School Vouchers: A Survey of the Economics Literature[†]

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We review the theoretical, computational, and empirical research on school vouchers, with a focus on the latter. Our assessment is that the evidence to date is not sufficient to warrant recommending that vouchers be adopted on a widespread basis; however, multiple positive findings support continued exploration. Specifically, the empirical research on small-scale programs does not suggest that awarding students a voucher is a systematically reliable way to improve educational outcomes, and some detrimental effects have been found. Nevertheless, in some settings, or for some subgroups or outcomes, vouchers can have a substantial positive effect on those who use them. Studies of large-scale voucher programs find student sorting as a result of their implementation, although of varying magnitude. Evidence on both small-scale and large-scale programs suggests that competition induced by vouchers leads public schools to improve. Moreover, research is making progress on understanding how vouchers may be designed to limit adverse effects from sorting, while preserving positive effects related to competition. Finally, our sense is that work originating in a single case (e.g., a given country) or in a single research approach (e.g., experimental designs) will not provide a full understanding of voucher effects; fairly wide-ranging empirical and theoretical work will be necessary to make progress. (JEL H52, H75, I21, I22, I28, O15)

1. Introduction

In the past two decades, both research and experience have contributed to significant progress in the understanding of educational vouchers. We review both. For the purposes of this review, we define a voucher to be a government-supplied coupon that is used to offset tuition at an eligible private school.[1] Programs that distribute such vouchers exhibit variation in dimensions including

who is eligible to receive them, their source of funding, and the criteria for private-school participation. For example, vouchers are frequently "targeted" to low-income students, are sometimes funded privately rather than through tax proceeds, and religious schools may or may not be eligible to participate.[2]

The research that has analyzed these programs seeks to answer five fundamental questions:

1. What effects do vouchers have on the students who use them?
2. Do vouchers induce nonrandom migration of students from public to private schools, possibly lowering the achievement of students that remain in the public sector via peer effects or other channels?
3. Do voucher programs pressure public schools to become more efficient, increasing the achievement of students that remain in the public sector?
4. What is the net effect of vouchers on aggregate educational performance?

5. What political-economy factors determine the existence and design of voucher programs?

Research frequently focuses on more specific questions that help to get at these fundamentals.

Our review begins by describing the issues and controversies that frame the research on these questions (section 2). We set out the "for" and "against" positions typically (and at times informally) cited on vouchers. The brief discussion is sufficient to show that the answers to questions 1–5 can depend on both the characteristics of the program analyzed and the context into which it is introduced.

We then summarize the features of voucher programs that have been implemented throughout the world (section 3). We make a distinction between two program types. First, by *small-scale* programs, we mean those that place significant restrictions on who can receive vouchers. The most common restrictions involve income or geography; for instance, vouchers may be made available only to low-income children in a given municipality within a country. Second, by *large-scale* programs we mean those in which vouchers are distributed countrywide with minimal restrictions on the type of children who can use them.

We then present a brief synopsis of the theoretical literature (section 4). It reveals that even in a qualitative sense, the answers to questions 1–5 depend on voucher design. The main exception surrounds question 2, where most models suggest that voucher systems will display a tendency towards stratification by ability and/or income—although this too can be mitigated by design and depends on context.

Finally, we turn to reviewing the empirical work—the focus of this survey (section 5). In terms of question 1, the empirical research does not suggest that awarding students a voucher is a systematically reliable way to

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[2] This program heterogeneity poses a challenge in determining which programs to classify as voucher programs. From the perspective of this review, the most difficult decision regards whether to include charter schools under the voucher umbrella. Most charter-school advocates would strenuously resist classifying charter schools as voucher schools, pointing to state requirements that the former be chartered as public schools, subjected to the oversight of the state-designated charter authorizer, and bound by constraints on admissions and funding. The counterargument is that, in some states, charter schools can be privately owned and operate under constraints on admission and financing not markedly different from those imposed by some of the more restrictive voucher programs. While there is merit to both perspectives, we view the distinction between charters and vouchers to be meaningful despite the fuzzy boundary between the two, in part because all of the voucher programs we review permit use of the voucher in private schools. Moreover, there is tremendous heterogeneity in charter school characteristics, both across and within states, making inclusion of charters in this review unwieldy if not unmanageable. Hence, we have chosen not to include research on charter schools in this review. See Epple, Romano, and Zimmer (2017) for a review of research on charter schools.

improve their educational outcomes. A perhaps surprisingly large proportion of the most rigorous studies suggest that being awarded a voucher has an effect that is statistically indistinguishable from zero. At the same time, there is also evidence that in some settings, or for some subgroups or specific outcomes, vouchers can have a substantial positive effect on those who use them. In addition, however, some recent evidence points to some discouragingly large negative test score effects. In terms of question 3, the literature generally suggests that competition from vouchers leads public schools to improve. That said, it also makes clear that it is very difficult to isolate the effect of competition on public-sector value added (the object of interest); this reflects that as implied by the answer to question 2, vouchers typically lead to sorting and can thus affect public schools through channels other than productivity enhancements. Taken together, these findings point to an ambiguous answer to question 4 regarding the net effect of vouchers. Finally, empirical work finds support for theoretical predictions regarding the political economy of voucher adoption.

Our "bottom line" assessment is that those hoping for definitive answers to questions 1–5 will not find them in the research to date. In our view, the available answers to these questions are insufficient to warrant recommending that vouchers be adopted on a widespread basis. In that respect, the effects of vouchers have been disappointing, relative to early views on their promise.

That said, our view is also that the record definitely warrants continued exploration. This assessment reflects three factors. First and as stated, there is evidence that in some cases vouchers can have significant positive effects on educational performance, or at least produce substantial cost savings. Second, there is some indication that the prevalence of such results might be increased with improved voucher design.

For instance, the accumulated research has begun to provide guidance regarding how voucher programs may be formulated to limit adverse effects related to sorting while preserving achievement-enhancing effects related to competition. Third, there is evidence that the returns to a well-functioning education system can be large, with the associated implication that a good understanding of voucher design could be very useful.

A final note is that given the evidence we have reviewed, our sense is that work originating in a single case (e.g., a given country) or in a single research approach (e.g., randomized-control trials) is unlikely to fully answer questions 1–5. The work on vouchers suggests that educational markets are complex, and that therefore fairly wide ranging empirical and theoretical work will be necessary to make progress.

2. *The Issues*

To provide perspective for our review, we begin with an overview of the types of issues theoretical and empirical research on vouchers must address. These issues are complex, in part because the effect of a voucher program depends on both its design and the institutional and economic setting in which it is introduced. For instance, the effects may depend on the size of the program and also on the alternative: What educational-provision regime would prevail without the voucher program? The "effects" that are of interest are themselves a fundamental issue. What is the social objective?

To introduce these issues, we list some classic claims that frame the voucher controversy—and virtually everything about vouchers remains controversial—without discussing any literature. This listing will begin to illustrate the challenges that research on vouchers faces, and our hope is that the subsequent review will help to clarify what issues remain the most unsettled. We

begin simply by stating some arguments for and against vouchers, essentially as they are commonly expressed.

The arguments in favor of vouchers include:

- Vouchers would lead to market or quasi-market provision of education, with competition among providers and choice by students inducing efficient provision.[3] The alternative of public provision is characterized by weak incentives, both because public providers are politically managed and monopolized, and because the exercise of student choice is limited. Thus, both static and dynamic efficiency would be promoted by vouchers, with gains coming both from private-school advantages and a public-school response.
- Market provision would lead to educational variety, better matching preferences to supply. Diversity would increase with respect to aspects like curricula and teaching methodology, an improvement over the excessive homogeneity associated with monopolized public provision.
- While there might be concerns regarding externalities from educational attainment (for example, a modern democratic society requires citizens to be literate in a common language), restrictions on private providers could address these. Similarly, the level of the voucher would address capital market failures affecting educational investment.[4]
- By decoupling residence and school choice, vouchers would increase access to quality education, especially for students at the low end of the socioeconomic ladder. Stratified educational provision

wherein quality rises with socioeconomic status would be reduced. In short, vouchers would provide both efficiency and equity gains.[5]

The arguments against vouchers include:

- Vouchers would lead to the sorting of students across schools along characteristics like income and ability (such sorting is often referred to as stratification). For example, the private sector might "cream skim" the highest income or most motivated children away from public schools. Teachers would sort as well—the most advantaged students would be taught by the best teachers and the least advantaged by the worst.
- Such sorting would have negative consequences due to peer effects. These would arise directly, for example, if the ability to interact with higher-achieving peers helps students to learn or to acquire useful networks. Peer effects could also reflect indirect mechanisms, e.g., if school oversight of wealthier parents disciplines school administrators and teachers.
- Even if peer effects do not exist, sorting would adversely affect less-advantaged students through informational channels. For example, being at a "bad" school could stigmatize students in the labor market, affecting their incentives to study. Further, sorting might be detrimental if the mixing of students along categories such as race and religion

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[3] In our discussion, we will refer to the student and the student's household as just the "student."

[4] If necessary, this could be supplemented with policies supporting educational loans.

[5] Additionally, a more philosophical argument for vouchers rests on the substitution of student choice for public choice. As noted, the traditional economic version of this argument emphasizes better matching of preferences to educational supply. The noneconomic version of the argument places value on freedom of choice per se, while rejecting the paternalistic alternative. Since the literature we review considers mainly economic outcomes and considerations, we abstract from such issues.

promotes mutual understanding valuable in a diverse society.

- If it is more expensive to educate disadvantaged students, then stratification would impose costs on the public sector. In as much as the public sector continues to serve a segment of students, political support for funding of public schools would be reduced by vouchers, compounding the problem.
- Choice by students who are not well-informed about educational quality could lead to poorer choices than decisions by policy makers. Poor choice could regard the focus of education, as well as the quality.

These "for" and "against" positions make clear that research faces a tall order in understanding the impact of vouchers. For example, a small-scale voucher system might produce no sorting response, and its evaluation will therefore not address concerns related to stratification. Similarly, a scheme that does not generate large-scale entry of new schools may not reveal gains from curricular variety.

The usual arguments also implicitly assume "universal vouchers," which are available to all students. In many cases, including programs in the United States, vouchers are "targeted" to poorer households, meaning available only to students whose household income falls below a threshold. Income targeting of vouchers is intended to provide access to better educational alternatives to students who cannot afford to buy expensive housing in neighborhoods with good public schools or pay tuition to attend a private school. Such targeting would seem to weaken both the "for" and "against" arguments about vouchers, presenting another challenge to research on vouchers. For example, the net aggregate effect of a targeted voucher program could be very different from that of a universal voucher program.

Another crucial design feature of voucher programs regards the extent and character of regulations imposed on schools that accept vouchers. For example, a school that accepts voucher-supported students might or might not be required to accept all applicants, or use an equal-probability lottery when applications exceed slots. Participating schools may or may not be allowed to charge additional tuition and, if allowed, might be regulated with respect to whether they can price discriminate.[6] Any of these traits will influence the type of sorting that vouchers can generate.[7]

Other issues concern not the design of the voucher program but the environment into which it is introduced. For instance, the extent of "take-up" of vouchers and the ease of entry of voucher-supported schools will vary with the population's density and preferences. In addition, the initial public provision regime may or may not already provide a degree of choice and sorting. For example, magnet public schools might exist or ability tracking might be practiced in the public sector. The baseline equilibrium may or may not have substantial Tiebout (1956) sorting by income and preference for education. Private schools might already attract a substantial number of students.

The thematic message is that it is an oversimplification to view research on vouchers as a simple test of market versus nonmarket provision of education. Nonmarket provision of education is anything but uniform, and a voucher program need not correspond to a pure market substitute.

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[6] Of course, admission and tuition restrictions are closely intertwined: requiring a school to admit all voucher applicants but letting it discriminate in tuition can render the former restriction moot.

[7] Sufficient regulation on voucher-supported providers, such that providers are essentially public, would violate our definition of a voucher program, though the threshold of regulations is blurry.

3. *Voucher Programs*

This section describes the characteristics of existing voucher programs in a total of eight countries. Given space constraints, our aim is not to do full justice to the details of these complex programs, but rather to provide the reader with useful background and references that will be relevant in our review of the empirical literature.

As stated, we make a distinction between *small-scale* and *large-scale* voucher programs. This will be relevant in our review of the empirical literature, since each type of program has analytic advantages and disadvantages for conducting research. We classify voucher programs as small scale when voucher eligibility is restricted geographically to only part of an education market (e.g., only the central-city school district in a metropolitan area) or vouchers are targeted based on individual characteristics (e.g., only low-income children are eligible) or based on school performance (e.g., only students in underperforming schools are eligible). Conversely, large-scale programs are those in which the distribution of vouchers is largely unrestricted within the education market—all children in a country are eligible. A large-scale program need not, in principle, be a nationwide program (e.g., a voucher available to all students in the New York metropolitan area would be a large program). In practice, however, all large-scale programs are nationwide.

3.1 *Small-Scale Programs*

We begin by describing the small-scale programs in the United States, the country that has produced the greatest number. This section also describes small-scale programs in Colombia and India.

3.1.1 *United States*

The United States has a highly decentralized education system in which states and districts have significant control over local schools. This has produced a large number of small-scale voucher programs—about sixty-five, by an admittedly rough count. We do not discuss each in detail; rather we summarize the characteristics of three types of programs that vary according to how vouchers are funded:

- *Programs funded by tax revenues*. We summarize the characteristics of nine in this category, providing additional detail on the largest and oldest, which operate in Milwaukee, Wisconsin.
- *Programs funded via tax credits*. We summarize the traits of seven in this group, elaborating briefly on the largest, operating in Florida.
- *Programs funded by private foundations*. We summarize the typical characteristics of about fifty in this class, highlighting those operated by the Children's Scholarship Fund (CSF).

Distinguishing US programs by their source of funding is for convenience. Nothing suggests that the source of funding per se will influence program effects, though some program characteristics tend to vary by funding source, as we discuss. We also provide further detail on some programs in our discussion of the empirical research in section 5.[8]

Tax-Revenue-Funded Programs.—Table 1 provides a summary of the main tax-funded

[8]These three categories do not include all small-scale voucher-type public programs. Specifically, since the 1800s, Maine and Vermont have had programs that give students in sparsely populated areas an alternative to public provision. Students can use vouchers to attend a nonreligious private school. In Vermont, for example, the voucher is for the lesser of average public schooling costs or tuition. In 2001–02 there were 90 "tuitioning towns" as they are called, with 7,147 students participating. There are also programs that target special-needs students that, in the interest of space, we do not discuss here.

