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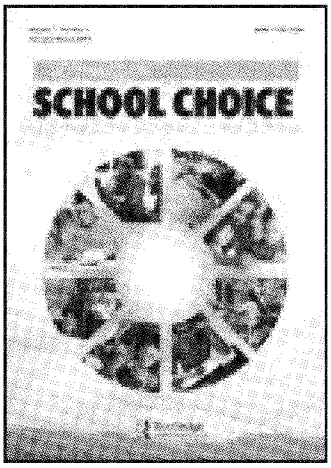

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Measuring Competitive Effects From School Voucher Programs: A Systematic Review

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Measuring Competitive Effects From School Voucher Programs: A Systematic Review

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Studies of the competition effects from voucher or tuition tax credit scholarship programs on public school student academic outcomes have taken place in seven locations throughout the United States, with the majority of studies taking place in Florida, followed by Wisconsin. This article reviews 21 total studies of the impacts on student academic outcomes, finding neutral to positive results. The various competition measures used in the literature are thoroughly reviewed and regression discontinuity design is identified as the most rigorous estimation strategy capable of identifying the causal effect of competition threats on traditional public schools.

KEYWORDS competitive effects, school vouchers, student achievement, systematic review

> [A school choice program] would permit competition to develop. The development and improvement of all schools would thus be stimulated. (Friedman, 1962)

Education policies that promote market forces in the education sector have become popular as a solution to the massive discontent with American educational performance in recent years (Betts, 2005, 2009; Chubb & Moe, 1990; Hoxby, 2000, 2003). This review does not address the productivity of market-based educational reforms for their own students; rather, it addresses the effects of competition on traditional public schools whose enrollments are threatened by nearby private schools. Scholarships that subsidize tuition at private schools, commonly referred to as vouchers, have been proposed for almost 60 years as a potential mechanism to promote educational reform (Friedman, 1955). Publicly funded voucher programs currently operate in

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nine states plus the District of Columbia. Similarly, eight states use personal or corporate state income tax policies to indirectly subsidize private school tuition payments (Glenn & Gininger, 2012). Many supporters of market-based approaches to education reform believe these reforms will produce positive results in conventional public schools. It is important to note that competition between public school districts or between pre-existing, nonsubsidized private schools and traditional public schools is a fundamentally different issue. The type of competition measures reviewed in this article capture the significant increase in competition that can result from the introduction of a publicly-funded school voucher or tax credit scholarship program.

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THEORETICAL UNDERPINNINGS

Questions about the potential benefits or harms of market forces in education can be guided by theory before analyzing the empirical evidence available so I begin by examining the theoretical foundation of educational competition and public school productivity, as measured by student test scores. Most of the arguments for competition effects are built around insights from economic theory. This is because the field of economics has developed the necessary mathematical models and theory to measure the effects of competition in a school choice environment in which schools seek to attract students analogous to how firms attract consumers (Betts, 2005). This section reviews the mechanisms by which we might expect competition for students to improve traditional public school systems where school assignment depends on one's residence.

Most economic models are based upon a utility function that defines the particular preferences of an individual or group of individuals. In the case of education, a family unit is the relevant group of individuals under study, with parents acting as the primary decision makers. A family's utility function, or happiness, is influenced by consumption and leisure both now and in the future. Parents may recognize that their family's utility is not only a function of parental well-being but also of their children's welfare (Betts, 2009). If the quantity and quality of schooling a child receives affects a child's knowledge, skills, and values, which in turns affect his/her future labor market prospects, then parents invested in maximizing family utility should care about selecting the best schooling opportunity for their children. In theory, we refer to an objective definition of school quality defined by test results yet, in practice, each family may differ in their definition of quality based on their unique preferences and the particular characteristics of their children. Regardless of the particular definition of school quality used, however, parents who wish to maximize their children's schooling opportunities may face constraints that prevent them from making the optimal choices.

In an education market where housing and schooling decisions are made at the same time, monopolistic traditional public schools may not face strong incentives for improving teacher instruction, curriculum, or general organizational arrangements in order to attract and retain students. Households may choose among public schools through the process of residential sorting, choosing those communities that provide their preferred bundle of public goods and taxes (Tiebout, 1956), but economically disadvantaged families are restricted to send their children to their assigned public schools. The very nature of these public schools may inhibit "strong leadership, professionalism, clear missions and other aspects of effective organization" due to the high levels of bureaucratization of their institutional setting (Chubb & Moe, 1990, p. 65). The introduction of choice through school voucher or tuition tax credit options, however, engineers a direct market mechanism that alters the incentives faced by traditional public schools and would, at least theoretically, spur improvements in productive efficiency (Friedman, 1962).

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HYPOTHESIZED RESPONSES TO COMPETITION

Competition for students between charter schools, voucher schools, and traditional public schools may provoke three potential responses: a positive response; a negative response; or no response whatsoever. A positive response may arise when, faced with competition, school leaders implement reforms that make more efficient use of existing resources; imitate successful practices; cooperate with partner institutions and organizations; expand or improve facilities, programs, or offerings; or increase responsiveness to student needs. Short term efforts might include motivating and coaching staff to work harder or focusing limited resources on achievement-related activities. Long term efforts may take the form of introducing more innovative curricula or implementing reforms that have the potential to change the composition of the teaching force by attracting highly qualified applicants through mechanisms such as merit pay.

