Charter school enrollment losses and tuition reimbursements on school districts: Lifting boats or sinking them?

Abstract

We analyze a natural experiment in which policymakers in Pennsylvania first implemented, and later removed, reimbursements to districts for students exiting to brick and mortar and cyber charter schools. Generalized difference-in-difference models show that larger shares of students enrolling in charter schools predict decrements in spending, financial health, and achievement in sending districts; however, these relationships attenuate in years when districts receive reimbursements. After receiving reimbursements, districts with increased competition spent more on instruction and instructional support services, but not on facilities or non-instructional operations. Perhaps due to higher instructional expenditures, the relationship between competition and student achievement in reimbursement years is significantly less negative, and at times even positive, compared to non-reimbursement years. Cyber charter schools induce fewer instructional expenditures in districts than brick and mortar charter schools. The findings show clear policy choices can support traditional public systems experiencing competition.

Keywords: school choice, charter schools, competition, education policy, economics of education

Education reformers in the United States and across the world suggest that school choice policies incentivize competition between schools to create "a rising tide that lifts all boats," meaning that choice improves outcomes for all students (Hoxby, 2001; 2003). This assumption drives policy adoption of various school choice models including charter schools, school vouchers, and inter- and intra-district choice schools, among others (Berends, Cannata, & Goldring, 2011). School choice implementation may expand as policymakers at the highest levels of the U.S. government continue to argue that choice provides "more options" that "yield better results, for all students" (DeVos, 2017).

The ubiquity of charter schools makes them an ideal school type to consider when determining how the competitive effects logic unfolds in practice. Charter schools enroll a growing share of K-12 students in the United States, recently up to 3.2 million, and have received backing from policymakers across the political spectrum (National Alliance for Public Charter Schools, 2018; Wohlstetter, Smith, & Farrell, 2013).

Pressures associated with charter school competition may impose financial and programmatic stress on nearby traditional public schools and districts (TPSDs). However, these patterns are inconsistent. Some studies find that TPSDs' financial outlooks and academic outcomes suffer as charter sectors expand, while others show relationships vary in magnitude and direction (Bruno, 2019; Epple, Romano, & Zimmer, 2015; Bifulco & Reback, 2013; Bettinger, 2005; Arsen & Ni, 2012; Cordes, 2018; Imberman, 2011;Winters, 2012). A systemic analysis of competitive effects studies shows small positive effects of competition on achievement, but these effects depend on policy design and differ based on student demographics (Jabbar et al., 2019). Increased competition in some contexts depresses home values, which can undercut the ability of TPSDs to increase resources (Cook, 2018; Imberman, Rourke, & Naretta,

2017). To extend the rising tide metaphor, competitive forces may create tides that lift all boats, but these forces may also sink the capacity of TPSDs by imposing unintended costs. Researchers need to continue to examine these issues, especially since TPSDs serve the majority of students in the United States (NCES, 2017).

One of the recommendations from past research is for state agencies to consider offsetting the diminished resources that competitive environments place on TPSDs (Cook, 2018, p. 61). The next step in this line of research is to identify and examine contexts where states have pursued this strategy. Additionally, the competitive effects of charter schools on TPSDs and districts may vary across policy and economic contexts. Yet one limitation of existing research is that studies examine specific contexts, such as states or smaller regions, which vary from one another along many dimensions. Studies conducted in a single local context make it difficult to know whether observed TPSD responses to competition are discretionary (e.g., to appeal to parents) or are determined by constraints (e.g., due to fixed costs). These limitations hinder theoretical understandings of educational competition and prevent extant work from offering clear guidance to policymakers.

We examine a natural experiment in Pennsylvania in which state policymakers introduced, and later removed, tuition reimbursements for TPSDs experiencing enrollment losses to charter schools. Using panel data on all TPSDs in the state over 16 years and detailed records of the number of students exiting each TPSD system for charter schools, we explore variation in the relationships between charter school enrollment losses and district operations as districts enjoy greater or lesser degrees of financial insulation from competitive pressures. The length of the panel allows us to consider periods before, during, and after the reimbursement policy while controlling for district and labor market-by-year fixed effects.

Pennsylvania data also distinguish enrollments in brick and mortar charter schools from cyber charter schools. Brick and mortar charter schools educate students in physical buildings and resemble traditional public schools in many ways. Cyber charter schools are fulltime online educational programs with students attending synchronous or asynchronous virtual classes. Brick and mortar charter schools enroll students from mostly urban areas, while cyber charter schools capture enrollment from nearly every school district in the state (Mann & Baker, 2019). Our use of statewide data and statewide competitive effect patterns (due to the statewide spread of cyber charter schools) allow us to explore whether differences in reimbursement policy and the type of charter school change TPSDs' competitive responses.

Research Questions

We consider four interrelated research questions:

1. How do enrollment losses to charter schools change the spending behavior of Pennsylvania school districts? Does spending change with the implementation of tuition reimbursements?
2. Do enrollment losses to charter schools reduce academic performance in Pennsylvania school districts? Do academic performance patterns change with the implementation of tuition reimbursements?
3. Do enrollment losses to charter schools hurt the financial health of Pennsylvania school districts? Does financial health improve with the implementation of tuition reimbursements?
4. Are the answers to RQs 1-3 different for brick and mortar and cyber charter school competition?

Competition, School District Finances, and Student Performance

Charter school implementation reflects the understanding that underpins school choice policy: competition for enrollment improves all schools in an educational ecosystem and forces schools to close if they do not improve (Friedman, 1955, Chubb & Moe, 1990). This logic assumes that schools of choice improve the educational experience for all students in a choice environment, including those who remain in TPSDs (Hoxby 2001, 2003). However, three critiques have emerged that challenge the theory of action of how competition serves as a school improvement mechanism.

The first critique is that academic improvement in TPSDs only occurs if districts have the capacity to allocate resources in a manner that improves student outcomes. Such responses may not be possible if duplicating educational services across sectors imposes excess costs on districts (e.g., growing per-pupil fixed costs; Bifulo & Reback, 2013). Indeed, competition causes many school districts to face financial strain (Arsen & Ni, 2012; Bruno, 2019; Cook, 2018; Ladd & Singleton, 2018; Imberman et al., 2017). However, financial strain findings are not universal. For example, school districts in Massachusetts saw increases in instructional spending over several years, especially related to reimbursements (Ridley & Terrier, 2018). Conversely, charter school entry to an educational ecosystem in Ohio decreased home values and limited districts' ability to raise additional tax dollars (Cook, 2018).

A second critique is districts do not always perceive and react to enrollment losses in a manner aimed at enhancing instruction. Instead, they respond to competitive pressures in complicated ways that vary based on organizational hierarchies and other factors (Jabbar, 2015). In one example, principals in Michigan perceived little competition from charter schools, and when they did perceive competition, it had little bearing on decision-making (NCSC, 2011).

Traditional systems may also create barriers that "blunt the potentially damaging impact of competition" by encouraging TPSD administrators to pursue activities like lobbying for a charter school to close rather than competing instructionally (Arsen & Ni, 2008, pg. 5).

A third critique is that school organizations follow patterns of institutional isomorphism and avoid innovation (DiMaggio & Powell, 1983). Classroom practices in charter schools often are the same as those in TPSDs (Berends, Goldring, Stein, & Cravens, 2010; Lubienski, 2003; Preston, Goldring, Berends, & Cannata, 2012). Many charter schools innovate administratively rather than pedagogically (Lubienski, 2003). An analysis of charter school mission statements shows variety in specialist charter schools, but these schools are rare because most resemble TPSDs (Renzulli, Barr, & Paino, 2015). As a result, often charter schools offer limited incentives for TPSDs to innovate due to few differences between sectors.

