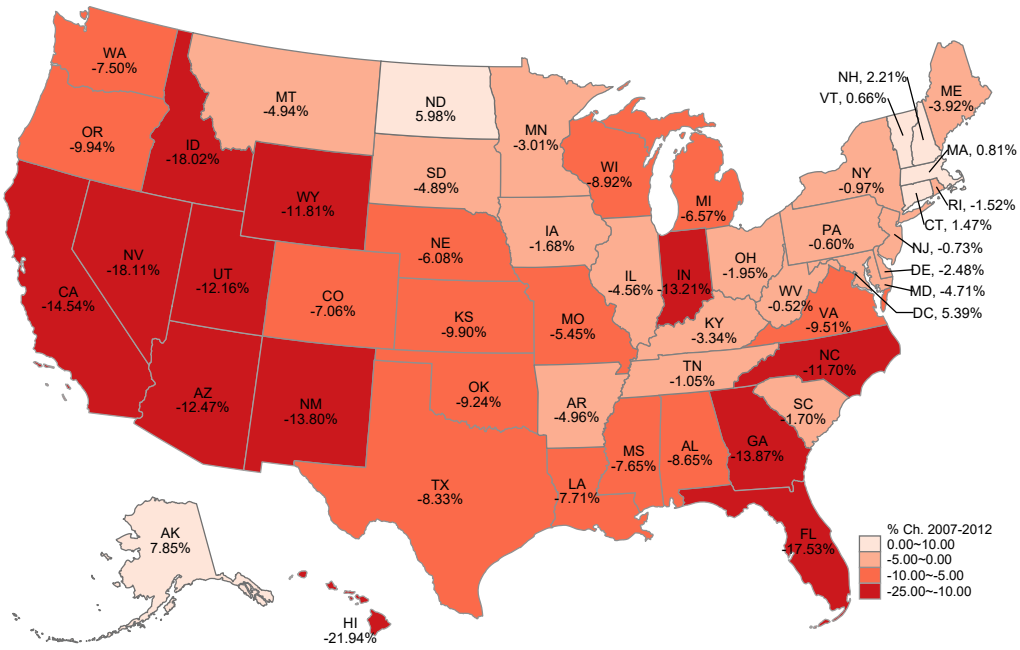
Figure 1: Total K-12 Appropriations per Pupil and Growth Rate



Source: Federal Reserve Economic Data, National Center for Education Statistics. Author's calculation.

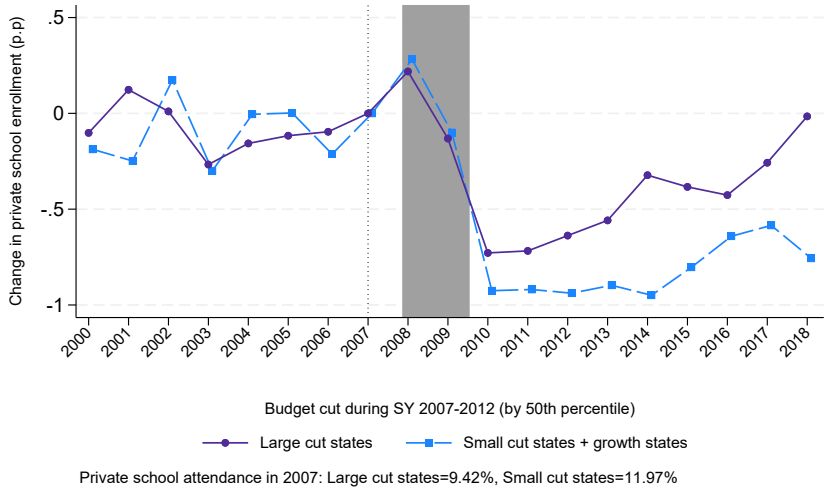
Note: Data aggregates the K-12 appropriations in 50 states and divides it by the full-time equivalent enrollment. The appropriations per pupil are adjusted for inflation (in 2010 dollars). The dashed line depicts the annual growth rate of the revenue per pupil in percent. Shaded areas represent recessions and the Great Recession is marked with a darker shade.