A negative organizational response may arise when, in response to increased threats of competition, public schools may be forced to cut expensive programs and instructional or support staff; the most advantaged students leave the public school system, leaving their disadvantaged and underperforming peers behind without positive student role models; and the general performance of public schools declines as a result of general despair and negativity from operating in a competitive environment.

Of course, public schools and districts may not respond at all if, for example, they perceive the threat from competition to their resources to be trivial. Hess (2002) also suggests that public schools may respond with empty symbolic gestures.

Characterizing the nature of these various responses requires a qualitative approach (Holley, Egalite, & Lueken, 2013). Rouse, Hannaway, Goldhaber, and Figlio (2013) use principal surveys, for instance, finding evidence that schools do change their behavior in response to competition from private schools. They show that "F"-graded Florida schools facing competition from school vouchers were more likely to offer summer school classes, feature a longer school year, focus on low performers, reorganize the learning environment, and increase the resources available to teachers. Quantitative measurements can perhaps detect the effects of such responses on student academic achievement. The focus of this review is to find, analyze, and synthesize the findings of quantitative studies of competition effects from voucher and tuition tax credit options.

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THE ENDOGENEITY PROBLEM

One serious problem that arises in the study of competition effects from choice options is the endogeneity problem of choice school location. Choice schools are frequently established in response to dissatisfaction with existing schooling options. In an area where the public schools are subpar, frustrated parents may campaign for the creation of new private or charter schools. Such a locale would thus have a variety of private or charter options simply because the quality of the public schools is so low. Take, for example, the case of Washington, DC which has both a school voucher program and a thriving charter school sector enrolling around 41% of all public school students (National Alliance for Public Charter Schools, 2012). Traditional public schools in the District display dismal scores on the National Assessment of Educational Progress (NAEP) (NAEP, 2011) yet high per pupil spending (U.S. Census Bureau, 2010), which is indicative of low public school productivity. Reports of malfeasance among public school officials further fueled the desire for alternative options such as charter and voucher schools to proliferate in the district.

The endogeneity of choice school location can introduce bias into naïve estimation models of the effect of choice options on public school achievement because areas with large numbers of choice options may appear to cause low productivity when in reality the opposite is true. Researchers can avoid biasing models in this way by comparing the same public school or district to itself before and after the introduction of a choice policy or by identifying a third variable that induces the availability of choice but is not correlated with the underlying causes of low public school productivity (Hoxby, 2003). The first of these solutions typically results in a difference-in-differences model, comparing treated schools before and after a choice reform with control schools that did not experience a

choice reform. The second solution typically results in instrumental variables analysis.

This article reviews the complete set of studies that measure the effects of private school competition on public school students' test scores as a result of school voucher or tax credit scholarship programs using one of the high-quality study designs described above or a similarly rigorous alternative specification. Section II details a comprehensive description of the search procedures used, Section III synthesizes and analyzes findings, and Section IV concludes.

METHODOLOGY

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This literature search consisted of three phases. Phase One was a replication and extension of an existing literature review in this area: Forster's (2011) review, "A Win-Win Solution: The Empirical Evidence on School Vouchers." All relevant papers cited in Forster's review were systematically coded and a decision for inclusion was made based on the criteria gathered during this process. Detailed coding of the studies uncovered during this process was conducted using a standardized coding form to ensure consistency of the information collected across studies (see Appendix).

Phase Two consisted of consulting with prominent school choice researchers to determine any studies of competition effects that may have been neglected in Phase One. In Phase Three, I supplemented these two informal search strategies with a formal systematic literature search using two well-known, comprehensive economics databases. A literature search of this nature has a number of distinct advantages. First, it uses transparent procedures to find, evaluate, and synthesize studies. Second, these procedures are easily replicable and add credibility to the integrity of the search. Third, search procedures and rules are explicitly defined in advance of the search in order to minimize bias (The Campbell Collaboration, 2012). Phase Three was essentially conducted as a secondary check for any literature that may have been overlooked in Phases One and Two. I now outline detailed descriptions of all three phases of the literature search.

Phase One: Critique of Previous Review

Forster (2011) identified 22 estimates from 19 empirical studies of competition effects in the United States (Table 4, p. 24). Of these 19 studies, he reports that 18 uncover improvements in public school math and reading performance and the remaining study finds no impact. Forster does not uncover any studies that find negative impacts on public school performance. During the first phase of this literature review, I carefully and systematically coded each of the 19 studies in Forster's review. Many of the references had to

be updated to reflect the most recent, published versions of these studies, which is one of the reasons why my findings are not identical to Forster's.

