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Introducing School Choice into Multidistrict Public School Systems

Thomas J. Nechyba

5.1 Introduction

School choice is a contentious issue in part because of the lack of agreement on many of the important empirical issues surrounding the policy debate.[1] Evidence regarding the role of such factors as peers and parents, class size and teacher quality, competition and bureaucracy, unionization and curriculum design remains hotly debated, and the impact of increased choice on many of these elements of school quality is still controversial. However, we do have decades of experience with school choice of a kind somewhat different from what is pondered in many choice-based policy proposals, and it is within this current system of school choice that at least some agreement can be found. Although it may therefore be difficult to fully predict the impact of new choice-based initiatives, information arising from the choices made by households in the current system may yield important evidence regarding some neglected empirical issues that are critical for policymakers to consider.

This paper begins by providing evidence regarding one such issue: the linkage between housing and school consumption, and the impact that private schools (and private school vouchers) can have by severing this linkage and thus setting off a series of general equilibrium effects that are quite independent from many of the more controversial issues surrounding

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1. Voucher experiments in the United States are still sparse, with only limited empirical investigations possible (see, for instance, Rouse 1998).

school choice. The intuition behind these results is quite straightforward: In a residence-based public school system, the location of a family's residence directly determines which public school that family's children are eligible to attend. Housing markets are typically such that low-income families may not be able to afford housing in high-quality public school districts, which implies that choice among public schools is greater for some than for others. By bringing choice into low-income school districts, private school vouchers sever the link between school quality and residential location, thus increasing the value of living in poor public school districts and lowering the value of living in wealthy districts. Such voucher proposals therefore tend to benefit lower-income households (through a variety of channels) more than high-income households that are already exercising choice in the present system. The research summarized in this paper provides evidence on the potential magnitude of these benefits as well as the likely channels through which they might emerge under a variety of different assumptions regarding empirical factors that remain controversial.

In addition, the paper proceeds to predict the impact of private school choice on school quality. Whereas results regarding residential segregation are rather unambiguous and robust, implications for school quality are more dependent on the precise underlying assumptions regarding the impact of competition within schools. Results indicate that, under the most pessimistic assumptions, increasing school choice may lead to surprisingly small declines in average public school quality and in the overall level of inequality in the system, whereas it may yield substantial gains under more optimistic assumptions. The first of these results is surprising because previous theoretical and simulation approaches have tended to compare the outcome under private school vouchers to a rather idealized outcome where all public schools provide equal educational quality, and these approaches have arrived at the conclusion that increased private school choice must necessarily lower public school quality and raise inequities in an otherwise equitable public school system.[2] Furthermore, these approaches have tended not to model the political process through which public school spending is determined and have thus ignored potential offsetting public school spending effects as some students leave the public system.[3] The ap-

2. To be fair, the models used to arrive at these analyses were not intended to arrive at predictions of the overall impact of vouchers but rather to demonstrate some of the trade-offs involved (Manski 1992) as well as explore such issues as the efficiency of pricing policies of private schools (Epple and Romano 1998; Caucutt 2001). Furthermore, it should be noted that previous approaches have investigated inequities within the public school system (Fernandez and Rogerson 1996, 1999, for instance) but not in the presence of private school alternatives and/or vouchers.

3. Political economy models have been used extensively to analyze school finance issues (as in, for example, Fernandez and Rogerson 1999) as well as voting on vouchers (Bearse, Glomm, and Ravikumar 2000; Glomm and Ravikumar 1998), but political economy models have not previously been combined with multidistrict models of public school finance, as is done here.

proach taken here differs fundamentally in that it incorporates from the start the very forces that have led to the inequities within the public system and in that it models explicitly an underlying political process within this environment. The approach then exploits the semi-competitive nature of the current public school system (and the resulting observed inequities across school districts) in order to model the structural parameters underlying the decisions made by households. This allows for a calibration of the model that can replicate current features of the data and then come to conclusions about extending competition to private schools in an environment where political and household choices are endogenously determined. It is then possible to compare these predictions to actual rather than idealized prevoucher outcomes.

Section 5.2 provides a basic overview of the methodological approach taken throughout the paper. Although this approach is different from the reduced-form regression analysis typically employed by empirical researchers, it is an approach particularly well suited for the kinds of issues that are central to the school choice debate. Section 5.3 goes on to provide a nontechnical summary of the details of the theoretical assumptions employed in the model, and section 5.4 provides the results from a number of policy simulations under different assumptions. The remainder of the paper considers the empirical justification for the model's key assumptions and the evidence for some of its testable implications (section 5.5) as well as some policy implications arising from the simulation results (section 5.6). Finally, section 5.7 concludes.

5.2 Predicting the Impact of Increased Choice from the Current Choice System

Whereas some have proposed marginal choice-based reforms to the current system, others advocate making choice the central theme around which to reform primary and secondary education. Conventional empirical approaches may be well suited to predicting some of the likely effects of small changes to the system, but one becomes less confident in such predictions as policy reforms get large and affect incentives, actions, and prices throughout the system. Put differently, large and discrete policy changes in an area as central to people's lives as primary and secondary education may change incentives in a way that brings to light forces that are unlikely to be important with small policy changes and impossible to pick up with many of the commonly employed empirical techniques. The approach taken in this paper therefore uses data on outcomes under the current limited-choice system to infer preference and production parameters in a very general model that incorporates forces likely to be important under large-scale reforms. Before that model is presented in section 5.3, section 5.2.1 begins with a brief discussion of how household choices under the current system

lead to observable outcomes; section 5.2.2 then argues that these observable outcomes can be used as the basis of an approach that can analyze the likely impact of large policy changes; and section 5.2.3 arrives at some of the basic features that must be modeled in order to implement this approach.

5.2.1 Choice under the Current System Leads to Observable Outcomes

Choice has been a pervasive feature of school systems in most U.S. states for the past half century. Parents can participate in the local political process that shapes their schools, and they can choose among tens of thousands of school districts or neighborhood school areas in which to reside. At least in principle, choice among many public schools is therefore pervasive. Elite private schools as well as more common parochial schools offer additional options for those unhappy with the public system, and choice is clearly being exercised. Approximately 12 percent of U.S. schoolchildren attend private schools; a small but growing number are homeschooled; and, most significantly, many of those households that remain within the public system consider public school quality carefully when choosing where to purchase or rent a home. Real estate agents typically come armed with information regarding public school quality associated with different neighborhoods, and such information is increasingly accessible through less formal channels. It is therefore no surprise that measures of perceived school quality can consistently explain at least a portion of the pattern of residential location that we observe, and house prices in good school districts are consistently higher than those in bad school districts.[4]

At the same time, differing constraints faced by different households clearly imply that some have more choice than others. Career and job constraints, for instance, are likely to narrow the number of possible public school districts that are feasible for different households. Furthermore, either due to historical forces or because of deliberate zoning policies, lower-income parents may find little or no affordable housing in some of the otherwise feasible school districts and neighborhoods.[5] Elite private schools are available only in some areas and are similarly unaffordable for low-income families, and even parochial schools are likely to be too expensive for many. Although some parents therefore clearly enjoy many school options, choice for others may be quite constrained by job considerations, housing markets, and lack of affordable private school alternatives.

The combination of the exercise of these constrained political, residential, and school choices then results in various outcomes that we can measure and observe. House prices differ both within and across school dis-

4. See, for example, Nechyba and Strauss (1998) and Bayer (1999) for discrete choice approaches, as well as a long literature on education and house prices with recent contributions such as Black (1999).

5. Even when lower-quality housing is available in good school districts, capitalization of public school quality will tend to inflate the prices of such houses substantially.

tricts, and markets incorporate both house/neighborhood quality and school quality considerations into these prices. Differing house quality and community amenity levels result in some mixing of different income groups within districts as well as some stratification by income across districts, both of which can generally be observed in the data. Commonly reported spending levels in schools reflect the result of an aggregation of preferences (however imperfect) through political institutions and thus give an indication of the value of per-pupil spending in household preferences. Finally, private school attendance rates in different districts give a measure of discontent within these districts with local public schools, spending levels, and other features such as the quality of peer interactions within those schools.

5.2.2 Using Observable Outcomes Today to Predict the Impact of Increased Choice Tomorrow

Although the choices that households make under the current school system—and the observed outcomes that result from these choices—are interesting in and of themselves, they also give rise to several research opportunities and challenges for those interested in predicting the impact of expanding school choice. One possible strategy takes as its starting point the empirical observation of varying degrees of choice within the current school system (across, say, metropolitan areas) and then attempts to link specific observed features of current public or private schools to the degree of competition faced by those schools.[6] A second strategy begins with a theoretical model that encompasses the forces we think are important for analyzing school competition, then tries to calibrate that model to replicate the most important outcomes (income and house price heterogeneity within and across districts, per-pupil spending levels, private school attendance rates) observed in the data under the current school system, and finally introduces new policies into the calibrated model to see how such policies would change outcomes. The first of these approaches therefore attempts to infer the impact of increased choice directly from current data and is most appropriate for predicting changes resulting from marginal policy adjustments. The second approach, on the other hand, uses the data to generate parameters within a structural model and then asks that model to simulate the impact of new policies assuming that the underlying structural parameters (in preferences and production functions) remain unchanged. Since economists generally are comfortable with the notion that preferences and production functions themselves are exogenous, the latter approach allows a full unfolding of all the forces within a general equilibrium setting where everything else is endogenous. This approach is potentially most useful for predicting the impact of large and discrete changes in policy, and it is the approach taken in this paper.

6. This approach is exemplified in Hoxby (1994, 2000a,b), McMillan (1999), and others.

5.2.3 Important Features to Be Modeled under This Approach

In order to implement this approach successfully, however, one must begin by convincingly identifying the core features of the current school choice environment (as well as specifying functional forms for preferences and production processes whose parameters are then to be dictated by the data). It is therefore worthwhile to pause and ask precisely what features a model would have to have in order to serve as an effective tool for the proposed analysis.

Given the important role of residential location and mobility in the current choice environment, one must start with a model that contains a heterogeneous housing market, with some locations inherently more desirable (apart from school considerations) than others. When applied to a specific context, such heterogeneity in housing within and across school districts is important because it serves as one of the limiting factors in school district choice. Second, in order for a relationship between housing and school choices to emerge under certain types of school financing, the heterogeneous houses must somehow be classified into different political jurisdictions. More precisely, it must be specified whether school finance decisions are made at the central level or more locally by regional or district governments; and it must be made clear how children gain access to particular schools (i.e., whether this is by living in a given jurisdiction or by some other rationing mechanism). Third, a meaningful analysis requires the model to incorporate different types of households that face different constraints, where the most important distinction between them is their wealth and ability. Fourth, in order for parents to be able to choose a school within their constrained choice set, they must have a way of evaluating school quality based on observable features within the model. Thus, an education production process—or at least a parentally perceived production process—must be formulated, a task made particularly challenging by the continuing disagreement in the literature regarding what matters in this process. Finally, both private and public schools can potentially enter the constrained choice sets of each household, and these choice sets could be expanded by policies such as private school vouchers. Therefore, we must model the private school market carefully, allowing for supply responses in case of changing demand for private schools.

5.3 The Model

The first challenge, then, is to construct a tractable and internally consistent model with (a) heterogeneous housing, (b) multiple jurisdictions describing how political choices regarding funding of public schools and admissions requirements are made, (c) households with different wealth and ability levels, (d) a specification of the education production process, and (e)

a description of the private school market. The second challenge is to use available data on outcomes in the current choice environment to infer parameters of preferences and production processes. A nontechnical discussion of the elements of such a model (detailed more precisely elsewhere) is offered in section 5.3.1 and is followed by a discussion of how an equilibrium arises in such a model (section 5.3.2) and how the various parameters can be matched to important features of the data (section 5.3.3).[7] Once matched to the data, the model is then shown to be relatively successful in replicating the outcomes we currently observe (section 5.3.4).

5.3.1 Components of the Model

The policy simulations in later sections are based on a model in which 1,500 types of households that differ in their wealth level and child ability simultaneously choose where among three school districts and fifteen neighborhoods (or house types) to live, which school to attend, and how much public school spending to support at the ballot box. The overall number of houses available in the three districts is assumed to be equal to the total number of households in the model. Thus, there is exactly one house per household, but just as households differ in wealth and ability, houses differ in quality. More precisely, the three school districts contain five house types (or neighborhoods) each, and the total quantity of houses is the same in each of the three districts. The quality of housing, however, differs among the three districts, with average quality lowest in district 1 and highest in district 3. In addition, housing quality varies both within and across districts, and some house types in district 1 are of higher quality than some house types in district 3 despite the fact that average quality is highest in district 3.

The house quality of a type h house in district d is indexed by a parameter k_{dh}, and this parameter enters directly into the utility function that all households (regardless of wealth and ability) share.[8] In particular, households are assumed to value consumption c and school quality s as well as house quality k_{dh}. The utility of living in district d and house type h while consuming school quality s and private consumption c is given by

$$u(d, h, s, c) = k_{dh} s^{\alpha} c^{\beta}, \tag{1}$$

and the fifteen house quality parameters as well as α and β are derived from the data in a way described below. For now it should simply be noted that, since house prices are used to calibrate the house quality parameters, any-

7. The earliest theoretical development of the local public finance portion of this model is due to Dunz (1985).

8. An alternative way for a model to generate heterogeneity of housing and household types within districts is to assume housing to be fully malleable and household preferences to differ in school quality (Epple and Platt 1998). The relative merits of that approach as compared to the one taken here (in which houses are assumed to not be malleable and preferences are assumed to be identical) are discussed in section 5.5.

thing that is captured in house prices is also captured in these parameters. Specifically, in addition to standard housing quality measures, these parameters would capture non-school-related local amenities as well as non-school-related neighborhood externalities.