These critiques help explain why competitive effects vary across contexts. Charter schools have positive effects on achievement and future career earnings in Florida (Sass, Zimmer, Gill, & Booker, 2016), no effects in North Carolina (Bifulco & Ladd, 2006), and little effect on achievement gains and school practices in California and Michigan (Buddin & Zimmer, 2009; Bettinger, 2005). States with large private school sectors have better outcomes in public schools because states provide more resources to these schools to insulate them from competition (Arum, 1996). Perhaps a lack of a response, or a lack of capacity, undermine goals of competition leading to universal improvement.[1]

While differences in responses may explain mixed findings in previous research, there are differences in educational governance across states that may lead to varying effects of

[1] While differences in response may lead to differences in results, variance in findings may also relate to research design (Betts, 2009). For example, Jinnai (2014) shows positive impacts of competition in overlapping grades, something noticed as a potential flaw in previous research. In New York City, proximity, including colocation, also played a role in uncovering positive spillover effects from charter schools (Cordes, 2018).

competition. Our study delves deeply into one state to see how differences in policy and incentives mediate differences in competitive effects. We also explore how different state-level policies on managing competitive effects changes the results of implementation.

Pennsylvania Charter School Policy and Implementation

It is appropriate to study competitive effects in Pennsylvania for two reasons. The first is that the history of Pennsylvania charter school policy offers two different financial realities for school districts over time: One where districts were provided reimbursements for charter school tuition expenditures (from 2002-03 to 2010-11) and one where the tuition reimbursements were not offered (prior to 2002-03 and 2011-12 to present). The second reason is that the policy environment in Pennsylvania has offered two types of charter schools: brick and mortar and cyber. While many states have virtual or cyber charter schools, Pennsylvania's cyber charter school sector has tens of thousands of students (Mann & Baker, 2019). The scale of cyber charter schooling puts a heightened level of pressure on TPSDs not seen in other charter school states, particularly because all districts in Pennsylvania face competitive pressure from schools that can enroll even students that live far away from the schools' offices.

Pennsylvania lawmakers enacted charter schools through Act 22 of 1997 and, as shown in Figure 1, by 2015-16 charter schools enrolled approximately eight percent of the state's public school students, with cyber charter schools accounting for roughly 30 percent of that enrollment. The Pennsylvania Department of Education (PDE) lists goals for the programs outlined by advocates of choice: improve schooling through choice, innovation, and accountability (2004).

[Insert Figure 1 about here]

A charter school in Pennsylvania begins when a school receives a charter from an authorizer, which usually are local school boards in Pennsylvania, though some districts like

Philadelphia have had a state-created school reform panel that controls district operations and possesses charter-authorizing authority (Pew, 2015).[2] Cyber charter schools must receive authorization from the PDE. Once authorized, all charter schools operate with greater autonomy than TPSDs, are not subject to conventional governance by elected school boards, and have flexibility in hiring and staffing (Pew, 2015).

The majority of funding for TPSDs in Pennsylvania comes from local tax dollars, as does funding for charter schools. When a student leaves for a charter school, the TPSD to which they are zoned (the "sending district") must pay the charter school an associated tuition. The tuition amounts to approximately 70 percent of the district's per-pupil expenditure after making deductions for funds and services not related to charter school operation, including some federal aid, adult education, transportation, debt service, and building construction (Hardy, 2015). The tuition payments occur on a monthly basis and represent the number of students enrolled in each charter school from the district during the previous month. This allows school district leaders continually to be aware of the number of the students in their district enrolled in a charter school. This funding allocation also leads to varied tuition rates. Using 2014's tuition rates for illustrative purposes, sending district tuition rates range from $6,600 to $17,000 for a non-special education student and $13,000 to $43,000 for a special education student (Hardy, 2015).

As shown in Figure 2, brick and mortar or cyber charter schools enrollment differs substantially based on sending district composition. Brick and mortar charter schools tend to operate and enroll students in urban areas, while cyber charter schools enroll students from across the state (Mann & Baker, 2019). Cyber charter schools have more urban students than

[2] The state-created reform panel arrangement is rare. However, it is noteworthy because Philadelphia, which is by far the largest district in Pennsylvania, had this arrangement and did not revert to local control until 2017 (after the end of our study). For this reason, as shown later, we run the analysis without Philadelphia in the models. We observe consistent results.

rural students, but an individual rural student is more likely to enroll in a cyber charter school (Mann, Kotok, Frankenberg, Fuller, & Schafft, 2016). Consistent with differences between charter school types, we find the share of district students enrolled in cyber charter schools correlates with the share enrolled in brick and mortar charter schools only weakly (r = .19).

[Insert Figure 2 about here]

Beginning with the budget for FY 2003 after an intense round of negotiations, the legislature enacted a measure that would provide a 30 percent reimbursement (additional to the aforementioned deductions) to Pennsylvania school districts for tuition payments to charter and cyber charter schools (Fitzgerald, Worden, & Wiggins, 2002). The reimbursements reflected prior year enrollment, so districts could plan and make changes to their budgets (Griffith, 2014). There could have been a slight lag effect due to districts waiting for the expected amount of reimbursements to get deposited into their accounts (these deposits happened six times annually), but districts generally could develop reasonable estimations of the reimbursement based on their charter school enrollment statistics from one year to the next. The legislature eliminated this reimbursement for the 2011-12 school year after enacting austerity measures following the 2008 financial crisis. These reimbursements remain a point of debate between lawmakers (Langley, 2016).

Understanding the effect of charter school reimbursement cuts on TPSDs in Pennsylvania is important because more than 90 percent of Pennsylvania students attend TPSDs. All schools face some level of competitive pressure because Pennsylvania features cyber charter schools that have drawn enrollment from 499 out of 500 school districts in the state (Mann & Baker, 2019). Lawmakers need to have reliable information on reimbursement funding as they continue to debate this policy in current and future legislative sessions, and in other states.

Data and Methods

Our data come primarily from public files released annually by PDE. These files cover the universe of Pennsylvania school districts, 500 districts, between the 2000-01 and 2015-16 school years.[3] These data include detailed revenue, expenditure, and budget reserve information, local property tax millage rates, English learner enrollment, and shares of students meeting academic proficiency standards on statewide end-of-year exams in math and reading. The number of students in a district enrolling in charter schools is our measure of competitive pressure faced by TPSDs. Because charter school enrollments are provided at the district-charter school level, we can distinguish enrollments in cyber charter schools from enrollments in brick-and-mortar charter schools.

We make three adjustments to these data. First, because tuition payments by sending districts to charter schools are categorized as instructional expenditures, we subtract these payments from both total and instructional expenditure figures. This prevents TPSD per-student spending amounts from being inflated by tuition costs for students exiting for the charter sector and thus no longer enrolled in the district itself. Prior to 2003-04 data, it is necessary to infer these tuition payment amounts from districts' per-pupil tuition rates and charter school enrollments, as actual payments were not released, and for some districts this is not possible in 2000-01 because tuition rates were not published. In other years, when it is possible to adjust total and instructional expenditures using actual and inferred tuition payments, those figures correlate at r = .99 and differ from one another by less than one-half of one percent on average.

[3] Our dataset includes 500 school districts prior to 2009-2010. In that year two districts merged to form a new district, leaving 499 districts in our dataset. This would result in 501 unique school districts, though in most of our analyses we use labor market-by-year fixed effects, resulting in the exclusion of one district that is the only Pennsylvania district in a labor market that extends into New Jersey.

This suggests that inferred and actual payments are similar, and in results available upon request, we find expenditure results are nearly identical if we exclude school years prior to 2003-04.