TABLE 1
PUBLICLY FUNDED US VOUCHER PROGRAMS

	Milwaukee	Racine	Florida	Cleveland	Douglas, CO	Ohio	Indiana	New Orleans	Washington, DC
Targeting	Below 300% poverty	Below 300% poverty 2013–	Failing school	Open to all, priority to low income	All students	Underperforming public	Below 150% poverty or failing school	Below 250% of poverty	Below 300% poverty or on food stamps
Admission to oversubscribed pvt schools	Lottery	Lottery	Lottery	Lottery	Lottery	Pvt school admission criteria	Pvt school admission criteria	Pvt school admission criteria	Pvt school admission criteria
Years of program	1990–	2011–	1999–2006	1995–	2013–	2005–	2011–	2008–	2004–
Enrollment	24,027 in 2012	520 in 2012	3,649 in 2012	6,300 in 2009	494 in 2011 (cap 500)	12,685 in 2009	3,919 in 2011	8,000 2013	3,105 in 2012
Funding per student	$6,442 in 2012/13	$6,442 in 2013/14	K–8: $4,250; HS: $5,000	K–8: $4,250; HS: $5,000	$4,600 in 2011/12	K–8: $4,250; HS: $5,000	$4,700 for K–8, HS slightly higher	$7,617 maximum in 2011/12	K–8: $8,256; HS: $12,385 in 2013
Transportation provided	Some, not routinely	Some, not routinely	Yes if voucher school in student's district	Yes		Yes	Up to school	No	Voucher can be used to pay for metro/bus
Number of participating private schools	112 in 2012	13 in 2013	32 in 2012	35 in 2012	23 in 2013	305 in 2009	280 in 2013	about 130	52 in 2012
Can tuition supplement be required?	K–8: No. HS: Yes above 220% poverty	K–8: No. HS: Yes above 220% poverty	K–8: No. HS: Yes above 200% poverty	K–8: No. HS: Yes above 200% poverty	Yes	Yes, above 200% poverty	Yes	No	Yes
Can vouchers be used at religious schools?	Yes since 1998	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Same achievement exams as in public schools?	Yes beginning 2006	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

voucher programs in the United States.[9] All of these programs apply for grades K–12, and almost all are targeted to students in low-income households or schools designated as underperforming. Programs vary in age, ranging from Milwaukee, which started in 1990, to New Orleans, which started in 2008. Programs also vary substantially in the number of students receiving vouchers. Several programs require that oversubscribed voucher schools choose students by lottery. Others permit private schools to apply the same admission criteria for voucher as for non-voucher students. Funding per student varies across programs, but most provide sufficient resources to attract participation of a substantial number of private schools. Vouchers may be used in religious schools in all of these programs. All now require that voucher recipients take the same standardized examinations as public school students. While not detailed in the table, all programs require participating schools to meet curricular and other criteria. Some programs (e.g., Milwaukee) require schools to be pre-accredited by an approved national agency; some (e.g., Ohio) require that schools obtain a state charter, and others require annual reporting to an oversight body.

Milwaukee is in many respects the most important voucher program in the United States and has served as a model for others; it therefore merits additional discussion. The Milwaukee Parental Choice Program was introduced in 1990 in the Milwaukee school district, targeting K–12 students with household income not exceeding 175 percent of the federal poverty level. At its inception, the program was not available to students attending religious schools. That changed in 1998, with students enrolled in religious schools retaining the right to opt out of religious instruction. The voucher pays the lesser of tuition at a private school and the standard district allocation, $6,442 in 2010. Initially, schools could not charge additional tuition. Beginning in 2011, high schools were permitted to charge additional tuition to eligible students above 220 percent of the poverty line. Transportation is provided by the district if the student is within a set attendance area. Participating private schools set the number of available slots for voucher students, and must accept all students, conducting a lottery if oversubscribed. They must also be accredited by one of several agencies. Private schools must also meet at least one of the following four performance standards:[10] (1) at least 70 percent of voucher-supported students must advance a grade level, (2) frequency of attendance by voucher students must be at least 90 percent, (3) at least 80 percent of program students must demonstrate significant academic progress, or (4) at least 70 percent of voucher-student families must meet parental involvement criteria set by the school.

The income threshold for eligibility has been on an upward trend. It was raised from the initial 175 percent of the federal poverty level to 220 percent in 2005, and 300 percent more recently. This allowed the program's coverage to grow. In 2004 it distributed about 24,000 vouchers, accounting for about 23 percent of total district enrollments. By 2002, 102 private schools were participating, including 26 schools reported as entering as a result of the voucher program (Chudgar, Adamson, and Carnoy 2007).

Tax-Credit-Funded Programs.—We next turn to tax-credit-funded voucher programs,

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[9] Though we discuss programs in the present tense, the Florida program described in table 1, known as the Florida Opportunity Scholarship Program (FOSP), was declared unconstitutional and suspended in 2006.

[10] Wisconsin Administrative Code, chapter PI 35, p. 117.

summarized in table 2.[11] The operation and funding of one of the earliest, the Florida Corporate Income Tax Credit Scholarship Program (FTC), illustrates similarities and differences between these programs and the tax-funded programs summarized in table 1. The FTC was established in 2001 and is financed by corporate contributions, for which donors get a 100 percent corporate income tax credit for contributions that do not exceed 75 percent of their tax liability. Total contributions are capped at 88 million dollars, currently. Vouchers are for free- or reduced-lunch students and the program is administered by approved nonprofit agencies. In 2012, the FTC awarded about 51,000 vouchers to students attending about 1,300 schools. This makes it the largest voucher program in the United States—roughly twice the size of Milwaukee, although relative to a much larger population.

As shown in table 2, the average voucher per student among tax-credit-funded programs was $4,335 in the 2012 school year. Private schools may impose their own admission policies, restricted only by antidiscrimination statutes, and can charge tuition in addition to the voucher, so long as this is their normal policy.

Privately Funded Programs.—Roughly fifty privately funded voucher programs also exist in the United States.[12] The largest

sponsoring organization is the CSF, and a brief description of its operation illustrates key characteristics of this type of program. The CSF received a founding contribution from the Walton Family Foundation and has provided vouchers to low-income students in numerous municipalities including New York City, Charlotte, Dayton, Baltimore, and Washington, DC. In 1999, it received 1.25 million applicants for 40,000 vouchers.

Its Baltimore program is typical. It targets low-income students in grades K–8. In 2008, it distributed vouchers to 490 students attending 70 private schools, 64 of which were religious. The average voucher was $1,759 and the maximum was $2,000. Families are required to pay at least $500 themselves, and their average payment was $2,711. All privately funded programs of which we are aware are similarly targeted, typically by income, and some to racial/ethnic groups. Some also target students that are identified as having high academic potential but limited means.

3.1.2 *Colombia*[13]

Small-scale voucher programs are much less common outside the United States, but Colombia provided a salient, if short-lived, example. Specifically, in 1992 it began operating the PACES secondary-school voucher program.[14] This initiative was launched to increase secondary-school enrollment—the intent was for private participation to help ease public-sector capacity constraints. The vouchers, which were renewable contingent on grade completion, were targeted at entering students who were: (1) residing in

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[11] The tax-credit-funded programs detailed in table 2 are to be distinguished from state income tax credit and deduction programs available to households for educational expenses that currently exist in Arizona, Minnesota, Illinois, and Louisiana. Given restrictions on amounts, eligibility, and state income taxation, these programs have limited effects. For example, the most recently passed program in Louisiana in 2008 allows taxpayers to deduct from the state income tax 50 percent of educational expenses, up to the minimum of $5,000 per child or the total taxable income of the individual. With the maximum marginal income tax of 6 percent in Louisiana, the maximum subsidy to educational expenditure is below $300.

[12] This calculation counts separately programs in different municipalities that are administered by the same organization.

[13] For further reference see King et al. (1997), King et al. (1998), and Angrist et al. (2002), on which this discussion is based.

[14] PACES stands for Programa de Ampliación de Cobertura de la Educación Secundaria—program for increasing secondary school enrollment.

TABLE 2
TAX-CREDIT-FINANCED VOUCHER PROGRAMS

	Florida	Georgia	Indiana	Iowa	Oklahoma	Pennsylvania	Rhode Island
Targeting	Below 230% of poverty level	All public-school students	Below 200% of poverty level or in underperforming public school.	Below 300% of poverty	Below 300% of poverty level or in underperforming public school.	Below $75,000 and in underperforming public school.	Below 250% of poverty level.
Years of program	2001–	2008–	2009–	2006–	2013–	2001–	2006–
Enrollment	51,023 in 2012–13	13,285 in 2011–12	2,890 in 2012–13	10,600 in 2011–12	N/A	45,100 in 2011–12	382 in 2012–13
Funding per student	$4,335 average in 2012–13	$3,388 average in 2011–12	$880 average in 2012–13	$1,031 in 2011–12	Up to $5,000	$990 average in 2011–12	$2,690 average in 2012–13
Number of participating private schools	1,330 in 2012–13	N/A	N/A	154 in 2011–12	N/A	400 in 2012–13	54 in 2012–13
Can tuition supplement be required?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Can vouchers be used at religious private schools?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Same achievement exams as in public schools?	Yes	No	Yes	No	No	No	No

Notes: Tax credits to businesses are generally limited as is the statewide total credit and amount available to provide vouchers to eligible students. Lotteries are then generally used to provide vouchers to applicants. The poverty level for eligibility is generally measured by the federal poverty level.

low-income neighborhoods,[15] (2) attending public school, and (3) accepted at a participating private school.

The initiative was implemented at the municipal level, with the national government covering about 80 percent of its cost and municipalities contributing the remainder. Resource constraints at both governmental levels resulted in excess demand in most jurisdictions. When this happened, the vouchers were generally allocated by lottery.[16]

The voucher covered registration and tuition payments up to a maximum. Specifically, its value increased with schools' fees up to about $150 dollars per year. Angrist et al. (2002) note this was roughly equivalent to the cost of a low-to-mid priced private school, and that it was common for recipients to supplement this amount. At the program's inception, any private school authorized to operate by the Ministry of Education could take vouchers, although more expensive schools generally did not. Starting in 1996, and following well-publicized reports of perceived low quality at specific private schools, participation was restricted to not-for-profit institutions.

By 1995, the year of peak activity, about 90,000 students were using vouchers to attend roughly 1,800 private voucher schools. These students accounted for about 1 percent of all secondary-level enrollments in Colombia (King et al. 1997). Subsequent declines reflected funding constraints that cut both the number of vouchers and their maximum value. The program was discontinued in 1997.

3.1.3 *India*[17]

India provides an interesting example of a small-scale voucher experiment that, like many in the United States, is privately funded. Specifically, in 2008 the Azim Premji Foundation began distributing vouchers in five districts of the state of Andhra Pradesh, focusing on 180 villages that each contained at least one legally operating private school. Baseline tests were conducted at all private and public schools in these villages.

All the test takers in public schools were then invited to apply for vouchers, with the knowledge that these would be allocated randomly. Students and parents were informed that the vouchers would cover all school fees and materials (e.g., textbooks, uniforms, shoes), but not transportation costs. Students in public schools are typically of lower socioeconomic status, and many found this offer attractive.

Private schools were given the option to join the program, with the understanding that the value of the voucher would be paid directly to them and was equivalent to about the 90th percentile of the distribution of all private-school fees in the 180 villages.[18] In joining, private schools had to specify how many slots they would make available for voucher recipients. The main condition placed upon these schools related to non-selection. If space permitted, they would have to admit all voucher winners; if they were oversubscribed, they had to enroll those selected via a lottery run by the funder.

This program featured a unique randomization, which took place in two stages. First, ninety villages were randomly selected to

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[15]Colombia had a scheme by which neighborhoods were classified into six strata depending on income; only children in the two poorest strata were eligible for vouchers.

[16]Angrist et al. (2002) present evidence consistent with these lotteries generating random allocation in the cities of Bogota and Cali, and use this to evaluate PACES, as discussed herein.

[17]This discussion is based on Muralidharan and Sundararaman (2015).

[18]The full voucher amount is paid directly to the school, which is in charge of distributing uniforms, textbooks, and other materials. Muralidharan and Sundararaman (2015) state that this arrangement reflects common practice among private schools in India.

TABLE 3
INTERNATIONAL VOUCHER PROGRAMS

Country	Years in operation	Enrollments in private or independent voucher-funded schools	Restrictions on private/independent schools			
			For-profit operation allowed	Selective admissions allowed	Religious affiliation allowed	Significant tuition charges allowed
Chile	1981–	47%	Yes	Yes	Yes	Yes
Denmark	1855–	12%	No	Yes	Yes	Yes
Holland	1917–	70%	No	Yes	Yes	No
New Zealand	1989–	15%	Yes	Yes	Yes	No
Sweden	early 1990s–	10%	Yes	No	Yes	No

receive vouchers, and ninety remained in a control group. Second, within the ninety treatment villages, about 3,000 households applied for vouchers. About 2,000 were randomly selected to receive them, and about 1,200 of these actually used them. As we will discuss below, this double randomization has analytic advantages.

3.2. *Large-Scale Programs*

We now turn to describing large-scale programs. The fact that they distribute vouchers without targeting implies that these have the potential to have a greater effect on educational markets, although this impact ultimately depends on their design and the context into which they are introduced. Table 3 summarizes five cases we consider, highlighting variation in the percentage of enrollments at independent schools and whether these schools can operate for profit, implement selective admissions policies, have a religious affiliation, and charge tuition above the voucher. The remainder of this section discusses these on a case-by-case basis.

3.2.1 *Chile*[19]

In 1981, Chile introduced a universal voucher scheme. Prior to this reform, three types of schools were in operation: (1) public schools were managed by the national Ministry of Education and accounted for about 80 percent of enrollments; (2) unsubsidized private schools catered to upper-income households, and accounted for about 6 percent of enrollments; and (3) subsidized private schools did not charge tuition, received limited lump-sum subsidies, were often Catholic, and accounted for roughly 14 percent of enrollments.

The 1981 reform had two main components. First, it transferred public-school management to municipalities, simultaneously awarding them a per-student subsidy sufficient to cover their costs. Second, subsidized (or "voucher") private schools began to receive exactly the same per-student subsidy

[19] For further background see Gauri (1998), McEwan and Carnoy (2000), Mizala and Romaguera (2000), Hsieh and Urquiola (2006), and Mizala and Urquiola (2013).

as municipal schools. These changes resulted in substantial private-school entry. By 2009, about 57 percent of all students attended private schools, with voucher schools alone accounting for about 50 percent.[20]

Chile's scheme imposes few restrictions on private schools. These can receive voucher subsidies regardless of their religious status and operate for profit. They are allowed to implement admissions policies subject to few restrictions and, as of 1994, can charge tuition add-ons.[21] The latter are capped at about four times the voucher payment, but this constraint rarely binds.[22] Public schools operate under more restrictions. They are not allowed to turn away students unless oversubscribed, and cannot charge tuition at the primary level. All schools must implement elements of a national curriculum and participate in annual standardized exams, the results of which have been public since the 1990s.[23]

Recent years have seen further reforms. Since 1997, schools charging tuition add-ons are required to provide exemptions on these for a percentage of low-income students. In 2008, the flat voucher became differentiated: it was increased for low-income students. However, not all schools receive these additional subsidies, as they have to comply with a number of conditions to receive them.

Even further significant reforms to the voucher system are under active discussion, in part in reaction to persistent student protests. The current Bachelet administration has submitted to congress a proposal with three main ingredients: (1) the elimination of tuition top-ups, (2) the end of the ability of private voucher schools to operate for profit, and (3) the introduction of a significant reduction of the ability of private schools to select students. The proposals are still under discussion, and the details of implementation remain to be seen.

3.2.2 *Denmark*[24]

Denmark has a long tradition of subsidizing independent schools. Since the Free School Act of 1855, it has allowed parents and organizations to set up independent schools to which any child can apply, and which are allowed to have religious affiliations. Historically, these schools were funded through a scheme by which the State reimbursed a large portion of their expenses.

In 1992, this system was replaced with one that provides independent schools with a grant based on the number of pupils enrolled by a certain date. Public schools continue to be financed by a combination of national and local government allocations; they do not receive per-student payments.