School quality s depends on whether the household has chosen a private school or the local public school. Two inputs are assumed to matter: (a) per-pupil spending and (b) average peer quality in the school. Per-pupil spending in the public school is determined through the political process of local voting (on property taxes) combined with an exogenously specified state aid formula (financed through state income taxes), whereas spending in the private schools is set by the school in order to maximize profit. Similarly, the public school has no control over peer quality but must admit all students who reside in the district and choose to attend the public school, whereas private schools are able to set a lower bound on peer quality. (Peer quality itself is specific to each household type and is a combination of child ability and parental income.[9]) Either type of school then takes its per-pupil spending x and combines it with average peer quality q to produce s through the production process given by

$$s = f(x, q) = \phi x^{(1-\rho)} q^{\rho} \quad \text{where} \quad 0 \leq \rho \leq 1. \tag{2}$$

The parameter ρ is derived from the data in a way described below, and ϕ is a function that depends on how the impact of competition is modeled.[10]

More precisely, current researchers differ on whether public and private schools face different types of production technologies. For many of the initial simulations reported in the next section, we will therefore assume that $\phi = 1$, and public and private schools face the same production technology regardless of the nature of the competitive environment they face.[11] Under such an assumption, the data *require* that both per-pupil spending and peer quality enter the production process. If only spending mattered, the model

9. More specifically, peer quality for household n is given by $q(n) = [z(n)^{\theta}\, a(n)^{(1-\theta)}]/7.5$, where $z(n)$ is household income and $a(n)$ is child ability. The inclusion of both household income and child ability arises from different notions of peer effects. Some view the school peer effect as operating primarily through parents and their involvement and monitoring of schools (which we know increases in income; McMillan 1999), whereas others see peer effects as operating through child ability. The empirical literature offers little guidance as to the appropriate value for θ, which is set to 0.5 in the simulations in this paper. Sensitivity analysis with respect to different values suggests that the precise value of θ is not critical for the results.

10. Note that, for purposes of predicting changes in behavior of households, it is unimportant whether per-pupil spending actually matters in generating better outcomes such as test scores—a proposition that continues to be surrounded by controversy (Hanushek 1999; Krueger 1999; Hoxby 2000b). Rather, what matters is whether households value additional spending in schools, for whatever reason, and it is rather uncontroversial to say that they might. Just how much households value spending as opposed to peer quality is determined by the parameter ρ as it is set in a way to replicate the data. This is described in more detail subsequently.

11. Different levels of inputs will of course nevertheless generally result in different levels of school quality among the various schools, both public and private.

would predict zero private school attendance even for high levels of vouchers. On the other hand, if only peer effects mattered, no public school could survive in the model even without any vouchers.[12] The assumption of identical production processes for private and public schools therefore necessarily entails a production process that places weight on both spending and peers: That is, ρ falls strictly between 0 and 1 and is dictated rather precisely by the data. In later simulations, however, we will allow technologies between schools to differ through the function ϕ in ways that will be made more precise in the section "School Quality When Public Schools Respond to Competition." These alternative models of school production essentially permit private schools the additional advantage of more efficient resource use. However, here again the data will restrict just how much private schools can differ from public schools while still permitting the model to predict accurately the levels of private school attendance that are observed. Specifically, as private schools gain a competitive advantage in terms of efficient resource use, their other large competitive advantage (being able to select peers) must take on less importance: That is, ρ decreases as resource use is assumed to be more efficient in private schools. Since ρ cannot fall below zero, the data therefore place a natural bound on how large the efficiency advantage of private schools can be in the model. The "assumption" that either peer effects play an important role or private schools are more efficient (or some combination of the two) is therefore not an assumption at all. Rather, it is an empirical conclusion that arises from the need to accurately predict current private school attendance rates.

A second concern in modeling school production is that researchers currently know little regarding the precise way in which peer effects enter school production or parentally perceived school production. The most common assumption in the literature is that such peer effects are of the form modeled in equation (2), where the mean of peer quality enters school production, and where mixing of peers consequently benefits lower peer quality children at the expense of high peer quality children. Alternatively, it may be the case that, under certain types of curriculum arrangements, not just the mean but also the variance of peer quality is important. This form of peer effects is incorporated into the model through the function ϕ in the Section on "School Quality When Public Schools Respond to Competition" under the heading of "curriculum targeting."[13] As is illustrated in that

12. This is because the main competitive advantage a private school has in the model when production technologies are identical to those of public schools is the ability to select its inputs, particularly the peer composition. When peer composition is assumed not to matter, then there is simply not enough of a competitive advantage for private schools to convince anyone to pay for them. On the other hand, if that competitive advantage is too large—that is, if peers matter too much—then private school markets can attract all students away from public schools.

13. One way of distinguishing these two views of peer effects would be to call the former the "American view" and the latter the "European view." More precisely, in the United States there

section, the latter formulation of peer effects tends to produce substantially more favorable impacts of vouchers on school quality. Finally, the degree of tracking that is present in public schools clearly affects the way in which peer effects matter. Although tracking is not included explicitly in the model, it should be pointed out that—conditional on whatever level of mixing occurs in public schools—parents *must* still have preferences that place weight on peers in order for any model of this kind to replicate private school attendance levels we actually observe in the data. Thus, the presence of tracking would not in fact alter the initial calibration of the model, but it would cause us to expect an increase in tracking as competition increases, a process that is modeled in the section "School Quality When Public Schools Respond to Competition" as an increase in curriculum targeting within public schools.

5.3.2 Defining an Equilibrium in the Model

An equilibrium in the model occurs when each actor is doing the best he or she can given the features of the economy that can be observed, and when those features are consistent with the underlying political and production processes. Thus, an equilibrium must specify those aspects that everyone can see—house prices, tax rates, public and private school quality levels—and these must be such that (a) no private school or potential private school could increase its profits by exiting or entering the market, or by changing its pricing or admissions policy; (b) no household wants to move or change schools; (c) all tax rates are consistent with majority rule yielding balanced government budgets; and (d) public school quality in each district arises from the inputs allocated to the public schools through the decisions of households to attend (thus determining peer quality) and the decisions resulting from the public choice process (which determines per-pupil funding levels). Although the formal definition of equilibrium and the necessary mathematical proof of its existence is given elsewhere (Nechyba 1997a, 1999), this section provides a brief overview of the issues involved. In essence, we can view a full equilibrium as consisting of equilibrium in three different areas: the private school market, the housing market, and the political market. I discuss each in turn.

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tends to be an effort to teach a relatively similar curriculum to all ability types within the same school through the age of eighteen, when a sharp ability-based separation takes place, whereas in Europe students are typically separated into different schools based on ability at a much earlier age and then taught very different subjects intended to prepare them for very different tasks. Under the U.S. system, it may well be the case that the presence of higher-ability students benefits lower-ability students that are being taught similar subjects, whereas in Europe such mixing would simply get in the way of the rather different missions of schools that are targeting curricula to different ability types. Some have argued that the introduction of competition may tend to lead to a more European peer effect because schools would differentiate themselves horizontally by targeting to different types of students.

The Private School Market

Recall that private schools compete along two dimensions: They set both a per-pupil spending level and a minimum peer quality admissions level. The assumption of perfect competition in the private school market then leads to a relatively straightforward private school hierarchy. Specifically, private schools (to the extent that they exist in equilibrium) are composed of children from the same type of household, and the tuition charged to each household is equal to the most preferred per-pupil spending level of that household. To see this, suppose either of these conditions were not satisfied in equilibrium. If the school consisted of several types of peer groups, then a new school could enter, set a higher minimum peer admissions level while charging the same tuition, and make the same profit as the existing school. Similarly, if tuition were greater than per-pupil spending, a school with the same admissions rule and per-pupil spending level but slightly lower tuition could enter and make positive profits. Thus, equilibrium in the private school market simply means that, if a particular household type demanded a private school with that household's peer quality and that household's most preferred level of spending, then such a private school will be available.[14] As a result of perfect competition, private schools make zero profits.[15]

The Housing Market

When households in the model evaluate which house type (or neighborhood) in which school district to choose, they can then check easily how much utility each option offers. For example, in evaluating the utility from house h in district d, a household would calculate both the utility of resid-

14. The equilibrium prediction of homogeneity of peer quality within each private school is, of course, somewhat extreme and not meant to be a perfectly realistic outcome. It arises from two particular assumptions in the model. First, the production process assumes no economies of scale in school production, thus permitting small schools in the model to arise easily. Even if economies of scale were explicitly introduced, however, the model would still predict relative homogeneity given the discrete number of household types, and unless such scale economies were substantially larger than is indicated by any of the available empirical estimates, the simplifying assumption of no scale economies does not result in substantial qualitatively or quantitatively different implications. Second, I am explicitly not allowing price discrimination within a school such as that used in Epple and Romano (1998) and Caucutt (2001). If private schools can observe peer effects, these papers have demonstrated that pricing of these peer effects is profit-maximizing and efficient—and results in a different form of cream skimming. Although it is unclear from the current empirical literature to what extent such differential pricing is actually practiced in private schools, it is certain that at least some does indeed take place, although probably not as much as predicted by Epple and Romano (1998). To whatever extent this would occur, some heterogeneity within private schools would, however, emerge.

15. An observationally equivalent set of assumptions for the model employed here would be that private schools, rather than being profit maximizers constrained to charge a single price, are exclusionary clubs of parents who agree to an equal cost-sharing rule (Nechyba 1999).

ing there while attending the district's public school and the utility of residing there and attending the private school offered by the market (i.e., a private school with that household's peer quality and most preferred level of tuition). The utility household n obtains from living in this house and attending public school is given by $u(d, h, s_d, c_{dhn})$ where s_d is district d's public school quality and c_{dhn} is the level of private consumption that is equal to household n's after-tax income minus the property tax–inclusive house payment required to live in house (d, h). The utility from living in the same house and attending private school, on the other hand, is given by $u(d, h, s_n, c_{dhn} - \tau_n)$, where s_n is the private school quality offered to household n by the market, and τ_n is the private school tuition required of household n. Thus, for a given location, public schools have the advantage that they permit higher private consumption, whereas private schools might offer higher school quality (due to their ability to tailor tuition to household demand, due to their ability to restrict access to lower peer quality students, and—in some specifications of the model—due to their more efficient use of resources).

Given house prices, tax rates, and public school quality levels, a household can therefore determine the utility of a house h in district d as simply the higher of $u(d, h, s_d, c_{dhn})$ and $u(d, h, s_n, c_{dhn} - \tau_n)$. The housing market is in equilibrium (given public school quality and tax rates) if every household chooses its most preferred location at the prevailing house prices and, as a result, all houses are occupied.

The Political Market and Full Equilibrium

Finally, residents of each district are assumed to vote on local property tax rates knowing that local tax revenues, supplemented by state funds through a prespecified state aid formula, will translate to spending on public education.[16] Alternatively, for versions of the model in which funding of public schools is equalized and centralized, residents of all districts vote on a state income tax rate with the understanding that revenues support equal levels of per-pupil spending in all districts. Households that send their child to public school have single peaked preferences over property tax rates (Nechyba 1997a), as do those who send their child to private school (Nechyba 1999) under certain voter myopia assumptions. For any given distribution of the population into districts, a political (voting) equilibrium therefore exists.[17] A full equilibrium is then a partition of households into

16. In addition, a state income tax rate sufficient to fund state aid (and vouchers in later simulations) is imposed.

17. These myopia assumptions are relatively standard in the literature and roughly assume that households hold a variety of factors fixed when voting. The assumptions essentially require voters to hold expectations that, although accurate in equilibrium, are not accurate out of equilibrium. For details on the required voter myopia assumptions to insure this single-peakedness of preferences, see Nechyba (1999). It should also be noted, however, that single-peakedness is actually a stronger condition than what is required for a voting equilibrium to

house types and school districts, a price for each house type, a local property tax rate for each district, a state income tax rate, and an indication of who goes to public and who goes to private school, such that private school markets and housing markets as well as the political market are in equilibrium.

5.3.3 Matching Parameters to Data

The three school districts in the model are intended to be representative of the several hundred low-income, middle-income, and high-income school districts located in four New Jersey counties (Bergen, Hudson, Essex, and Union Counties) that include the suburbs of New York City. More specifically, using the *1990 School District Data Book* (National Center for Education Statistics 1995) and census (Bureau of the Census 1992) data from all districts in these four counties, school districts in these counties were divided into three categories by median household income such that each category ends up with roughly equal numbers of households. The features of the model to be matched to these data are (a) the income/wealth and ability distributions; (b) the parameters in utility and production functions of equations (1) and (2); and (c) the formula of state aid that is taken as given by voters.

Income/Wealth and Ability Distributions

The simulation model begins with twenty different income levels endowed with fifteen different types of houses, yielding a total 300 different endowment or wealth levels. Incomes in the model range from 1 (corresponding to $10,000) to 20 (corresponding to $200,000) and represent a discretized version of the actual household income distribution in the data, and house values (which are properly interpreted as annualized flows of housing services) range from 0.3 to 3.5. Since income types are initially spread uniformly across the fifteen house types, the addition of housing endowments has the effect of smoothing the income distribution in the model.[18] In addition, ability endowments take on five different possible discrete values, which are set to range from 1 to 10. Empirical estimates of the correlation of parental and child income of 0.4 (Solon 1992; Zimmerman 1992) are used as a proxy for the correlation of parental income and child ability.[19] The addition of five ability endowments to the 300 income/wealth

exist when voters have a private alternative to the publicly provided service (Epple and Romano 1996; Glomm and Ravikumar 1998), although weaker conditions are difficult to guarantee easily within the present setup.

18. It is important to note that, although this implies that some low-income households in the model are initially endowed with expensive houses, this is not the case once the equilibrium has been calculated, when such houses would have been traded at market prices.

19. One can also interpret the correlation between parental and child income of 0.4 as an upper bound on the correlation between parental income and child ability because of the correlation of school quality and parental income. Sensitivity analysis with versions of the model

endowments then yields a total of 1,500 different types of households in the model.