Second, charter school enrollment data show an anomalous drop in charter school enrollment in 2008-09. Twenty-nine charter schools reporting enrollments in previous and subsequent years are not present in the data file in that year, so we impute enrollments from each district as the mean of those enrollments in 2007-08 and 2009-10. This produces charter school enrollment figures consistent with the overall time trend. Finally, in 2009-10 the Appalachian Area School District[4], newly formed by the merger of two other school districts, reports charter school enrollments far below what is observed in the next year or what is observed in its component districts in the previous year. On the assumption this reflects a temporary disruption in reporting, we impute this district's charter school enrollment in this year as the mean of its charter enrollment share in 2010-11 and the enrollment-weighted mean of the charter enrollments of the merged districts in 2008-09. In results available upon request, excluding Appalachian Area School District in 2009-10 and all districts in 2008-09 has virtually no effect on our estimates.

We supplement the data from the PDE with data from three additional sources. First, we link school districts to labor markets using comparable wage index files from the National Center for Education Statistics (NCES; Taylor & Fowler, 2006). While we adjust all financial figures for inflation (to 2016 dollars), linking school districts to specific labor markets allows us to adjust for geographic variation in the costs of labor and other economic factors. Controlling for unobserved differences between labor markets helps to alleviate concerns that our results are biased by factors, such as contemporaneous policy changes or changes in economic conditions

[4] This is a pseudonym.

that do not vary consistently statewide. Second, we use district total and special education enrollment figures and other student demographic data, as well as data on districts' debt levels, from the NCES Common Core of Data. Finally, while the PDE's student proficiency rate data have the advantage of spanning the length of our dataset, it may be that the shares of students meeting academic standards do not adequately capture changes in student achievement within different proficiency bands, particularly as testing regimes have changed. Therefore, we supplement Pennsylvania proficiency rate data with data from the Stanford Education Data Archive (SEDA; Reardon et al., 2017). Though only available for the 2008-09 through 2014-15 school years and including some charter school achievement data with that of their local or affiliated TPSDs, SEDA produces estimates of districts' mean student achievement in math and English/language arts (ELA) on a scale that is comparable across tests and years by combining proficiency rate data from state tests with data from the National Assessment of Educational Progress.

Summary statistics for our variables of interest are presented in Table 1. There is considerable variation in the shares of students that districts send to charter schools. Some districts send none in some years and others send more than half of their potential students. Further, there is a considerable positive skew in our revenue, expenditure, and debt figures even when measured on a per-pupil basis. We therefore subject these figures to an inverse hyperbolic sine transformation prior to conducting the analyses. This gives our results a similar interpretation as would a natural log transformation, but allows us to retain observations in which districts report values of zero (Burbidge, Magee, & Robb, 1988).

Analytical Strategy

We estimate a series of models for each achievement or fiscal outcome *Y* in district *d* in labor market *l* and year *t*:

(1) $Y_{dlt} = \beta_1 \%charter_{dlt} + \beta_2 reimbursed_t + \beta_3[\%charter_{dlt} \times reimbursed_t] + \delta_d + \psi_{lt} + \boldsymbol{D_{dlt}\Omega} + \varepsilon_{dlt}$

%charter represents the percentage share of the district's students enrolling in charter schools, and *reimbursed* is a dummy variable equal to one in years in which the state offered aforementioned tuition reimbursements (2002-03 through 2010-11), and zero otherwise. Because we interact these two variables, $\beta_1$estimates the relationship between charter enrollment shares and our outcomes in non-reimbursement years (i.e., when *reimbursed* = 0) and β_3 estimates the extent to which those relationships differ in reimbursement years (i.e., when *reimbursed* = 1).

We use a generalized difference-in-difference approach, making within-district comparisons over time. δ_d is thus a set of district fixed effects to control for unobserved, time-invariant differences between districts. We further include labor market-by-year fixed effects (ψ_{lt}), where labor markets are Census-defined place-of-work areas (Taylor & Fowler, 2006). This allows us not only to control for statewide changes over time, but also to compare only districts operating in a similar economic context (e.g., with similar local labor costs) in a given year. $\boldsymbol{D}$ is a vector of time-varying district characteristics that are likely to be related to finances and achievement, including the natural log of district enrollment to control for economies of scale, as well as the shares of district students who are white, English language learners, or eligible for free or reduced-price lunch or special education services. ε is an error term, and we cluster standard errors on districts. These approaches align with methodological strategies used in similar previously education research on charter schools and their influence on school finance (e.g., Arsen & Ni, 2012; Bruno, 2019).

Results

RQ 1: TPSD Expenditures

Larger charter enrollments are associated with lower per-pupil spending in TPSDs, particularly when tuition reimbursements are not provided to districts. Table 2 presents results from models predicting per-pupil spending as a function of charter school enrollment shares. Because these expenditure outcomes have been subjected to an inverse hyperbolic sine transformation, coefficients can be interpreted (as in the case of a natural log transformation) roughly as semi-elasticities, or as a percent change in spending associated with a percentage-point increase in charter school enrollment.

[Insert Table 2 about here]

In non-reimbursement years, a percentage point increase in charter school enrollment is associated with lower per-pupil spending in the sending TPSD of about 0.5 percent (column 1). A district going from one to eight percent of its students enrolled in charter schools – approximately the statewide change during this time period – would thus be predicted to spend roughly 3.3 percent, or $485, less per student in the absence of tuition reimbursements.

The coefficient on the interaction term indicates that that relationship is substantially less negative in years in which districts receive state reimbursement for their tuition payments, suggesting that districts spend, rather than save, some of these additional revenues. In reimbursement years, the relationship between charter competition and total spending per student is indistinguishable from zero (p = .73).

It is perhaps surprising that larger charter school enrollment shares are associated with lower per-pupil spending in sending districts because districts losing enrollment would tend also to lose economies of scale. Moreover, as discussed above, districts' tuition payments to charter

schools for each pupil are substantially less than the district's per-pupil expenditure; this should increase a district's per-pupil spending on remaining students when a student exits for the charter sector. However, because we control for the district's TPS enrollment, we account for changes in economies of scale over time. Our results are thus relationships between charter school enrollment and district expenditures net of the fact that districts will tend to lose economies of scale when enrollments fall *ceteris paribus*, and will thus tend to spend more per pupil. In results available upon request, when we no longer control for the log of district enrollment, the main effect of charter school enrollment on total per-pupil spending switches signs ($\beta = 0.003$, $p = .07$), though the coefficient on the interaction term is essentially unchanged. Additionally, the negative relationship between charter school enrollment and per-pupil spending previews our revenue results below indicating that, as in other contexts, charter school enrollment is associated with decreased local property tax revenue, which tends to put downward pressure on spending.

Financial reports provided by the state segment district spending into several more specific categories of activity, including instruction, instructional support services, non-instructional operations, and facilities management. Considering these categories separately offers insight not only into how district spending changes are associated with charter competition, but also on how districts use the additional resources that tuition reimbursements provide.

As shown in Table 2, in non-reimbursement years an additional percentage point of students enrolled in charter schools is associated with significantly lower per-pupil spending on all major categories of expenditure, including instruction (-0.7 percent, column 2), instructional support (-0.5 percent, column 3), non-instructional operations (-2.3 percent, column 11), and facilities (-6.2 percent). One might expect that these relationships would all become more

positive (or less negative) in the presence of tuition reimbursements, but this is not what we observe.