The voucher-type payment for independent schools is indexed to expenditures in public schools and varies with two factors: school size (with higher payments for smaller schools, to account for economies of scale) and the age distribution of students and teachers. These payments cover only about 80 percent of average educational costs, and independent schools are therefore allowed to charge tuition (low-income households can apply for waivers) or seek external grants to cover the remainder. Despite this, total per-pupil expenditures are slightly lower in

[20] The "elite" unsubsidized private schools continued to account for about 6 percent of enrollments.

[21] Over the years, education-related legislation often mentions that private schools should not select students. The anecdotal evidence indicates that this rarely binds—for instance no admissions lotteries are required. We return to this issue below.

[22] Most of the "elite" unsubsidized private schools could take vouchers but choose not to; see Urquiola and Verhoogen (2009).

[23] These tests have been used for purposes of accountability and targeting. For instance, Chay, McEwan, and Urquiola (2005) consider a program that targeted the 900 worst-performing schools in the country.

[24] For further discussion see Justesen (2002), on which this discussion is based.

the independent-school sector.[25] By 2005 independent schools accounted for about 12 percent of enrollments. They operate subject to nationwide collective agreements with teachers, and to basic curricular requirements that leave them relatively broad pedagogical autonomy.

3.2.3 *Holland*[26]

The Dutch 1848 constitution allows for churches, foundations, and parental associations to set up independent school boards that operate schools to which any child can apply. The 1917 constitution further includes commitments of equal financial support for public and independent schools. While both types of schools receive funds for infrastructure, a substantial part of schools' support is in the form of a per-pupil grant, with greater payments when they enroll children of low socioeconomic status.

While this system was initially set up to allow for transfers to Catholic and Protestant schools, at present it also covers schools with other religious affiliations. Nevertheless, a majority of independent schools still identify as Protestant or Catholic, with enrollment shares of 27 and 29 percent, respectively. The public sector's share is 35 percent, with the remaining 9 percent of children in schools of other types. Independent schools must be run on a not-for-profit basis and "top-up" tuition charges are not allowed. In addition, these schools must implement at least parts of a core national curriculum, participate in national standardized exams, and comply with regulations regarding aspects like class size, teacher qualifications, and minimum enrollments. Private schools implement selection policies and may deny admission for various reasons, including religious affiliation.

3.2.4 *New Zealand*[27]

In 1989, New Zealand implemented a decentralization initiative transferring control of each public school from a national department of education to a "Board of Trustees"—largely consisting of parents—elected locally. In 1991, this system was extended by granting per-pupil funding to all schools, including independent and "integrated" institutions. The latter are schools which, while being institutionally independent, had been affiliated with the public system since the 1970s; most, though not all, have a religious affiliation. At present, the enrollment shares of public, integrated, and independent schools are 85, 11, and 4 percent respectively.

These arrangements put in place a key ingredient of a voucher system—schools that attract more students receive greater funding. That said, they depart from the textbook voucher in some ways. First, not all schools receive the same per-student funding. Public schools receive subsidies for teacher salaries, operational costs, and capital expenses; integrated schools are only compensated for teacher salaries and operational costs; and independent schools receive only a portion of the per-student payments awarded to integrated schools (the percentage has fluctuated around 30 percent over the years). Second, public and integrated schools do not have control over teacher pay; pay scales are centrally determined for all but the independent schools.

In addition, while public schools may supplement their central subsidies via fundraising activities and donations, they are not allowed to charge mandatory fees. Integrated schools are allowed to collect donations and

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[25] Justesen (2002) indicates that in the aggregate, 77 percent of independent schools' resources come from voucher-type payments, 18 percent from user fees, and the remaining 5 percent from other external sources.

[26] For further reference, see Justesen (2002), Patrinos (2002), and Levin (2004), on which this discussion is based.

[27] This description is based on Ladd and Fiske (2001); Adams (2009); and Lubienski, Lee, and Gordon (2013).

charge compulsory "attendance dues" to meet capital costs. Independent schools can charge fees.

The 1991 legislation allowed all schools wide latitude in setting up admissions procedures. For example, admissions policies could specify a catchment area, sibling preferences, and the use of parental interviews. Lubienski, Lee, and Gordon (2013) point out that some restrictions on selection were implemented in the 1990s. These mainly related to transparency in stating the selection criteria and the specification of catchment areas (there had been objections around the fact that children living very close to a given school might not gain access to it). Nevertheless, schools retain wide latitude in selecting students.

3.2.5 *Sweden*[28]

Prior to the early 1990s, almost all Swedish children (about 99 percent) attended municipal schools. While controlled by local jurisdictions, municipal schools were funded by earmarked transfers originating in the national government, which also directly hired teachers. Beginning in 1991, these arrangements underwent reforms that had four main components. First, the government turned the earmarked funds into largely lump-sum subsidies, with municipalities gaining latitude in financial management. Second, municipalities became teachers' official employers, obtaining the ability to negotiate pay and terminate employment. Through 1996, however, the national government largely fixed teacher pay as a function of credentials and experience (Hensvik 2012). Beginning in 1996, salaries were determined by negotiation at the local level. Although these negotiations allowed for greater pay differentials, their

outcomes continued to be constrained by agreements at the national level.[29] Third, "open enrollment" plans were instituted at the municipal level, such that, in principle, students could attend any school in their jurisdiction; in practice, distance to school continued to be a criterion for admission. Fourth, independent schools were given the right to receive municipal funding as well— the government mandated that municipalities fund them with a per-student payment equivalent to the resources they would have spent themselves. In practice, these payments equal about 80 percent of per-student costs at municipal schools.[30]

Independent schools must be approved by the National Agency for Education. While municipalities can raise objections regarding specific institutions that apply for approval, they do not have veto power. Independent schools may be operated on a for-profit or nonprofit basis, they can be religious or secular, and they can focus on specific ethnic groups or languages. In all cases, however, independent schools must be open to all students—regardless of their municipality of origin, ethnicity, or religion—and they cannot charge tuition beyond the voucher. Further, grades cannot be used as admissions criteria at the compulsory level. Instead, proximity to the school, wait list (first-come, first-served), and sibling presence at a school determine priority. Ability-based admissions are allowed at the secondary level. Top-up funding is not permitted. Ownership of a school is unrestricted, and hence can be religious, for-profit, or nonprofit.

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[28] For further reference see Sandstrom and Bergstrom (2005) and Bohlmark and Lindahl (2007), on which this discussion is based.

[29] There were two five-year agreements between the central government and the teachers' union. The first raised teacher pay by 10 percent over five years and the second, beginning in 2000, by 20 percent. Hence, local negotiations were constrained by minimum-pay requirements set at the national level.

[30] Further, if a student crosses municipal lines, the locality losing him has to make a similar transfer to the municipality that accommodates the student.

Bohlmark and Lindahl (2012) point out that there was relatively little voucher school entry through 1998; at that point, the independent-school share began to grow. By 2004, the independent-school enrollment rate reached 10 percent for high schools and 6 percent for primary and lower secondary. By 2009, independent schools accounted for roughly 10 percent of all students. The reasons for the relative lack of voucher school entry for the first several years are unclear. These could include anything from a lack of information or risk aversion on the part of parents, to the fact that the 1996 relaxation of centralized wage setting might have allowed independent schools to compete more effectively.

4. *Theory*

In this review, our primary emphasis is on empirical research (a comprehensive review of theoretical and computational research is provided by Epple and Romano 2012). Nonetheless, this section provides a brief summary of the theoretical literature with an emphasis on empirical and policy implications.

The case for a market-based educational voucher was laid out by Milton Friedman (1962), who provided a vision for voucher design and an enumeration of the benefits that he foresaw from voucher adoption. He supported public funding of education on the grounds that such funding was warranted by the social externalities flowing from an educated population and due to borrowing constraints, but argued that public funding need not imply public provision. He envisioned a system in which parents could choose a school for their child with public funding going to the chosen school. The role of government would be to provide funding while "… insuring that schools meet certain minimum standards, such as inclusion of minimum common content in programs…"

(p. 89). Implicit in this government role would be assurance that voucher funds be spent on education. Friedman argued that competition for students would induce schools to operate efficiently and reward quality teaching, with effective schools establishing good reputations. The poor would have educational choices not bound by the residence restrictions embodied in neighborhood public school systems. In Friedman's view, the education environment was not sufficiently different from other market settings to interfere significantly with effective functioning of such a marketplace for education.

More recent research has modeled educational vouchers taking account of distinctive features of the education environment. Table 4 provides a summary of the characteristics of models that we discuss in this section. The delineation of model characteristics in table 4 is imperfect and does not, of course, fully describe differences across papers. For example, the table indicates whether the vouchers that are studied are targeted, but does not indicate the type of targeting, which varies in important ways across studies. Likewise, there are important differences in what makes public schools heterogeneous in the models that have such differentiation. In the discussion below, these modelling differences are highlighted. In reviewing this recent literature, we make reference to how it helps to address the five fundamental questions on vouchers that we set out in section 1.

A central theme that emerges is that the answers to these questions depend on voucher design. Regarding question 2, virtually all theoretical analyses predict that a laissez-faire design will induce "cream skimming," with the associated implication for question 1 that some students will gain more than others; and some will be made worse off unless the effects on public-school performance (question 3) are substantial.

TABLE 4
CHARACTERISTICS OF THEORETICAL MODELS OF VOUCHERS

Voucher models	Peers affect quality	Public schools			Student differentiation			Vouchers				Private price discriminate	Housing market	Public choice	
		Homogeneous	Heterogeneous	Rent seeking	Income	Aptitude	Imperfectly observed	Universal	Targeted	No topping up	Limit admissions			Public expenditure	Voucher
Manski (1991)	X	X		X	X	X		X							
Epple and Romano (1998)	X	X			X	X		X				X			
Nechyba (1999)	X		X		X	X		X					X	X	
Nechyba (2000)	X		X		X	X			X				X	X	
Nechyba (2003)	X		X		X	X		X	X				X	X	
McMillan (2005)	indirectly	X		X	X			X	X						
Ferreyra (2007)	X	X			X	X		X					X		
Epple and Romano (2008)	X	X			X	X		X	X	X		X			
Macleod and Urquiola (2009)		X				X	X	X			X				
Ferreyra and Liang (2012)	X	X		X	X	X		X	X						
Chakrabarti (2013c)		X		X	X	X		X		X					
Nielson (2013)			X	X	X				X				X		
Chakrabarti (2013d)		X		X	X	X			X		X				
Public-choice models															
Ireland (1990)		X			X			X							
Epple and Romano (1996)		X			X			X						X	
Hoyt and Lee (1998)		X			X			X						X	X
Chen and West (2000)		X			X			X	X					X	X
Fernandez and Rogerson (2003)		X			X			X	X					X	X
Bearse et al. (2009)		X			X				X						X
Epple and Romano (2014)		X			X			X						X	X
Epple, Romano, and Sarpca (2014)		X			X				X					X	X

Theoretical models are often paired with a computational counterpart to quantify magnitudes, distributional effects, and, with respect to question 4, net impacts. As problematic implications of the laissez-faire design have become better understood, research has increasingly emphasized ways in which benefits from voucher-induced competition can be obtained without adverse distributional effects. While the natural focus with regard to question 1 is on educational outcomes, theory has also developed interesting implications regarding impacts on residential choice and housing values, and the connection to voucher design. Regarding question 3, theoretical research has identified potential sources of efficiency gains from educational competition, as well as ways that public-school performance might be adversely affected. Failures of voucher proposals at the ballot box have motivated research addressing question 5.

4.1 *The Effects of Vouchers*

The theoretical and computational literature typically begins from a characterization of the educational environment, while taking the existence and characteristics of vouchers as exogenous. The question then is how the introduction of a given voucher program into a school "market" affects school effectiveness, the distribution of outcomes and welfare across students, the distribution of students across schools, tax revenues, public-school expenditures, residences, and property values. In our discussion below, we draw out the predictions of theoretical models, while also noting those that have not yet received empirical testing.

Manski (1992) pioneered this type of approach developing a theoretical and computational model that captures features of the educational environment including: public and private sectors between which students can choose; students differing by household income and motivation, with demand

for educational quality rising with income and motivation; a positive peer externality from highly motivated students; educational quality determined by expenditure per student and peer quality; analysis of alternative public-sector objectives including rent seeking; and zero-profit private schools that set tuition to maximize enrollments with tuition and a voucher spent on educational inputs.[31] Manski uses this setup to assess if vouchers would induce changes that equalized educational opportunity. The simulations and outcomes he considers are numerous, but overall the conclusion is that vouchers are not a "panacea." A key prediction is that, as the voucher level rises, the fraction of highly motivated students in the public schools tends to fall, especially in poor communities. He states that "even in the most favorable case, a systemic choice system would not come close to equalizing educational opportunity across income groups." Thus, Manski's analysis predicts that cream skimming of the sort raised in question 2 will adversely affect less-motivated students.

Epple and Romano (1998) study private- and public-school competition when students vary in ability and household income, and school quality increases with peer ability. Private schools maximize profits and can price discriminate, i.e., charge tuition that varies with student ability and income. Schools have fixed costs, as well as variable costs that are an increasing convex function of enrollment, i.e., cost per student is U-shaped in enrollment. The model gives rise to the following predictions. First, because school quality increases with peer ability, private schools charge lower tuitions (i.e., provide

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[31] While Manski describes students as varying in motivation, we label such variation as "aptitude" in table 4. Many authors describe students as varying in ability, and we have just chosen one term in the table to describe student variation along these lines. Note, too, that Manski considers rent-seeking public schools as we indicate in table 4, but also other objectives.

more financial aid) for high-ability students. Second, higher-income households with low-ability students pay a tuition premium to enable their children to attend high-quality schools. Thus, the school system will have a general tendency towards stratification in two respects. There will be stratification across schools within the private-school sector and there will be stratification between the public and private sectors. Moreover, private schools will be differentiated in quality and will exhibit "diagonal stratification," with each private school having a student body that is a "diagonal slice" in the income–ability plane. The lowest-income and lowest-ability students will attend public schools. Thus, the model predicts that there will be a higher correlation between income and ability in public than in private schools.[32] The model predicts that introduction of a universal (flat-rate) voucher will induce additional private schools to enter, with each entering school being of lower quality than the preceding entrant, and each exhibiting the diagonal-stratification pattern. As the amount of the voucher increases, average peer quality in the public schools is predicted to decline as private entrants "cream skim" higher-income and higher-ability students from the public schools. If a comparatively low voucher is introduced, those switching to private schools will attend a school with higher peer quality than the public-sector school they depart. As the voucher level is increased, however, students who are induced to switch to private school exit a public-school sector whose peer quality has been diminished by cream skimming to a private school with comparatively low peer quality. Thus, regarding questions 1 and 3, the model predicts that there will be high-achieving voucher schools

serving the relatively more able and affluent, lower-achieving voucher schools serving the relatively less able and affluent, and a public-school sector with lower achievement still. Epple and Romano (2008) extend this setup to show that these properties persist when school quality depends on expenditure per student in addition to peer quality.[33]

Could all students nonetheless have improved educational outcomes with the voucher? If private schools have an educational approach that is sufficiently superior to that of the public schools they supplant, and if the remaining public schools are induced by competition to adopt a superior delivery approach, all students might have higher achievement than in the no-voucher equilibrium. Computational analysis calibrated to the US context suggests, however, that some students will benefit from the voucher—the comparatively more able and affluent—while others—the comparatively less able and affluent—will be hurt. Regarding question 4, the effect on normed aggregate achievement (equal to future earnings) may be positive or negative depending on the extent to which private-school education delivery is more effective than preexisting public schools, and the extent to which public schools upgrade delivery in response to competition. In summary, the model yields unambiguous predictions about stratification, private-school pricing, and relative achievement across the predicted school hierarchy, while predicted aggregate effects depend on the impact of vouchers on educational effectiveness. It

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[32]These and other predictions of the model are tested in Epple, Figlio, and Romano (2004) and are found to be supported by the data.