In Florida, Forster reports 11 estimates of competition effects. I report nine. There are two main reasons for this discrepancy. First of all, Forster identifies Chakrabarti (2004) as a standalone study but investigation revealed that this reference is a 446-word segment of a longer *Education Next* article by Winters and Greene. I rejected this estimate outright because it was too short to adequately code. The same data later appeared in a 2008 publication by Chakrabarti reviewed by Forster that more thoroughly answers the competitive effects question alluded to in the short 2004 segment (Chakrabarti, 2008a). The second reason I report fewer Florida estimates than Forster is because he counts Chakrabarti (2007), which has since been published and is referred to in this article as Chakrabarti (2012), and Chakrabarti (2008a) as separate estimates. A close investigation of the two datasets used in these separate papers reveals that both studies use the same dataset. In order to avoid double-counting studies, I only count this estimate once (the study I refer to in this article is Chakrabarti, 2008a).

Regarding Milwaukee studies, Forster reports six estimates; I report 5 during Phase One (Mader, 2010 is added in Phase Three). The reason for this discrepancy is, once again, because of double counting of two Chakrabarti studies that use the same data. In the text, Forster says there are two Chakrabarti Milwaukee studies released in 2006; in the table, he instead lists a 2007 and a 2008 Chakrabarti study. A thorough review of Chakrabarti's publication record reveals two Chakrabarti Milwaukee studies, both released in 2008. One of these studies is a staff paper for the Federal Reserve Bank of New York (No. 315), while the other is a publication in a peer-reviewed journal, *The Journal of Public Economics*. Because these studies rely on the same data, I only count the published study (referenced in this article as Chakrabarti, 2008b). Another important note regarding Milwaukee estimates is that Forster identifies Hoxby (2001) as a study of competition effects in Milwaukee. When coding this study, I found it necessary to use a 2003 version of this study in place of the 2001 *Education Next* study which lacked key information necessary to appraise study quality. In Texas; Ohio; Washington, DC; and Maine/Vermont, my Phase One search yield is identical to Forster's.

A number of international studies were drawn to my attention during the review process (Card, Dooley, & Payne, 2010; Chan, 2009; Hsieh & Urquiola, 2001; McEwan & Carnoy, 2000; West & Woessmann, 2009) but I excluded those studies for a number of reasons, including study rigor in certain cases. The primary reason for exclusion of those studies, however, was one of external validity. I limited this review to studies of programs within the United States because extrapolating from one context to another international context is too difficult for studies of this nature, which are so easily influenced by local policy environments. My total yield from Phase One of the literature search is 18 empirical studies of competition effects.

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Phase Two: Consultation With School Choice Researchers

In Phase Two of this literature review, I conducted informal consultations with school choice researchers, familiar with the scope of literature in this field. This process identified two additional studies that had not yet been uncovered (Carr, 2011; Merrifield & Gray, 2009). These two studies bring the updated search yield to 20 studies of competition effects.

Phase Three: Systematic Searches

The third and final phase of this literature search took a systematic approach to ensure no studies had been overlooked. I defined the start of the search period as 1991, one year after the establishment of the nation's first urban private school voucher program, the Milwaukee Parental Choice Program. I identified a number of high-quality, comprehensive databases that would be likely to index rigorous studies on the systemic effects of choice programs in the United States, specifically school vouchers and scholarships from tuition tax credit programs. The first database is the American Economic Association's electronic bibliography, *Econlit,* which indexes over 120 years of literature in the field of economics. This comprehensive economics index features journal articles, books, works from collective volumes, working papers, and dissertations.

The second database examined houses the working papers of the economics of education research program of The National Bureau of Economic Research, the largest economics research organization in the United States. This private, nonprofit organization makes working papers available online in a preliminary form in order to encourage discussion and solicit feedback before final publication. I was particularly keen to incorporate this database in order to avoid publication bias.

Common search criteria were used across both databases:

- Sample Period: post-1991 for *Econlit* and post-1994 for the National Bureau of Economic Research (NBER) (due to lack of records pre-1994);
- Study Focus: competition effects from school vouchers, or tax credit scholarships;
- Geography: United States only;
- Language: English;
- Grades: K–12;
- Analytic Approach: quantitative studies only, must include statistical control for pretest;
- Outcomes: student scholastic achievement measured by standardized exams;
- Databases Examined: *EconLit* and NBER Working Papers; and
- Search Terms: public and school and competition, public and school & response, education and markets and competition, voucher and school and competition.

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One new study identified through this systematic process (Mader, 2010) was coded using the same coding form in the previous search phases (see Appendix). Table 1 tabulates the results of the systematic review of two major economic databases.

Four separate searches were run in the *Econlit* database, while the limited search function of the *NBER* database required systematic searches by year, through all titles. A total of 1,022 titles were retrieved across the two databases. A number of titles were immediately discarded as being irrelevant to the topic under study and 87 titles survived through the second phase of the systematic search. An abstract review was conducted and 30 titles were

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TABLE 1 Tabulation of Systematic Searches, 1991 Through November 2012