Parameters in Utility and Production Functions

More challenging is the process of setting the parameters in the utility and production functions. These parameters include the housing quality parameters ($k_{11}, \ldots, k_{dh}, \ldots k_{35}$), the preference parameters α and β, and the production parameter ρ. The methodology used to calibrate these parameters builds on that of Nechyba (1997b, 2000) and is outlined more fully in Nechyba (forthcoming). The method translates a near-continuum of house qualities observed for each district type into five discrete quality intervals (neighborhoods) of equal sizes. It starts by assuming an underlying utility function $u(h, s, c) = h^{\delta}s^{\alpha}c^{\beta}$ where h jointly captures housing and neighborhood quality and is interpreted as the annualized flow of housing/neighborhood services. Substituting equation (2) for s, this utility function can be rewritten as

$$u(h, x, c; q) = h^{\delta}[x^{(1-\rho)}q^{\rho}]^{\alpha}c^{\beta} = \gamma h^{\delta}x^{(1-\rho)\alpha}c^{\beta},$$

where q is equal to peer quality and $\gamma = q^{\rho\alpha}$. When h, x, and c are treated as choice variables in an ordinary maximization problem, the exponents δ, $(1 - \rho)\alpha$, and β can then, without loss of generality, be normalized to sum to 1 and interpreted as budget shares. Thus, I calculate the budget shares for h, x, and c for a hypothetical "median household" that consumes the imputed median annualized flow of housing/neighborhood services (in the data), earns the median income, and chooses the mean school spending level observed in the New Jersey districts, and these budget shares become our estimates of δ, $(1 - \rho)\alpha$, and β (equal to 0.22, 0.12, and 0.65, respectively).[20]

Of course, housing in the model is not a continuous variable h, but rather consists of a discrete number of house/neighborhood quality levels denoted by ($k_{11}, \ldots, k_{dh}, \ldots k_{35}$) in equation (1). I therefore combine the housing value distribution data from the *School District Data Book* with our estimate for δ to calibrate the fifteen values for k_{dh} across the three representative school districts. In particular, I take the housing distribution for all houses in districts of a particular type (i.e., low-, middle-, or high-income as defined above), find house values at the 10th, 30th, 50th, 70th, and 90th percentile (corresponding to neighborhoods 1 through 5 in district 1) and con-

that drive the correlation to 0, however, suggest that this makes little difference for the results I report. In particular, changing the correlation to 0.2, for instance, results in essentially no change in the results of tables 5.4 and 5.7. Results in tables 5.5 and 5.6 are affected slightly in that public school quality levels in the poor district are slightly lower, and the impact of vouchers on public school levels is slightly less favorable. Overall, however, these differences in results are minor and therefore go unreported.

20. Given data on house prices rather than flows of housing services, the median annualized flow of housing/neighborhood services is calculated for the median house value in the data assuming a 5.5 percent interest rate.

vert these to annualized housing flows (using a 5.5 percent interest rate). I then combine these annualized flow values with the exponent δ to arrive at the five housing (or neighborhood) quality parameters for this representative district.[21] As noted in an earlier section, this methodology—because it employs all the information contained in housing prices—is quite general in that it incorporates not just house quality measures but also non-school-related neighborhood amenities and non-school-related peer effects into the k_{dh} quality parameters.[22]

Finally, although the calibration procedure above has placed a restriction on the values of ρ and α (given that $[1 - \rho]\alpha = 0.12$ from the budget share exercise), the precise values of ρ and α are set to match private school attendance rates. Recall from equation (2) that ρ is the weight on peer quality (as opposed to per-pupil spending) in the school production function. When ρ is set to 0, school quality differences are determined solely by per-pupil spending differences, which, in this model, yield zero private school attendance even if private school vouchers are introduced at relatively high levels. On the other hand, if ρ is set close to 1, public schools cannot survive even without private school vouchers. As ρ rises from 0 to 1, private school attendance increases monotonically, and ρ is set to replicate as closely as possible the level of private school attendance observed in the data (yielding $\rho = 0.475$). Given the restriction that $(1 - \rho)\alpha = 0.12$, this also determines the value of α (= 0.229). When an additional efficiency advantage of private schools is introduced in the section on "School Quality When Public Schools Respond to Competition" through the function ϕ, ρ is adjusted (downward) so as to continue to allow the model to accurately predict private school attendance rates.

State Aid Formula

As argued in MaCurdy and Nechyba (2001), it is difficult to construct state aid formulas from statutory language because of the fungibility of aid and the subtle trade-offs that local policy makers are aware of but that are unobservable to the outsider. Rather than attempting to mimic a statutory

21. More precisely, suppose that for houses in districts falling into district category 3 (i.e., high-income districts), the annualized flow of housing services for a house at the 50th percentile of the distribution is 1.5 (corresponding to $15,000). The housing quality parameter for neighborhood 3 (the median neighborhood) in district 3 is then just equal to $(1.5)^{\delta}$, i.e. $k_{23} = (1.5)^{\delta} = (1.5)^{0.22} = 1.093$. This procedure is then similarly applied to other district types to arrive at housing quality parameters for all neighborhoods in all representative districts. These parameters are reported in Nechyba (forthcoming).

22. It should be noted, however, that these neighborhood quality measures are assumed to stay constant throughout the policy simulations. This implies that, although the benchmark equilibrium presented below accurately captures current neighborhood externalities, the simulations do not allow for a *change* in these externalities as populations migrate. However, as I have argued elsewhere (Nechyba forthcoming) and will argue again in what follows, this actually implies that the migration results highlighted in the paper are *understated* and would probably be stronger if neighborhood externalities were endogenized.

Table 5.1 **Benchmark Equilibrium to Replicate New Jersey Data**

	Average Income	Average Property Values	Fraction Private	Per-Pupil Spending	School Quality
District 1	3.1120	0.6121	0.2000	0.6652	0.4322
District 2	4.6216	1.0720	0.2250	0.7910	0.6178
District 3	6.5863	1.5248	0.1250	0.8621	0.7803

Table 5.2 **Predictions versus Data**

	Representative School Districts		
	Low Income ($d = 1$)	Middle Income ($d = 2$)	High Income ($d = 3$)
Mean house value	$157,248	$192,867	$271,315
Predicted mean land value[a]	$117,412	$205,629	$292,484
Median household income	$30,639	$45,248	$67,312
Predicted mean household income	$31,120	$46,216	$65,863
Per-pupil spending	$6,702	$7,841	$8,448
Predicted per-pupil spending	$6,652	$7,910	$8,621
Fraction choosing private school	0.21	0.23	0.20
Predicted fraction in private school	0.20	0.23	0.13
Fraction raised locally	0.52	0.77	0.87
Fraction raised locally in model	0.52	0.77	0.87

[a]Calculated from static values assuming 5.5 percent interest rate.

formula, I therefore implement a state aid formula that combines block grant and matching grant elements (as defined in Nechyba 1996) in such a way as to allow the model to replicate the levels of per-pupil spending observed in the data.

5.3.4 The Calibrated New Jersey Equilibrium

With the distributional properties and functional parameters chosen, the computer model is then asked to generate an equilibrium. If the calibration is successful, the stylized facts in the data should be approximately replicated by the computer simulation. Table 5.1 provides numbers for key equilibrium values generated by the computer model when $\phi = 1$, and table 5.2 translates these to be comparable to the numbers in the data employed to calibrate the model. Overall, the match between the predicted values from the computer model and those found in the data seems reasonably close (with some exceptions).[23] The remaining simulations then employ the same

23. The generated data also match well in terms of other moments of the within-district distributions of house values and income levels. In fact, the calibration method seeks to match not only the means but also the variances of these distributions. For space considerations, these details go unreported here.

income/wealth/ability distributions for the 1,500 household types, and the same parameters for utility and production functions (with adjustments made only to ρ as ϕ is altered in the section on "School Quality When Public Schools Respond to Competition." The New Jersey specific state aid formula, however, is not employed in all simulations because some are intended to reflect results in more stylized state-financed or locally financed systems.

5.4 Policy Simulations

Two types of predictions arise from the policy simulations reported in this section. First, a substantial portion of the current level of income-based residential segregation can be attributed to the limits on competition inherent in the current public school system, and the fostering of additional private school choice has the potential to dramatically reduce this kind of segregation. This prediction is robust to the inclusion of various controversial assumptions regarding other forces unleashed by increased competition. On the other hand, assumptions regarding the impact of competition on school behavior do matter for predicting the degree to which increased competition from private schools may affect school quality. Such policies may create winners and losers while leaving average school quality roughly unchanged, or they may create substantial increases in school quality. Section 5.4.1 focuses on the first of these predictions, and section 5.4.2 discusses the second.

5.4.1 Public Schools, Residential Segregation, and Private School Choice

It is apparent, both in the data and the benchmark equilibrium (which is relatively consistent with the data) that there is a substantial degree of residential segregation by income across school districts. Given the interdistrict distribution of housing quality, this is of course no surprise. The simulation results reported in this section, however, suggest an additional role played by the rules inherent in different types of school systems, and they suggest a large potential for private school vouchers to change the degree of residential segregation. In the following section, I begin by investigating the school-related causes of segregation in the absence of vouchers, and the subsequent section builds on these intuitions and investigates the role of vouchers.

The Role of Private and Public Schools without Vouchers

The results of five simulations are reported in the five rows of table 5.3, which is taken from Nechyba (2002). The first row establishes a benchmark for the degree of residential segregation implied simply by the housing market absent any distortion through the public school sector. This is accom-

Table 5.3 Schools and Residential Segregation

Public Financing	Income				Property Values			
	Average Income ($)			Ratio: Dist. 3 Avg./ Dist. 1 Avg.	Average Property Values ($)			Ratio: Dist. 3 Avg./ Dist. 1 Avg.
	Dist. 1	Dist. 2	Dist. 3		Dist. 1	Dist. 2	Dist. 3	
None[a]	25,700	50,175	67,325	2.62	8,254	11,844	13,892	1.68
No private schools								
Local tax[b]	17,628	39,647	85,925	4.87	5,301	10,639	20,457	3.86
State tax[c]	19,875	42,250	81,075	4.08	5,322	11,507	20,204	3.80
Private schools								
Local tax[d]	29,725	50,262	63,212	2.13	6,424	11,038	15,370	2.39
State tax[e]	29,891	51,309	62,000	2.07	6,177	11,800	16,490	2.67

Note: Property values are expressed as annualized flows.

[a]This simulation sets public spending to zero and assumes only private schools operate.

[b]This simulation prohibits private schools and assumes all funding for public schools comes from local voting on a proportional local property tax. All tax revenues within a district are assumed to be spent on schools in that district.

[c]This simulation prohibits private schools and assumes all funding for public schools comes from voting on a proportional state income tax. Under this state system, all public schools receive the same per-pupil funding.

[d]This simulation allows a full private school market and assumes that all funding for public schools comes from local voting on a proportional property tax. All tax revenues within a district are assumed to be spent on schools in that district.

[e]This simulation allows for a full private school market and assumes that all funding for public schools comes from voting on a proportional state income tax. Under this state system, all public schools receive the same per-pupil funding.

plished by setting public school spending to zero in all districts, thus causing all households in the model to choose private schools. Housing price differences now reflect solely the house/neighborhood quality differences embodied in the k_{dh} values in equation (1), and no public choices regarding schooling interfere with where households choose to live.

Next, the second row reports simulation results in which private schools are prohibited and all public schools are financed at the local level through a local property tax. The difference is striking: The residence-based public school system (in the absence of private schools) introduces a substantial degree of segregation, as evidenced in both average incomes and average property values across the three districts. For instance, the ratio of average income in district 3 to average income in district 1 rises from 2.62 to 4.87, and the ratio of average property values in district 3 over those in district 1 rises from 1.68 to 3.86. Capitalization of public schools (which is absent in the first row but not the second) raises average housing values in the wealthy district by nearly 50 percent while lowering them in the poor district by similar magnitudes.

One natural reaction to this comparison might be to suspect that the dramatic difference in the first two rows of the table is due to the decentralized nature of public school financing in the second row. The third row therefore reports simulation results from a state income tax–supported equalized public school system, with private schools again prohibited. Somewhat surprisingly, the results are rather similar to those of the second row, implying that the increase in segregation from row 1 to row 2 is due primarily to the switch from a purely private to a purely public system and only secondarily due to the level of decentralization of public financing.

Finally, the fourth and fifth rows repeat the previous two simulations but this time permit the emergence of a private school market. Again, the results are striking: Not only does the emergence of the private school market alleviate the segregation observed in the purely public systems, but it actually produces less income segregation than exists in the purely private system, in which public schools played no role in where households chose to reside. Given that public school quality continues to increase with community wealth, however, capitalization of school differences must—and does—persist in equilibrium. Thus, under local public financing, capitalization still raises average property values in district 3 by 11 percent and lowers them in district 1 by 28 percent.[24] This yields the curious outcome that the district 3 to district 1 ratio of average district income actually falls below the pure private simulations (first row), but the similar ratio of average property values settles well above the pure private benchmark (first row).

These seemingly contradictory results on income segregation and capitalization, however, are closely linked. Consider a relatively high income household that resides in district 3 under both the purely public and the purely private systems. Under the public system the household chooses district 3 because this is the only way to consume high-quality education. Under the private system, on the other hand, there is no reason for a household to choose any particular district: The only factor that matters is housing/neighborhood quality. When a private market is introduced into a public system, however, an important effect emerges for households considering private schooling: The difference in public school quality is capitalized into house prices (albeit at a lesser rate than under pure public financing), thus making the same house (if it exists in both districts) substantially cheaper in the poor district than in the rich district. In the case of local public financing, this results in an average price difference of approximately 40 percent for the same type of house in district 3 versus district 1. Unlike the case of a purely private system, this capitalization of public school differences then gives rise to rather strong incentives for those choosing private schools to choose a house in the poor district—even if that house is of suboptimal

24. These capitalization differences appear even higher in the last column (under state funding) for reasons addressed elsewhere (Nechyba forthcoming).

quality. Households with high-ability children receive the biggest payoff from opting out of the public system, as do middle- to high-income households. Thus, the introduction of private schools into a public system—whether state- or locally financed—provides incentives to middle- and high-income families (with high-ability children) to settle in poor districts. As a result, average income differences narrow substantially more than property value differences that continue to capitalize public school quality.[25]

Vouchers and Segregation

Tables 5.4, 5.5, and 5.6 report simulation results for three different public school finance regimes (local, state, and the system calibrated to the New Jersey data) and three types of vouchers: The top portion of each table simulates vouchers that are universally available; the middle portion simulates vouchers targeted only to residents of district 1; and the lowest portion reports results from the introduction of vouchers targeted only to households earning below $25,000. Vouchers simply allow eligible households to redeem the face value for that level of private school tuition, and they can freely supplement the voucher amount.