While the coefficients on the interaction term are never negative – indicating that charter enrollment is not associated with *additional* decrements to spending in reimbursement years – they are only significantly positive in the case of instruction and instructional support services. These relative increases in instruction-related spending are consistent with competition inducing instructional improvements in TPSDs. However, the decrements to all categories of spending in non-reimbursement years suggests that the fiscal pressures associated with competition from charter schools may constrain districts looking to make such improvements.[5]

We are unable to link district tuition payments to charter schools to specific types of instructional expenditure (e.g., regular education vs. vocational education), and are thus unable to adjust those expenditure categories as we do for instruction as a whole. However, tuition payments are not attributed to instructional support services. Specific categories of this service spending therefore do not require such adjustment and can be disaggregated to understand why districts facing additional charter competition spend relatively more on these activities in reimbursement years. This is seen in columns 4-10 of Table 2.

Reductions in instructional support service spending associated with charter school enrollment in non-reimbursement years are driven by lower spending on pupil support (e.g., guidance services; column 4), staff support (e.g., professional development; column 5), administrative support (e.g., legal costs; column 6), pupil health services (e.g., vision screenings;

[5] Our finding that charter school enrollment is associated with proportionally large decreases in spending on facilities is somewhat at odds with previous work that shows that such capital-related costs are largely fixed for districts losing enrollment to charter schools (e.g., Cook, 2018). However, as shown in Table 1, districts in Pennsylvania report spending only an average of $45 per pupil per year on facilities during this time. Indeed, most districts report no such spending in most years and many districts never report facilities spending at all. Moreover, as shown in Appendix Table A1, our estimates of facilities spending are sensitive to the inclusion of district-specific time trends. We thus believe our facilities results should be interpreted with caution.

column 7), and plant services (e.g., grounds keeping; column 9). Charter school enrollment is not associated with lower per-pupil spending on business services (e.g., payroll services; column 8) or student transportation between home and school or between schools (column 10), consistent with such costs being relatively fixed for districts.

Again, in no case are these relationships more negative in reimbursement years, and are often significantly more positive. In particular, when tuition reimbursements are available, districts facing additional charter school enrollment appear to spend more on administration, pupil health services, plant services, and student transportation; the coefficient on the relevant interaction term is also marginally significant for business service spending.

RQ 2: TPSD Student Achievement

We find that higher levels of charter school competition associate with lower achievement in district schools. These relationships attenuate – and even reverse – in years when districts receive reimbursements for enrollment losses.

[Insert Table 3 about here]

Results from models predicting student achievement outcomes are presented in Table 3. As shown in column 1, in years when districts do not receive tuition reimbursements an additional percentage point of students enrolled in charter schools is associated with 0.19 percentage points fewer TPSD students meeting state proficiency standards in reading. The coefficient on the interaction term indicates that that relationship is significantly less negative in years in which districts receive reimbursements. Results are similar in math (column 3), including a significantly more-positive relationship between charter competition and student achievement in reimbursement years relative to non-reimbursement years, though the estimated relationship during non-reimbursement years is not significantly different from zero.

Results using cohort-standardized student scale scores provided by SEDA (columns 2 and 4) are similar in both math and ELA, suggesting results are not simply an artifact of the use of proficiency rate measures of achievement. In non-reimbursement years, a percentage point of students exiting TPSDs for charter schools is associated with student achievement in districts that is lower by 0.006 standard deviations in ELA (column 5) and 0.009 standard deviations in math (column 6). Again, these relationships significantly attenuate, in each case by approximately two-thirds, when districts receive tuition reimbursements. These results are consistent with charter competition imposing an operational strain on nearby TPSDs and suggest that competitive pressures, if they improve outcomes at all, do so only when associated fiscal pressures are ameliorated.[6]

RQ 3: TPSD Revenue and Financial Health

Greater charter school enrollment losses are associated with financial strain in TPSDs, even in the presence of tuition reimbursements, due at least in part to decreases in revenue. As shown in Table 4, lower overall spending levels in districts with larger charter enrollment shares appear to be partially driven by lower revenues from state and local sources, which collectively represent more than 90 percent of district revenues in Pennsylvania. Larger charter school enrollment shares are not significantly related to higher per-pupil state revenues in non-reimbursement years (column 1), though, as expected, that relationship increases in magnitude in reimbursement years. Total local revenues (column 2) are, if anything, negatively related to charter enrollment shares, and these relationships are likely to be positively biased in some sense by the fact that

[6] A disadvantage of the SEDA data is that they include some charter schools in district achievement figures. This may contaminate results insofar as we are interested in student performance in TPSDs, and not in charter schools that operate within the district. However, SEDA's district estimates do exclude charter schools from district figures when they offer primarily online instruction. This alleviates some concerns about contamination. Additionally, our results using SEDA data are consistent with our results using uncontaminated proficiency rate data, which suggests any remaining contamination is small in magnitude.

districts sending larger numbers of students to charter schools are obligated to redirect larger amounts of revenue to those schools in the form of tuition payments.[7]

[Insert Table 4 about here]

Much as was the case with total spending, it is perhaps surprising that we find a negative relationship between charter school enrollment and local revenue. Again, however, this is due in part to the fact that we control for (the natural log of) district enrollment, accounting for the fact that falling enrollment will tend to increase per-pupil revenue, all else being equal, because revenues are distributed across a smaller number of students. Moreover, our local revenue results are consistent with previous literature. This result is driven primarily by a negative relationship between charter school enrollment and local property tax revenue (column 3). We are unable to establish why this happens, but it does not appear to be a result of local property tax effort; as shown in column 4. Larger charter enrollment shares are associated with (insignificantly) higher property tax rates. This suggests that lower property tax revenues may be driven by declines in local property tax value. While perhaps surprising, this is consistent with studies finding that plausibly exogenous expansions of charter schooling can decrease local property values (Brehm, Imberman, & Naretta, 2016; Cook, 2018). This could be the case, for example, if charter schools are interpreted by homebuyers as a signal of poor local TPSD quality.

Given that we observe both lower spending and lower revenues in districts as local charter sectors expand, the net impact on districts' overall financial health is ambiguous. The results in Table 4 suggest that these impacts are negative on balance. A percentage point increase in the share of district students enrolled in charter schools is associated with a decrease in per-

[7] While districts' tuition payments to charter schools are accounted as instructional expenditures, they are not attributed to specific revenue sources. This means there is no obvious way to adjust district revenues for these payments.

pupil undesignated fund balances of roughly $80 per pupil (column 5), or more than five percent of the average balance we observe in districts during this period. Since these balances represent amounts available to districts to spend on any purpose, this suggests districts' finances are strained by competitive pressure from charter schools, and declines in spending are insufficient to fully offset declines in available revenue.

The relationship between charter enrollment and districts' undesignated fund balances is not significantly different between reimbursement and non-reimbursement years. This again suggests that reimbursements, when available, are used primarily to bolster spending rather than to stabilize budgets. Consistent with this, the same percentage point increase in charter enrollment is associated with an increase in per-pupil long-term debt levels of roughly two percent (column 6).

RQ 4: Brick and Mortar vs. Cyber Charter Schools

Table 5 presents results from models similar to those presented earlier, but distinguishes the enrollment shares of brick and mortar charter schools from those of cyber charter schools. Results are qualitatively similar for both types of charter school but differences – while not always statistically significant – are generally consistent with cyber charter schools inducing relatively fewer competitive improvements in TPSDs. For example, while relationships between charter school enrollments and overall TPSD spending are similar for both types of charter school (column 1), in non-reimbursement years a percentage point increase in the share of students enrolling in charter schools is associated with a decrease in per-pupil instructional spending of roughly 0.6 percent if those students enroll in brick and mortar charter schools, but 1.4 percent if those students enroll in cyber charter schools (column 2).