[33]One additional finding is that low-quality "bottom feeder" schools may enter when vouchers are available, providing financial aid "kickbacks" to induce low-income households to choose low-quality schools. It is shown that this can be prevented by a mandate that the voucher be spent on education. Theoretical models have generally assumed that kickbacks are not allowed. The incentive to kickback monies to poor students raises the related question as to whether vouchers would lead schools to provide noneducational goods to students as a way around a requirement to spend all of a voucher on education.

bears emphasis that these predictions are for a universal (flat-rate) voucher design, the Chilean voucher (at least in roughly its first two and a half decades) being perhaps the closest observed counterpart.

Epple and Romano (2008) also investigate the implications of voucher design for cream skimming, showing that an ability-targeted and tuition-constrained voucher can preserve efficiency benefits from competition while eliminating cream skimming and providing relatively uniform benefits across the distribution of student income and ability types. The tuition constraint disallows "top-ups" and "kickbacks." Such an ability-targeted design has not been implemented in practice.[34] Voucher designs requiring that oversubscribed schools select by lottery and that all school funds be spent on education, coupled with a prohibition against topping up, may be the nearest operational counterpart. Chakrabarti (2013b) provides a model of such a voucher and tests the sorting predictions, as discussed in section 5.3.[35]

Relative to the design of Epple and Romano (2008), the absence of enhanced voucher funding for low-ability students reduces incentives for schools to seek out and retain less able students.

Nechyba (1999, 2000, 2003) analyzes the effects of voucher programs in multi-district local economies. He develops a rich theoretical and computational model to investigate the effect of several voucher programs under alternative public-school financing schemes. He demonstrates the importance of household mobility and general equilibrium effects in predicting outcomes from large-scale voucher programs. In his 1999 framework, there are multiple local school districts, a fixed stock of heterogeneous housing units, neighborhoods within districts differentiated by housing quality, district-wide homogeneous public schools, perceived education quality that varies with expenditure per student and average peer quality, and peer quality that is correlated with household income. Tuition varies across private schools, but, in contrast to Epple and Romano (1998, 2008), price discrimination is not permitted, implying each private school is specialized to serve one student type. This and the willingness of higher-income households to pay a premium for quality results in stratification by peer ability and income in the private sector. Households simultaneously choose where to live (district and neighborhood), whether to send their child to public or private school, and vote for a district-wide property tax used to finance public schools. Nechyba conducts policy analysis in a computational

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[34] In related work, Eden (1994) examines efficient voucher policy in a model with peer effects within schools and an achievement externality to society. Education is a pure investment good and capital markets are (implicitly) perfect. He shows that an achievement subsidy aligns school and social incentives, and combined with a type-dependent voucher equal to the efficient expenditure plus the student's peer externality cost induces an efficient (zero-profit) equilibrium in which students pay nothing out of pocket.

[35] Chakrabarti (2013b) assumes students differ continuously in income and ability, with demand for school quality increasing in both. School quality is equated to expenditure per student, with a maximum quality. She considers a voucher that, for simplicity, covers the highest-quality cost of education, effectively implying no topping up. Neither can private schools kick back any of the voucher. Private schools have no incentive to base admissions on ability due to an absence of peer effects, as with a voucher that requires equal probability of admission. Private-school slots are, however, limited. While the voucher covers all tuition costs, students face utility costs of applying for a voucher that they may not get, and may face a monetary cost of attendance if, for example, transportation costs are not covered. Chakrabarti shows that there is sorting by ability at the application stage, but there may not be sorting by income. The former is because higher-ability

types value quality by more and there are utility costs of applying. The latter is because tuition is fully covered, utility costs of applying are independent of income, and the potential monetary cost may not be enough to deter application. In contrast, in the enrollment stage, there will likely not be ability sorting but there will be sorting by income. The former is because ability sorting has already occurred, and the latter is because monetary-attendance costs that arise for some will deter take up by some lower-income students.

counterpart calibrated to data for New Jersey. His model predicts that private schools will emerge in poor communities as high-income households take vouchers and relocate to occupy higher-quality housing in such communities. Hence, stratification of income and property values across communities is reduced. Poorer households do not experience improved peer quality in their (public) schools, however, because incumbent somewhat higher-income households opt for private schools or relocate to communities with better public schools. Expenditure per student rises in public schools as long as the voucher is not high enough to induce more than half the population to attend private schools. Hence, public-school quality could increase if this increased spending offsets the decline in public-school peer quality. By allowing mobility and expenditure effects in public schools, Nechyba's analysis predicts more favorable effects of universal vouchers on poor students, relative to Epple and Romano (1998, 2008). On the other hand, by not allowing price discrimination, benefits from vouchers to high-ability students, whether rich or poor, are curtailed.

Nechyba (2000, 2003) extends this framework by studying vouchers targeted to poor individuals and poor districts, as compared to universal vouchers. This is of particular relevance for the US context.[36] He concludes that a small non-means-tested voucher targeted to residents of low-income districts is largely equivalent to a universal voucher that is not targeted, due to household mobility.

Most households taking such vouchers would reside in or move to low-income districts, whether or not targeted to these districts. More generally, for realistic values, vouchers targeted to the poor district will have small effects. Similarly, income-targeted vouchers will have modest effects unless school quality depends largely on child ability. In that case, low-income parents of high-ability children will choose private schools in districts with poor-quality public schools. Milwaukee would appear to be fertile ground for empirical investigation of Nechyba's predictions of the effects of vouchers on household location, but such testing has not been undertaken.

Ferreyra (2007) builds on Nechyba's model introducing both preferences for religious schools and idiosyncratic (randomly drawn) preferences for school types (public, private, secular, religious) and location. She estimates the parameters of the model using data from seven metropolitan areas. She then uses these estimates to simulate the effect of several voucher programs. In particular, Ferreyra examines the differential effects of vouchers depending on whether these can be used at religious schools.[37] She finds that both types of voucher programs increase private-school enrollment and give rise to mobility effects of the type identified by Nechyba. She also finds that a prohibition on the use of vouchers at religious schools results in less private-school enrollment and can shrink religious enrollments as some students take a voucher and switch from religious to secular private schools. Milwaukee's 1998 shift to allowing the use of vouchers at religious schools provides a potentially promising environment for testing these predictions, although, to date such testing has not been undertaken.

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[36] As reported in tables 1 and 2, targeting vouchers to the poor usually characterizes US voucher programs. Targeting to poor districts would be similar to the practice of targeting to poorly performing schools if households need only reside where their designated public school is so labeled to get a voucher, though prior attendance requirements limit this. In addition to differences in the underlying models, the ability targeting analyzed in Epple and Romano (2008) has a normative focus, while targeting forms studied in Nechyba (2000, 2003) are better motivated empirically.

[37] We describe the vouchers in Ferreyra (2007) as universal and nontargeted in table 4, but the variation in whether vouchers can be used at religious schools or not is central to her paper.

Neilson (2013) develops and tests a model with geographically differentiated schools that compete for vouchers that are higher for poorer households. The empirical application is to Chile, as we discuss in section 5.3. Private schools are differentiated by their endogenously chosen quality, as well as by their location. There are no peer effects. Households differ demographically (e.g., in income) and in residence, with idiosyncratic preferences over schools, as well as (estimated) systematic differences in preferences. Locational differences among private schools and idiosyncratic preferences imply market power.[38] Profit-maximizing private schools choose quality below the competitive (zero-profit) level, with the quality reduction increasing in their market power. The quality markdown is greater in poorer areas, where households are estimated to be more price sensitive. As such, vouchers that are higher for poorer households have a greater positive effect on quality. This paper speaks to question 1, with gains to voucher students coming largely from reduction in market power among private providers; but it is also relevant to question 3 on public-sector responses.

In contrast to the research discussed so far, McMillan (2004) is squarely focused on question 3. This paper endogenizes how public schools adjust their effectiveness in response to competition from more effective private schools. In McMillan's framework, households are of two income types, with high-income households willing to pay more than low-income households for school quality. Schools exert effort, which raises their effectiveness but comes at a cost to them. Competition constrains private schools to provide efficient effort. Private schools serving low-income students charge lower tuition and provide lower effort than private schools serving high-income students. The rent-seeking public-school sector will provide one of two quality levels, a high level sufficient to attract both high- and low-income students, or a low level that attracts only low-income students. If the former, high-income students prefer public schools over paying tuition to attend private school; hence the public sector attracts all students. McMillan considers the effect of a universal voucher in the high public-school effort case. The voucher lowers the cost of private-school education, and may induce high-income households to switch to private schools. If this happens, public schools choose to lower effort to the level required to retain only low income students. A voucher could, alternatively, induce public schools to increase effort to retain high-income students. Hence, McMillan provides a mechanism such that, instead of improving public-school effectiveness, voucher-induced private-school competition, and associated income stratification, may have an adverse effect on public-school effectiveness. McMillan's framework thus captures an endogenous peer effect associated with variation in how parents of different income levels are able to induce school effectiveness.

Building on McMillan (2005), Ferreyra and Liang (2012) model imperfect parental and policy maker monitoring of schools' effort choices. Households vary in ability and income, and higher-ability households are more efficient at monitoring their children's learning. Competitive private schools are sufficiently small that no free-rider problem arises in parental monitoring, while free riding prevails in the public sector. They demonstrate that combining vouchers with increased public monitoring of the public sector has the potential to increase everyone's achievement and aggregate welfare.

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[38] Nielson's schools are then differentiated "vertically" by quality and "horizontally" by location and idiosyncratic appeal. Epple et al. (2013) also provide a model of vertical and horizontal school differentiation, applied to colleges.

Chakrabarti (2013c) also develops a model where vouchers could increase or decrease effort of rent-seeking public schools. In her model, students differ continuously in income and ability, with demand for quality increasing in both and school quality depending on school effort and mean ability. Private schools cannot price discriminate as in Nechyba's (1999) model. Universal vouchers induce higher-ability students to exit the public sector, implying students at the margin of attending public school are of lower ability in the voucher regime. Increasing effort and public-school quality has a smaller marginal effect on increasing their attendance. If this is the dominant effect, then public schools worsen as in McMillan (2004).

Motivated by voucher programs like the former Florida program (FOSP), targeted to failing schools, Chakrabarti then contrasts such a voucher with a policy that awards vouchers only if the public school fails to meet a quality standard. She shows that with appropriate setting of the quality standard, such a program will induce increased public-school effort and quality improvement. This is because public schools have a stronger incentive to improve to meet the standard and avert the voucher and loss of students, while students at the margin of attending private schools would always exit with a universal voucher. She goes on to test the model as discussed in section 5.3.

In exploring why sorting might adversely affect students left in the public sector, the above models focus on peer effects.[39] MacLeod and Urquiola (2009, 2012) depart from this by studying informational mechanisms instead. Specifically, they model the combination of educational and labor markets. In a first period, each individual attends school and accumulates skill as a function of

her innate ability, her effort, and her school's value added. In the second period, the individual is employed in a competitive labor market. MacLeod and Urquiola assume that innate ability and effort are not directly observed; employers infer ability from all the available information. A key assumption is that individual innate ability is more accurately assessed by schools than by employers. For example, schools might be better able to administer admissions exams or conduct parental interviews. As a result, employers rationally use an individual's school of origin as a signal of her skill. In turn, students seek to attend schools with good reputations, where a school's reputation is the expected skill of its graduates.

Two key sets of empirical implications emerge. First, "laissez-faire" school systems have a tendency towards stratification by ability. Students in nonselective schools (e.g., the public sector) will be hurt by this stratification; their low ability is revealed to employers by their failure to gain admission to a selective school. Second, the effects of school competition induced by vouchers will depend on design. For example, schemes that restrict schools' ability to select students will maximize effort on the part of students and their willingness to choose schools with the highest value added. Schools, in turn, will be forced to build their reputations on their advantage in value added, as opposed to just their ability to select high-ability students. In contrast, systems that facilitate selection will tend to lower students' study effort and raise the probability that they choose schools based on peer quality rather than value added.

To summarize, MacLeod and Urquiola (2009) show that even in the absence of peer effects, the reputational mechanisms emphasized by Friedman (1962) do not ensure that vouchers will increase the production of skill. The intuition behind this result is twofold. First, the fact that school membership

[39] See Sacerdote (2011) and Epple and Romano (2011) for recent surveys of the literature on educational peer effects.

allows students to convey their innate ability reduces the incentive they face to work hard and do well in school. Second, under some conditions, rational parents will not always prefer the highest value-added schools, and rational schools will not always choose to compete on value added. These implications are consistent, for example, with the well-identified empirical evidence that selective schools only sometimes produce higher learning (e.g., Clark 2010; Abdulkadiroglu, Angrist, and Pathak 2014; Pop-Eleches and Urquiola 2013).

4.2 *Vouchers and Political Economy*

The research reviewed thus far studies implications of vouchers but does not analyze the endogenous public choice of voucher policy, a subject of obvious importance given the poor performance of voucher proposals in referenda in California and Michigan. Ireland (1990) provided the foundation for research on this issue. In his framework, households obtain utility from the education of their children and from the consumption of other goods. Households' demand for educational expenditure is increasing in income. Expenditures on public schools and on a voucher, if any, are funded by a proportional income tax. Ireland investigates how public-school spending is impacted by the introduction of a universal voucher smaller than per-student public-school expenditure. The effect may be either an increase or decrease, depending on whether the reduction in outlay for students who switch from public to private school in response to the voucher is sufficient to offset the cost of providing a voucher to students who would attend private school anyway.

Ireland treats the voucher and tax rate as exogenous; subsequent work has sought to model these as chosen by majority rule. This effort encounters two challenges. First, the policy vector has three variables (tax rate, public-school expenditure per pupil, voucher). Invoking the public-sector budget constraint eliminates one of these variables, leaving a two-dimensional choice set and the accompanying challenges for analyzing majority rule set forth by Plott (1967). Second, even if one variable, say the voucher, is exogenous, preferences over the tax rate are not single peaked. Epple and Romano (1996) investigate the second of these issues, considering voting over the tax rate that funds public educational expenditure and the voucher, taking the voucher amount as given.[40] They show that, despite the non-single-peaked preferences, equilibrium under majority rule is likely to exist for realistic parameter values. The equilibrium is of an ends-against-the-middle form, with a coalition of poor and wealthy households, comprising half the population, favoring a reduction in the tax rate and middle-income households, comprising the other half, preferring an increase.[41]

Work to endogenize voucher choice has followed two avenues. One is to consider voting one issue at a time. The other is to limit the choice set in other ways, such as requiring that the voucher equal public expenditure or by considering voucher-only economies. Hoyt and Lee (1998) endogenize both the voucher and tax rate by considering sequential voting with the voucher determined first and then the tax rate second. Employing information on the income distribution in each state, they find that there are some states in which introduction of a $1,000 voucher would permit lowering the tax rate without lowering public expenditure per student.

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[40] See also Glomm and Ravikumar (1998).

[41] In a very similar model, assuming existence of majority-choice equilibrium, Rangazas (1995) identified the trade-offs in the public choice of expenditure in the public school for a given voucher. His computational analysis predicts that a voucher equal to 1.25 percent of a teacher's annual salary would cause per-student public expenditure to increase. Investigation of "ends-against" voting is undertaken by Brunner and Ross (2010).