Figure 2: Change in Appropriations Per Pupil from SY 2008 to 2013



Note: The figure shows the variation in funding cut across states induced by the Great Recession from 2007 to 2013. The percent change is calculated using the real value of appropriations per pupil in 2010 dollars. Darker shade means larger cuts and the 16 states with the brightest shade are states with a positive growth.

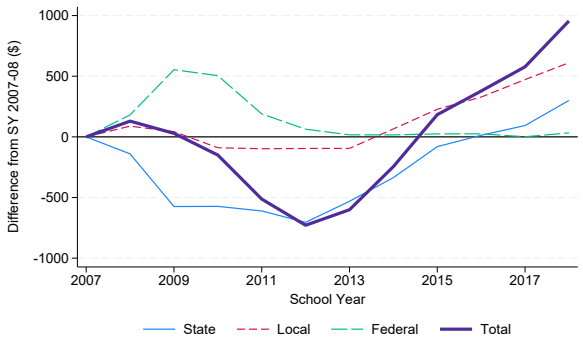
Figure 3: Trend of Private School Enrollment Relative to 2007 by the Magnitude of Funding Change



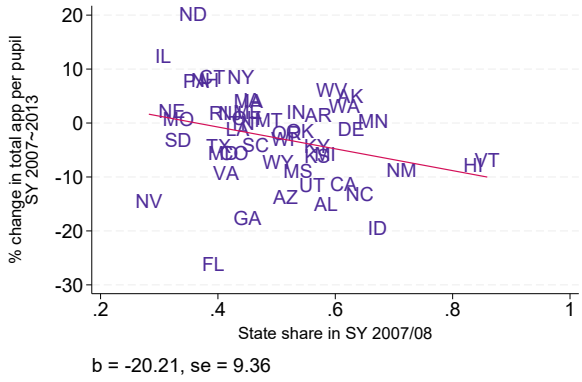
Note: The figure shows the trend of private school enrollment relative to 2007 separately by large and small funding cut states. Large cut states are 25 states with a growth rate below the median (-5.7 percent). Small budget cut states include 16 states with positive growth.

Figure 4: Relation Between State Share and Education Funding Cuts

(a) Trend of Appropriations by Sources

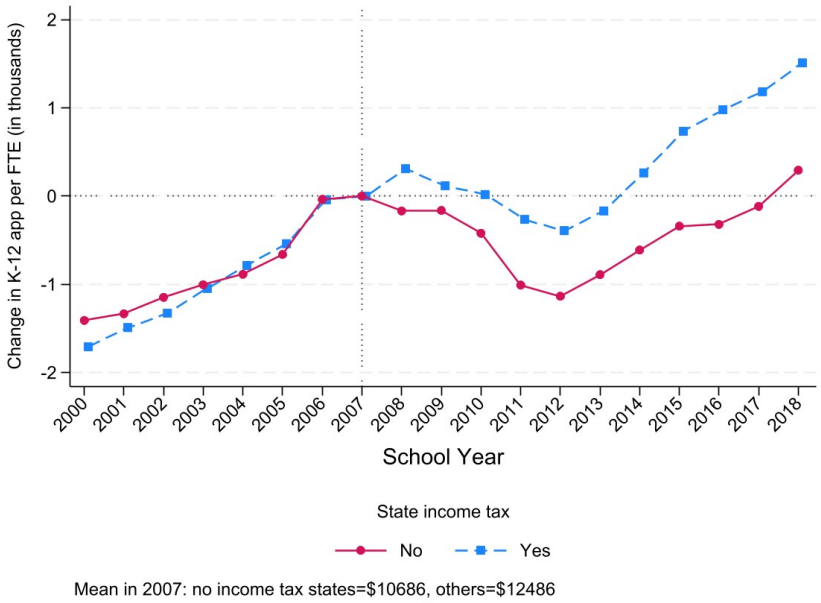


(b) Change in Total Appropriations



Note: Panel (a) shows the trend of the change in K-12 appropriations by source relative to the school year 2007-2008, this paper's version of JWX's Panel B of Figure 2. Panel (b) displays the change in total appropriations per pupil from 2007 to 2013 and the state share. The coefficient and standard error of the linear regression are denoted below the figure. All monetary values are in 2010 dollars.