The impact of private school vouchers on segregation then follows straightforwardly from the logic behind the previous results. To the extent that a voucher causes someone who previously chose public schools to switch to private schools, the same price incentive to settle in the poor rather than the rich district applies. At the same time, however, interdistrict housing price differences narrow as more households choose private schools in poor districts and as voucher levels increase the value of housing in those districts. Thus, two opposing effects emerge as vouchers are introduced: First, the capitalization-induced price incentive for private school attending households to reside in poorer communities applies to a larger number of households, thus causing households with incomes above the average for district 1 to immigrate and raise average income. Second, this price incentive declines as housing price differences narrow and as only lower-quality housing remains for private school immigrants in district 1—thus causing lower-income households with high-ability children to compose the additional private school–attending population. Since vouchers are taken up primarily by households that are not at the lowest end of the income distribution, however, these effects are either absent or modest when vouchers are small in size or targeted only to low-income households (as opposed to low-income districts).

25. A cautionary note is perhaps in order: Although the results in table 5.3 suggest that segregation would be greater in a purely private system than in mixed private/public system, it would be stretching the bounds of the model to take this implication too literally. Specifically, linking public schooling to housing for decades causes housing stocks to evolve endogenously, whereas private schooling introduces no such distortions. Because housing is fixed at its present quality levels in this paper, the model cannot be used to infer where the segregation would have ended up under public versus private financing. Rather, the model suggests that, conditional on housing markets fixed at present levels and not being allowed to change, a purely private system would lead to higher levels of income segregation.

Table 5.4 Private School Vouchers under Local Public Financing[a]

Voucher Amount	Average Income ($)		Property Values ($)		Ratio: Dist. 3/Dist. 1		Private (%)	
	Dist. 1	Dist. 3	Dist. 1	Dist. 3	Income	Property	Dist. 1	Dist. 3
				All Eligible for Voucher[b]				
$0	29,725	63,212	6,424	15,370	2.1266	2.3926	30	10
$1,000	31,925	59,800	7,122	14,654	1.8731	2.0576	40	10
$2,500	33,425	58,000	9,097	14,468	1.7352	1.5904	62.5	25
$4,000	33,125	57,425	8,256	13,339	1.7336	1.6157	87.5	30
$5,000	32,900	56,425	8,027	11,816	1.7150	1.4720	100	37.5
				Voucher Targeted to District 1[c]				
$0	29,725	63,212	6,424	15,370	2.1266	2.3926	30	10
$1,000	34,050	59,950	7,124	14,974	1.7606	2.1019	37.5	10
$2,500	37,125	54,125	9,979	14,804	1.4579	1.4835	70	10
$4,000	43,275	52,950	13,741	15,141	1.2236	1.1019	100	17.5
$5,000	44,624	53,632	14,282	15,041	1.2019	1.0531	100	19.84
				Voucher Targeted Families with Income below $25,000[d]				
$0	29,725	63,212	6,424	15,370	2.1266	2.3926	30	10
$1,000	29,725	63,212	6,424	15,370	2.1266	2.3926	30	10
$2,500	30,185	62,320	6,513	15,220	2.0646	2.3369	45	10
$4,000	32,325	60,340	7,012	15,184	1.8667	2.1654	82.5	7.5
$5,000	32,675	62,250	9,187	15,589	1.9051	1.6969	100	10

Note: Property values are expressed as annualized flows.

[a]These simulations introduce vouchers funded by the state through an increase in the state income tax sufficient to balance state budgets. No local sources of revenues are used to fund vouchers. A household can redeem the value of the voucher as part or all of tuition at any private school that will accept the household's child. All public schools are locally funded through proportional property taxes set through local voting with all revenues staying within the district.

[b]This set of simulations assumes that vouchers are not restricted; that is, regardless of where a household lives and how much income that household earns, the household is eligible for the voucher.

[c]This set of simulations assumes that vouchers are restricted to households who reside in district 1—the poorest district. Within district 1, all households are eligible regardless of household income.

[d]This set of simulations assumes that only households with incomes below $25,000 are eligible for vouchers.

First, consider the top portions of the tables 5.4, 5.5, and 5.6 (which do not restrict voucher eligibility). For low levels of such vouchers, the first effect dominates, thus causing decreases in income segregation as households with incomes above district 1's average immigrate to take advantage of lower house prices while sending their children to private school. For higher levels of such vouchers, on the other hand, the second effect dominates, thus causing increases in income segregation.[26] The impact of uni-

26. If vouchers were to get high enough to cause all public schools to collapse, the degree of residential segregation would settle to what appears in the purely private system in row 1 of table 5.3.

Table 5.5 **Vouchers under Central Public Financing**[a]

Voucher Amount	Average Income ($)		Property Values ($)		Ratio: Dist. 3/Dist. 1		Private (%)	
	Dist. 1	Dist. 3	Dist. 1	Dist. 3	Income	Property	Dist. 1	Dist. 3
				All Eligible for Voucher[b]				
$0	29,891	62,000	6,177	16,490	2.0742	2.6696	22.5	15
$1,000	33,375	60,350	6,215	15,599	1.8082	2.5099	30	25
$2,500	34,188	58,254	6,431	15,851	1.7039	2.4648	35	27.5
$4,000	33,500	61,225	7,710	14,908	1.8276	1.9336	62.5	30
$5,000	28,775	64,875	8,327	14,016	2.2546	1.6832	100	100
				Voucher Targeted to District 1[c]				
$0	29,891	62,000	6,177	16,490	2.0742	2.6696	22.5	15
$1,000	33,400	59,645	6,242	15,711	1.7858	2.5170	30	12.5
$2,500	39,326	59,825	6,720	15,940	1.5213	2.3720	42.5	11.25
$4,000	43,202	53,861	8,652	16,805	1.2467	1.9423	70	10
$5,000	44,225	58,850	12,509	16,100	1.3307	1.2871	100	37.5
				Voucher Targeted Families with Income below $25,000[d]				
$0	29,891	62,000	6,177	16,490	2.0742	2.6696	22.5	15
$1,000	29,891	62,000	6,177	16,490	2.0742	2.6696	22.5	15
$2,500	29,891	62,000	6,177	16,490	2.0742	2.6696	22.5	15
$4,000	30,281	61,348	6,091	16,573	2.0260	2.7209	37.5	12.5
$5,000	31,644	60,858	5,910	16,940	1.9232	2.8663	52.5	10

Note: Property values are expressed as annualized flows.

[a]These simulations introduce vouchers funded by the state through an increase in the state income tax sufficient to balance state budgets. A household can redeem the value of the voucher as part or all of tuition at any private school that will accept the household's child. All public schools are equally funded through a proportional income tax.

[b]This set of simulations assumes that vouchers are not restricted; that is, regardless of where a household lives and how much income that household earns, the household is eligible for the voucher.

[c]This set of simulations assumes that vouchers are restricted to households who reside in district 1—the poorest district. Within district 1, all households are eligible regardless of household income.

[d]This set of simulations assumes that only households with incomes below $25,000 are eligible for vouchers.

versally available vouchers on income segregation is, therefore, U-shaped in the size of the voucher.

Now consider the middle parts of tables 5.4, 5.5, and 5.6—results for vouchers targeted solely to residents of district 1. For such vouchers, it appears that the second effect never materializes. Since vouchers are available only to residents in district 1, migration of private school–attending households into district 1 continues despite the fact that price differences are narrowing, with higher-income immigrants out-competing others for the houses that ensure voucher eligibility despite the fact that some of these houses are not of high quality. In the middle portions of tables 5.4, 5.5, and 5.6, income segregation therefore continues to decline as houses in district 1 become increasingly valuable to those interested in private education. At

Table 5.6 Vouchers under New Jersey Financing System[a]

Voucher Amount	Average Income ($)		Property Values ($)		Ratio: Dist. 3/Dist. 1		Private (%)	
	Dist. 1	Dist. 3	Dist. 1	Dist. 3	Income	Property	Dist. 1	Dist. 3
All Eligible for Voucher[a]								
$0	31,120	65,863	6,121	15,248	2.1164	2.4911	20	12.5
$1,000	32,845	63,100	6,534	14,921	1.9211	2.2836	32.5	15
$2,500	35,525	60,050	8,692	14,312	1.6904	1.6466	40	22.5
$4,000	33,350	61,340	9,342	13,164	1.8393	1.4091	67.5	30
$5,000	32,533	61,788	8,210	12,329	1.8992	1.5017	100	32.5
Voucher Targeted to District 1[c]								
$0	31,120	65,863	6,121	15,248	2.1164	2.4911	20	12.5
$1,000	33,250	61,125	6,623	15,120	1.8383	2.2830	35	12.5
$2,500	38,466	56,380	9,922	14,792	1.4657	1.4908	47.5	15
$4,000	43,620	52,890	12,331	14,910	1.2125	1.2091	82.5	15
$5,000	44,130	54,210	12,910	14,225	1.2284	1.1019	100	17.5
Voucher Targeted Families with Income below $25,000[d]								
$0	31,120	65,863	6,121	15,248	2.1164	2.4911	20	12.5
$1,000	31,120	65,863	6,121	15,248	2.1164	2.4911	20	12.5
$2,500	31,120	65,863	6,121	15,248	2.1164	2.4911	20	12.5
$4,000	31,833	64,421	6,223	15,005	2.0237	2.4112	40	12.5
$5,000	32,960	63,184	7,325	15,225	1.9170	2.0785	67.5	10

Note: Property values are expressed as annualized flows.

[a]These simulations introduce vouchers funded by the state through an increase in the state income tax sufficient to balance state budgets. A household can redeem the value of the voucher as part or all of tuition at any private school that will accept the household's child. All public schools are funded through a mix of local property and state income taxes under a formula replicating the New Jersey finance system in 1987.

[b]This set of simulations assumes that vouchers are not restricted; that is, regardless of where a household lives and how much income that household earns, the household is eligible for the voucher.

[c]This set of simulations assumes that vouchers are restricted to households who reside in district 1—the poorest district. Within district 1, all households are eligible regardless of household income.

[d]This set of simulations assumes that only households with incomes below $25,000 are eligible for vouchers.

the $5,000 voucher level, the decline in segregation is most dramatic, with district 3's average income now only 20 percent higher than district 1's average income for the local financing simulation and property values (despite higher housing quality) only 5 percent higher.

Both types of vouchers—those that are not targeted and those targeted to the poorest district—can therefore reduce segregation. However, universally available vouchers, by privatizing the system at high enough voucher levels, eventually lead to the level of segregation that would occur in a purely private system (which is higher than the segregation in the present mixed system). For universally available vouchers, residential income desegregation then occurs only at lower levels of vouchers. Vouchers targeted to poor

districts, on the other hand, have the potential to increase significantly these desegregating effects by preventing a complete privatization of the public system and instead making the poor district increasingly attractive to those seeking private education at high voucher levels.

Finally, the lowest portions of tables 5.4, 5.5, and 5.6 report simulation results for vouchers targeted only to households that earn below $25,000 per year. These households can be grouped into two broad conceptual categories: those that have high-ability children and those that have low-ability children. Whatever migration is caused by such vouchers is then primarily migration of relatively low income families (who are eligible for the voucher) with high-ability children that locate in the poor district and send their children to private schools. As a consequence, relatively little change in the degree of interdistrict income segregation arises (with the ratio of average income in district 3 to average income in district 1 falling by a modest 5 to 10 percent for high levels of the voucher). Furthermore, the voucher is actually not used until it reaches at least the $2,500 level.[27] Cases between universally available vouchers and household-targeted vouchers of the kind modeled here are of course also possible, and results for such vouchers fall predictably between those reported in the top and bottom portions of the table panels. For instance, vouchers might be set high for low-income households and phased out as incomes rise. This would then introduce some (but not all) of the migration forces unleashed by universally available vouchers.

Finally, it should be noted that the assumption that housing quality is fixed (i.e., k_{dh} does not change) tends to bias the mobility results emphasized in this section *downward.* In the discussion of the calibration of the model, for instance, I emphasized that the methodology (using housing prices) employed to calibrate house/neighborhood quality parameters incorporates not just housing quality but also non-school-related neighborhood amenities and externalities. Holding the k_{dh} parameters fixed as migration takes place then assumes that housing qualities as well as non-school-related neighborhood amenities and externalities are also unchanged. Because the migration that takes place primarily involves relatively higher income households moving from middle- and high-income districts to the low-income district, one would expect k_{dh} values to increase in district 1 (as these households expand houses and add to neighborhood amenities and externalities) and to decrease in district 3 (as the converse happens there). This

27. It should be noted that, in voucher experiments in some cities, the demand for low levels of vouchers targeted to low-income families has been higher than predicted here. Since the "low-income district" in this model is an aggregation of the lowest one-third of all districts, the model clearly does not capture desperate conditions in the worst public schools and thus the demand for vouchers in such districts. It is in such primary inner-city districts, however, that voucher demand by low-income families has been surprisingly high even when voucher levels were relatively low. We should therefore expect voucher take-up rates for low levels of vouchers targeted to the poor in very poor districts to be higher than what is predicted by this model.

would make district 1 even more attractive, thus causing even less segregation and a further narrowing of property values. Thus, the explicit exclusion of adjustments in the k_{dh} values yields lower-mobility results than what the model would otherwise tend to predict.