Chen and West (2000) take the voucher as equal to public-school expenditure per student in their examination of the political economy of income targeting. If vouchers produce some efficiency gains, they find that the targeted regime is likely to be majority preferred both to the no-voucher status quo and to a nontargeted voucher regime.

Another approach, voucher-only economies, is employed by Fernandez and Rogerson (2003) to study vouchers in a dynamic setting in which education spending impacts adult earnings. They consider three alternative voucher programs: a universal flat-rate voucher, a means-tested voucher, and a "means-equalizing" voucher that depends on household income and the amount of income devoted to education. They find that all three alternatives increase utilitarian welfare substantially, relative to the purely private system, and all tend to correct the inefficiency from low investment on the part of poor households.[42]

Bearse et al. (2013) continue the study of income-targeted programs by considering a voucher that is positive for the lowest-income household and declines linearly with income to zero. A sequential voting equilibrium, with the tax rate chosen first, followed by the parameters of the voucher program, is shown to exist. Their computational model shows that, compared to the no-voucher public equilibrium, the means-tested voucher chosen by majority rule benefits the poor via higher education spending and a lower tax rate, while also benefitting wealthy households who prefer private schooling coupled with a low tax rate.

An alternative approach to overcome the Plott existence issue is adopted by Epple and Romano (2014). They analyze simultaneous voting over the tax rate, public-school expenditure per student, and the voucher, exploiting the citizen-candidate model of Besley and Coate (1997). They provide necessary and sufficient conditions for equilibrium, and show computationally that equilibrium exists for realistic parameter values. They also show that a voucher is likely to garner greater political support when income inequality is low. Intuitively, when inequality is low, a relatively small number of households choose private school. A marginal increase in the voucher induces a relatively large exodus from the public schools, permitting an increase in public-school expenditure per student with a lower tax rate, a change that garners unanimous support.

Epple, Romano, and Sarpca (2014) extend this model to include income targeting via simultaneous voting over the tax rate, expenditure per student in public schools, the voucher amount, and the maximum income of households eligible for vouchers. They find that income targeting increases political support for vouchers by limiting their use by high-income households that would use private school even in absence of vouchers, and that a targeted voucher always garners political support. The preference for targeted vouchers conforms to observation, but the finding that a targeted voucher would always garner political support does not. This latter finding brings to the fore limitations of the workhorse Ireland (1990) framework, particularly the assumptions that all households have the same preference function and differ only in income. Evidence on voting by legislators for voucher proposals discussed in section 5, along with differences in opinions evoked by vouchers, point to consideration of ideological differences in preferences as an avenue for extending the Ireland framework. This is being pursued in ongoing research of Epple, Romano, and Sarpca.

[42] Fernandez and Rogerson (2003) note that their three voucher systems can be viewed as analogous to three different systems of state grants to local districts (foundation, means tested, and power equalizing). Hence, their analysis can alternatively be viewed as informing the political economy of public-school finance.

To summarize the research on the political economy of vouchers, two prominent themes emerge. One is that the majority of voters, those who do not choose private school in the absence of vouchers, will benefit by targeting vouchers so as to prevent take-up by those who would attend private school anyway. The other is that a voucher offering less than per-student expenditure in public school will generally be preferred by those who would continue to attend public school. Such a partial voucher induces some households to switch to private school, and this yields a net tax savings to those attending public school equal to the differential between per-student public spending and the voucher.

5. *The Empirical Evidence*

This section reviews the empirical evidence on each of the five questions raised above. For each, we highlight the methodological challenges that arise and we focus the review on the papers that have most successfully dealt with these challenges. This implies that we discuss some voucher programs more than others, depending on the question at hand.

5.1 Question 1: What effects do vouchers have on the students who use them?—The key challenge in answering this question is establishing credible counterfactuals; e.g., what would the outcomes of voucher winners have been had they not received a voucher? While different types of research attempt to do this, the papers on small-scale voucher programs are the most focused on it and have tackled it with the highest degree of credibility.

This reflects that, in many cases, their setup at least emulates a randomized controlled trial in which subjects are randomly assigned to treatment (voucher) or control (no-voucher) groups. Specifically, some publicly and privately funded voucher programs have been explicitly designed as experiments. In other instances, nonexperimental programs are oversubscribed, and random assignment arises from the use of lotteries to allocate scarce slots. These cases, at least in principle, establish a clear counterfactual—on average the observed and unobserved characteristics of treated and untreated groups should be identical, and therefore simple comparisons of their achievement can reveal the causal effect of vouchers.

One aspect to bear in mind is that in all the programs we discuss, those who are offered a voucher are not required to use it. Hence, a distinction arises between the effects calculated by focusing the comparison on those who have been offered the voucher and those who actually take it up. A comparison of the average outcomes of those offered and not offered the voucher yields an "Intent to Treat" (ITT) estimate. A "Treatment on the Treated" (TOT) estimate adjusts for the proportion of students who take up the voucher—thus providing an approximation to the effect of the treatment on those who received it. Both types of estimates have analytical advantages. For instance, the ITT estimate might provide a reasonable approximation to the effect of implementing a small-scale voucher scheme, since it is always the case that the proportion of students who take up the voucher is less than one.

Finally, in some cases we also review the results of papers that, facing a lack of a (quasi-) experimental counterfactual, seek to establish one by using matching techniques or otherwise attempting to control for observable characteristics. In such cases, one must bear in mind that estimates can still be biased if unobserved student or parental characteristics are correlated with treatment.

To preview the bottom line on question 1, the evidence does not suggest that awarding students a voucher is a systematically reliable

way to improve their educational outcomes. A perhaps surprisingly large proportion of the best-identified studies suggest that winning a voucher has an effect on achievement that is statistically indistinguishable from zero. Moreover, three recent studies find large negative effects on test scores of voucher recipients. This is contrary to what one would expect, for example, if private or independent schools had systematically higher value added. There is, however, recent evidence from two randomized-control studies that point to more favorable effects on attainment. There is also evidence that in some settings, or for some subgroups or specific outcomes, vouchers can have substantial positive effects on those who use them.

A question is, therefore, what accounts for the variation in estimated impacts? The literature offers some tentative and useful clues, but no definitive guidance. This reflects two aspects we will be explicit about. First, the best evidence on question 1 comes from very different settings—in this section we review studies on the United States, Colombia, and India—and while all these provide useful evidence, extrapolating is difficult, as these settings vary along multiple dimensions. Second, the experimental studies can provide clear counterfactuals and credibly answer question 1, but they deliver a "reduced-form" answer that does not fully reveal what *mechanisms* account for the effects—a further reason for why extrapolation is difficult.

5.1.1 *The United States*

Wolf et al. (2010a, 2010b) report on the Washington DC Opportunity Scholarship Program, which used an experimental design. Their sample consists of roughly 2,300 students, of whom about 60 percent were offered a voucher, with the rest serving as a control group. Of those offered a voucher, 77 percent made use of it. The authors find no significant impact on test scores after one, two, or four years (a significant effect emerges for reading after three years, but none for math). Overall, there is little evidence that the Washington DC Opportunity Scholarship Program resulted in a sustained improvement on test scores.

In contrast, Wolf et al. (2010a) report that the program had a large and statistically significant impact on graduation rates. After four years, students who were offered a voucher (ITT) were 12 percentage points more likely to graduate than those who were not, with a corresponding TOT effect of 21 percentage points. Exploring heterogeneity in impacts, Wolf et al. find similar effects among students originally in schools designated as "in need of improvement."

The School Choice Scholarship Foundation created three voucher programs—New York City, Dayton, and Washington, DC— that also conform to experimental design. The most intensively studied of these is the one in New York, where in 1997 a lottery was conducted among approximately 11,000 applicants (Peterson et al. 2003). None of these experiments yield significant test score effects for non–African American students. Nonetheless, Mayer et al. (2002) find the program increased the test scores of African American students in New York by about 6 percentile points (ITT). Krueger and Zhu (2004) show, however, that this finding is sensitive to how ethnicity is coded, as well as to how one handles students with missing baseline scores.[43] In Washington, Peterson et al. (2003) find significant effects for African American students at the end of two years of treatment, but these vanish by the third. In Dayton, they find that African Americans had a 4 percentile point advantage at the end of two years (significant at the 10 percent level). Overall, this group of experiments suggests some—albeit not very robust—indication of test score effects for

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[43] On this issue see also Barnard et al. (2003), Krueger and Zhu (2003), and Peterson and Howell (2004a, 2004b).

African American students, and none for the rest.

As in the DC Opportunity Scholarship Program, however, these experiments produced better results in terms of graduation rates, at least for African American students. Specifically, Chingos and Peterson (2015) study college enrollment as another outcome in New York. At the time of the experiment (late 1990s), participants were in grades K–5. Chingos and Peterson were able to obtain follow-up information on college enrollment for a remarkable 99 percent of the roughly 2,700 students in the original study. They find no significant differences between the treatment and control groups as a whole, but a significant difference for African American students—for those offered a voucher (ITT), the estimated increase in part- and full-time enrollment is 7 percentage points, a 20 percent increase.

The above papers focus on voucher programs that were designed with an explicit experimental setup in mind. This was not the case in Milwaukee, which displays variation in its ability to deliver clear counterfactuals over time. Specifically, in its early years the Milwaukee program featured randomization due to oversubscription, but starting in 1994, increases in the income cap and the incorporation of Catholic schools had the effect of making vouchers generally available to most eligible students without recourse to lotteries.

Rouse (1998) analyzes impacts during both periods.[44] First she exploits randomization, finding little evidence of effects for reading. Her estimates (both ITT and TOT) for mathematics are substantial—statistically significant effects of 0.3 to 0.5 standard deviations over a four-year period. She also follows Witte (1997) in considering a random

sample of public-school students as the comparison group, obtaining similar findings.

Witte et al. (2008, 2009, 2010, 2011, 2012) conduct a five-year study of the effects on voucher recipients (TOT) using a matching strategy. They find no significant effects on test scores in the first, second, and third year of the program. A statistically significant fourth-year gain of 0.15 standard deviations emerges in reading; gains in mathematics are also evident, but are significant only for students in grade seven. Overall, this analysis suggests that during this post-expansion phase, the Milwaukee voucher program had little, if any, effect on test scores. In contrast Cowen et al. (2011) and Cowen et al. (2013) use a matching strategy and find positive impacts on years of schooling, although the results are not entirely robust to different specifications. Beyond potential biases from unobserved characteristics, a concern with these longer-term matching-based estimates emerges from the possible existence of contemporaneous non-voucher-related policies. For instance, starting in 2002 the public reporting of schools' test scores began to be required, and this might have affected schools' performance quite aside from vouchers.

While the studies discussed above find little systematic evidence of positive effects of vouchers on achievement, they do not find significant negative effects. By contrast, Abdulkadiroglu, Pathak, and Walters (2015) (APW henceforth) find large negative test score effects for the Louisiana Scholarship Program (LSP). APW study test scores in 2012–13, the first year following statewide adoption of the Louisiana voucher program, a program that previously had been available only in New Orleans.

APW exploit lottery selection of students to oversubscribed private schools for LSP voucher applicants in third through eighth grades, studying effects on scores in standardized tests of math, science, social studies,

44 See also Witte, Sterr, and Thorn (1995) and Greene, Peterson, and Du (1996).

and English. APW find that 1,412 students who applied to oversubscribed schools were selected by lottery, with subsequent test scores available for upwards of 85 percent of these students. Causal local average treatment effects on math, science, and social studies are -0.413σ, -0.263σ, and -0.331σ respectively, all significant at the 1 percent level. A negative but insignificant effect is found for English.

APW conduct extensive analyses to investigate robustness and possible differences in impacts of the voucher across student income groups and geographic areas. Their findings of negative impacts of vouchers are robust, e.g., with estimation methods accounting for sample attrition, and are found for all income groups and geographic areas. Participating private schools are found to have falling enrollments prior to their participation in LSP, suggesting that the voucher program is attracting schools that are struggling. It will be important to investigate whether these negative effects persist for subsequent years of the LSP, but as APW conclude, "These results suggest caution in the design of voucher systems aimed at expanding school choice for disadvantaged students."

A first indication regarding persistence of negative effects of the LSP emerges from work by Mills and Wolf (2016). These authors use a slightly larger sample of LSP students, and are able to expand the analysis to a second year. Mills and Wolf state that their first-year results largely match those in APW. For the second year, they still find negative effects, although somewhat smaller in magnitude.

Figlio and Karbownik (2016) also find large negative and significant effects on both math and reading scores of voucher recipients in the statewide Ohio "EdChoice Scholarship Program," notably persisting for students through the three years of the study. Voucher-eligible students have their designated public school deemed to be low performing, but must also be accepted by a participating private school. Mathematics scores decline each year by around -0.5σ and reading by around -0.3σ, estimates that are very robust to alternative specifications. Because participating private schools can select students, propensity score matching is employed for identification. Specifically, voucher takers in barely eligible schools are matched on observables to ineligible students in public schools that barely exceeded low performance. As the authors discuss, this sharp identification limits the treated students to 445, implying that effects on voucher takers in the worst public schools might differ.

Why students in these studies elect to attend private school where they perform relatively poorly on tests is an important and open research question. Students may have alternative goals, e.g., religious study, or may be making mistakes. It is notable that expenditure per student in the attended private schools is generally lower than in their public alternatives.

Overall, the evidence on the United States finds not very robust effects on test scores, most frequently nonexistent, some positive effects on blacks, but also the just-discussed large negative effects. More robust evidence has accumulated regarding positive impacts on graduation probabilities, particularly for black students.

5.1.2 *Colombia*

Colombia yields perhaps the most positive evidence that emerges from (quasi-)experimental work on question 1. Specifically, Angrist et al. (2002) exploit voucher lotteries implemented in the cities of Bogotá and Cali. In terms of test scores, their key finding is that three years after the allocation, voucher winners scored 0.2 standard deviations higher on achievement tests. Using a similar design, Angrist, Bettinger, and Kremer (2006) find that, correcting for

differences in test taking between lottery winners and losers, the program increased high-stakes college admissions test scores also by 0.2 standard deviations. They further find an effect on longer-term outcomes: voucher winners were 15–20 percent more likely to complete secondary school, less likely to work while in school, and less likely to marry or cohabit as teenagers.

In short, the experimental results from Colombia are more positive than those from the United States in every measured dimension. A relevant question is: why are voucher winners in Bogotá and Cali benefiting more consistently than those in New York City or Washington DC? None of the experimental studies reveal the precise channels through which its effects work—the clear identification comes at this cost, to some extent—so it is not possible to answer this question definitively. Nevertheless, the institutional differences between the US and Colombia voucher experiments render some differences more or less likely as potential candidates.

Is it possible that public schools in Colombia are much weaker than in the United States, and so the opportunity to use a private school has a large effect? This may play a role but is unlikely to provide a full explanation, as—somewhat unusually—*both* voucher winners and losers in Colombia tended to enroll in private schools. For example, Angrist et al. (2002) point out that while about 94 percent of lottery winners attended private school in the first year, so did 88 percent of the losers. This partially reflects (section 3.1.2) that a requirement for application was to have been accepted at a private school (the stated goals of the program were related to raising enrollment rates by increasing private participation). Thus, one might reasonably expect the program to be more attractive to students strongly interested in private school anyway.

Is it possible that the positive findings reflect greater resources at the receiving schools? This is a possibility, since winners on average used the voucher to "upgrade" to more expensive institutions—Angrist et al. (2002) report that vouchers "crowded in" educational expenditure to some extent. There is less data on the resource changes that vouchers imply in the United States.