[Insert Table 5 here]

Perhaps one reason TPSDs do not change spending is because of reports of poor instructional quality in the cyber charter school sector (CREDO, 2015; Ahn & McEachin, 2017). Further, coefficients on their respective interaction terms suggest that patterns substantially attenuate in the presence of tuition reimbursements. Differences in other major categories of expenditure between cyber and brick and mortar charter school enrollments are generally not significant (columns 3 to 5), though they suggest that competition from brick and mortar charter schools is associated with decreases in spending on non-instructional operations (e.g., student activities and community services). Competition from cyber charter schools is also associated with lower facilities spending.

Results considering student achievement (columns 6 and 7) are consistent with instructional expenditures being an important mechanism by which charter schools affect TPSD student outcomes. In non-reimbursement years, a percentage point increase in the share of students enrolled in brick and mortar charter schools is associated with 0.16 percentage points fewer TPSD students who are proficient in reading, but a similar increase in cyber charter school enrollment is associated with 0.44 percentage points fewer TPSD students who are proficient in reading. Similarly, the coefficients on respective interaction terms suggest these relationships attenuate at higher levels in relationship to cyber charter schools relative to brick and mortar charter schools during reimbursement years. The pattern is similar in math.

As discussed, previous research shows that charter schools are associated with reduced property tax revenue. As shown in Table 5, we observe this pattern in Pennsylvania only for brick and mortar charter school enrollment (column 9). This is consistent with brick and mortar charter schools signaling low school quality to homeowners or potential homeowners. These relationships are not significantly different from one another ($p = .25$) and cyber charter school

enrollment shares are positively related to local property tax rates (column 10). We thus cannot rule out that cyber charter schools also relate to declines in local property values that are offset by increases in millage rates.

Both cyber and brick and mortar charter school enrollments are associated with lower per-pupil undesignated fund balances in TPSDs (column 11), suggesting similar financial stress associated with both types of charter school. Only cyber charter school enrollments are associated with TPSD debt levels (column 12). This may seem odd given the fund balance results, but districts may take out long-term debt for a variety of reasons that may not always indicate fiscal duress (e.g., necessary capital improvements), and as shown in Appendix Table A1, our long-term debt results are sensitive to the inclusion of district time trends. These results should thus be interpreted with caution.

Robustness Checks

Our use of district and labor market-by-year fixed effects affords us considerable protection from bias due to unobserved factors. Our estimates may nevertheless be biased by unobserved factors varying within districts over time that are associated with charter school enrollment shares and outcomes of interest if those factors do not vary uniformly within labor markets. In Appendix Table A1 we present results from models predicting our outcomes of primary interest that also include quadratic or cubic district-specific time trends. If these time trends are driven by districts' charter enrollment, their inclusion in the model will tend to bias estimates toward zero, making these results conservative. Moreover, if these trends explain virtually all of the residual variation in our outcomes, the resulting estimates may be unstable and identified primarily from measurement error.

Nevertheless, including these time trends serves as a useful test of whether our results are driven to a substantial degree by differing pre-existing district trends. The results controlling for the cubic trends are of particular interest because our panel spans not only a period of economic growth leading up to the Great Recession, but also the subsequent downturn and recovery. These changes likely had major implications for district budgets and outcomes. If these implications differed for districts within a labor market in ways correlated with charter school enrollment, our results may be biased even net of our fixed effects. For example, the elimination of tuition reimbursements was just one part of a large set of education budget cuts enacted for the 2011-12 school year, and those other cuts may disproportionately have affected districts receiving more reimbursements. If so, allowing districts' time trends to differ flexibly (e.g., not simply linearly) should reveal whether unobserved factors substantially affect our estimates.

Appendix Table A1 suggests that these trends are not a major concern in most cases. Our student achievement, total spending, and financial health results change very little in the presence of linear time trends, particularly when we do not attempt to distinguish enrollments in different types of charter school. Our results for specific categories of expenditure are somewhat sensitive to these checks, particularly for spending on non-instructional operations and facilities, but these represent small portions of districts' budgets. Estimates of the relationship between charter enrollment shares and districts' property tax revenues also change in these specifications, but because these models explain virtually all of the variation in property tax revenue, these coefficients may not be well identified.

While we should be cautious about interpreting specific differences in the composition of districts' revenues and expenditures, our main results are robust to relaxing the assumption that districts would have parallel trends in their outcomes in the absence of changes in charter school

enrollment. Some estimates even increase in magnitude in these specifications. Whether we allow districts their own time trends or not, larger shares of students enrolled in charter schools are associated with greater financial strain and lower student achievement in TPSDs. The relationship with student achievement attenuates when tuition reimbursements are available, but the relationship with financial health is not, perhaps because districts use the additional revenue to bolster their instructional programs rather than maintaining their reserves or paying down debts.

Another potential issue we encountered was district enrollments in brick and mortar charter schools are weakly correlated with enrollments in cyber charter schools. It may therefore be that the different relationships we observe for the different kinds of charter schools reflect differences between districts that experience competition only from one or the other type of charter school. However, we observed similar results, available upon request, when considering only the 346 districts for which both cyber and brick and mortar charter school enrollment shares were larger in 2015-16 than in 2000-01 (i.e., the districts for which there was net enrollment growth in both types of charter school during this time).

The final robustness check we employed was to run the analyses without Philadelphia's school district in the dataset. The reason for this check is that Philadelphia has long been a central focus of education reformers, has had unique charter authorization arrangements, and it is the largest district in the state. These outlier possibilities could skew findings. Our findings remained the same when removing Philadelphia.

Discussion and Policy Recommendations

Our study shows that larger shares of students enrolling in charter schools across Pennsylvania associate with decrements to spending, financial health, and student achievement in sending

districts. However, we show some of these relationships substantially or completely attenuate during years in which districts receive partial reimbursement for revenue losses associated with charter school enrollment. Districts facing charter competition spend relatively more on instruction and instructional support services when they receive reimbursements, but they spend no more on facilities or non-instructional operations.

This research adds to a growing body of literature indicating that, whatever the other benefits, school choice schemes can impose financial hardship on TPSDs, especially if there are no available supplementary sources of revenue such as tuition reimbursements. These factors should be considered in jurisdictions where school choice programs are expanding. We find some of the first direct evidence that competitive hardship can be alleviated by state-level policymakers.

Another noteworthy aspect of our findings is that academic achievement relates to changes in reimbursements and spending. The relationship between charter school enrollment and student achievement in TPSDs is less negative – or even positive – when reimbursements are offered, though relationships with district financial health are unchanged. These results are unchanged – and in some cases increase in magnitude –when we relax the parallel trends assumption common to difference-in-difference estimation strategies. We also find suggestive evidence that cyber charter schools impose somewhat different, and perhaps weaker, competitive pressures on TPSDs than brick and mortar counterparts. Previous studies show inconsistent results in regards to competitive effects in school choice environments (Buddin & Zimmer, 2009; Bettinger, 2005; Arum, 1996). Our findings show the influence of school type and policy construction (particularly related to funding) on whether or not competitive effects occur in choice environments.

These findings have implications for both policy and the theory of action of school choice. A key metaphor in explaining the theory of action is that "a rising tide lifts all boats" (Hoxby, 2001; 2003). We remind leaders and policymakers that they need to carefully navigate this tide to ensure lifting, or else the imposition of competitive markets has the potential to sink the capabilities and outcomes of TPSDs. One key element in Pennsylvania is extra funding ensures that TPSDs can effectively compete with charter schools.

Another interesting finding is that results change when considering cyber charter schools. This may happen for a few reasons. One possibility is that because they are neither generally authorized by a district nor physically located in a district's boundaries, cyber charters are less salient than brick and mortar charters to TPSD administrators. Similarly, to the extent that cyber charter schools have relatively poor student achievement outcomes (e.g., CREDO, 2015; Ahn & McEachin, 2017), TPSD administrators may be inclined to compete with them in ways unrelated to instructional quality (e.g., aforementioned non-instructional operations).