Database/Search terms	Titles retrieved	Abstracts reviewed	Methods reviewed	Studies coded	Unique studies accepted
EconLit					
Search terms:					
public & school & competition	119	40	10	2	2
public & school & response	99	1	1	1	0
education & markets & competition	104	13	5	2	0
voucher & school & competition	17	12	7	2	0
Subtotal:	339	66	23	7	2
NBER (by year)					
2012	72	1	0	0	0
2011	85	1	0	0	0
2010	88	2	1	1	1
2009	65	0	0	0	0
2008	64	1	1	0	0
2007	65	2	1	1	1
2006	56	0	0	0	0
2005	53	4	1	0	0
2004	35	1	1	0	0
2003	49	4	0	0	0
2002	40	1	1	0	0
2001	9	4	1	1	1
2000	0	0	0	0	0
1999	0	0	0	0	0
1998	0	0	0	0	0
1997	0	0	0	0	0
1996	0	0	0	0	0
1995	1	0	0	0	0
1994	1	0	0	0	0
Subtotal:	683	21	7	3	3
Grand Total:	1,022	87	30	10	5

Note. NBER = The National Bureau of Economic Research. Searches in EconLit were geographically limited to Northern America. Searches in NBER were conducted within NBER's Economics of Education program; records only go back as far as 1994.

submitted to a methods review. After this, 10 studies were coded using a standard form (see Appendix). Duplicates were removed at this stage and five unique studies remained at the end of this process. Only one of these five studies had not been uncovered during Phase One (Mader, 2010). The updated search yield is 21 total studies. Combined results from Phases One through Three are now presented by site, due to the unique school choice programs and policies specific to each region.

Competition Measures

A variety of competition measures were uncovered during the search process. These can be organized into seven distinct categories.

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1. Quasi-Experimental Methodologies
   By far the most rigorous competition measures observed in the literature are quasi-experimental methodologies such as a regression discontinuity analysis, which estimates the casual effect of a policy by comparing outcomes above and below a discontinuity in the treatment. By comparing observations from two similar groups that fall on either side of a prespecified cutoff point, this approach approximates a "gold standard" random-assignment research design. Six of the Florida estimates gathered in this review use this approach, made possible by Florida's unique accountability policy that assigns letter grades to schools and makes voucher availability contingent on these school grades being below a cut-off point (Chakrabarti, 2008a; Figlio & Rouse, 2006; Greene, 2001; Greene & Winters, 2004; Rouse et al., 2013; West & Peterson, 2006).
2. Percentage of Students Eligible for Vouchers
   A very popular competition measure used, particularly in Milwaukee studies, is the percentage of public school students eligible for a voucher to transfer to a private school (Carnoy, Adamson, Chudgar, Luschei, & Witte, 2007; Chakrabarti, 2008b; Forster, 2008b; Greene & Forster, 2002; Hoxby, 2003; Mader, 2010). This measure may be influenced by random, unexplained variation, however, as not all students who are eligible for vouchers actually end up using one.
3. Density Measures
   Density measures use the count of private competitors within a given radius as the competition measure (Carnoy et al., 2007; Figlio & Hart, 2010; Greene & Marsh, 2009; Greene & Winters, 2008). These measures may be endogenous to public school performance: the poorer the performance of local public schools, the increased likelihood of private schools being able to attract potential students, which might motivate private schools to establish in an area.
4. Proximity Measures

Proximity measures use the distance between a public school and its nearest private school competitor as the competition measure, under the assumption that shorter distances represent higher levels of competition (Figlio & Hart, 2010; Greene & Winters, 2006). This measure may also be endogenous to public school performance.

5. Diversity Measures
   A diversity measure considers the number of different types of local private schools close to a given public school. A type might be defined by religious affiliation, for example. This measure is intended to capture competition by measuring the variety of schooling options available to students (Figlio & Hart, 2010). This is not a very commonly used measure as it too may be endogenous to public school performance.
6. Private School Size
   Proxies for private school size include counting the number of enrollment slots available at nearby private school competitors or using private school physical seating capacity as a proxy for private school size (Mader, 2010). These measures may be imprecise, however, as school size and school appeal are not perfectly correlated. Although larger private schools certainly have greater capacity to attract voucher students, in reality, we have no way of knowing if they actually do.
7. Other Measures
   In Vermont and Maine, Hammons (2002) counts the percent of a district's budget attributable to students who were "tuitioned-in" as the competition measure. This is roughly equivalent to counting the number of student transfers. The unique policy environment in Vermont and Maine make this measure possible but it is unlikely that this measure could be used in other states that do not have town tuitioning.

RESULTS

Twenty-one studies of competition effects were uncovered during the literature review process (Table 2). Eighteen of these studies were uncovered during Phase One, two studies during Phase Two (Carr, 2011; Merrifield & Gray, 2009) and one additional study was collected during Phase Three (Mader, 2010). All but one of these 21 studies found neutral/positive or positive results. The only study to find no effects across all subjects was a 2006 study by Greene and Winters of the federal voucher program in Washington, DC. Although each choice program examined in this review takes place in a unique environment, the DC voucher program was exceptional because it was restricted to a relatively small number of participants in the year this study was conducted. Furthermore, a "hold-harmless" provision ensured that public schools were insulated from the financial loss from any students that transferred into private schools with a

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TABLE 2 All Empirical Studies of Competition Effects on Public Schools From Voucher/Tuition Tax Credit Programs