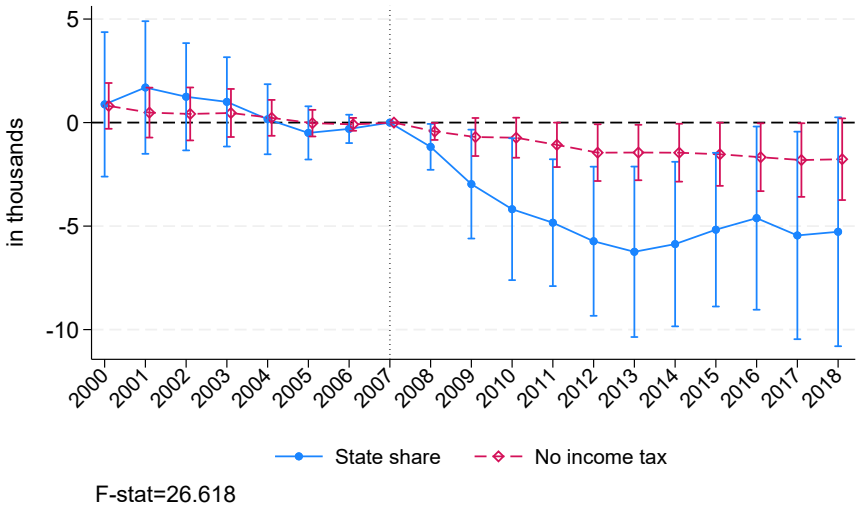
Figure 5: Trend of Total Appropriations by Income Tax Status



Note: The figure compares total appropriations for K-12 education in states with and without income tax, relative to 2007. The means of two groups of states are denoted below the figure.

Figure 6: First Stage and Reduced Form Results

(a) First Stage



F-stat=26.618

(b) Reduced Form

F-stat=34.800

Note: N=9,792,716. The first stage and reduced form results in the most preferred specification (including individual, household controls, and Bartik prediction of state unemployment rate and income) are presented in this figure. The figures display the coefficients of interaction terms of year dummies and state share, and income tax status (γ_{1k}'s and γ_{2k}'s) along with 95% confidence intervals. F-statistics of the instrument variables are 26.62 and 34.8 for Panels A and B, respectively. The state share is a continuous variable from 0 to 1 representing the contribution of state-distributed appropriations to the total education appropriations, and the no-income tax indicator is a binary indicator. See the notes of 3 for further information on the controls. Standard errors clustered at the state level. See Appendix Figure A.6 for other specifications.