A final possible channel relates to student incentives. In Colombia the vouchers were renewable contingent on grade completion, and thus the program included an incentive component—voucher winners faced a stronger reward for doing well at school. Thus, superior performance could have been due to incentives, rather than to the voucher provision itself.[45]

To summarize, the Colombian experiment suggests that vouchers had a positive effect on tests scores and several other outcomes, but the difficulty in attributing effects to a precise channel makes it difficult to draw precise policy implications.

5.1.3 *India*

Turning to India, Muralidharan and Sundararaman (2015) analyze an experiment in villages of the state of Andhra Pradesh, as described in section 3.1.3. They find that four years after treatment, lottery winners did not have higher test scores than losers in Telugu (the local language), Math, English, Science, and Social Studies; in contrast, there was a positive and significant effect in Hindi. The authors interpret this as an overall positive effect, since private schools achieve higher Hindi results with no disadvantage in the other tests.

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[45] Digging even deeper into mechanisms, the gains in Colombia could have also reflected peer effects. However, Bettinger, Kremer, and Saavedra (2010) suggest that at least for a subgroup of PACES beneficiaries, at least observable peer quality does not seem to account for the results. Specifically, they show that the advantage found in Angrist et al. (2002) persists, even when one considers students who chose to attend vocational schools with typically lower observable peer quality.

Interpreting the effect in Hindi is complicated by the fact that public schools in Andhra Pradesh essentially do not teach Hindi at all. More specifically, Muralidharan and Sundararaman use interesting complementary data to show that the private schools spend much more time teaching Hindi (essentially relative to a base of zero in public schools) and substantially less on the remaining subjects, except for English.[46]

The setting this paper explores also raises interesting contrasts with the US and Colombia cases described above. Importantly, in contrast to Colombia, where voucher winners benefited from greater expenditure, Muralidharan and Sundararaman (2015) point out that private schools in the villages analyzed have expenditures that are only about one-third of those in public schools. This reflects that many private schools in India operate without subsidies, even as they cater to very low-income individuals. This is observed in other settings, including Pakistan and parts of Africa (e.g., Andrabi, Das, and Khwaja 2013); in these areas, private expansion has been observed on a magnitude that in middle- or high-income countries would seem to require significant public subsidies. This might reflect parental willingness to escape a deeply dysfunctional public sector in which there is evidence of rampant absenteeism by teachers; see, for example, Duflo,

Hanna, and Ryan (2012) and Muralidharan and Sundararaman (2011).

Muralidharan and Sundararaman (2015) emphasize that, coupled with the above findings on achievement, the fact that the private schools spend so much less implies a substantial private productivity advantage. They also show that the crux of this cost difference is in teacher salaries—private-school teachers are younger, typically less trained, more often female, and on average make only one-sixth the salary of their public-sector counterparts. In short, private-school students have instructors who are paid much less. On the other hand, in some dimensions private-school students have access to more educational resources. For instance, they enjoy lower class sizes, and the probability that they are in multi-grade classrooms is lower by about 50 percentage points.[47]

In short, private and public schools in Andhra Pradesh are organized very differently, but on net have no testing performance differences except in Hindi, which the public schools do not teach. It is again the case that the myriad of differences in setting provide interesting implications, but complicate extrapolation. Just to cite one example, the voucher schools in Andhra Pradesh, India, on average have lower class sizes than public schools; the opposite is the case in present-day Chile.

To summarize, question 1 is perhaps the most straightforward among those we ask, and yet the above review makes clear that the answer to it is complex. The results are not clear-cut—in many cases and for many outcomes transferring students to private school does little to their achievement; in others, it improves or lowers it substantially. In addition, the most rigorous research on this question typically delivers reduced-form

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[46] The authors further note that not all private schools use Telugu or Hindu as the language of instruction, with some using English instead. While acknowledging that this is an endogenous choice (and hence not a feature of the experimental design), they present suggestive evidence that the choice of English as a medium of instruction disrupts learning. If parents do not realize this is the case, then further regulation of private schools may be warranted. But another possibility is that parents are aware of this but willing to make the sacrifice if, for example, English has high labor-market returns. A broader point the findings around Hindi and English illustrate is that choice is likely to produce more of what parents want that may or may not be skills along the precise dimensions policy makers prefer.

[47] The research in Duflo, Dupas, and Kremer (2011) suggests this might have a large favorable impact on performance.

results. These do not reveal the mechanisms that account for the differences, making it hard to draw clear implications. It is relevant to point out that the evidence—particularly that from the United States—is consistent with vouchers improving some types of skills more than others. For example, it is possible that the positive effects on graduation rates in the United States stem from improvements in noncognitive skills, while the lack of a consistent impact on test scores points to weaker impacts in a cognitive dimension.[48]

5.2 Question 2: Do vouchers induce nonrandom migration from public to private schools, possibly lowering the achievement of students that remain in the public sector?— Another fundamental question on vouchers is whether these lead to sorting. As discussed above, this is the common prediction of theoretical work. However, that work also makes clear that the type of sorting observed will be a function of the rules governing the voucher system.

We begin by considering the evidence on large-scale voucher programs. These are analytically suited to addressing question 2 in that they provide a chance to study situations in which large numbers of students of all types are given a chance to exercise school choice, and in which schools get a chance to enter and exit the market in response.

Yet the evidence from large-scale programs has disadvantages too. Most importantly, almost by definition, very clear identification is difficult to obtain from these programs. They involve the distribution of vouchers to anyone who wishes to use them, and are typically implemented countrywide. Thus, it is very difficult to establish clear counterfactuals regarding what would have happened in the absence of these programs,

and of course randomizing at the country level is not feasible.

5.2.1 *Large-Scale Voucher Programs: Chile and Sweden*

The original design of Chile's voucher scheme allowed private schools ease in setting up admissions policies. These could include features such as admissions exams and parental and student interviews.[49] In addition, since the mid-1990s, schools have been able to charge tuition add-ons. Under such circumstances, models like Epple and Romano (1998) and MacLeod and Urquiola (2009, 2015) suggest that the introduction of vouchers would lead to cream skimming from the public sector, and stratification by income and/or ability within the private sector.

Hsieh and Urquiola (2003, 2006) analyze this by looking at the growth of the private sector across municipalities. They essentially implement a difference-in-differences analysis that asks if stratification measures increased more in markets with greater growth in the private-voucher sector. Again, this is not equivalent to a randomized experiment and biases could arise, for instance, from preexisting trends. Nevertheless, Hsieh and Urquiola find evidence that the voucher-induced growth in the private sector was associated with a "middle class" exodus from public schools consistent with cream skimming; this is robust to the use of candidate instrumental variables for private growth.

McEwan, Urquiola, and Vegas (2008) additionally present a descriptive analysis of sorting in small markets. The idea—one related to an approach used in industrial

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organization—is that fixed costs determine that private voucher schools must be of at least a minimum size in order to break even. This implies that very small markets—say very small towns—will tend be served by public schools only. Larger towns will have private participation. McEwan, Urquiola, and Vegas (2008) focus on the range of towns (by population size) where private entry is first observed, comparing the degree of sorting observed just below the approximate size threshold that determines private entry to that observed just above. This is akin to a "fuzzy" regression discontinuity design, albeit one with limited statistical power. They find that private entry is indeed related to stratification, consistent with the first private-school cream skimming the highest ability/income kids from the public sector.

Finally, a large number of studies point to cross-sectional evidence of high stratification in Chile. For instance, Valenzuela, Bellei, and de los Rios (2010) suggest that Chile displays one of the highest levels of school-level stratification by socioeconomic status in the OECD. In addition, Mizala, Romaguera, and Urquiola (2007) suggest stratification is particularly extensive in the private sector.[50]

In closing the discussion on Chile, it is worth mentioning that there is widespread consensus among observers and policy makers there around the claim that vouchers have facilitated sorting. In addition and as we discuss below, the high degree of stratification in the school sector seems to be a significant contributing factor to student protests that have persisted over a number of years.

Stratification has been less of a focus on the research in Sweden. Speculating, this might reflect that Sweden's voucher design likely promotes sorting less than Chile's. As stated,

independent schools must partially apply a first-come-first-served criterion if oversubscribed, and tuition add-ons are not allowed. Nevertheless, research points to some sorting effects. For instance, Sandstrom and Bergstrom (2005) report that independent-school students are more likely to be immigrants and to have parents with higher income and education (see also Bjorklund et al. 2006). Further, Bohlmark and Lindahl (2007) find that public schools tend to lose students who are second-generation immigrants or whose parents are more highly educated, but find no evidence of sorting by income.

In more recent work that considers effects through 2009, Bohlmark, Holmlund, and Lindahl (2015) find that after accounting for residential sorting, school segregation increased more in municipalities in which school choice became more prevalent (as measured by the number of independent schools in operation). Specifically, segregation in such areas has grown between immigrants and natives, and between children of parents with high/low levels of education. Nevertheless, they conclude that the magnitude of the effect of choice on segregation is relatively low, and that Sweden still ranks as a country with relatively low levels of across-school sorting along such dimensions.

5.2.2 *Small-Scale Voucher Programs*

The literature on small-scale programs has also explored question 2. These programs can be expected to have a different impact on sorting (relative to large-scale programs) due to the fact that they tend to display four features: (1) targeting of low-income students, (2) lotteries in cases of oversubscription, (3) requirements that voucher proceeds be used for educational expenses (i.e., not to provide financial aid), and (4) rules against tuition "top-ups." In addition, in the case of the United States the potential for voucher-induced sorting is set against a

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[50] For other examples of large-scale school market liberalization leading to stratification, see Lucas and Mbiti (2012) for the case of Kenya. For related evidence in the United States, see Urquiola (2005).

backdrop of a public-school system in which parents can sort into school districts or catchment areas (Tiebout 1956). Nevertheless, some scope for cream skimming remains since the more affluent and/or more able among the eligible population may be more likely to apply for or use a voucher.

Turning to the evidence, we begin with the largest voucher system in the United States: Milwaukee's. Chakrabarti (2013b) investigates sorting during its first five years, 1990–94. She finds significant evidence that the probability of applying to the program rises with individual ability, but not with income. Among winners, there is some evidence that the probability of take-up rises with income but not with ability. Given the income targeting of the Milwaukee program during this period, any income stratification with respect to voucher use is limited to variation within the population of low-income students. Hence, the finding of stratification by ability is more salient from the perspective of concerns about cream skimming.

As it has grown, Milwaukee's program has changed in ways that increase the potential for sorting. First, the income eligibility limit was raised to 300 percent of the poverty level. Second, a tuition premium for high-school students with household income more than 220 percent above the poverty limit was allowed.[51] Fleming et al. (2013) analyze sorting in Milwaukee during this more recent period. They compare voucher students to a random sample of Milwaukee

public-school students in school year 2006. They find that voucher students are significantly more likely to be black or Hispanic, English language learners, and female. They also use a matched panel to consider parental characteristics. They find that voucher parents report significantly lower incomes. Their overall education levels are also lower, but there is a somewhat higher college participation rate among them. Perhaps the most salient difference in the matched panel is that a much higher proportion of voucher recipients report being Catholic (29 percent versus 19 percent) and attending religious service at least once a week (62 percent versus 48 percent).

Wolf et al. (2009) investigate the take-up of vouchers in Washington, DC. Of about 1,400 students offered a voucher, 41 percent used it for the full (three-year) period, 34 percent made partial use of it, and 25 percent never used it. Comparing ever-users to never-users, the most prominent difference was that ever-users were only one-third as likely to have a learning or physical disability.[52] There were no significant differences in baseline test scores, family income, or mothers' education. Ever-users were somewhat more likely to be African American, less likely to be Hispanic, and somewhat less likely to be male.

There is less evidence on the effects of tax-credit-funded vouchers on sorting. An exception is work by Figlio, Hart, and Metzger (2010), who study the FTC program. They find that, compared to nonparticipants, voucher participants attended lower-performing public schools. Moreover, voucher students were among the lower-performing students in the public schools they had attended. Hart (2014) presents results

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[51] That these two changes would go together is in some sense not surprising—raising the income eligibility limit results in a concurrent increase in political support for permitting private schools to charge a tuition premium to voucher students. When only low-income households are eligible for vouchers, few could afford a tuition premium, making the issue moot. As higher-income households become eligible, more are willing to pay a premium for more costly private schools. The conditions giving rise to political support for permitting tuition premia are thus the same as the conditions likely to give rise to cream skimming, if such premia are permitted.

[52] Similarly Wolf, Witte, and Fleming (2012) estimate that between 7.5 to 14.6 percent of Milwaukee voucher students have disabilities, as compared with 19 percent for Milwaukee public schools.

consistent with this, suggesting that voucher participants tend to come from schools with worse academic performance and higher rates of violence. In addition, they are more likely to exit public schools when they encounter more convenient (e.g., by distance) and varied private-school options. Finally, they are more likely to exit schools with high concentrations of African American students, and the latter holds regardless of the student's own race.

To summarize, the evidence suggests that, perhaps not surprisingly, vouchers can result in the nonrandom reallocation of students across and within sectors. That said, the details of program design clearly matter. For one example from among large-scale programs, Chile's design generally facilitates sorting more than Sweden's.

5.3 Question 3: Do voucher programs pressure public schools to become more efficient?—A key reason to introduce competition into any industry is the possibility that it will lead to productivity improvements. Question 3 asks whether vouchers induce these in the public sector, perhaps as its schools attempt to fend off gains on the part of private competitors.

To illustrate the methodological challenges that this question raises, Hsieh and Urquiola (2003) point out that a first-pass answer to it is provided by calculating the difference in average public-school performance before and after the introduction of vouchers. They point out however, that one would ideally want to decompose this change into three effects:

(1) The public sector's change in value added—essentially the object of interest in question 3

(2) A composition effect—for example, vouchers may worsen public-sector performance if they result in higher

ability/income children leaving to private schools, and

(3) A peer effect—for instance, if there is nonrandom sorting the performance of those "left behind" may be affected by no longer interacting with departing students.

While (1) is the object of interest in this case, the presence of (2) and (3) make it very difficult to isolate this effect. Specifically, in order to isolate (1) it would be necessary to control for children's characteristics, some of which may be unobserved. Further, even if one observed all student characteristics, adequately controlling for peer effects is difficult, given that the literature has not produced a consensus on the functional form of such effects, or even on whether a stable functional form exists (Carrell, Sacerdote, and West 2013). A clear prior on the direction of at least some of the effects in (1)–(3) could provide analytical leverage to empirically get a sense of the direction of the others. However, as noted in section 4, theory does not provide unambiguous guidance on any of these.

Hsieh and Urquiola (2003, 2006) present evidence of these difficulties for the case of Chile. For example, they show that public performance *worsened* in municipalities that experienced greater private growth after the introduction of vouchers. They point out that this could be driven purely by composition effects—(2) in the listing above. They therefore call for a focus on how the introduction of vouchers affects *aggregate* performance. This does not solve the challenge posed by (3), but it does control for (2) and potentially comes closer to identifying the effect of vouchers on overall school productivity. We will return to that issue in the context of discussing question 4 (which focuses on aggregate, net effects); for now we review the evidence on question 3, keeping in mind the above challenges.

5.3.1 *The United States*

Hoxby (2003a) studies question 3 in the context of Milwaukee. She measures the intensity with which public schools face competition by the proportion of their students that are eligible for vouchers. In Milwaukee, this measure varies because eligibility for a voucher is dependent on students' income. In this approach, schools with a low proportion of poor students serve as the control group. As an additional control, Hoxby chooses a set of low-income public schools outside of Milwaukee. She finds that more intensively treated public schools have higher rates of productivity growth measured as achievement on a standardized exam, relative to expenditure.