#	Author (year)	Program name	Results
SITE:	FLORIDA (9 estimates)		
1	Greene, J. P. (2001)	A-Plus School Choice	Positive
2	Greene, J. P. & Winters, M. A. (2004)	A-Plus School Choice	Positive
3	Chakrabarti, R. (2008a)	A-Plus School Choice	Positive
4	Figlio, D. N. & Rouse, C. E. (2006)	A-Plus School Choice	Positive
5	Rouse, C. N., Hannaway, J., Goldhaber, D., & Figlio, D. N. (2013)	A-Plus School Choice	Positive
6	West, M. R. & Peterson, P. E. (2006)	A-Plus School Choice	Positive
7	Forster, G. (2008a)	A-Plus School Choice	Positive
8	Greene, J. P. & Winters, M. A. (2008)	McKay Special Needs Voucher	Positive
9	Figlio, D. N. & Hart, C. M. D. (2010)	FL Tax Credit Scholarship Program	Positive
	MILWAUKEE (6 estimates)		
10	Hoxby, C. M. (2003)	MPCP	Positive
11	Greene , J. P. & Forster, G. (2002)	MPCP	Neutral to Positive
12	Chakrabarti, R. (2008b)	MPCP	Neutral to Positive
13	Carnoy et al. (2007)	MPCP	Positive
14	Greene, J. P. & Marsh, R. H. (2009)	MPCP	Positive
15	Mader, N. S. (2010)	MPCP	Positive
	OHIO (2 estimates)		
16	Forster, G. (2008b)	EdChoice Vouchers	Positive
17	Carr, M. (2011)	EdChoice Vouchers	Positive
	TEXAS (2 estimates)		
18	Greene, J. P. & Forster, G. (2002)	Edgewood SD Scholarship Program	Positive
19	Merrifield, J. & Gray, N. (2009)	Edgewood SD Scholarship Program	Neutral to Positive
	MAINE and VERMONT (1 estimate)		
20	Hammons, C. W. (2002)	Town Tuitioning	Positive
	DC (1 estimate)		
21	Greene, J. P. & Winters, M. A. (2006)	DC OSP	Neutral

Note. MPCP = Milwaukee Parental Choice Program. OSP = Opportunity Scholarship Program.

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voucher. The absence of a positive competition effect is thus unsurprising, given these design features.

Results by Site

Florida

Nine competition estimates come from studies in Florida, more than any other location in the United States, thanks to an aggressive and controversial education policy that was unique to this state until very recently (Table 3). Florida's A+ Plan combines two simultaneously implemented education reforms: high-stakes testing and school vouchers. All Florida public school

TABLE 3 Detailed Summary of Competition Effects Studies in Florida

#	Author (Year)	Sample	Program name	Results
1	Greene, J. P. (2001)	1999–2000; 4th, 5th, 8th grade Reading and 4th, 5th, 8th, 10th grade Math	A-Plus School Choice	Positive
2	Greene, J. P. & Winters, M. A. (2004)	2001–2002 through 2002–2003; Math, Reading, Writing; Grades 3–10	A-Plus School Choice	Positive
3	Chakrabarti, R. (2008a)	1997–1998 through 2001–2002 Grade 4 Reading; 1993–1994 through 2001–2002 Grade 4 Writing; 1997–1998 through 2001–2002 Grade 5 Math	A-Plus School Choice	Positive
4	Figlio, D. N. & Rouse, C. E. (2006)	1998–1999 through 1999–2000; Grade 4 Math and Grade 5 Reading	A-Plus School Choice	Positive
5	Rouse, C. N., Hannaway, J., Goldhaber, D., & Figlio, D. N. (2013)	2002–2003 through 2004–2005; Math and Reading	A-Plus School Choice	Positive
6	West, M. R. & Peterson, P. E. (2006)	2001–2002 through 2003–2004; Math and Reading; Grades 3–5	A-Plus School Choice	Positive
7	Forster, G. (2008a)	2001–2002 through 2006–2007; Math; Grades 3–10	A-Plus School Choice	Positive
8	Greene, J. P. & Winters, M. A. (2008)	2000–2001 through 2004–2005; Math and Reading; Grades 3–10	McKay Special Needs Voucher	Positive
9	Figlio, D. N. & Hart, C. M. D. (2010)	1999–2000 through 2006–2007; Math and Reading; Grades K–12	FL Tax Credit Scholarship Program	Positive

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students in Grades 3–10 take the Florida Comprehensive Assessment Test (FCAT). Results from this state test are used to grade schools on a scale from A to F. If a school receives two F grades in a 4-year period, its students automatically become eligible for vouchers to transfer to alternative private or public schools. The motivating theory behind the A+ Plan is that chronically failing schools will be motivated to improve and because the only way to remove the voucher threat is to produce better academic results, these improvements should be focused on student academic performance.

The Florida Opportunity Scholarship Program was written into law in June 1999. Vouchers were associated with the loss of revenues and visibility in the press. As a result, the shame associated with receiving an "F" grade served as an alternative treatment effect. The unique policy design permitted the use of a regression discontinuity analysis around assignments of grades to schools near the accountability cutoffs, permitting numerous rigorous

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quasi-experimental analyses. I identify seven estimates of competition effects from the A+ Plan, all of which find positive impacts on math, reading, and writing outcomes (Chakrabarti, 2008a; Figlio & Rouse, 2006; Forster, 2008a; Greene, 2001; Greene & Winters, 2004; Rouse et al., 2013; West & Peterson, 2006).