Tables

Table 1: Summary Statistics in the Pre- and Post-Recession Periods

	Pre-Recession					Post-Recession				
		State Share		Income Tax			State Share		Income Tax	
	All states (1)	High (2)	Low (3)	No (4)	Yes (5)	All states (6)	High (7)	Low (8)	No (9)	Yes (10)
Panel A. Private School Enrollment										
All	10.34	9.12	10.94	8.18	10.79	9.92	8.86	10.43	8.13	10.33
Age 6-13	11.05	9.84	11.65	8.84	11.52	10.23	9.21	10.73	8.49	10.64
Age 14-17	8.92	7.68	9.53	6.85	9.35	9.29	8.16	9.84	7.42	9.72
Race: white	13.01	11.58	13.64	11.59	13.26	13.19	11.97	13.73	12.30	13.35
Race: Hispanic	5.74	4.92	6.00	4.04	6.06	5.78	4.69	6.11	4.71	6.01
Race: black	5.30	4.66	5.76	4.21	5.74	5.00	4.40	5.37	4.48	5.22
Income: >90	22.01	21.06	22.46	21.77	22.06	20.46	19.82	20.75	19.81	20.58
Income: 90-75	13.31	12.32	13.80	10.91	13.74	12.05	11.31	12.40	9.82	12.49
Income: 75-50	9.67	8.47	10.27	7.14	10.14	9.15	8.22	9.62	7.35	9.54
Income: 50-25	6.68	5.43	7.35	4.59	7.13	6.75	5.64	7.33	5.24	7.12
Income: <25	4.60	3.82	4.98	3.25	4.91	5.02	3.94	5.53	4.06	5.26
Panel B. K-12 Appropriations per pupil										
Appropriations per pupil ($)	11,225	10,466	11,599	9,903	11,502	12,220	10,943	12,840	10,254	12,675
State Share	0.47	0.60	0.42	0.43	0.48	0.46	0.58	0.41	0.42	0.46
Panel C. Covariates										
Female	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Number of Siblings	1.45	1.50	1.43	1.43	1.46	1.50	1.53	1.48	1.51	1.50
Age	11.54	11.53	11.54	11.51	11.54	11.53	11.52	11.53	11.49	11.54
Foreign Born	0.06	0.07	0.06	0.09	0.06	0.06	0.06	0.06	0.08	0.05
White	0.60	0.56	0.62	0.51	0.62	0.54	0.50	0.55	0.42	0.56
Black	0.15	0.11	0.17	0.13	0.15	0.14	0.10	0.16	0.13	0.14
Hispanic	0.18	0.22	0.15	0.29	0.15	0.23	0.27	0.21	0.37	0.20
Household Income ($)	80,863	79,239	81,661	75,644	81,956	82,475	80,993	83,194	76,539	83,850
Two Parents	0.70	0.71	0.69	0.69	0.70	0.69	0.70	0.68	0.68	0.69
One Parent	0.25	0.24	0.26	0.26	0.25	0.27	0.25	0.27	0.28	0.27
Observations	4,727,133	1,558,419	3,168,714	794,782	3,932,351	5,065,583	1,655,834	3,409,749	927,077	4,138,506

Note: The table presents the pre-and post-Great Recession averages of various variables. The states are categorized based on their share value (with a cut-off at 0.54) and whether they have income tax. Panel A displays the average private school attendance for each subgroup. Panel B shows the average total appropriations and state shares across these categories. Panel C presents the averages of crucial covariates.

Table 2: Test of Exclusion Restriction in 2SLS

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Individual Level Covariates						
	HH Head Employed	HH Income	<150% Poverty Line	Owns Dwelling	Minority	Foreign Born
App per pupil ($1,000)	0.0031	0.4598	0.0034	0.0065**	-0.0084	0.0050
	(0.0021)	(0.6126)	(0.0038)	(0.0029)	(0.0050)	(0.0035)
	0.787	*80.865*	*0.280*	*0.695*	*0.397*	*0.063*
Panel B. State Level Characteristics (in log)						
	Median House Value	Num of Children	Num of Whites	Num of Blacks	Num of Hispanics	Num of Poverty
App per pupil ($1,000)	-0.0245	-0.0399**	0.0019	-0.0338	0.0346	-0.0214
	(0.0273)	(0.0172)	(0.0199)	(0.0378)	(0.0613)	(0.0150)
	5.211	*14.242*	*13.699*	*12.038*	*12.019*	*12.958*
Panel C. State Spending per Capita (in $1,000)						
	Total Expenditure	Higher Education	Health	Medicaid	Welfare	UI Benefits
App per pupil ($1,000)	0.2107**	-0.0152	-0.0183	0.0025	0.0126	0.0029
	(0.1036)	(0.0177)	(0.0158)	(0.0450)	(0.0536)	(0.0065)
	8.769	*0.673*	*0.249*	*0.984*	*1.264*	*0.125*