5.4.2 School Choice and School Quality

Previous models of vouchers have ignored the implications of voucher policies on residential mobility and have instead focused on single-community settings in which private schools compete with a homogeneous public school sector. The purpose of these models is to study the effect of vouchers on average school quality as well as the distribution of school quality across different types of students, and to investigate the likely workings of private school markets in a voucher environment. The problem with comparing pre- and postvoucher outcomes within single-district models of this kind, however, is that they abstract away from one of the defining characteristics of the U.S. public school system—the degree of inequality in existing public schools—and thus analyze the issue of vouchers from an empirically incorrect benchmark. We therefore now revisit the competition forces analyzed in single-district models here in the context of the multidistrict model with heterogeneous public schools.

These competition forces are of two general kinds: First, it is argued by voucher opponents that a policy of private school vouchers will drain the public system of resources and thus leave it worse off. The term "resources" needs to be interpreted loosely to include not only financial resources (which may in fact increase on a per-pupil basis[28]) but also peer quality (including whatever part of peer quality is due to parental involvement [McMillan 1999]) and political support. Second, it is argued by proponents of vouchers that the increased competition for students will lead to greater effort by public schools and that the greater variety of education options will lead to a better matching of resources with student needs.[29] The loss of resources would, of course, lead to a decline in public school quality, whereas the competition-induced efficiency gains through more efficient resource uses and better matching of resources with students would lead to an increase.[30]

The next section begins with the version of the model (outlined in section 5.3) that incorporates only the first of these forces—that is, the cream-

28. If the voucher amount is below per-pupil spending in the public school, then, assuming no change in overall government spending on education (including spending on vouchers), per-pupil spending in public school would increase as students depart with vouchers. If vouchers also go to those currently attending private schools, then the increase in per-pupil spending would occur only if the number of students departing the public system is sufficiently large.

29. Chubb and Moe (1990), for instance, argue such points, as do others.

30. Manski (1992) formalizes this type of trade-off in a single-district context. Epple and Romano (1998) and Caucutt (2001) add a different type of efficiency gain when they allow private schools to price peer externalities, a point I do not investigate here.

skimming by private schools of top students from the public schools. Again, three types of vouchers are analyzed: universally available vouchers, vouchers targeted only to residents of district 1, and vouchers targeted to the poorest families (i.e., those earning below $25,000 per year). Naturally, without the second counteracting force, the presence of just private school cream-skimming implies that vouchers will have a tendency to lower public school quality, although—perhaps surprisingly—not always and not primarily in the district in which vouchers are being taken up. The subsequent section then considers two types of potential efficiency-enhancing forces resulting from increased competition—forces that will tend to produce results more favorable for those interested in promoting vouchers.

School Quality in the Absence of School Responses to Competition

Tables 5.7, 5.8, and 5.9 present public school variables as well as private school attendance rates for each of the districts under different levels of the three types of vouchers for different public school funding systems (local, state, and a system calibrated to New Jersey). The cream-skimming effect of private schools is evident in the peer quality columns of these tables: Higher peer quality students tend to leave the public school system as vouchers are introduced, thus decreasing the average peer quality in the public sector. However, because of the mobility forces described above, the declines in public school peer quality are not as concentrated in school districts that experience a decline in public school enrollment and an increase in private school attendance. Rather, private schools are drawing high peer quality students from all public schools even though marginal private school–attending households reside in poorer districts as a result of moving to take advantage of more favorable housing prices. For the same reason, vouchers targeted to the poor district have impacts similar to untargeted vouchers so long as voucher levels are modest: Because marginal households who take up vouchers tend to move to the better neighborhoods in the poor district, the targeted nature of the voucher is relatively nonbinding as long as voucher levels are not too high.[31]

Whether or not public school quality declines, however, depends on whether or not the declines in average peer quality are offset by increases in per-pupil spending. In table 5.7 (under local financing), public school quality shrinks relatively uniformly in all three districts, whereas in table 5.8 (under state financing), public school quality is relatively unchanged in all districts (until voucher levels become high). The intuition for these results is straightforward: As vouchers push high peer quality households into private

31. The differences and similarities between district-targeted and universal vouchers are discussed in detail in Nechyba (2000). That paper also demonstrates formally the clear intuition emerging from the exercise that household income targeting has significantly different policy implications from district targeting, again because of the mobility forces that arise in a multidistrict public school environment. I return to this point in section 5.6.

Table 5.7 **Vouchers and Public School Quality under Local Financing and Cream-Skimming[a]**

	Peer Quality[c]			Per-Pupil Spending[d] ($)			School Quality[e]			Attending Private (%)		
Voucher Amount	Dist. 1	Dist. 2	Dist. 3	Dist. 1	Dist. 2	Dist. 3	Dist. 1	Dist. 2	Dist. 3	Dist. 1	Dist. 2	Dist. 3
All Eligible for Voucher[b]												
$0	0.2613	0.5142	0.6404	5,000	7,326	10,215	0.36737	0.61922	0.8183	30	20	10
$1,000	0.2292	0.4745	0.6000	5,000	7,593	9,768	0.34519	0.60734	0.77494	40	27.5	10
$2,500	0.2211	0.3036	0.5419	5,000	7,645	9,555	0.33934	0.49302	0.72985	62.5	40	12.5
$4,000	0.1054	0.1370	0.3373	5,000	5,000	9,388	0.23868	0.27033	0.57731	87.5	82.5	30
$5,000	—	—	0.2626	—	—	9,696	—	—	0.5321	100	100	37.5
Voucher Targeted to District 1 Residents Only[f]												
$0	0.2613	0.5142	0.6404	5,000	7,326	10,215	0.36737	0.61922	0.8183	30	20	10
$1,000	0.2097	0.4026	0.4943	5,000	7,065	9,539	0.33092	0.54088	0.69805	37.5	25	10
$2,500	0.2015	0.2984	0.4944	5,000	6,346	8,333	0.32471	0.44345	0.65029	70	40	10
$4,000	—	0.2174	0.3993	—	5,000	7,774	—	0.33663	0.56651	100	40	17.5
$5,000	—	0.2152	0.3937	—	5,000	7,777	—	0.33501	0.56283	100	40	19.8
Voucher Targeted to Families with Incomes below $25,000[g]												
$0	0.2613	0.5142	0.6404	5,000	7,326	10,215	0.36737	0.61922	0.8183	30	20	10
$1,000	0.2613	0.5142	0.6404	5,000	7,326	10,215	0.36737	0.61922	0.8183	30	20	10
$2,500	0.2104	0.4718	0.6404	5,000	7,381	10,146	0.33144	0.59675	0.8154	45	20	10
$4,000	0.1054	0.4142	0.6307	5,000	7,269	9,801	0.23868	0.55648	0.79494	82.5	25	7.5
$5,000	—	0.3993	0.6298	—	7,132	9,657	—	0.54144	0.78825	100	25	10

Note: Dashes indicate that figure cannot be computed given results elsewhere in row.

[a]These simulations introduce vouchers funded by the state through an increase in the state income tax sufficient to balance state budgets. A household can redeem the value of the voucher as part or all of tuition at any private school that will accept the household's child. All public schools are funded through local property taxes, and all local tax revenues go to only public schools. This set of simulations assumes cream-skimming by private schools and no responses from public schools to increased competition.

[b]This set of simulations assumes that vouchers are not restricted; that is, regardless of where a household lives and how much income that household earns, the household is eligible for the voucher.

[c]Peer quality is the average of peer characteristics (with parental income and child ability weighted equally) within the public school in a district.

[d]Per-pupil spending refers to spending within the public school in the district. A minimum level of $5,000 per pupil is assumed. The spending level is determined by majority rule voting on local property taxes in each district, with tax revenues in each district going solely to public schools in that district.

[e]School quality refers to public school quality as determined by the production function that incorporates both peer quality and per-pupil spending.

[f]This set of simulations assumes that vouchers are restricted to households who reside in district 1—the poorest district. Within district 1, all households are eligible regardless of household income.

[g]This set of simulations assumes that only households with incomes below $25,000 are eligible for vouchers.

Table 5.8 **Vouchers and Public School Quality under State Financing and Cream-Skimming[a]**

	Peer Quality[c]			Per-Pupil Spending[d] ($)			School Quality[e]			Attending Private (%)		
Voucher Amount	Dist. 1	Dist. 2	Dist. 3	Dist. 1	Dist. 2	Dist. 3	Dist. 1	Dist. 2	Dist. 3	Dist. 1	Dist. 2	Dist. 3
All Eligible for Voucher[b]												
$0	0.2826	0.5469	0.6470	7,195	7,195	7,195	0.46158	0.63161	0.6841	22.5	17.5	15
$1,000	0.2619	0.5688	0.5727	7,363	7,363	7,363	0.45063	0.65134	0.65346	30	10	25
$2,500	0.2570	0.5040	0.5652	7,781	7,781	7,781	0.45974	0.63306	0.66848	35	22.5	27.5
$4,000	0.2055	0.3117	0.4713	8,831	8,831	8,831	0.44182	0.53849	0.65535	62.5	40	30
$5,000	—	—	—	—	—	—	—	—	—	100	100	100
Voucher Targeted to District 1 Residents Only[f]												
$0	0.2826	0.5469	0.6470	7,195	7,195	7,195	0.46158	0.63161	0.6841	22.5	17.5	15
$1000	0.2762	0.5582	0.5962	7,336	7,336	7,336	0.46126	0.6443	0.66478	30	10	12.5
$2500	0.2529	0.5048	0.5969	7,416	7,416	7,416	0.44488	0.61776	0.66895	40	12.5	11.3
$4000	0.2208	0.3314	0.5447	7,904	7,904	7,904	0.43129	0.52304	0.66228	70	27.5	10
$5000	—	0.2301	0.3204	—	4,250	4,250	—	0.31755	0.37163	100	40	37.5
Voucher Targeted to Families with Incomes below $25,000[g]												
$0	0.2826	0.5469	0.6470	7,195	7,195	7,195	0.46158	0.63161	0.6841	22.5	17.5	15
$1,000	0.2826	0.5469	0.6470	7,195	7,195	7,195	0.46158	0.63161	0.6841	22.5	17.5	15
$2,500	0.2826	0.5469	0.6470	7,195	7,195	7,195	0.46158	0.63161	0.6841	22.5	17.5	15
$4,000	0.2521	0.5348	0.6470	7,293	7,293	7,293	0.44032	0.62939	0.68898	37.5	17.5	12.5
$5,000	0.2347	0.5247	0.6662	7,456	7,456	7,456	0.43059	0.63099	0.70677	52.5	17.5	10

Note: Dashes indicate that figure cannot be computed given results elsewhere in row.

[a]These simulations introduce vouchers funded by the state through an increase in the state income tax sufficient to balance state budgets. A household can redeem the value of the voucher as part or all of tuition at any private school that will accept the household's child. All public schools are funded equally (on a per-pupil basis) through a state income tax determined by majority rule. This set of simulations assumes cream-skimming by private schools and no responses from public schools to increased competition.

[b]This set of simulations assumes that vouchers are not restricted; that is, regardless of where a household lives and how much income that household earns, the household is eligible for the voucher.

[c]Peer quality is the average of peer characteristics (with parental income and child ability weighted equally) within the public school in a district.

[d]Per-pupil spending refers to spending within the public school in the district. A minimum level of $5,000 per pupil is assumed. The spending level is determined by majority rule voting on state income taxes, with tax revenues distributed equally on a per-pupil basis to all public schools.

[e]School quality refers to public school quality as determined by the production function that incorporates both peer quality and per-pupil spending.

[f]This set of simulations assumes that vouchers are restricted to households who reside in district 1—the poorest district. Within district 1, all households are eligible regardless of household income.

[g]This set of simulations assumes that only households with incomes below $25,000 are eligible for vouchers.

Table 5.9 **Vouchers and Public School Quality under New Jersey Funding System and Cream-Skimming[a]**

	Peer Quality[c]			Per-Pupil Spending[d] ($)			School Quality[e]			Attending Private (%)		
Voucher Amount	Dist. 1	Dist. 2	Dist. 3	Dist. 1	Dist. 2	Dist. 3	Dist. 1	Dist. 2	Dist. 3	Dist. 1	Dist. 2	Dist. 3
All Eligible for Voucher[b]												
$0	0.2684	0.4701	0.6989	6,652	7,910	8,621	0.43224	0.61778	0.78031	20	22.5	12.5
$1,000	0.2422	0.4698	0.6521	6,923	7,734	8,354	0.42038	0.61034	0.74267	32.5	22.5	15
$2,500	0.2212	0.4110	0.5910	7,054	7,221	8,111	0.40663	0.55251	0.69786	40	27.5	22.5
$4,000	0.1124	0.3302	0.4127	5,000	6,939	7,781	0.24608	0.48764	0.57573	67.5	40	30
$5,000	—	0.1425	0.2921	—	5,000	8,004	—	0.27544	0.49587	100	82.5	32.5
Voucher Targeted to District 1 Residents Only[f]												
$0	0.2684	0.4701	0.6989	6,652	7,910	8,621	0.43224	0.61778	0.78031	20	22.5	12.5
$1,000	0.2416	0.4623	0.5881	6,992	7,812	8,572	0.42207	0.60889	0.71673	35	22.5	12.5
$2,500	0.2183	0.3945	0.4916	6,859	7,696	8,210	0.39819	0.56029	0.6435	47.5	30	15
$4,000	0.1058	0.2772	.04122	5,000	7,102	8,114	0.23911	0.45426	0.5882	82.5	42.5	15
$5,000	—	0.2294	0.4097	—	6,910	7,761	—	0.40927	0.57297	100	47.5	17.5
Voucher Targeted to Households with Incomes below $25,000[g]												
$0	0.2684	0.4701	0.6989	6,652	7,910	8,621	0.43224	0.61778	0.78031	20	22.5	12.5
$1,000	0.2684	0.4701	0.6989	6,652	7,910	8,621	0.43224	0.61778	0.78031	20	22.5	12.5
$2,500	0.2684	0.4701	0.6989	6,652	7,910	8,621	0.43224	0.61778	0.78031	20	22.5	12.5
$4,000	0.1988	0.4365	0.6922	6,832	7,892	8,638	0.38009	0.59568	0.77755	40	22.5	12.5
$5,000	0.1438	0.4022	0.6856	5,000	7,834	8,551	0.27663	0.57076	0.76991	67.5	20	10

Note: Dashes indicate that figure cannot be computed given results elsewhere in row.