The earliest study was conducted by Greene (2001) and provided a descriptive analysis of the reading and math performance of "D" schools compared to "F" schools in 1999–2000. Greene finds positive effects of a school receiving an "F" grade in both subjects. In 2004, Greene and Winters used school-level test scores to compare changes in average test scores by cohort for the 2001–2002 through 2002–2003 time period, once again finding positive impacts. A 2008 report prepared for the Friedman Foundation by Greg Forster (2008a) analyzed math scores over a 5-year time period, from 2001–2002 through 2006–2007, also finding positive effects.

Four of the most rigorous of the Florida studies take advantage of the highly nonlinear and discontinuous relationship between school achievement and the probability of that school's students becoming eligible for vouchers to implement a regression discontinuity design. Comparing treated "F" with control "D" schools, Chakrabarti (2008a), finds that Grade 4 FCAT reading scores increase by 2.99 scale score points, Grade 5 FCAT math scores increase by 7.88 scale score points, and Grade 4 FCAT writing scores increase by 0.31 scale score points.[1]

A second study using this rigorous design, Figlio and Rouse (2006), uses student-level data and school fixed effects. Figlio and Rouse find a small positive effect of being classified as low performing on math and reading in the high-stakes grades. A third study to implement a regression discontinuity design, Rouse et al. (2013), uses school-level data from 2002–2003 through 2004–2005. They find large improvements in schools facing the prospect of receiving a second failing grade and becoming obliged to offer vouchers to students. Finally, West and Peterson (2006) use student-level data from 2001–2002 through 2003–2004, finding that schools made improvements in math and reading high-stakes exams. The size of the impact was approximately 0.04 of a standard deviation (henceforth, SD).

Another Florida reform unique to special education students is the McKay Scholarship Program for Students with Disabilities. Greene and Winters (2008) use a student fixed effects methodology with individual-level data on the universe of public school students in Florida to determine if the McKay voucher program impacts public school productivity, finding positive impacts in both math and reading, particularly for students with a specific learning disability whose test scores increase by about .05 SD in math and .07 SD in reading as a result of exposure to competition from the McKay scholarship program.

The most recent study of competition effects in Florida is a working paper by Figlio and Hart (2010). The authors examine the effects of

private school competition resulting from the Florida Tax Credit Scholarship Program, which offers tuition scholarships to eligible low-income students to attend private schools in Florida. Figlio and Hart use a variety of competition measures including proximity, density, and diversity measures that capture ease of access to private schools and the variety of private school options available. They find that increased levels of competitive pressure on all four measures led to general improvements in public school performance. A -mile decrease in the distance of the nearest private school leads to an increase of .02 SD in math and .01 SD in reading. Likewise, a one SD increase in the number of private schools nearby is associated with a .02 to .03 SD increase in reading and math scores. Finally, a one SD increase in nearby private school concentration increases test scores by about .01 SD in reading and math.

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Milwaukee

The Milwaukee Parental Choice Program (MPCP) was enacted by the Wisconsin Legislature in 1990, greatly expanding the educational options available to Milwaukee families. Initially, this taxpayer-funded voucher program was limited to nonreligious schools but legislation granting approval to religious schools wishing to participate in the voucher program was implemented in 1998, which greatly expanded the size of the program (Figure 1). The Legislature raised the enrollment cap on the MPCP in 1993, 1995, and 2005. Changes to the program in 2011 abolished the enrollment cap and raised the income eligibility requirement to 300% of the Federal Poverty Level, opening the program to an even broader set of families wishing to receive public assistance to attend a private school either inside or outside the city of Milwaukee (State of Wisconsin, 2011). The most recent data on the program indicates that there are 106 private schools participating in the MPCP, with a total enrollment of 22,762 students each receiving a $6,442 voucher (Wisconsin Department of Public Instruction, 2012).

There have been six high-quality studies of the competitive effects of the MPCP (Table 4). Four of these studies find significant positive achievement impacts (Carnoy et al., 2007; Greene & Marsh, 2009; Hoxby, 2003; Mader, 2010). The first study of competition effects in Milwaukee was conducted by Hoxby (2001). I use the data from her later publication (Hoxby, 2003) to thoroughly analyze her methods and results. Using the percentage of public school students eligible for vouchers as her competition measure, Hoxby implements a school-level difference-in-differences model to estimate the systemic effects of the MPCP. Because all Milwaukee schools were essentially "treated," Hoxby creates a 12-school control group from the set of urban schools outside of the City of Milwaukee that had more than 25% of students qualify for free or reduced price lunch and at least 15% of the student