Note: Panel A: N=9,792,716, first stage F-stat=33.566. Panel B: N=950, first stage F-stat=33.409. Panel C: N=850, first stage F-stat=20.074. The dependent variable of each regression is indicated above the coefficient. 2001 and 2003 are omitted in Panel C due to data limitations. Regressions are weighted using sample weights in Panel A and school-aged children population in 2000 in Panels B and C, respectively. All monetary values are in real terms (in 2010 dollars). Robust standard errors are in parentheses clustered by state. * significance at 10%; ** significance at 5%; *** significance at 1%.

Table 3: Main Effects on Private School Enrollment

Dependent variable: private school enrollment(in percentage point)

	(1)	(2)	(3)	(4)	(5)
App per pupil ($1,000)	-0.397**	-0.472**	-0.547***	-0.567***	-0.611***
	(0.192)	(0.197)	(0.203)	(0.187)	(0.172)
First Stage F-Stat	33.57	33.55	35.85	26.62	28.34
Individual Controls		Yes	Yes	Yes	Yes
Household Controls			Yes	Yes	Yes
Bartik Controls				Yes	Yes
Baseline State Char × Time Trend					Yes

Note: N = 9,792,716. This table reports the estimates of the impact of K-12 appropriations per pupil on private school enrollment using Equation 1. The coefficients are rescaled to represent private school enrollment in percentage points. All regressions are estimated with the 2SLS model using Equation 2 as the first stage. The instruments are the sets of interaction terms of state share and no state income tax status with year indicators dummies. See the main text for further information. The K-12 appropriations per pupil is adjusted for inflation in 2010 dollars and scaled in $1,000. All specifications include students' ages in the full set of dummy variables with state and year-fixed effects. Individual controls include race, sex, number of siblings, and an indicator for limited English proficiency and foreign-born. Household controls include the log of total household income, parental characteristics such as education, race, foreign-born indicator, and employment status, and the presence of parents 1 and 2. Bartik controls include Bartik predictions of state unemployment rate and income. Baseline state characteristics include the share of minority, foreign-born, under 150% of the poverty line at the state level, and the number of school-aged children. I interact these characteristics in 2000 with the time trend. Regressions are weighted using sample weights from the Census and ACS. Robust standard errors are in parentheses clustered by state. * significance at 10%; ** significance at 5%; *** significance at 1%.

Table 4: Heterogeneity in Effect by Age, Race, and Household Income

Dependent variable: private school enrollment (in percentage point)

	(1)	(2)	(3)	(4)	(5)
Panel A. By Age					
	6-13	14-17			
App per pupil ($1,000)	-0.613***	-0.485***			
	(0.212)	(0.163)			
	11.16%	*8.86%*			
First Stage F-Stat	24.04	40.15			
Observations	6,455,360	3,337,356			
Panel B. By Race and Ethnicity					
	US Born	White	Black	Hispanic	Asian
App per pupil ($1,000)	-0.576***	-0.547**	-0.419**	-0.710***	-0.554
	(0.192)	(0.244)	(0.190)	(0.170)	(0.443)
	10.64%	*12.49%*	*5.60%*	*5.68%*	*10.60%*
First Stage F-Stat	28.39	23.16	273.53	398.87	530.55
Observations	9,246,536	6,059,216	1,128,225	1,747,340	414,823
Panel C. By Household Income Percentile					
	Richest				Poorest
	>90	90-75	75-50	50-25	<25
App per pupil ($1,000)	-0.135	-0.603*	-0.844***	-0.514**	-0.163
	(0.289)	(0.301)	(0.273)	(0.217)	(0.210)
	21.70%	*13.06%*	*9.66%*	*7.05%*	*4.91%*
First Stage F-Stat	32.28	52.45	44.41	26.43	31.26
Observations	1,325,093	1,913,054	2,732,610	2,148,129	1,656,186

Note: All regressions follow the main specification (column 4 of Table 3). In Panel C, the national percentile of household income in each year to define the subsamples. Robust standard errors are in parentheses clustered by state. Means of the private school enrollment of each group in the pre-recession period are in italics below the standard errors. * significance at 10%; ** significance at 5%; *** significance at 1%.