Chakrabarti (2008) extends Hoxby's approach, considering two periods in the Milwaukee voucher system. She designates 1990–97 as Phase I; Phase II consists of years after 1998, roughly when the program experienced changes including the expansion of the proportion of eligible students and religious school eligibility. She uses school-level data, with the proportion of students on free or reduced lunch (FRL) as a measure of the intensity of treatment. As controls, she uses the thirty-three Wisconsin public schools outside Milwaukee that had at least 25 percent of their population eligible for FRL, had a black population of at least 15 percent, and were in locales similar to Milwaukee in 1990. Chakrabarti finds little evidence that the voucher program had effects on public schools in Phase I. By contrast, for Phase II, she finds significant gains on the order of 0.1–0.15 standard deviations; these are statistically significant in reading and language arts, but mostly not in mathematics and science.

Figlio and Hart (2014) study the effect of the FTC on public-school performance. This program is available for students from families with incomes below 185 percent of the poverty line. Their logic is that the competitive impact of voucher availability on public schools will be greatest when public schools have nearby private competitors. They create four measures of private-school proximity, and find that public-school achievement is related to each of these measures significantly, albeit modestly: a one standard-deviation increase in the number of nearby private schools raises achievement by 0.02 to 0.03 standard deviations.

A special feature of the (now canceled) FOSP facilitates identification of program effects, but potentially confounds their interpretation for purposes of analyses related to vouchers. Specifically, in this program Florida schools were graded based on student performance on a series of standardized exams. If a school received an F grade twice within four years, its students became eligible for a voucher. Schools that received one F faced a threat of a voucher, and the performance of students in these schools can then, for example, be compared to that of their peers in schools that received a D grade.

Figlio and Rouse (2006) examine test-score gains in schools receiving one F grade using several strategies including regression discontinuity, with D schools serving as a control group. They find effects on high-stakes mathematics tests (i.e., tests relevant to grading of the schools) of about 0.2σ, larger than effects on low-stakes exams, suggesting nontrivial gains but also some strategic focusing of resources. However, they emphasize and present some evidence suggesting that the gains may be due to the stigma associated with receiving another F grade, rather than to the threat of loss of funding associated with a voucher. In short, the program may confound the effects of vouchers with those of accountability.

Chakrabarti (2013a, 2013d) continues the study of the FOSP program. Using difference-in-differences and regression discontinuity designs, Chakrabarti (2013a)

provides evidence that schools receiving one F focused resources on improving the scores of students predicted to be near the boundary of the threshold of failure, and on preparing for the writing exam, where performance is believed to be more easily improved. She provides some evidence that the voucher threat was important, for example, finding larger effects of receiving an F grade on schools that faced more private-school competition, as in Figlio and Hart (2014). Chakrabarti (2013a) focuses on pure gaming effects of the program by investigating whether schools classify students with an eye to preventing their scores from counting toward the school grade. This analysis again compares F to D schools, and finds significantly increased classification of students as having limited English proficiency. While F schools might have tried to do the same by classifying more students as special education, their test scores also excluded from the school's grade, the gains from this strategic reclassification would come at the cost of these students then becoming eligible for another Florida voucher program. These schools did not increase such classification. It bears repeating that studies of the FOSP program provide interesting avenues for identification of the program effects, but the challenge of disentangling the accountability and voucher effects weakens implications that can be drawn for the more common accountability-independent voucher programs.

Figlio and Karbownik (2016, FK henceforth) study the competitive impact of the Ohio voucher program, EdChoice, using a regression discontinuity analysis. The idea is to compare performance of students assigned to public schools barely eligible for vouchers to ineligible students in public schools that barely avoided their students being voucher eligible. The estimated impacts are sensitive to functional form. With linear functions on either side of the

voucher eligibility threshold, they find large, significant three-year achievement impacts of voucher eligibility ranging between 0.05σ to 0.1σ, and four-year impacts of similar magnitude. These estimates are robust to including demographic controls and allowing different slopes on the two sides of the eligibility threshold. Analysis of impacts by demographic groups suggests that these estimated gains accrued primarily to white, non-disadvantaged students. Insignificant effects are found with polynomial functions. Hence, while the results with linear functions point to positive competitive impacts, lack of robustness to more flexible functional forms argues for caution.

5.3.2 *Canada*

Chan and McMillan (2009) study the effect on public-school performance from a private-school tax credit in Ontario. This was passed into law on short notice in June 2001, with the credit becoming available in January 2002. The plan provided for a private-school tax credit that was scheduled to grow in increments over five years, but the program was canceled in December 2003, retroactively to January 2003. Using the 2002–03 private-school enrollment share in a public-school attendance zone as their measure of private-school competition, Chan and McMillan find that a 1 standard-deviation increase in competition is associated with a statistically significant 0.1 standard-deviation increase in the percentage of public-school students achieving the provincial performance standard for grade 3.

5.3.3 *Sweden*

Sandstrom and Bergstrom (2005) consider whether students in Swedish public schools perform better if they live in municipalities that have a larger share of independent schools. As stated, such an evaluation confronts difficulties that originate in the non-random sorting that follows private entry, as

well as the endogeneity of this entry. The first of these might be somewhat mitigated, since Swedish independent schools are not allowed to select on ability. Nevertheless, applying to an independent school is still endogenous. Sandstrom and Bergstrom (2005) deal with this by way of a Heckman correction. In order to address the endogeneity of private entry, they use variables approximating whether local authorities are "hostile to independent schools." Specifically, they proxy for these attitudes using measures of the extent to which municipalities contract out responsibilities to the private sector. The identifying assumption is that this attitude will only affect educational outcomes through the channel that municipalities with less hostility will be less likely to block independent-school entry. The key finding is that the presence of independent schools results in better public performance in a GPA-type measure, as well as in standardized mathematics exams and an indicator for whether students passed all three exams necessary for high-school admission.

To summarize, several studies of public-school response to voucher-school competition have measured intensity of competition either by the proportion of a public school's students who are potentially eligible for vouchers, or by the proximity of private-school alternatives. Virtually all of these studies find that public-school achievement increases with the intensity of treatment. That said, most of these analyses do not have an iron-clad strategy to deal with potential biases from composition effects (which section 5.2 suggests could be significant) or with potentially confounding policies such as accountability.[53]

5.4 *Question 4: What is the net effect of vouchers on educational outcomes?*—As

stated above, some studies focus not on questions 1–3, but rather on the net effect of vouchers—question 4. The reason to do this can be stated by summarizing some of the difficulties that arise in answering questions 1–3, and why even ideal answers to these three questions may only give a partial sense of the overall effect of vouchers.

Specifically, as stated, question 1 can be credibly addressed with experiments, but doing so provides only a partial assessment of the impact of vouchers. For instance, to the extent that a private advantage is at least partially due to a peer effect, then this gain will not be independent of the size of the private sector and/or the sorting its growth induces. In other words, the advantage conferred by transferring to a private school may dissipate as the private sector grows and incorporates weaker children. In some scenarios—e.g., if private schools are not more productive and peer effects are linear in means, private expansion may be zero sum (Hsieh and Urquiola 2003).

Further, even a solid answer to question 1 does not provide an assessment of the consequences on the children not using vouchers. Studying questions 2 and 3 begins to provide a sense of this, but immediately raises significant empirical challenges. For instance, if vouchers induce sorting, then it is very hard to empirically isolate their effect on public-school value added.

One alternative in the face of these difficulties—particularly when looking at large-scale programs—is to simply analyze market-level net effects (Hsieh and Urquiola 2003). This does not allow one to isolate the specific channels through which vouchers work, but can provide a sense of their aggregate effect.

5.4.1 *Chile*

One of the more common approaches to addressing question 4 has been to use panel data for multiple local school markets. The

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[53] Figlio and Hart (2014) study the effects of Florida's FTC program before implementation, and therefore avoid sorting-related concerns.

changes in the private sector's reach within these are then compared to the change in average performance. This controls for market-specific fixed characteristics. In this spirit, Hsieh and Urquiola (2006) apply a difference-in-differences approach to municipal-level data for 1982 to 1996, suggesting that while municipalities with greater private growth display clear signs of greater sorting, they display no relative advantage in terms of the evolution of achievement on standardized tests and years of schooling. As with the analyses of the effects of large-scale programs on sorting (question 2), the key source of concern with these estimates—despite the use of some candidate instrumental variables (e.g., population density)—is that private entry into school markets is endogenous. For instance, if outcomes had been declining in areas where the private sector grew more, these effects would underestimate the salutary effects of competition.

Other work implements a cross-sectional variant of this idea by looking for an instrument for the prevalence of voucher schools and evaluating its effect on aggregate performance. Here again, the challenge is finding credible instrumental variables for private enrollment. Auguste and Valenzuela (2006) use distance to a nearby city and find evidence of cream skimming and significant positive effects on achievement. Gallego (2006) uses the density of priests per diocese and finds substantial effects on average achievement.

Another way to consider aggregate effects—the one that takes this logic the furthest—is to simply look at aggregate country performance, particularly in international tests. Hsieh and Urquiola (2003) point out that Chile's performance did not improve in the first twenty years after the voucher reform. Recent experience in this area has been more favorable. After dropping by five and seven points respectively from 1999 to 2003, Chile's 8th grade math and science scores increased substantially—by twenty-nine and forty-eight points respectively from 2003 to 2011. Hanushek, Peterson, and Woessmann (2012) estimate that Chile had the second-highest growth rate among forty-nine countries they studied for this period. Looking at national tests, Neilson (2013) shows evidence of improvement among voucher schools in fourth-grade test scores during 2008–12—this contrasts with stagnant performance between 2003 and 2007. At the same time, this progress seems to have significantly decelerated, depending on the subject tested, as measured by the last PISA tests in 2013.

The literature features another approach to look at the net aggregate effects of choice: structural estimation. Papers that take this route often achieve interesting analytical richness, but also require strong assumptions. Beginning with test scores as an outcome, Neilson (2013) argues that the 2008–12 improvement cited in the previous paragraph is due to a 2008 reform that increased the voucher for low-income students. Specifically, the reform increased the voucher by about 40 percent for the poorest 40 percent of the population, with schools having higher concentrations of low-income students receiving even higher payments. In exchange for this higher subsidy, voucher schools were required to eliminate tuition top-ups for these students, and to refrain from selective admissions. About three-fourths of voucher schools eventually chose to participate.

The paper uses rich data (that includes distance to school) to estimate school-specific quality measures and a random utility model of school choice by heterogeneous households. The results suggest that the targeted voucher: (1) increased average school quality by 0.21σ, (2) increased average voucher-school quality by 0.16σ, and (3) did not affect quality at the non-voucher (elite) private schools. These estimates are then used

to parcel achievement gains between those that result as low-income students switch to higher-quality schools (as tuition drops to zero) and to increases in school quality. The counterfactual with the targeted voucher introduced but with no change in school qualities is simulated to estimate the former effect. The analysis suggests that one-third of the achievement gain is from changes in school choice, and two-thirds is due to school quality improvements. Further research here might consider further whether gains can be explained "simply" by increased school expenditure from the voucher.

This approach addresses very interesting issues, but also requires strong assumptions. For instance, period-specific school quality is measured by regressing test scores on a school fixed effect and a number of controls. This assumes there is no selection on unobservable characteristics; e.g., parental tastes for educational achievement or religious instruction.[54] In addition, the framework assumes that students can attend any school they are willing to travel to and pay for. While consistent with the Chilean legislation, these assumptions would seem at odds with the extensive stratification and heated current discussion over the implementation of more binding mechanisms to stop selection, such as centralized lotteries.

Finally, Bravo, Mukhopadhyay, and Todd (2010) present an evaluation of the attainment and labor market—as opposed to test score—effects of the Chilean voucher regime based on estimation of a structural model of dynamic school and labor-market choices. They use the 2002 and 2004 waves of a large survey of working-aged individuals that includes educational and work history, and

family background characteristics. The identification originates in that individuals vary in the number of years they were exposed to the voucher regime. The parameters of the structural model are estimated using about 100,000 person–year observations. The results are then used to simulate choices and outcomes for those fully exposed to the voucher regime and to compare these to the counterfactual with the voucher program shut down.

The results suggest that the introduction of vouchers led to an increase in earnings from years attending municipal and subsidized private primary schools, but a decrease from years attending secondary schools. The authors note that the secondary-school effects might be explained by entry of less-efficient schools induced by the voucher, and by reduced per-student expenditures noted in section 3. Educational attainment is estimated to be substantially increased by the voucher regime. For example, full exposure to the regime is estimated to increase high-school graduation by 3.6 percent, and completion of at least two years of college by 2.6 percent. Average lifetime earnings are estimated to be unchanged by the voucher. The increased attainment is offset by the lower return to secondary education and delayed entry into the labor force.[55] Earnings variation is reduced by the voucher, as those at the bottom end of the earnings distribution benefit from improved primary education, while those at the top end suffer from weakened secondary schools. The authors find substantial increases in average discounted lifetime utility, approximately 10 percent. These gains arise from the utility of time spent attending school and not working. Gains are found at all percentiles, with

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[54] This is a highly restrictive way of measuring school quality/value added, relative to other recent efforts in the literature, e.g., Abdulkadiroglu, Angrist, and Pathak (2014), Kane and Staiger (2008), and Chetty, Friedman, and Rockoff (2014a, 2014b).

[55] Earning returns to college education are estimated to be relatively low. The model does not allow the voucher regime to directly affect the returns to college education.

larger increases at lower percentiles than higher percentiles.

The paper is ambitious and the findings of large attainment effects, no (average) earnings effects, and substantial lifetime utility gains add new findings on the net effects of vouchers. Identifying the effects of vouchers at different school levels and on different school types is also notable, relative to other approaches. Again, however, the structural approach comes at a cost. First, the identification challenges inherent in a large-scale program are still present. Second, to make the model tractable, individuals are of "just" three types. Related to this, the model has limited potential to provide insight into sorting effects on schooling and labor-market outcomes. For example, might the finding of lower earnings from attending secondary school be a result of sorting (with both municipal and subsidized schools having worse students on average in the voucher regime), whether through composition or peer effects?

5.4.2 *Sweden*

Bohlmark and Lindahl (2008) present an analysis analogous to that of Hsieh and Urquiola (2006)—they ask if outcomes improved by more in municipalities that experienced more extensive independent-school entry. They focus on three types of student outcomes: (1) GPA for the ninth and twelfth grades, (2) participation in higher education (a dummy for having completed at least one year of education within six years of leaving compulsory schooling), and (3) years of schooling eight years after compulsory education. On outcome (1), the results point to a small positive effect on average ninth-grade GPA that does not persist until grade 12; on (2) and (3) there is no evidence of an effect.

Bohlmark and Lindahl (2012) extend this analysis to several additional cohorts, finding significantly more positive conclusions.

Specifically, measures (1)–(3) are found to increase with the independent-school enrollment share. For instance, a 10 percentage-point increase in this share is associated with a 0.08σ increase in language and math scores at the end of ninth grade, and a 0.04σ rise in the fraction of individuals completing at least one semester of university. As stated, these estimates are obtained using data at the municipality level. When observations are aggregated further the results, with respect to test score and grade gains, are robust, while those with respect to college attendance and years of schooling are somewhat less so.