[a]These simulations introduce vouchers funded by the state through an increase in the state income tax sufficient to balance state budgets. A household can redeem the value of the voucher as part or all of tuition at any private school that will accept the household's child. All public schools are funded through a mix of local property and state income taxes under a formula replicating the New Jersey finance system in 1987. This set of simulations assumes cream-skimming by private schools and no responses from public schools to increased competition.

[b]This set of simulations assumes that vouchers are not restricted; that is, regardless of where a household lives and how much income that household earns, the household is eligible for the voucher.

[c]Peer quality is the average of peer characteristics (with parental income and child ability weighted equally) within the public school in a district.

[d]Per-pupil spending refers to spending within the public school in the district. A minimum level of $5,000 per pupil is assumed. The spending level is determined using the New Jersey financing system with voting taking place at the local level.

[e]School quality refers to public school quality as determined by the production function that incorporates both peer quality and per-pupil spending.

[f]This set of simulations assumes that vouchers are restricted to households who reside in district 1—the poorest district. Within district 1, all households are eligible regardless of household income.

[g]This set of simulations assumes that only households with incomes below $25,000 are eligible for vouchers.

schools, the political constituency for public school funding declines. At the same time, the exit of some into the private sector implies that those remaining in public schools now receive more per-pupil funding for any given tax rate—that is, voting for public school spending has just become cheaper. All else being equal, the first effect causes the median voter to prefer less public school spending, whereas the second effect causes him to prefer more. Under state funding, the latter effect outweighs the former, causing increases in per-pupil funding in public schools as voucher levels increase. The argument that vouchers result in a decrease in public school resources therefore holds only for peer quality and not for school spending once the political economy forces are taken into account under state financing, and the net effect is relatively unchanged public school quality. In table 5.7, on the other hand, public school quality in the poor district falls because per-pupil spending is determined by the constitutional minimum rather than the median voter and thus does not change to offset the decrease in peer quality. Effects in the other districts differ, with some experiencing an increase in quality and others a decrease. Finally, table 5.9 presents school outcomes for the New Jersey calibrated state funding system, a hybrid system that includes both local and state funding. Implications for public school quality are closer to those under the state system, primarily because of the fact that state aid in New Jersey insures that the poor district is not at some constitutionally minimum spending level but, rather, determined in a local public choice equilibrium. Only when more than 50 percent of the population attends private school in the poor district does public school quality suffer considerably.

Including both the multidistrict nature of public schools and a political economy model for the setting of public school spending therefore casts doubt on the common perception emerging from single-district, non-political-economy models that public schools are bound to decline in quality unless competition itself produces considerable efficiency gains. Here, the two additions to the model undo much of the negative effect of cream-skimming private schools by allowing those remaining in the public school system to free-ride on the contributions of others and to benefit from mobility forces that insure declines in peer quality will not be concentrated in only those districts that experience the biggest declines in public school attendance. While the model certainly does not rule out the possibility that public schools will suffer in the absence of competitive efficiency gains, it does suggest this effect to be smaller and less concentrated than one might have imagined. Variances in school outcomes (not reported in the tables) similarly do not change significantly.

School Quality When Public Schools Respond to Competition

The simulation results in the absence of a competitive efficiency effect can then serve as a benchmark, and any efficiency-enhancing impact of compe-

tition would be expected to improve the impact of vouchers (as in the single-district models; Manski 1992). Efficiency-enhancing effects could in principle come in many forms, but I focus in this section on two types of possible competition-induced changes in the production relationship. Essentially, the production function has two inputs, and competition could affect either one of these. In the case of peer quality, we have assumed thus far that only average peer quality matters. It is conceivable, however, that the variance matters as well. If two schools are identical in every way (i.e., average peer quality and average spending) except that school A has a greater variance in peer quality than school B, school B may well be able to more effectively target its resources to the student population's needs because those needs are more uniform across the student population. I will refer to this effect as *curriculum targeting.* In the case of spending, on the other hand, it is often argued that the marginal product of a dollar of spending will rise in public schools as those schools face greater competition. This effect will be referred to as *competitive efficiency gain.* Each of these effects is included in separate simulations reported below.

More precisely, tables 5.10, 5.11, and 5.12 present simulation results for universal, district-targeted, and household-targeted vouchers, respectively, for the case of both curriculum targeting and competitive efficiency gains. The curriculum-targeting effect is modeled as a constant ϕ in front of the school production function (2) that declines as the variance of peer quality increases,[32] and the competitive efficiency effect is modeled as a similar constant in the public school production function that rises in the percentage of private school attendance in all three districts combined.[33] Both of these changes in production functions affect only public schools, but each does so in a different way. The curriculum targeting is public school–specific in that it affects the production functions in different districts differently as school population variances changed. The competitive gain, on the other hand, affects all public school production functions similarly in that it provides an overall measure of the competitive pressures faced by the public system. These changes of course require recalibrations of various parameters of the model in order to replicate something close to the benchmark quantities in table 5.2. For the sake of brevity, I forgo a detailed discussion of this calibration process and instead simply note that the size of the two types of public school responses

32. This constant is $\phi = (1 - \lambda_1 * \text{variance})$ for all schools, where λ is calibrated jointly with ρ to match private school attendance rates in the absence of vouchers. Given zero variance in peer quality for private schools, the private school production function is effectively unchanged by this (i.e., $\phi = 1$ in equilibrium for all private schools).

33. This constant is $\phi = (1 - \lambda_2 * \text{PUB}^2)$ for public schools and $\phi = 1$ for private schools, where PUB is the fraction of the population attending public schools and λ_2 is calibrated jointly with ρ to match private school attendance rates in the absence of vouchers.

Table 5.10 **School Quality and Vouchers under New Jersey Calibration and Universally Available Vouchers**[a]

Voucher Amount	Public School Quality[c] Dist. 1	Dist. 2	Dist. 3	Average Private School Quality	Variance After/ Variance Before[d]	Attending Private School (%)
Schools Become More Efficient through Curriculum Targeting[b]						
$0	0.4167	0.5922	0.7761	1.1628	—	18.67
$1,000	0.4528	0.6012	0.7705	1.1167	0.9721	23.50
$2,500	0.4770	0.6216	0.7679	1.0335	0.9512	29.25
$4,000	0.4833	0.6277	0.7802	0.9411	0.9481	36.33
$5,000	0.4551	0.6014	0.7522	0.8623	0.9551	46.66
Schools Become More Efficient through More Efficient Resource Utilization[e]						
$0	0.4023	0.6121	0.7629	1.1711	—	19.25
$1,000	0.4127	0.6233	0.7771	1.1018	0.9891	24.33
$2,500	0.4273	0.6421	0.7849	1.0911	0.9821	27.25
$4,000	0.4351	0.6591	0.8033	1.0300	0.9755	32.66
$5,000	0.4391	0.6718	0.8116	1.0029	0.9812	33.00

[a]These simulations introduce vouchers funded by the state through an increase in the state income tax sufficient to balance state budgets. A household can redeem the value of the voucher as part or all of tuition at any private school that will accept the household's child, and all households—regardless of residence and income—are eligible for the voucher. All public schools are funded through a mix of local property and state income taxes under a formula replicating the New Jersey finance system in 1987. This set of simulations assumes cream-skimming by private schools and some responses from public schools to increased competition.

[b]The simulations involving "curriculum targeting" assume that school quality is related inversely to the variance in peer quality—that is, all else being equal, a lower variance in peer quality is better because teaching can be more targeted to particular student needs.

[c]Public school quality in this set of simulations is not only a function of public school spending and average peer quality, but also a function of the variance in peer quality within the school.

[d]This column reports the overall variance in school quality consumed by all children—those in public and private schools.

[e]Simulations invoking efficiency of resource utilization assume that the marginal product of a dollar in per-pupil spending in public schools increases with the level of private school competition (attendance). Private schools are assumed to use resources efficiently regardless of the level of private school attendance. Public school quality in this set of simulations is a function not only of per-pupil spending and average peer quality but also of the degree of private school competition (attendance).

modeled in the simulations I report represents the midpoint of a feasible range of such effects.[34]

34. The λ constants in the curriculum-targeting and the competitive gain formulations of production functions can of course be set at various levels and thus introduce competitive effects of various magnitudes. As alluded to earlier, the recalibration requires primarily a change in the value ρ—the strength of the peer quality as opposed to spending in production. More precisely, for any λ constant that is chosen for either the curriculum-targeting or the competitive gain specification, public school quality falls while private school quality remains constant. Maintaining benchmark levels of private school attendance requires lowering the value of peer quality in production, the factor that gives private school their other competitive advantage. There is, however, an upper bound to how high λ can be and still produce only

Table 5.11 **School Quality and Vouchers under New Jersey Calibration and District 1 Targeted Vouchers**[a]

Voucher Amount	Public School Quality[c]			Average Private School Quality	Variance After/ Variance Before[d]	Attending Private School (%)
	Dist. 1	Dist. 2	Dist. 3			
Schools Become More Efficient through Curriculum Targeting[b]						
$0	0.4167	0.5922	0.7761	1.1628	—	18.67
$1,000	0.4613	0.5892	0.7783	1.1218	0.9721	23.25
$2,500	0.4852	0.5923	0.7811	1.0613	0.9512	26.12
$4,000	0.4925	0.6011	0.7734	1.0015	0.9481	26.12
$5,000	0.4727	0.5985	0.7692	0.9476	0.9551	35.25
Schools Become More Efficient through More Efficient Resource Utilization[e]						
$0	0.4023	0.6121	0.7629	1.1711	—	19.25
$1,000	0.4096	0.6186	0.7685	1.1102	0.9932	24.25
$2,500	0.4111	0.6322	0.7774	1.1033	0.9906	26.00
$4,000	0.4171	0.6556	0.7813	1.0731	0.9843	29.50
$5,000	0.4219	0.6555	0.7938	1.0663	0.9892	30.25

[a]These simulations introduce vouchers funded by the state through an increase in the state income tax sufficient to balance state budgets. A household can redeem the value of the voucher as part or all of tuition at any private school that will accept the household's child, but only households who reside in district 1 qualify for the voucher. All public schools are funded through a mix of local property and state income taxes under a formula replicating the New Jersey finance system in 1987. This set of simulations assumes cream-skimming by private schools and some responses from public schools to increased competition.

[b]The simulation involving "curriculum targeting" assume that school quality is related inversely to the variance in peer quality—that is, all else being equal, a lower variance in peer quality is better because teaching can be more targeted to particular student needs.

[c]Public school quality in this set of simulations is not only a function of public school spending and average peer quality, but also a function of the variance in peer quality within the school.

[d]This column reports the overall variance in school quality consumed by all children—those in public and private schools.

[e]Simulations invoking efficiency of resource utilization assume that the marginal product of a dollar in per-pupil spending in public schools increases with the level of private school competition (attendance). Private schools are assumed to use resources efficiently regardless of the level of private school attendance. Public school quality in this set of simulations is a function not only of per-pupil spending and average peer quality but also of the degree of private school competition (attendance).

Table 5.10 focuses on curriculum targeting where improvements in public school production processes hinge on each school's variance in peer quality. Since migration patterns are similar to those discussed in section 5.4.1, this effect is most pronounced in district 1, which experiences the greatest decline in student population and with it the greatest increase in peer quality homogeneity. As a result, public school quality rises most in district 1,

modest private school attendance levels in the absence of vouchers. The simulations reported here set the λ constants in both the curriculum-targeting and the competitive gain specification of production processes to be the midpoint between this upper bound and the lower bound of zero.

Table 5.12 **School Quality and Vouchers under New Jersey Calibration and Vouchers Targeted to Households with Incomes below $25,000[a]**

Voucher Amount	Public School Quality[c] Dist. 1	Dist. 2	Dist. 3	Average Private School Quality	Variance After/ Variance Before[d]	Attending Private School (%)
Schools Become More Efficient through Curriculum Targeting[b]						
$0	0.4167	0.5922	0.7761	1.1628	—	18.67
$1,000	0.4167	0.5922	0.7761	1.1628	1.000	18.67
$2,500	0.4167	0.5922	0.7761	1.1628	1.000	18.67
$4,000	0.4439	0.5881	0.7734	1.0872	0.9822	21.85
$5,000	0.4623	0.5793	0.7702	0.9763	0.9719	27.33
Schools Become More Efficient through More Efficient Resource Utilization[e]						
$0	0.4023	0.6121	0.7629	1.1711	—	19.25
$1,000	0.4023	0.6121	0.7629	1.1711	1.000	19.25
$2,500	0.4023	0.6121	0.7629	1.1711	1.000	19.25
$4,000	0.3827	0.6281	0.7774	1.1005	1.041	23.50
$5,000	0.3540	0.6411	0.7829	1.0324	1.0720	26.67

[a]These simulations introduce vouchers funded by the state through an increase in the state income tax sufficient to balance state budgets. A household can redeem the value of the voucher as part or all of tuition at any private school that will accept the household's child, but only households whose income is below $25,000 qualify for the voucher. All public schools are funded through a mix of local property and state income taxes under a formula replicating the New Jersey finance system in 1987. This set of simulations assumes cream-skimming by private schools and some responses from public schools to increased competition.

[b]The simulations involving "curriculum targeting" assume that school quality is related inversely to the variance in peer quality—that is, all else being equal, a lower variance in peer quality is better because teaching can be more targeted to particular student needs.

[c]Public school quality in this set of simulations is not only a function of public school spending and average peer quality, but also a function of the variance in peer quality within the school.