These findings suggest that the nature of policymaking for cyber and brick and mortar charter schools should reflect the differences between these types of schools. We are unable to fully explain these differences here because we are only able to observe the response in terms of resource allocations. School districts may use other tactics not captured through observations of finances. One example, as shown in previous research, is districts have used a variety of restructuring strategies to create their own online schools, but still could not recapture students (Mann, 2019). Due to this lack of success, perhaps TPSDs do not allocate additional finances because they believe students leave anyway. Understanding strategies like these require more research to understand the full range of responses, but based on our study the responses are much different from to brick and mortar charters.

Taken together, our findings suggest TPSDs make competitive improvements to their educational programs in the presence of charter schools only if they have additional financial resources to do so. This means funding effective competitive environments is costly. These findings help to reconcile inconsistent results from prior studies because we provide some of the first evidence that straightforward policy choices help sustain and improve TPSD systems experiencing competition. This evidence has implications for policymakers and for researchers seeking to understand how competition affects statewide systems. States considering or experiencing expansions of school choice programs may wish to consider adopting policies, such as tuition reimbursements, that help to insulate districts from associated competitive pressure. However, the costs of such policies need to be weighed carefully against their benefits.

The recommendation of re-adopting tuition reimbursements in Pennsylvania begs the question: Is it possible for a state to adopt such an expensive reform? One of the promises of school choice is that the market could be more cost efficient because it offers a cost-efficient mechanism for effectively determining quality schools and seeing others close or fail (Hoxby, 2001). Our study shows effective choice environments are *more expensive* than other arrangements because maintaining multiple school sectors requires duplicating programs and services. In short, excess cost could be a natural byproduct of choice, not the other way around. Honest conversations about the cost of effectively implementing choice plans are necessary and timely. Noting that traditional public schools may require more resources to compete should be part of this conversation.

In our conversations with school leaders across school types (charter schools and traditional public schools), there seems to be general agreement about reinstating tuition reimbursements. The reason for this is not ideological, but rather practical. There is less tension

between organizations when one is not perceived as taking resources from the other, and charter advocates may feel less political pressure from traditional public school advocacy groups if choice happens in such a way where traditional public school districts do not financially suffer. This means there is potential for a broad coalition of support for a policy that offers choice with financial guardrails for the organizations participating in the competitive environment.

However, reimbursement policy likely may not please fiscal conservatives seeking to enhance market logics while reducing costs of school services. Winning supporters of reimbursement policy from this group is challenging, but Pennsylvania did it in the past with some Republicans supporting reimbursement early in charter school adoption. Additionally, more Republicans favor increasing per-pupil spending than reducing it in recent education spending polls (EducationNext, 2020). It was the austerity-minded politics after the 2008 recession that led to the reimbursements being cut. As the state's financial conditions improve and lawmakers push for more school options, it may be politically possible to support financially struggling school districts through reinstating reimbursements. These reimbursements could alleviate resource drains and elevate possibilities for healthier, and perhaps even effectively competitive, choice environments.

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Tables

Table 1 – Summary Statistics

	N	Mean	SD	Min	Max
Enrollment	7977	3389.4	8003.5	124	201190
% Charter	7977	2.0	3.2	0.0	60.3
% Cyber Charter	7977	1.3	1.1	0.0	12.9
% Brick & Mortar Charter	7977	0.8	2.8	0.0	52.2
% FRL	7962	32.5	18.3	0.0	100
% SPED	7975	16.1	3.8	0.0	45.2
% White	7977	87.6	17.5	1.1	100
% EL	7977	1.1	2.1	0.0	23.1
Achievement					
% Proficient or Advanced in Math	7975	66.3	16.7	6.0	97.3
% Proficient or Advanced in Reading	7975	69.1	11.9	9.1	94.9
Mean Cohort-Standardized Achievement in Math	3480	0.2	0.3	-1.2	1.2
Mean Cohort-Standardized Achievement in ELA	3480	0.2	0.3	-1.4	1.2
Revenue					
State Revenue	7977	6068	2733	1627	45399
Local Revenue	7977	7999	3690	2001	26491
Real Estate Taxes	7977	6088	3443	913	24944
Real Estate Tax Rate (Mills)	6973	48	47	7	616
Expenditures					
Total Expenditures	7893	14570	3248	7800	46736
Instruction	7893	8125	1584	4816	25846
Instructional Support Services	7977	4307	979	2213	13942
Pupil Support	7977	412	155	0	2665
Instructional Staff Support	7977	426	215	0	2503
Administration Support	7977	898	236	334	2695
Pupil Health Services	7977	149	52	48	731
Business Services	7977	203	96	0	1591
Plant Services	7977	1236	293	483	3782
Student Transportation	7977	802	314	64	3202
Non-Instructional Operations	7977	283	127	0	1301
Facilities	7977	45	216	0	6920
Financial Health					
Undesignated Fund Balance	7977	1461	1357	-7320	17342
Long-Term Debt	6979	7	10	0	605

Note. Data in this table combine annual observations of 500 unique districts from 2000-1 through 2015-16. Revenues, expenditures, fund balances, and debt are per-pupil and expressed in 2016 dollars.

Table 2 – Fixed Effect Regressions Predicting Per-Pupil Spending

			Instructional Support Services									
	Total	Instruction	All	Pupil Support	Instructional Staff Support	Admin. Support	Pupil Health Services	Business Services	Plant Services	Student Transport	Non-Instructional Operations	Facilities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
%age Charter	-0.005***	-0.007***	-0.005***	-0.022*	-0.024*	-0.006**	-0.008*	-0.002	-0.006***	0.010***	-0.023*	-0.062*
	(0.001)	(0.001)	(0.001)	(0.009)	(0.011)	(0.002)	(0.003)	(0.007)	(0.002)	(0.003)	(0.010)	(0.026)
Reimbursed x %age Charter	0.004***	0.003*	0.005**	0.009	0.003	0.004**	0.006***	0.009+	0.006***	0.003**	0.000	0.033
	(0.001)	(0.001)	(0.002)	(0.008)	(0.006)	(0.001)	(0.002)	(0.005)	(0.002)	(0.001)	(0.012)	(0.026)
Adj. R-sq	0.79	0.93	0.93	0.82	0.73	0.86	0.81	0.78	0.88	0.94	0.71	0.44
Districts	500	500	500	500	500	500	500	500	500	500	500	500
Observations	7876	7876	7960	7960	7960	7960	7960	7960	7960	7960	7960	7960

Note. Standard errors clustered on districts. All models include district and labor market-by-year fixed effects and control for the natural log of district enrollment and the shares of district students who are white, eligible for free- or reduced-price lunch, are English learners, or receive special education services. + p<.1, * p<.05, ** p<.01 *** p<.001

Table 3 – Fixed Effect Regressions Predicting Student Achievement

	Percentage Proficient or Advanced				Mean Cohort-Standardized Achievement	
	Reading		Math			
	All	SEDA Sample	All	SEDA Sample	ELA	Math
	(1)	(2)	(3)	(4)	(5)	(6)
%age Charter	-0.190**	-0.280**	-0.142	-0.316*	-0.006**	-0.009**
	(0.063)	(0.099)	(0.110)	(0.123)	(0.002)	(0.003)
Reimbursed x %age Charter	0.274***	0.233***	0.320*	0.227*	0.004*	0.006***
	(0.072)	(0.060)	(0.127)	(0.103)	(0.002)	(0.002)
Adj. R-sq	0.91	0.94	0.93	0.95	0.95	0.90
Districts	500	497	500	497	497	497
N	7958	3471	7958	3471	3471	3471