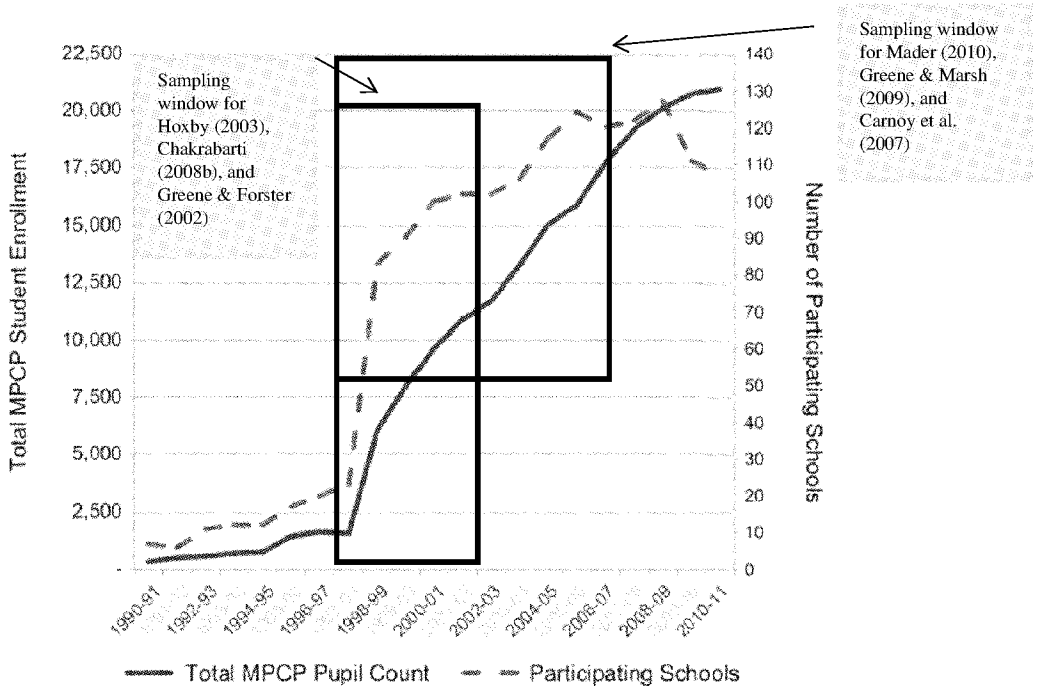

FIGURE 1 Historical MPCP schools and student enrollment showing sampling windows of the various studies of MKE voucher competitive effects. Data obtained from the Wisconsin Department of Public Instruction.

TABLE 4 Detailed Summary of Competition Effects Studies in Milwaukee

#	Author (Year)	Sample	Program name	Results
1	Hoxby, C. M. (2003)	Compared 1996–1997 to 1999–2000; Math, Reading, Science, Social Studies, Language; Grade 4	MPCP	Positive
2	Greene, J. P. & Forster, G. (2002)	Compared 1996–1997 to 2000–2001; Grades 4, 8, 10; Math and Reading	MPCP	Neutral to Positive
3	Chakrabarti, R. (2008b)	1986–1987 through 2001–2002; Grade 3 Reading and Grade 5 Reading and Math	MPCP	Neutral to Positive
4	Carnoy et al. (2007)	1996–1997 through 2004–2005 for Math and 1997–1998 through 2004–2005 for Language; Grade 4	MPCP	Positive
5	Greene, J. P. & Marsh, R. H. (2009)	1999–2006; Grades 4, 8, 10; Language Arts, Reading, Math	MPCP	Positive
6	Mader, N. S. (2010)	2000–2001 through 2006–2007; Grades 3–5, Reading and Math	MPCP	Positive

Note. MPCP = Milwaukee Parental Choice Program.

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population African American. She finds strong, positive effects on math, reading, science, social studies, and language. She notes that schools that were the most treated according to her competition measure had dramatic productivity improvements. Based on mathematics achievement, for example, Hoxby notes productivity growth of about 0.7 national percentile points per thousand dollars between 1996–1997 and 1999–2000 in the most-treated schools. More recent publications by Carnoy and colleagues (2007), Greene and Marsh (2009), and Mader (2010) also find positive achievement impacts, although smaller in magnitude. Greene and Marsh show, for example, that the addition of one voucher-accepting school in Milwaukee improves student Language Arts achievement by .06 Normal Curve Equivalent (NCE) points. Math achievement rises by .05 NCE points and reading achievement by .06 NCE points.

Chakrabarti (2008b) replicates and extends Hoxby's methods, using three treatment groups instead of two and finds mixed impacts; positive effects in reading but no effect on math outcomes. Mixed findings were also reported by Greene and Forster (2002). A 2007 study by Carnoy and colleagues finds positive effects in the first 2 years after the program expanded but no significant gains or losses in later years. A 2009 report by Greene and Marsh using student-level fixed effects with a control for voucher options finds small positive effects in Language Arts (0.055 NCEs), Math (0.047 NCEs), and Reading (0.058 NCEs). Finally, an unpublished 2010 dissertation by Mader finds small, positive competition effects in his analysis of Grade 3–5 test scores in the time period 2000–2001 through 2006–2007. In summary, none of the Milwaukee studies report negative impacts but the magnitude of the positive impact reported varies by study. What can explain these mixed findings?