[d]This column reports the overall variance in school quality consumed by all children—those in public and private schools.

[e]Simulations invoking efficiency of resource utilization assume that the marginal product of a dollar in per-pupil spending in public schools increases with the level of private school competition (attendance). Private schools are assumed to use resources efficiently regardless of the level of private school attendance. Public school quality in this set of simulations is a function not only of per-pupil spending and average peer quality but also of the degree of private school competition (attendance).

although other districts experience a narrowing of the variance in their student population as well even though the total population in those schools does not decrease by as much. Average private school quality falls with increasing private school enrollment because the marginal private school choosers have lower peer quality and thus enjoy lower private school quality. Moreover, although those switching to private schools increase the overall variance in school outcomes, those remaining in public schools now experience higher school quality and thus bring about a counteracting narrowing in the overall variance of outcomes. Finally, since the public school responds under these simulations, private school attendance does

not rise as quickly with increases in voucher amounts as it does in previous simulations without competitive effects. Results are similar for district-targeted vouchers (table 5.11) as they are for universal vouchers, although private school take-up rates are predictably smaller when eligibility is restricted solely to one district. Similar forces also operate in table 5.12 for household-targeted vouchers, although changes are modest (or absent for low levels of vouchers) given the limited impact on migration discussed in the previous section.

The lower portions of tables 5.10, 5.11, and 5.12 offer simulation results under the assumption of a competitive effect. Here, the effect on public school production functions is the same across all public schools because the competitive pressure on the entire public school system is modeled, rather than school-specific effects (as under curriculum targeting). Thus, improvements in public schools are more uniform across all districts, and private school take-up rates are lower. Again, for the same reasons as under curriculum targeting, average private school quality falls as more households choose private schools. Moreover, the overall variance in educational outcomes falls slightly. A comparison of results for targeted versus universal vouchers gives rise to predictable differences in take-up rates under higher levels of the voucher.

The broad conclusion regarding school quality under vouchers in this model, is then, that the impact on average educational opportunities as well as the variance in such opportunities depends on what assumptions are made regarding the responses by public schools. In the base case in which cream-skimming by private schools was permitted but no competitive response on the part of public schools was assumed, average public school quality remains relatively constant under some public financing and declines slightly under others (unless voucher levels become very high).[35] When different types of competitive effects are included, on the other hand, both average public school quality and overall average school quality can rise substantially, and the variance in outcomes may drop somewhat. Impacts tend to be strongest for vouchers that induce large migrations, which occurs under universally available vouchers and even more so under district targeted voucher. Such migrations are, however, significantly more muted when vouchers are targeted to low-income households.

5.4.3 Robustness of Results on Segregation and School Quality

Finally, we return to the issue of residential segregation. In section 5.4.1, it was demonstrated that residential segregation can be affected significantly by the introduction of vouchers, especially vouchers targeted to poor districts. These results were arrived at in simulations that ignored any

35. Overall average quality, including private schools, was not reported but stays relatively constant or falls slightly in the benchmark cases. Overall variances rise as well.

potential competitive effects. Table 5.13 then provides comparisons of indicators of residential segregation for both centralized and decentralized public school systems when the two types of competitive effects we introduced in section 5.4.2 are included. These results indicate that the segregation effects raised in section 5.4.1 are robust to the inclusion of such effects.[36]

5.5 Empirical Foundation and Testable Implications

The simulations reported in section 5.4, and the model structure of section 5.3 that gives rise to these simulation results, offer a variety of predictions regarding the policy impact of expanded private school choice. Although it is difficult to test these predictions directly (due to the current lack of a sufficiently large policy experiment of this kind in the United States), the model itself does have testable implications that can be analyzed with current data, and some of the key foundations of the model can be empirically challenged. This section provides a brief discussion of both the empirical foundations and the testable implications arising from the model, and some of the available empirical evidence that speaks to these.

5.5.1 Foundations of the Model: Tastes, Housing Markets, and Mobility

In arriving at a model that has the potential to replicate both the current interdistrict differences in public school quality and the heterogeneity of income and property values within jurisdictions, two possible avenues are available to the economic theorist: First, he could model the outcome as a result of taste differences, where household tastes differ over housing or school quality, and both high- and low-income households settle in jurisdictions with similar school quality as a result.[37] This approach is put forth by Epple and Platt (1998), empirically implemented by Epple and Sieg (1999), and will henceforth be called the Epple-Platt-Sieg (EPS) approach. A second alternative approach—and the one taken in this paper—is to assume that households share preferences but the housing market, whether because of zoning regulations or historical evolution, offers only limited bundles of school quality and housing combinations. In particular, this approach assumes that low-quality housing is relatively more concentrated in some districts, which then results endogenously in relatively worse public schools in those districts. Both approaches can be reconciled with the data, but both contain underlying assumptions that are problematic for policy analysis. Below we discuss several of these as they relate to some other literature.

36. Results for public school finance systems calibrated to results for New Jersey show similar robustness but are not reported explicitly.

37. Without heterogeneity in preferences, this model results in perfect stratification of incomes across districts (Epple, Filimon, and Romer 1993).

Table 5.13 District 3/District 1 Variables for Different Assumptions Regarding School Quality

	No Private School Markets Permitted		Private School Markets Permitted									
					Nontargeted Vouchers[a]				District-Targeted Vouchers[b]			
			No Vouchers		Voucher = $2,500		Voucher = $5,000		Voucher = $2,500		Voucher = $5,000	
	Local[c]	Central[d]	Local[c]	Central[d]	Local[c]	Central[d]	Local[c]	Central[d]	Local[c]	Central[d]	Local[c]	Central[d]
School Quality Assuming No Adjustments from Public Schools												
Income[e]	4.874	4.079	2.126	2.074	1.735	1.704	1.715	2.255	1.458	1.521	1.202	1.331
Property[f]	3.859	3.796	2.392	2.667	1.590	2.465	1.472	1.683	1.484	2.372	1.053	1.287
Public Schools Become More Efficient through Curriculum Targeting												
Income[e]	4.505	4.188	2.076	2.033	1.798	1.921	1.832	2.119	1.397	1.510	1.193	1.279
Property[f]	3.791	3.586	2.222	2.512	1.553	2.213	1.394	1.762	1.427	2.181	1.081	1.231
Public Schools Become More Efficient through More Efficient Resource Utilization												
Income[e]	4.771	3.892	2.231	2.100	1.751	1.691	1.802	2.387	1.424	1.478	1.249	1.414
Property[f]	3.712	3.603	2.469	2.702	1.539	2.568	1.528	1.732	1.329	2.292	1.103	1.302

[a]Vouchers that are available for all households regardless of income or place of residence. Voucher amounts can be used as part of private school tuition, with parents able to pay additional tuition out of household funds.

[b]Vouchers that are available only to households residing in district 1—the poorest district. Voucher amounts can be used as part of private school tuition, with parents able to pay additional tuition out of household funds.

[c]Local financing through a property tax, with all revenues staying in the district.

[d]State financing through an income tax, with all public schools receiving equal per-pupil funding.

[e]Ratio of average income in district 3 (the wealthiest district) to average income in district 1 (the poorest district).

[f]Ratio of average property values in district 3 (the wealthiest district) to average property values in district 1 (the poorest district).

Housing Markets

The EPS approach treats housing as a good similar to other types of goods in that, at any particular location, consumption of the good can be changed in either direction as conditions change. From the urban economics literature we know, of course, that housing is a rather durable good, and although it is often possible to increase housing quantity or quality at a particular location, it is not similarly possible to decrease these (except through depreciation in the long run). The approach taken in this paper, on the other hand, models housing as entirely fixed and thus does not permit quality improvements of the kind that might be made under certain policy changes while precluding the unrealistic decreases in housing quantity allowed under the EPS model. Thus, one model seems to err in the direction of allowing too many types of changes in housing consumption at a particular location, whereas the other errs in the direction of permitting too few.

Empirical discussion of this issue is primarily embedded in the literature on local property taxation, with the "New View" of the property tax arguing for the EPS model of housing markets and the "Benefit View" arguing for a model similar to that in this paper.[38] As a result, the New View suggests that taxation of residential property is primarily taxation of all forms of capital because higher property taxes simply imply a fleeing of capital from housing to other uses, whereas the Benefit View argues that the local property tax, through both direct payments and capitalization effects, approximates a local benefits tax. Unfortunately, different versions of both these views are difficult to empirically distinguish, and much of the debate therefore centers on the degree to which zoning in fact keeps housing stocks at particular locations fixed. Thus, the literature offers little guidance as to which model is more correct.[39]

For purposes of analyzing the forces discussed in this paper, however, the latter approach has one distinct advantage over the EPS approach. First, to whatever extent a bias in the policy prediction is introduced, it is predictable that the bias is in the direction of making the forces weaker rather than stronger. In particular, the model predicts that vouchers, by disentangling housing and schooling choices and resulting in various general equilibrium price effects, will tend to cause middle- to high-income households to settle in poorer districts to send their children to private schools. High-quality housing in these districts is, of course, limited, and were these migrants to change housing stocks, they would be likely to improve them. This additional flexibility would cause migration forces to become more pronounced, thus causing predictions regarding mobility to represent a con-

38. Recent expositions of this debate can be found in Fischel (2001) and Zodrow (2001).

39. For a discussion of the difficulty in finding testable implications that distinguish between these views, see Nechyba (2001).

servative lower bound. It is not clear that a similar direction for the bias introduced by the EPS housing model could be determined were a similar policy exercise undertaken in such a model. In addition, the model employed in this paper allows for a calibration of housing quality to include various other neighborhood features (through the use of market prices in the calibration exercise) even though it then holds these features fixed as policies change. Here again, however, the assumption of fixed neighborhood features biases the predictions downward by not allowing middle- to high-income immigrants to low-income districts to improve local neighborhoods in ways other than schooling.

Differences in Tastes

Second, because of the perfect flexibility of housing choices at each location, the EPS model requires preferences to vary in order to generate heterogeneity of household income and house prices within districts.[40] Because housing markets themselves are calibrated to yield this within-district heterogeneity in this paper, no heterogeneity in tastes is required. Although taste heterogeneity could easily be introduced into the model used in this paper, it is preferable of course not to do so unless it is either necessary in order for the model to match the important features of the data or unless there is strong empirical evidence suggesting how such heterogeneity should be introduced. The empirical literature in this area is still evolving, although recent work by Bayer (1999) suggests that the hypothesis of persistent taste differences for education in different income or racial/ethnic groups can be largely rejected.

Mobility and School Choice

Much of what is reported in this paper would be of little value if school choice and residential choice were not indeed closely linked. However, the empirical evidence in this regard is overwhelming (and discussed in part earlier in the paper). Capitalization studies, starting with Oates (1969) and continuing with recent papers such as Black (1999), have consistently confirmed the importance of school quality in housing prices, thus providing evidence that housing choices are based in part on perceptions of local public schools. Even more recently, Figlio and Lucas (2000) provide fascinating evidence of how quickly this process happens as perceptions of public school quality change when new information is provided.[41] Similarly, discrete choice studies have linked residential location choices more di-

40. In the absence of such heterogeneity in tastes, households segregate perfectly into districts (Epple, Filimon, and Romer 1993).

41. The state of Florida began assigning grades to school in order to determine who qualifies for school-targeted vouchers under the new statewide voucher initiative. Figlio and Lucas demonstrate the immediacy with which seemingly new information that is revealed affects prices, and how these prices change as additional information becomes available.

rectly to the costs of living in particular school districts and the benefits from local public school quality.[42] The notion that households consider school quality when choosing residences is therefore rather uncontroversial, and the model in this paper simply assumes that this consideration of school quality does not change under new policy regimes. The only remaining issue is the speed with which it is reasonable to assume mobility to play out, an issue difficult to analyze in the static model of this paper. It is unlikely, for instance, that households would respond immediately by changing residences, but with mobility rates (for non-school-related reasons) as high as they are in the United States, the process may be shorter than otherwise expected.

5.5.2 Testable Implications

Section 5.5.1 was concerned with direct challenges to the foundations of the model underlying the simulation results. We now turn to consider more directly the testable implications of this model. A variety of such implications regarding mobility, segregation, private school formation, and school quality changes from increased choice policies arise from the simulations in section 5.4, but these cannot be tested directly without a large policy experiment. Several other related implications, however, are testable and are discussed below.

Voting on Voucher Initiatives

The model has rather straightforward predictions regarding the distribution of benefits from voucher policies. Benefits arise in two areas: First, households with high peer quality can more easily improve the school quality of their children by choosing private schools, and other households may benefit from better public schools if a competitive effect of the types incorporated into some simulations arises. Second, every household—whether in the public or private system—is affected through changes in household wealth as housing prices change dramatically. Results from the model suggest that, for most households, the latter effect may outweigh the former—at least for versions of the model that do not include a large competitive efficiency improvement from increased choice. More precisely, the model predicts that homeowners in good public school districts will tend to experience large capital losses, whereas homeowners in poor school districts will tend to experience large capital gains.

The empirical implication for homeowners is therefore straightforward: One would expect support for broad-based private school vouchers to vary inversely with local public school quality. Of course, a similar implication for homeowners arises from a different model that simply generates a greater desire for vouchers in districts with worse public schools because

42. See Nechyba and Strauss (1998) and references therein as well as Bayer (1999).

parents in those districts are more dissatisfied with public education. The two models can be empirically distinguished, however, by drawing a distinction between renters and owners who are similarly affected by public schools but differently affected by changes in property values. In particular, renters in poor school districts would be adversely affected by higher rents resulting from vouchers under the model in this paper, whereas renters in good school districts would benefit from lower rents. At the same time, renters and homeowners go to the same public schools and thus would not differ in their support for vouchers under the alternative model.