Table 5: Impact on Expenditure Categories and Staff

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A. Expenditure per pupil (in $1,000)							
	Total Instructional	Support	Total Capital	Noninstructional	General Administrative	School Administrative	Private Schools
App per pupil ($1,000)	0.526***	0.240***	-0.0315	0.00224	0.0224*	0.0292***	0.0309**
	(0.0593)	(0.0403)	(0.0834)	(0.00531)	(0.0132)	(0.00913)	(0.0140)
	5.961	*3.357*	*1.417*	*0.397*	*0.199*	*0.545*	*0.084*
Panel B. Expenditure per teacher (in $1,000)							
	Salary	Employee Benefits	Staff Support				
App per pupil ($1,000)	1.524**	4.092***	0.0643				
	(0.630)	(0.769)	(0.328)				
	67.069	*23.280*	*7.954*				
Panel C. Staff per 100 students							
	Teacher	Aides	Guidance Counselor	Library Staff	School Admin	LEA Admin	Student Support
App per pupil ($1,000)	0.0730*	0.115*	0.00246	0.00499**	0.00545	-0.00523	-0.00946
	(0.0365)	(0.0584)	(0.00440)	(0.00210)	(0.0151)	(0.00733)	(0.0456)
	6.303	*1.474*	*0.212*	*0.103*	*0.353*	*0.132*	*0.527*

Note: N=950. First stage F-stat = 35.518. Dependent variables defined at the state level are indicated above the point estimates. All regressions include year and state fixed effects, Bartik controls, and baseline state characteristics interacted with the linear time trends. Regressions are weighted using the school-aged children population of the state in 2000. Robust standard errors are in parentheses clustered by state. The means of the dependent variables before the Great Regression are in italics below the standard errors. * significance at 10%; ** significance at 5%; *** significance at 1%.

Table 6: Alternative Specifications

Dependent variable: private school enrollment(in percentage point)

			Alternative definition of appropriations			Alternative definition of state share and NT			
	State Level Obs	State linear time trend	Exclude Charter Only	Exclude All Charter	CPUMA Expenditure	5-yr avg state share	2000 state share	1990 state share	Add NH,TN in NT states
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
App per pupil ($1,000)	-0.395**	-0.540**	-0.620***	-0.539***	-0.685***	-0.609***	-0.595***	-0.659***	-0.667***
	(0.195)	(0.249)	(0.178)	(0.177)	(0.223)	(0.195)	(0.180)	(0.239)	(0.220)
Observations	950	9,792,716	9,792,716	9,748,194	9,792,716	9,792,716	9,792,716	9,792,716	9,792,716

Note: All regressions follow the main specification (column 4 of Table 3). In column 1, I collapse the sample to the state level and estimate the impact of state-level appropriations per pupil on the mean of private school enrollment. Column 2 includes a linear time trend of states ($\eta_{ps} \times t$). F-statistics of the first stage are not estimated due to high collinearity. Columns 3 and 4 exclude charter-only districts and districts with any charter schools, respectively, from the district finance sample to calculate the state-level finance data. Column 5 uses CPUMA-level appropriations instead of state. Instead of the state share defined in 2007, the 5-year average, and state share in 2000 and 1990 are used in columns 6-8, respectively. New Hampshire and Tennessee are included in NT states in column 9. Robust standard errors are in parentheses clustered by state. * significance at 10%; ** significance at 5%; *** significance at 1%.