Figure 1 graphs the historical enrollment patterns of both students and schools participating in the MPCP. The sampling windows of the various studies of the competitive effects of the MPCP are overlaid on these graphs to demonstrate variation in the periods studied. Examining the sampling frames like this is critical if we are to reconcile the conflicting size of the impacts estimated from the various studies of the competitive effects of the MPCP over time. The sampling windows of Chakrabarti (2008b) and Hoxby (2003) compare student performance before and after the major expansion of the program in 1998. They found large, statistically significant effects of the program on student achievement. Carnoy et al. (2007) and Mader (2010), however, examine the competitive impacts of the voucher program in a later time period, finding much smaller positive impacts on competition-threatened public schools. This could be explained if the competition effect of the voucher is nonlinear. It is possible, for instance, that the largest gains were realized in the initial period after the expansion, the period examined by Chakrabarti (2008b) and Hoxby (2003) and that the returns to competition

reached a plateau in the period immediately following that (Carnoy et al., 2007; Greene & Marsh, 2009; Mader, 2010).

Ohio; Washington, DC; Texas; Maine; Vermont

The six remaining studies all find modest positive competition effects with the exception of Greene and Winters' 2009 study of the Washington, DC voucher program (Table 5). As mentioned previously, however, the unique policy environment surrounding that program should be considered when interpreting those findings.

In Texas, Merrifield and Gray (2009) estimate an effect size of 0.09 SD in math and find no effect in reading. Greene and Forster (2002) analyze the same voucher program in an earlier time period (1998–2001) and report that the Edgewood school district performed well above the average Texas school district after the introduction of the voucher program. In Ohio, the largest effect found by Forster (2008b) is the math effect in Grades 4–5 and again in Grades 6–7. Schools experiencing competitive pressure raised scores by 5 scale score points (effect sizes not given). The second Ohio study (Carr, 2011) uses school fixed effects with a dichotomous variable indicating whether a school faced a voucher threat or not, finding a positive voucher threat effect of a 2.7 percentage point gain for treated schools in terms of proficiency passage rates. Finally, in Maine and Vermont, Hammons (2002) estimates the competition effect increases high school math, reading, and science scores by 11.8 scale score points (effects sizes not given).

TABLE 5 Detailed Summary of Competition Effects Studies in OH, DC, TX, ME, and VT

SITE	Author (year)	Sample	Program name	Results
OH	Forster, G. (2008b)	2005–2006 through 2006–2007; Grade 3–8; Math and Reading	EdChoice Vouchers	Positive
OH	Carr, M. (2011)	2005–2006 through 2007–2008; 4th and 6th Grade; Reading and Math	EdChoice Vouchers	Positive
TX	Greene, J. P. & Forster, G. (2002)	1998–2001; San Antonio, TX, Reading and Math	Edgewood SD scholarship program	Positive
TX	Merrifield, J. & Gray, N. (2009)	1994–2008; San Antonio, TX (Edgewood SD); Grades 3–11; Math, Reading, Writing	Edgewood SD scholarship program	Neutral to Positive
ME/VT	Hammons, C. W. (2002)	Grades 10 and 11; Math, Reading and Science	Town Tuitioning	Positive
DC	Greene, J. P. & Winters, M. A. (2006)	2003–2004 through 2004–2005; Grades 3, 5, 8, and 10; Math and Reading	DC OSP	Neutral

Note. OSP = Opportunity Scholarship Program.

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CONCLUSION

This review of the literature on the competition effects of public voucher and tuition tax credit scholarship programs on student academic performance uncovered 21 total studies. A diverse set of identification strategies for uncovering competition effects were reviewed. The strongest studies were those employing a regression discontinuity approach. This sophisticated quasi-experimental, empirical method should be used wherever possible as the primary means to deduce compelling estimates of the competitive effect of participation in a voucher or tuition tax credit scholarship program on school achievement levels in future research because the high internal validity of this regression discontinuity design allows us to interpret estimates from this model as causal estimates of the competitive effects of a voucher program. Results from studies using this approach unanimously find positive impacts on student academic achievement. Such overwhelming evidence supports the development of market-based schooling policies as a means to increase student achievement in traditional public schools.

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NOTE

1. Effect sizes are not given for FCAT gains but are available for gains on the low-stakes Stanford 9 test which was administered also (Chakrabarti, 2008a, Table 9). Chakrabarti finds positive and statistically significant effects in reading and math on the Stanford 9 in all 3 years after the program, with effect sizes ranging from 0.24 of a standard deviation to 0.80 of a standard deviation.

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APPENDIX Coding Form

#	Reference	Study sample	Specific voucher/tax credit scholarship program	Competition measure	Estimation method	Results	Limitations
SITE 1: (Study Site [e.g., State] and *n* [i.e., number of studies found for this location])							
1	Complete citation in APA format	Time period, outcome examined, grade levels studied	Name of specific program studied, e.g., Florida's A-Plus School Choice	Specific competition measure used, e.g., Proximity measure counting number of private schools within a given radius	Details of econometric approach, e.g., Descriptive analysis	Summary of findings, shaded green for positive effects, red for negative effects, and yellow for mixed or insignificant findings	Summary of study's limitations which may detract from validity of findings, e.g., Descriptive analysis on one year of data; doesn't fully address possibility of mean reverting measurement error