Thus, the testable implication arising from this model is that renters and homeowners will differ in their support for vouchers, with homeowners in good districts opposing vouchers due to the fear of capital losses and homeowners in poor districts favoring vouchers due to anticipated capital gains. Renters would be expected to exhibit the reverse preferences, with those in good school districts looking forward to lower rents and those in poor districts anticipating higher rents. These implications are formalized by Brunner, Sonstelie, and Thayer (2000) and tested for the case of the California statewide voucher initiative that was defeated in the election of 1994. Their results provide strong evidence for the hypothesis that homeowners in good districts voted against vouchers to protect their property values. When implications regarding renters versus homeowners are tested against an alternative hypothesis, the analysis provided no additional conclusive evidence one way or another.

Residential Location, School Choice, and Family Size

Although the model assumes each family has a single child, the implications of the model for families with different numbers of children is straightforward but, to my knowledge, remains untested. In particular, the choice of private school is one that brings with it a relatively constant marginal cost per child, whereas this may not be the case for the choice of high-quality public schools to which a family can gain access by residing in that school's district. A family with three children, for instance, must pay roughly the same private school tuition for each of its children if private schools are chosen, whereas the same family pays a lump-sum "capitalization fee" when choosing a house in the good public school district. Of course, house size also increases with family size, and thus the marginal cost of sending an additional child to public school is not zero. Nevertheless, it is likely to be less than private school tuition,[43] which gives the implication that, all else being equal, families with more children would choose good public schools whereas families with few children would more likely choose private schools in poorer public school districts.

43. In principle this can also be tested, and, were it not the case, the implication would run in the opposite direction.

Evidence from Current Experiments

Although private school choice experiments in the United States at this point are too small to give rise to effects such as those simulated in this paper, there are other types of choice arrangements for which the model has similar testable implications. For instance, large numbers of charter and magnet schools in various states do not use the residence-based admissions criteria so common in the rest of the public school system. Although clearly different from private school choice in that no tuition requirements are made of parents and various regulations inhibit the more extreme forms of cream-skimming, the introduction of such choice vehicles within the public system does weaken the link between residential and school choices. If such arrangements are widespread in a given geographic region, then mobility and price effects similar to those predicted in the simulations of section 5.4 should emerge.

Similarly, public school choice programs (such as those in Minnesota)—to the extent that they offer true choice rather than having good public schools close their doors by claiming capacity constraints—similarly alter the link between residential location and school choice. As a result, a model similar to that applied to private school choice in this paper would suggest capitalization effects that reflect this change. Research on this topic, to my knowledge, has been limited, although Reback (2002) provides evidence that mobility forces of the type raised in section 5.4.1 may play an important role.

Finally, the model offers predictions regarding private school formation, residential segregation, housing price differences, and so on for different types of state funding systems for public schools, but these are explored elsewhere (Nechyba 1999, forthcoming). Given the diversity of such state systems as well as their changing nature over the past few decades, such state differences provide yet another opportunity to test predictions other than those related to increasing choice. One notable test comes out of the 1970s California experience, when school finance changed rapidly and gave rise to a large number of private schools in a relatively short period of time. Downes and Greenstein (1996) present evidence on these private school formations and particularly the location of new private schools. Consistent with predictions arising from the model in this paper, they show that private schools tended to form in lower-income districts and near poorly performing public schools.

5.6 Policy Implications

The large policy implication emerging not only from the simulations reported in this paper but also from the broader research project referenced throughout is that, given the evidence that the links of residential, political,

and school choices are strong in the current system, these links are potentially important for a variety of school finance policies, including the proposal of expanding choice through vouchers. When models abstract away from these links, the debate on vouchers becomes a stylized argument over which of two forces—the cream-skimming of private schools or the efficiency enhancements of increased choice—is likely to dominate. As a matter of theoretical exploration, limiting models to considering only some forces in isolation is, of course, extremely valuable and has provided numerous insights, some of which are included in the simulation exercises above. However, as a matter of policy analysis, forces that are best analyzed in isolation for conceptual clarification must ultimately be analyzed in a single framework.

The exercise in this paper is therefore one of expanding the framework within which we analyze the merits of vouchers to include components that move us away from a narrow debate and toward utilizing empirical facts that are less controversial than those asserted in much of the debate. These facts include (a) the current public school system is far from a homogeneous ideal and full of inequities that are commonly acknowledged in the literature; (b) these inequities are due largely to a linkage of residential and school choices that offer real school choice to only those who can afford to live in multiple types of school districts; (c) the forces that have shaped current schools under the current choice environment are unlikely to change as choice is expanded; (d) political processes are important and will probably continue to be important in setting school spending and thus school quality differences; and (e) private schools arising from voucher policies are likely to search out high peer quality students over low peer quality students. It is only after finding implications from these primitives that we have moved on to consider additional forces that are more controversial.

5.6.1 Winners and Losers from Vouchers

Most policies have clear winners and losers. In the case of private school vouchers, however, the problem of identifying precisely who wins and who loses is not an easy one. The analysis in this paper offers an opportunity to suggest which households are likely to definitely win, which might win under different assumptions, and which are most likely to lose. The gains and losses to households in the model arise from two different effects: First, most households will experience some change in the school quality consumed by their children, and, second, homeowners are likely to experience capital gains or losses as changing school choice affects market prices.[44] We can discuss each of these in turn.

44. A third avenue through which households are affected is through changing tax burdens, but we forgo a detailed analysis of these effects here. Furthermore, households already attending private schools benefit from lump-sum transfers through the voucher.

Winners and Losers in School Quality

With respect to winners and losers in terms of educational quality, the intuitions arising from this model are similar to those in the current single-district literature. Because private schools are assumed to gain a competitive advantage through their ability to exclude low peer quality students, it is clearly high peer quality students that are most likely to experience improvements in their school quality. In the context of the model in this paper, peer quality arises from both family income and child ability. Thus, relatively high ability children from high-income households who do not choose private schools before vouchers are put in place are the first to benefit from higher private school quality. Conversely, low-ability children from low-income households are likely to see little benefit or modest declines in their school quality as either public schools decrease in quality or they are forced to choose a private school with only their peer type. Similarly, low-ability children from higher-income households do not switch to private schools unless voucher amounts become high, and they, too, experience similar modest declines in their public school quality. The main additional insight offered by the model here over previous single-district models is that declines in public school quality are likely to be spread across districts even if private schools themselves arise primarily in poor districts, and because of this they are not likely to be as large as might otherwise be predicted (or may in fact be absent for some school financing systems). An important caveat to this, however, is that a restriction of vouchers to only poor households (as opposed to a targeting to poor districts) gives rise to sharper losses for public schools in poor districts once vouchers are taken up at high rates, and competitive effects are not readily spread to other districts whose populations do not qualify for the voucher regardless of where they move.

The prediction becomes significantly more rosy, however, as competitive effects are introduced. Since public school quality now generally increases, all children can in principle benefit from the introduction of vouchers. The precise nature of this competitive effect is, of course, important, as is the nature of the voucher itself. Particular concern for children who remain in poor public schools is warranted both because they are most likely to suffer in the absence of a competitive effect within the context of this model, and because of empirical evidence from abroad suggesting the possibility that choice may leave those children behind even when benefiting most other children.[45] Furthermore, the simulations suggest that vouchers limited only to low-income families (as opposed to low-income districts) carry with them a bigger potential threat to public schools in the poorest districts. The ambiguity regarding the likely impact of vouchers on those children that re-

45. In particular, Fiske and Ladd (2000) present compelling evidence that this has occurred under the public school choice reforms in New Zealand.

main in low-income public school districts therefore suggests that voucher initiatives—especially those motivated by concerns for poor children—ought to be accompanied by strong efforts to independently improve public schools in those districts. Additionally, the insights regarding migration effects that are uncovered in this model suggest that district targeting is a much more effective way of limiting eligibility than household targeting, both on efficiency grounds (because district targeting spreads the competitive effect throughout the public school system) and on equity grounds.

Winners and Losers in Housing Markets

Winners and losers in housing markets are more easily identified. As already discussed in the section on "Voting on Voucher Initiatives," and despite the fact that renters are not specifically included in the model of this paper, we can predict from the results in this model that homeowners and renters are affected differently.[46] In particular, homeowners in good districts experience relatively large capital losses while homeowners in poor school districts experience capital gains. Renters, of course, do not experience such gains and losses. Finally, to the extent that neighborhood effects may spread beyond school buildings, the desegregating effect of vouchers may have additional benefits for poor districts that are not modeled in this paper.

5.6.2 Implications for Targeting Vouchers

After the failure of broad-based vouchers to pass the political test in several state referenda, it now seems likely that voucher policies, to the extent that they will be enacted, will be targeted in some way. Current experiments at the city level are following that pattern with only low-income families qualifying for vouchers, and the only statewide plan to pass a legislature and be enacted (in Florida) has targeted vouchers to underperforming schools, as does the Bush proposal at the national level. However, the two kinds of targeting—toward low-income households or low-income or underperforming schools—are predicted to have very different implications within the framework of this paper.

More precisely, vouchers targeted to low-income families have little impact in the context of this model unless the voucher amount is set quite high. The reason for this is that household-targeted vouchers do not unleash similar mobility and capitalization effects because moving would have little value to anyone whose income is too high to receive the voucher. District targeting, on the other hand, creates the incentive to move in order to take advantage of private schools. Vouchers targeted to low-income households would therefore not give rise to the forces that a multidistrict model picks

46. Including renters does not alter the positive predictions of the model significantly because the capital gains and losses for homeowners (which are absent for renters) produce only income effects that do not alter behavior in major ways. Renters would have similar incentives to settle in poor districts if they choose private schools.

up, and single-district models illustrating the trade-offs between cream-skimming private schools and benefits from competition would give predictions similar to models of the kind employed in this paper. The clear policy implication, then, is that higher response rates are to be expected from district targeting than from household targeting, and these are likely to have greater efficiency and equity-enhancing consequences.

5.6.3 Designing Politically Feasible Vouchers

The difference in implications for different types of targeting thus rests on the fact that district targeting takes advantage of mobility forces whereas household targeting does not, and this may lead policymakers to view district targeting as a more effective tool to infuse competition into the public school system. On the other hand, this difference makes district targeting considerably less politically palatable to the population as a whole unless large competitive gains in public schools are expected. More specifically, district targeting affects homeowners in ways very similar to no targeting at all, with homeowners in wealthy districts suffering and homeowners in poor districts gaining. If voters are aware of such effects when expressing political preference for or against vouchers (as Brunner, Sonstelie, and Thayer 2000 suggest California voters were in 1994), homeowners in good school districts are almost as likely to be opposed to district-targeted vouchers as they are to universal vouchers. Put differently, targeting to households instead of districts would in effect isolate homeowners in such districts from capital losses.

Thus, the same factors that cause district targeting to be a more potent policy tool are likely to make it politically more difficult to implement. A trade-off between policy impact and political feasibility therefore emerges for policymakers. This trade-off is unlikely to be optimally resolved at either extreme (i.e., pure district targeting or pure household targeting) and is more likely to involve a combination of district targeting with income phaseouts. To the extent that higher-income households are ineligible for vouchers, this reduces the mobility and capitalization effects but may increase their willingness to agree to the proposal. On the other hand, if competitive effects are sought, these too are diminished as income phaseouts become more severe. A detailed analysis of this trade-off is, however, beyond the scope of this paper.

5.6.4 Short Run versus Long Run

A final issue worth raising involves the timing of changes and their impact. The model in this paper has little to offer in regard to this because it does not include a multiperiod analysis during which households adjust to policies. Rather, the model provides a snapshot of the prevoucher world and another of the postvoucher prediction but is not equipped to analyze the transition. The most critical issue is, of course, that of the speed at which

mobility forces come into play. Although I have cited evidence that price adjustment to new education-related information are relatively fast, residential moves are typically undertaken for multiple reasons, with education being only one. Thus, a likely transition would include household relocations for a variety of job- or family-related reasons, where the considerations related to schools come into play once the decision to move has been made on other grounds. As a result, those predictions related to mobility are likely to take some time to unfold and require reasonable confidence on the part of households that policy changes are not just transitory.

In the short run, it may therefore be prudent to place some weight on results emerging from single-district models in which residential location is, in effect, assumed to be fixed. As is mentioned throughout this paper, this would imply considerably more negative short-run effects of vouchers because the more positive effects arise primarily from multidistrict considerations. In addition, voucher take-up rates would be considerably more muted in the short run, and decreases in public school quality more concentrated. Therefore, although the model has little to offer in terms of predicting the length of time between short-run and long-run effects, it does suggest that a full evaluation of the impact of large-scale voucher programs will require a considerable period of maintaining the policy in place.

5.7 Conclusion

In summary, this paper has placed the previously analyzed forces related to private school vouchers into a multidistrict context that is capable of more accurately establishing a prevoucher benchmark from which to conduct policy analysis. I have then argued that this gives rise to a number of general equilibrium effects that are important to such an analysis. Two main conclusions emerge: First, most voucher policies have profound implications for how the broader set of choices that households make are undertaken and how residential districts are likely to evolve, with vouchers offering a large potential for reducing income segregation across district boundaries. Second, the likely impact of private school vouchers on public school quality depends on a number of assumptions regarding public school responses, assumptions that all remain controversial. Under the more pessimistic set of assumptions, public school quality may suffer as a result of vouchers, although this decline would not be as large or as concentrated as predicted by a narrower single-district analysis. Under more positive assumptions, on the other hand, public school quality may improve through private school competition. In one case, overall school quality (including private schools) remains relatively unchanged, with clear winners and losers (in terms of educational opportunities), whereas in the other cases both average quality and the variance in quality can improve significantly. Since the potential losers (in terms of school quality) under the more

pessimistic assumptions of the model are the very poorest children who remain in public schools in poor districts, an important implication arising from these simulations is that caution would dictate that strong efforts to independently improve public schools in poor districts accompany any vouchers intended to help poor children. Similarly, the simulations suggest a more hopeful picture for vouchers targeted to districts rather than vouchers that are targeted to households. More empirical analysis is, of course, required in order to narrow the range of likely school quality outcomes under different types of voucher policies.

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