Note. Standard errors clustered on districts. All models include district and labor market-by-year fixed effects and control for the natural log of district enrollment and the shares of district students who are white, eligible for free- or reduced-price lunch, are English learners, or receive special education services. + p<.1, * p<.05, ** p<.01 *** p<.001

Table 4 - Fixed Effect Regressions Predicting Per-Pupil Revenue and Financial Health Measures

		Local Revenue				
	State Revenue	All	Real Estate Taxes	Real Estate Tax Rate (Mills)	Undesignated Fund Balance	Long-Term Debt
	(1)	(2)	(3)	(4)	(5)	(6)
%age Charter	0.003	-0.004	-0.006*	0.726	-81.107***	0.019*
	(0.002)	(0.003)	(0.003)	(0.538)	(20.631)	(0.009)
Reimbursed x %age Charter	0.003+	-0.001	-0.001	0.203	9.420	-0.008
	(0.002)	(0.001)	(0.001)	(0.329)	(15.140)	(0.006)
Adj. R-sq	0.99	0.98	0.98	0.74	0.51	0.74
Districts	500	500	500	500	500	500
Observations	7960	7960	7960	6958	7960	6962

Note. Standard errors clustered on districts. All models include district and labor market-by-year fixed effects and control for the natural log of district enrollment and the shares of district students who are white, eligible for free- or reduced-price lunch, English learners, or receive special education services.
[a]Inverse hyperbolic sine-transformed. + p<.1, * p<.05, ** p<.01 *** p<.001

Table 5 – Results Distinguishing Brick and Mortar Charter Schools from Cyber Charter Schools

	Per-Pupil Spending[a]					Percentage Proficient or Advanced		Per-Pupil Local Revenue[a]				
	Total	Instruction	Instructional Support Services	Non-Instructional Operations	Facilities	Reading	Math	Local Revenue	Real Estate Taxes	Real Estate Tax Rate (Mills)	Undesignated Fund Balance	Long-Term Debt[a]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
%age Brick & Mortar	-0.005**	-0.006***	-0.006***	-0.026*	-0.042	-0.157*	-0.133	-0.005	-0.007*	0.396	-77.020***	0.008
	(0.002)	(0.002)	(0.001)	(0.011)	(0.028)	(0.065)	(0.112)	(0.003)	(0.003)	(0.556)	(22.971)	(0.009)
Reimbursed x %age B&M	0.004***	0.001	0.005*	0.001	0.029	0.232**	0.233+	-0.001	-0.001	0.173	18.186	-0.003
	(0.001)	(0.001)	(0.002)	(0.012)	(0.027)	(0.072)	(0.122)	(0.001)	(0.001)	(0.321)	(14.680)	(0.007)
%age Cyber	-0.006	-0.014***	-0.005	-0.007	-0.183*	-0.444*	-0.342	-0.001	-0.000	2.301*	-89.920	0.086**
	(0.004)	(0.003)	(0.003)	(0.019)	(0.088)	(0.177)	(0.233)	(0.005)	(0.005)	(0.935)	(58.632)	(0.029)
Reimbursed x %age Cyber	0.007+	0.015***	0.006+	-0.006	0.077	0.645***	1.070***	0.001	-0.002	0.110	-65.841	-0.044+
	(0.004)	(0.003)	(0.003)	(0.022)	(0.091)	(0.191)	(0.265)	(0.004)	(0.004)	(0.883)	(57.654)	(0.023)
p(Main Effects)	0.70	0.04	0.78	0.40	0.13	0.13	0.41	0.43	0.25	0.06	0.84	0.01
p(Interactions)	0.50	0.00	0.78	0.75	0.61	0.04	0.00	0.72	0.73	0.94	0.16	0.10
Adj. R-sq	0.79	0.93	0.93	0.71	0.44	0.91	0.93	0.98	0.98	0.74	0.51	0.74
Districts	500	500	500	500	500	500	500	500	500	500	500	500
Observations	7876	7876	7960	7960	7960	7958	7958	7960	7960	6958	7960	6962

Note. Standard errors clustered on districts. All models include district and labor market-by-year fixed effects and control for the natural log of district enrollment and the shares of district students who are white, eligible for free- or reduced-price lunch, English learners, or receive special education services. p(Main Effects) and p(Interactions) are two-sided p-values from Wald tests of the equality of the coefficients on the main effects and interactions, respectively, for brick and mortar and cyber charter enrollment shares. [a]Inverse hyperbolic sine-transformed. + p<.1, * p<.05, ** p<.01 *** p<.001

Figures

Figure 1

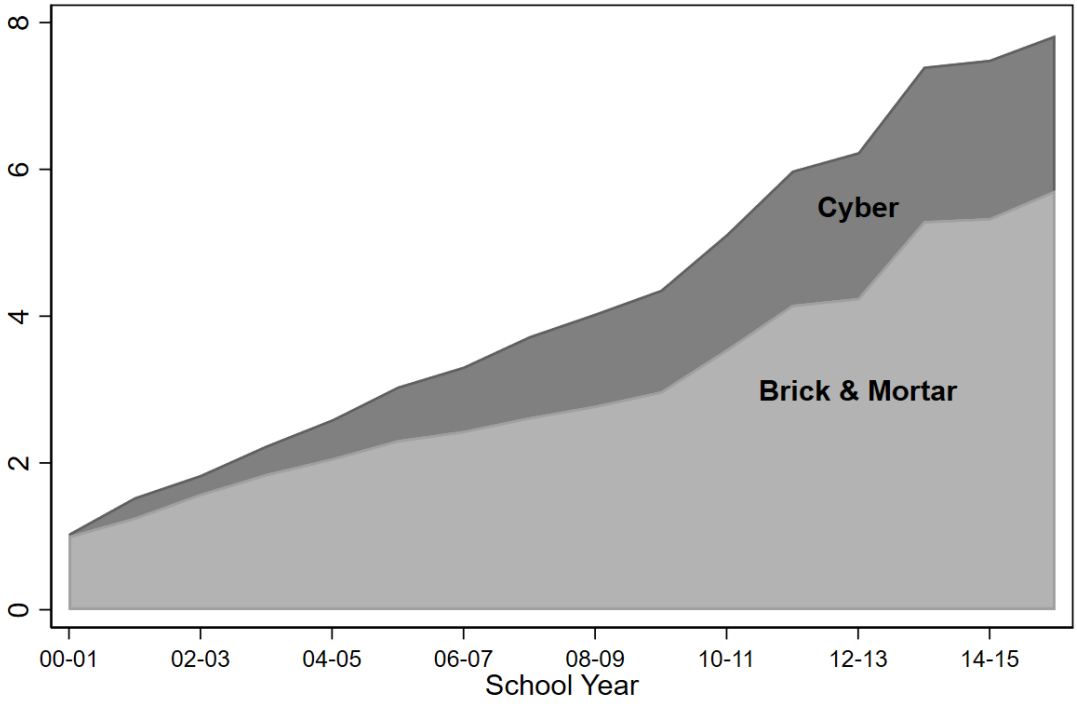

Figure 1. Percentage of students enrolled in charter schools in Pennsylvania. Authors' calculations from Pennsylvania Department of Education data.