Bohlmark and Lindahl (2012) conclude by discussing the contrast of findings for Sweden relative to Hsieh and Urquiola's (2006) findings for Chile. They observe that the more favorable results for Sweden with respect both to cream skimming and educational outcomes are consistent with the predictions of the reputational model of MacLeod and Urquiola (2009). Namely, the fact that it is harder for independent schools to cream skim may imply that they may seek to build reputations for quality on value added, rather than peer composition; parental school choice may in turn be driven by value added as well.

However, recent work suggests a potential source of caution with respect to the test-score-related results from Sweden. Specifically, while as stated the content of the tests is nationally standardized, they are graded at each school. A concern that had been mentioned in Sweden is that independent schools might grade more leniently; indeed this is something that Bohlmark and Lindahl (2008) themselves mention. This was recently analyzed in a regrading exercise described by Tyrefors, Hinnerich, and Vlachos (2013). Independent graders reexamined exams from different schools. The authors point out that independent schools were more likely to have their grades

lowered upon a second examination.[56] It is possible that the independent schools—perhaps under greater pressure to please parents—engaged in more grade inflation.

Consistent with this, Wondratschek, Edmark, and Frolich (2013) look at other outcomes and find modest to zero effects. Two aspects distinguish their study. First, rather than look at variation in school choice at the municipality level, they use a more finely grained measure calculated using geographical information. Specifically, they suppose that children who lived closer to more (public or private) schools were impacted more by the voucher reform, which allowed them greater choice among nearby schools. Second, they consider both short- and long-term outcomes. They find small effects on test scores from exams graded at school (again, grade inflation may be a concern, although Wondratschek, Edmark, and Frolich (2013) suggest it is not a major one) and military exam scores for men. They find zero effects on longer-term outcomes such as university educational attainment, employment, criminal activity, and health.

Finally, as in Chile, one can undertake the most aggregate analysis by simply looking at the evolution of Sweden's performance in international test scores (with analogous threats to identification). Here the picture is distinctly more negative, as Sweden has seen significantly deteriorating performance in the years since vouchers were implemented. As in Chile, there have been calls for reform, although the details remain under debate.

5.4.3 *Canada*

The aggregate effect of a voucher-like system is also explored by Card, Dooley, and Payne (2010) in Canada. Specifically, they consider the case of Ontario, where two parallel systems coexist. First, non-Catholics are allowed to attend public schools—for this segment the public sector essentially operates a monopoly. Second, Catholics (who account for roughly 40 percent of the population) are allowed to attend a "separate" Catholic school system. If they do so these schools receive the resources that would have otherwise gone to the public sector, emulating a voucher system. In short, Catholics have greater choice and their presence can generate competition between schools.

In particular, the competitive pressure will be greater in a given area to the extent that: (1) Catholics are prevalent in it, and (2) they are willing to switch between sectors. Card, Dooley, and Payne (2010) measure the former simply by the population share of Catholics; they proxy the latter by measuring how willing the eligible population is to switch between systems when a school of a system that previously did not exist opens in a given area. They find that this is more likely to be the case in areas that are growing. A key assumption is that the fraction of Catholics has no direct effect on average test score gains. A further concern is that the entry of the Catholic system into a given area may be endogenous.

Card, Dooley, and Payne (2010) find statistically significant average gains in achievement (in terms of test-score improvement between the third and sixth grades) that are greater in more competitive markets—those that have more Catholics and are growing faster. They describe these as modest; for instance, markets with 60 as opposed to 20 percent of children with choice would have achievement higher by 0.03 to 0.05 standard deviations.

5.4.4 *India*

Finally, as noted in section 3.1.3, the experimental design in Andhra Pradesh was unique and notable in that randomization involved not only students, but also

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[56] This brief synopsis is based on correspondence with the authors, as the article cited is in Swedish. In addition, see the reporting in Fisman (2014).

towns/markets. Specifically, first some towns were selected for distribution of vouchers; second, within the towns selected for treatment, some children were randomly selected to receive the vouchers. This allows Muralidharan and Sundararaman (2015) to go beyond the usual comparison (lottery winners versus lottery losers) and address potential externalities on children who remain in public school. For example, by comparing non-applicants in towns that did not receive vouchers to non-applicants in towns that did, they can get a sense of negative effects on children "left behind" in the public sector. The authors find little if any evidence of such externalities. In short, the gains in performance found in the tests for Hindi may represent true aggregate-level gains.

5.5 *Question 5: What political-economy factors determine the existence and design of voucher programs?*—We close our review of the empirical literature by looking at evidence related to political economy. Brunner, Sonstelie, and Thayer (2001) study voting on the 1993 California voucher proposal using data from 3,786 precincts in Los Angeles County. They take Nechyba (1999) as their point of departure, noting that this model predicts that a voucher would cause house prices to fall (rise) in neighborhoods with high (low) quality schools. The authors use a hedonic equation to estimate the relationship of housing prices and school quality—measuring the latter by scores on standardized tests—to estimate the housing price premium for schooling in each district. This price premium is then included in a regression in which the dependent variable is the proportion of voters supporting the voucher. They find strong support for predictions with respect to housing owners. Holding other variables constant, their estimates imply that the difference in the vote favoring vouchers between districts with a housing premium 15 percent above the average would

be 8 percent lower than in a district with a housing price premium 15 percent below the average.

Brunner and Sonstelie (2003) analyze a 2000 voucher proposal in California. They study opinions on the proposal using data from a statewide opinion poll conducted three months prior to the vote. The poll asked respondents whether they supported the voucher, their perception of quality at their local public school, and their income and demographic characteristics. The authors investigate responses among three groups of home owners: those without children, those with children in public school, and those with children in private school. For owners without children, support for the voucher was inversely related to local public-school quality. This is in keeping with a concern for property values. Households with children in private schools are much more supportive of the voucher, but also at the margin have a larger reduction in support as public-school quality increases. For those with children in public school, voucher support was positively related to public-school quality, though significant at only the 10 percent level. Brunner and Sonstelie note that this finding might emerge if (as Nechyba's analysis predicts) some households with children in public school expect to move to a neighborhood with low-quality public schools (low housing prices), take up the voucher, and send their children to private school. Households with children already in private school who choose nonetheless to live in a neighborhood with a high-quality public school would presumably not relocate in response to the voucher. Hence, results that at first glance seem contradictory can in principle be reconciled.

Brunner and Imazeki (2008) extend the analysis of California voting, arguing that higher-income voters' support for a voucher depends on the extent of choice in local education markets. In markets with many districts, higher-income households can be

expected to have paid a substantial housing price premium to locate in a high-quality district. For such households, a private-school voucher program could adversely affect home values. By contrast, in low-choice markets, high-income households would likely benefit from being able to use vouchers to pay for private schooling. They use block-level voting data from the 2000 ballot initiative (Proposition 38) that would have offered a flat voucher of $4,000 per student in California. They create an index for choice among public schools and estimate regressions in which the dependent variable is a logistic transformation of the fraction of yes votes. The regressions include income, an interaction of income and the choice index, and demographic controls. They predict that income will have a positive coefficient, the interaction of income and the choice index will have a negative coefficient, and the sum of the coefficients will be negative. Their predictions are supported. Moreover, the effects are quite large and are robust to a variety of specification checks, providing evidence that the extent of Tiebout choice impacts voucher support.

Brunner, Imazeki, and Ross (2010) exploit the idea that votes on the California voucher initiative may signal intent to use the voucher. They find that support for the voucher by white households with children increased with the proportion of nonwhite students in their children's schools. No comparable phenomenon was present either for nonwhite households or for households without children. They provide some evidence that households may be responding to correlates of race/ethnicity rather than race/ethnicity per se. For example, voucher support among nonwhite households with children increased with the share of nonwhite students with limited English proficiency.

Kenny (2005) studies support for vouchers, both in referenda and state legislatures. He identifies ten referenda initiatives that,

in some way, provide support for private schools. These include proposals for transportation for private-school students, in addition to a variety of voucher models. All ten referenda were defeated. Kenny then turns to a descriptive assessment of factors that influence whether a voucher proposal is considered by a state legislature, a number of which have been passed or at least supported by one chamber, and factors that raise its probability of success. He concludes that ideology plays a central role, noting that virtually all proposals were in states where the Republican Party controlled the legislature, and among those, the successful proposals were in states with relatively more conservative Republicans. Kenny also finds evidence that voucher proposals focused on big-city districts tend to garner more support.

Kenny (2010) investigates voting on two voucher proposals that have come before the US Congress. One, an amendment to the No Child Left Behind (NCLB) Act, would have allowed federal funds to help children in poorly performing or unsafe public schools attend private schools. The other was to authorize a voucher for Washington, DC. Only four Democrats, found by Kenny to be highly conservative, voted for either. Hence, Kenny again focuses on an empirical description of the determinants of votes by House Republicans. He considers the degree of conservatism of the legislator—based on Americans for Democratic Action (ADA) scores—and characteristics of the legislator's district: percent urban, percent low income, percent black, percent teachers unionized, and percent of private-school attendees. Of these, the ADA score is highly significant in the expected direction. The variation in percent teachers unionized is negatively correlated with voting on the NCLB amendment, but essentially uncorrelated with the position on the Washington, DC vote. Kenny notes this is consistent with teachers' unions exerting more effort to defeat the NCLB

legislation, which would have had impact nationwide. Variation in percent black across districts has a relatively significant positive impact on the NCLB vote, but not on the Washington, DC vote. This may also be consistent with legislators voting in constituents' interest,[57] since constituents would be directly impacted by NCLB legislation but not by the Washington, DC voucher.

We saw in our review of theoretical research on the political economy of vouchers an emphasis on variation in preferences for education spending across the income distribution, and associated financial incentives for support or opposition to vouchers. Kenny's work suggests a greater role for ideology in theoretical modeling of preferences over vouchers. Theoretical analysis of the political economy of vouchers also emphasizes the fiscal incentives for adoption. In particular, that research highlights the potential for reducing school taxes if a voucher less than per-student public-school expenditure induces students to exit to private schools.[58] For example, Brunner and Sonstelie (2003) report that the Legislative Analyst's Office estimates overall fiscal cost of the voucher to be in the range from an increase of $500 million to a decrease of $2.5 billion. Thus far, these fiscal incentives have not been investigated empirically, making this an interesting open issue for research.

[57] Opinion polls regarding vouchers generate considerable debate about the sensitivity of responses to the phrasing of questions. Overall, however, polls on voucher programs tend to find greater support among African Americans than among the overall population. See, for example, responses to questions (16a) through (16c) in http://educationnext.org/files/2014ednextpoll.pdf. Eight surveys of African Americans were conducted between 1996 and 2008 by Bositis (2008). The proportion supporting vouchers exceeded the proportion opposed in the eight surveys, with a majority supporting vouchers in five of the eight.

[58] We noted above that such fiscal gains arise from the Milwaukee voucher, although peculiarities of the financing result in the gains accruing to Wisconsin taxpayers outside of Milwaukee.

6. *Conclusion*

Vouchers have been neither the rousing success imagined by proponents nor the abject failure predicted by opponents. While the evidence does not make a case for wholesale adoption of vouchers, recent theoretical and empirical results suggests a need for—and reasons for cautious optimism about—potential gains from improving voucher design.

In high-income countries, research on the impact of small-scale programs on test scores exhibits no consistent, robust pattern. While the effects are sometimes adverse and sometimes favorable, it is frequently the case that no significant impact is found. The most robust finding is that voucher threats induce public schools to improve. While significant identification challenges arise in this type of analysis, the estimated effects seem to us reliable and large enough to be educationally meaningful and warrant further research. In addition, recent evidence from small-scale experiments in the United States finds substantial gains in years of school for recipients who had not experienced gains in test scores. While potentially due to differential peer composition between public and private schools, the effects are large by the standards of the peer effects literature, and therefore encouraging with respect to the impact of vouchers. Nonetheless, the evidence is from a few programs, and hence still too limited to permit generalizations.

More encouraging results on the effect of small-scale programs come from developing countries. First, there are positive reduced-form findings from Colombia, although questions remain as to whether the central mechanisms that account for these are really due to vouchers. Further interesting evidence comes from India. While vouchers there delivered modest test-score gains, they did so at one-third the cost per student of public schools and with no adverse

distributional effects. Such results have not been mirrored elsewhere, but may have relevance in other developing countries that, like India, have dysfunctional public-school systems (e.g., with severe teacher attendance shortfalls). Other educational reforms are also likely to be effective in such countries, and at some level, interventions that increase achievement might have higher priority than innovations that merely reduce cost. Further, the extent to which cost savings—which come largely from lower pay to untrained (e.g., individuals who may be high-school graduates only), entry-level teachers—can be sustained in the longer term and at higher grade levels remains an open question. On the other hand, the observed results might improve as new teachers gain experience.

The evidence on large-scale programs raises methodological challenges, and very much highlights the importance of voucher design. For instance, analysis of the first two decades of the Chilean voucher provided strong evidence of cream skimming and, at best, mixed evidence of impacts on test scores. These adverse findings—and discontent with the education system more generally—brought and is likely to bring further reforms. Notably, in 2008 the government introduced greater voucher payments targeting lower-income students, and prohibited tuition "top-ups" (charging more than the voucher) for these students at participating schools. Recent research suggests favorable effects from this reform and highlights the desirability of further analysis in this dimension.

Finally, the Chilean case also shows the importance of getting voucher design right. As stated, large protests surrounding the school system have been prevalent over the past years. Michelle Bachelet, who returned to the presidency in 2014, made a salient campaign promise to remove the ability of private voucher schools to operate for profit. The existing research does not speak directly

or definitively to whether this would be productive, but aside from this, these events highlight the desirability of getting design elements right, before popular discontent and political considerations direct voucher design.

In the case of Sweden's large-scale voucher program, early research with respect to effects on test scores likewise found little effect. More recent work features evidence of significant gains, although there are mixed results and concern related to grade inflation among private schools. Recent research also tends to support the finding that voucher competition has improved the performance of public schools, and that the program design has contributed to limiting cream skimming. Like in Chile, however, there is significant discontent with vouchers in Sweden, although perhaps not as widespread. Interestingly, while Chile historically has had low performance in international test scores, it has been improving; in contrast, Sweden historically had high performance and has been declining. This juxtaposition is to some extent arbitrary—for example, Chile's gains may be larger and more relevant than Sweden's decline. The more general point is that aggregate educational performance is the product of complicated processes with significant lags, and methodologically it is difficult to isolate how vouchers affect it.

To summarize, the evidence does not make a case for wholesale adoption of vouchers, but does strongly suggest the desirability of continued experimentation and evaluation. Recent evidence from the United States highlights the attendant challenges. On the one hand, some encouraging positive evidence on graduation and college attendance has emerged along with some additional evidence of competition-induced improvements in public-school performance. On the other hand, some discouragingly large negative achievement effects for voucher recipients have been found. The evidence

also suggests that work originating in a single country or in a single research approach is unlikely to completely answer questions regarding vouchers. Small-scale experiments are appealing in providing strong statistical identification, but do not always isolate mechanisms (e.g., peer effects, differences in expenditure per pupil) and leave open the issue of scalability. Large-scale programs provide scope for assessment of the effects of vouchers in practice, but identification is a greater challenge due to potential selection effects and associated differential peer effects (and, sometimes, to potential confounding effects of contemporaneous policy changes). For research, the ongoing tasks include continuing refinement of identification strategies, investigating longer-term impacts, providing a better understanding of why effects emerge or fail to emerge, and marshaling theory and evidence to improve voucher design.

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