Figure 2

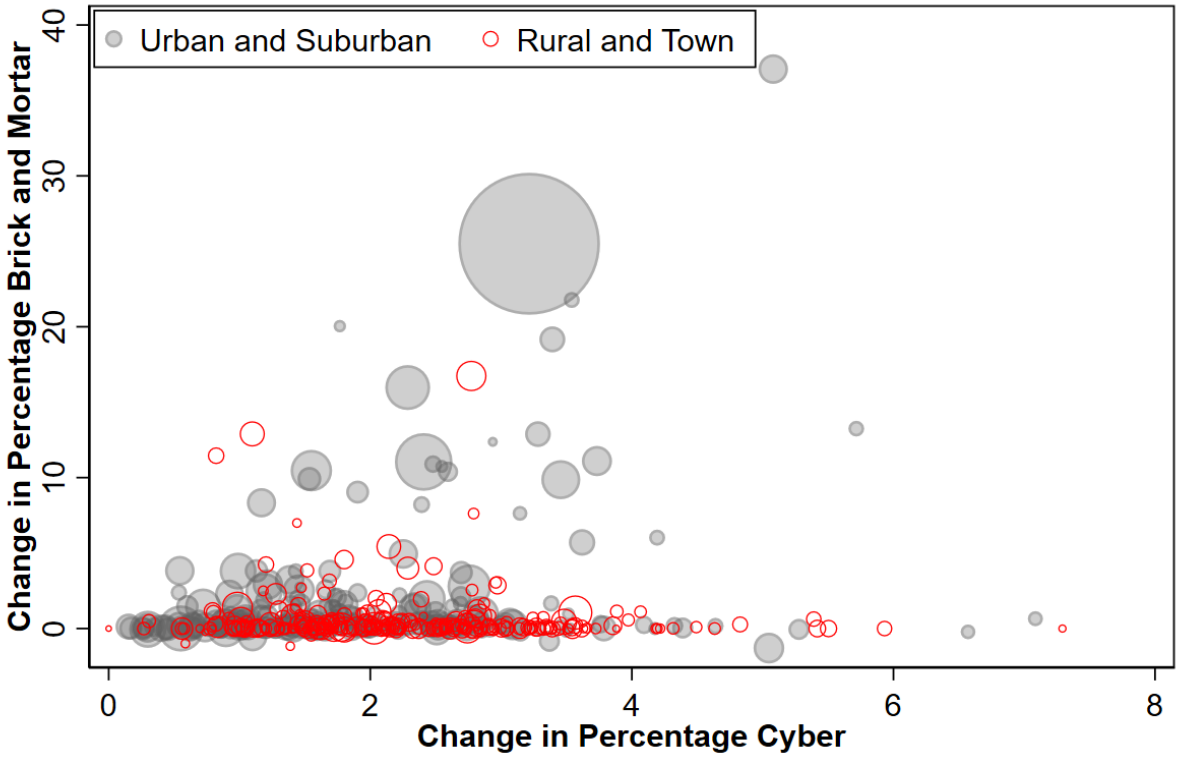

Figure 2. Change in the percentage of students enrolled in charter schools in Pennsylvania districts between 2000-01 and 2015-16. Marker size proportional to average district student membership. Urbanicity based on 2000-01. Authors' calculations from Pennsylvania Department of Education data.

Appendix A – Robustness Checks

Table A1 - Fixed Effect Regressions with District-Specific Time Trends

	Per-Pupil Expenditures[a]										Percentage Proficient or Advanced									
	Total		Instruction		Instructional Support Services		Non-Instructional Operations		Facilities		Reading		Math		Real Estate Taxes Per Pupil[a]		Undesignated Fund Balance Per Pupil		Long-Term Debt Per Pupil[a]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
%age Charter	-0.004*	-0.004*	-0.006***	-0.006***	-0.003^{+}	-0.003^{+}	-0.002	-0.002	-0.019	-0.019	-0.195*	-0.194*	-0.252*	-0.252^{+}	0.003	0.003	-100.06**	-100.04**	0.014	0.014
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.010)	(0.010)	(0.031)	(0.032)	(0.092)	(0.096)	(0.123)	(0.128)	(0.002)	(0.003)	(32.80)	(34.14)	(0.010)	(0.010)
Reimbursed x %age Charter	0.004***	0.004***	0.002	0.002	0.004*	0.004*	-0.001	-0.001	0.032	0.032	0.258***	0.258***	0.311*	0.311*	-0.003***	-0.003**	19.89	19.88	-0.008	-0.008
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.010)	(0.011)	(0.025)	(0.026)	(0.072)	(0.075)	(0.133)	(0.138)	(0.001)	(0.001)	(14.81)	(15.41)	(0.006)	(0.006)
Adj. R-sq	0.79	0.77	0.96	0.95	0.95	0.95	0.82	0.80	0.50	0.45	0.93	0.92	0.94	0.94	0.99	0.99	0.63	0.60	0.86	0.84
Models Distinguishing Enrollments in Brick and Mortar and Cyber Charter Schools																				
%age Brick & Mortar	-0.003^{+}	-0.003^{+}	-0.005***	-0.005***	-0.003	-0.003	-0.003	-0.003	0.016	0.016	-0.109	-0.108	-0.127	-0.127	0.003	0.003	-83.68*	-83.65*	0.013	0.013
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.010)	(0.011)	(0.028)	(0.029)	(0.091)	(0.094)	(0.131)	(0.137)	(0.003)	(0.003)	(35.99)	(37.46)	(0.009)	(0.009)
Reimbursed x %age B&M	0.004***	0.004***	0.001	0.001	0.004*	0.004*	0.001	0.001	0.031	0.031	0.214**	0.214**	0.201	0.201	-0.002*	-0.002*	27.27^{+}	27.25^{+}	-0.007	-0.007
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.011)	(0.012)	(0.026)	(0.028)	(0.075)	(0.078)	(0.130)	(0.135)	(0.001)	(0.001)	(15.87)	(16.52)	(0.006)	(0.007)
%age Cyber	-0.005	-0.005	-0.009**	-0.009**	-0.003	-0.003	0.008	0.008	-0.114	-0.114	-0.578**	-0.577**	-0.965***	-0.964***	0.004	0.004	-119.95*	-119.93*	0.021	0.021
	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.017)	(0.018)	(0.097)	(0.101)	(0.180)	(0.187)	(0.232)	(0.242)	(0.004)	(0.004)	(53.81)	(56.04)	(0.028)	(0.029)
Reimbursed x %age Cyber	0.004	0.004	0.011***	0.011***	0.004	0.004	-0.016	-0.016	0.013	0.013	0.597**	0.597**	1.227***	1.226***	-0.008^{+}	-0.008^{+}	-58.88	-58.94	-0.013	-0.013
	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.018)	(0.019)	(0.105)	(0.110)	(0.194)	(0.202)	(0.303)	(0.315)	(0.004)	(0.004)	(56.71)	(59.07)	(0.023)	(0.024)
Quad. Trend	X		X		X		X		X		X		X		X		X		X	
Cubic Trend		X		X		X		X		X		X		X		X		X		X
p(Main Eff.)	0.78	0.79	0.21	0.23	0.81	0.82	0.53	0.55	0.21	0.22	0.02	0.02	0.00	0.00	0.82	0.82	0.54	0.55	0.76	0.77
p(Interactions)	0.96	0.96	0.00	0.00	0.87	0.88	0.38	0.40	0.87	0.87	0.07	0.08	0.00	0.00	0.25	0.26	0.15	0.17	0.82	0.83
Adj. R-sq	0.79	0.77	0.96	0.95	0.95	0.95	0.82	0.80	0.50	0.46	0.93	0.92	0.94	0.94	0.99	0.99	0.63	0.60	0.86	0.84
Districts	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Observations	7876	7876	7876	7876	7960	7960	7960	7960	7960	7960	7958	7958	7958	7958	7960	7960	7960	7960	6962	6962

Note. Standard errors clustered on districts. All models include district and labor market-by-year fixed effects and control for the natural log of district enrollment and the shares of district students who are white, eligible for free- or reduced-price lunch, English learners, or receive special education services and, if indicated, a district-specific linear time trend. Models are otherwise specified as described in tables 2-5. [a]Inverse hyperbolic sine-transformed. + p<.1, * p<.05, ** p<.01 *** p<.001