PUBLIC SCHOOLS FINANCE AND URBAN SCHOOL POLICY:
General vs Partial Equilibrium Analysis

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1. Introduction

The effects of alternative approaches to educational finance on public school quality have attracted substantial attention from researchers and policy makers. Much of this analysis, however, focuses narrowly on the effects of financial resources on school quality in the absence of behavioral adjustments to policy changes. In contrast, this paper examines the relationship between school financing methods and school quality in a framework that explicitly links public finance issues, housing markets and school quality. In the framework employed here, the quality of a school varies with its financial resources and the quality of students (and their families) that attend the school. Student and family quality in turn depend on both the ability with which school children arrive at school as well as the economic status of their parents who may be able to contribute in other ways to local schools. Households vote for public school spending and pay taxes to support schools, and they may respond to changes in school financing policy by moving or placing their children in private schools. Thus, household responses to policy changes not only cover a broad range of options but also interact with the choices of other households – because school quality depends on who else attends local schools, because local housing prices and private school markets reflect overall changes in demand, and because local voting on public school spending is affected by all these changes.

Using this framework, I focus on three widely-examined policy changes – shifts from local to state financing, changes in state aid formulae, and state-funded vouchers. The main finding is that the indirect (general equilibrium) effects of policy changes on school quality – for example, those that arise from households moving and hence the quality of neighborhoods and students changing, or those that arise from parents choosing to shift their students from public to private school or vice versa – tend, in many cases, to dominate the direct (partial equilibrium) effect on the amount of financial resources devoted to schools. In many ways, this should not be surprising. Public school institutions shape the way many households decide where to live and where to send their children to school, and changes in these institutions alter the fundamental trade-offs faced by families as they make these choices.

This principal finding has several key implications for the analysis of educational finance issues. First, urban housing markets and residential mobility play an important role in determining the impact of many school finance policies. Given the strong link between housing markets and access to public schools, an analysis of policy should include an explicit recognition of changes in these markets brought about by household mobility. Second, the existence of private schools, and the extent to which parents are willing and able to shift their students from the public to the private sector, imposes constraints on the impacts of public school policies. In the presence of an active private school market that might respond to changes in public school policies, a focus on only public schools is furthermore incomplete as it ignores the impact of public school policies on a significant number of children. Third, the existence of likely behavioral responses to policies and the link of schools to neighborhoods place severe limits on the extent to which equalizing school financial resources will result in equalizing school outcomes. This implies that the court-driven focus on spending inequalities may have excessively narrowed policy discussions to only one dimension of a multi-dimensional problem. Finally, the results in this paper suggest that – to the extent that they accurately forecast the general equilibrium effects of school finance policies, many households will be more affected by changes in their wealth (through changes in housing values) from changing school finance policies than through changes in educational opportunities for their children. This adds an important dimension to the political economy analysis of proposals such as school vouchers which would adversely impact the wealth of those who are likely to be disproportionately influential in the political process. In many cases, the politics behind school policy making may thus have less to do with schools and more with property values.

The advantages of the framework employed in this analysis include the ability to examine effects of alternative policies within a single, internally consistent model and to isolate the relative importance of each channel through which effects occur. With key structural parameters of the model matched to real world data in order to successfully replicate important features of real world communities and schools, the resulting computational model is used to conduct policy experiments that explicitly trace out not only the immediate impact of large policy changes but also the long run impact of changes in the economic environment in which households make choices about schooling. While this makes possible an explicit comparison of partial equilibrium and general equilibrium effects within a single framework, the assumptions made are in some cases tenuous enough to recommend caution in interpreting results as absolute predictions.

The analysis begins below by outlining the main features of the modeling framework. The next section examines the effects of the three types of policies mentioned above and decomposes the results into direct and indirect effects. I then discuss a series of caveats to interpreting the model. A final section concludes.

2. An Economic Model of Equilibrium Differences in Public School Quality

The effects of school reform depend in part on the underlying causes for current public school quality differences. Two such possible underlying causes are differences in parental tastes for education and differences in parental information regarding public schools – either of which could cause parents to choose different types of schools. This paper takes a different approach in that it explains differences in public school quality by incorporating explicitly the political and economic environment within which parents make educational choices.[i]

Although public schools are "free" in the sense that they do not charge tuition, access to each public school is typically restricted to those who consume housing within the attendance zone (or district) of that school.[ii] Housing markets are such that not all house qualities are available in all school districts – thus limiting options for some families. Furthermore, the housing market capitalizes public school quality – thus explicitly introducing "tuition" to public schools through a housing price premium in the better school districts. Finally, public school inputs are at least partially linked to local community characteristics, with higher income communities likely to spend more per pupil as well as contribute more to the local public school in non-pecuniary inputs such as teacher quality, peer quality, parental involvement, etc.[iii]

An economic model that does not rely on preference or information differences in explaining large inter-district variances in public school quality must therefore explicitly include empirically relevant levels of household income inequality and a housing market with uneven distributions of housing quality across districts, and it must allow for household mobility across districts. In addition, the model must contain some empirically relevant mechanism for funding public schools as well as a private school market that can account for observed levels of private school attendance. Each of these features is incorporated in this paper's underlying model.

2.1. The Structural Model

The underlying structural model accurately replicates a number of stylized features of public schools and local public finance (Nechyba 1997a,b, 1999, 2000, 2003). It begins with a continuum of households N where each household is endowed with one house, a child with a given ability, an income level and preferences over private consumption, neighborhood and house quality, and school quality consumed by the household's child. The main features of the model can then be summarized as follows:

- Preferences of all households are assumed to be identical[iv] but incomes, house endowments and abilities differ across households

(with income imperfectly correlated with child ability). The total number of different household types is 1,500.

- Houses are divided exogenously into neighborhoods. All houses in a neighborhood share the same quality and neighborhood characteristics, and collections of neighborhoods form school districts. There are three school districts – high-, middle- and low-income – each with five neighborhoods. House quality distributions potentially overlap across jurisdictions. The model takes the housing stock as given rather than explaining its evolution over time.

- Schools produce educational quality by combining per pupil spending with peer inputs,[v] and all schools – public and private – face the same production technology. Per pupil spending levels are determined through majority rule voting in public schools and through competitive price setting in private schools. The "peer input" contributed to a school by a household includes a component related to household income (proxying for non-pecuniary inputs) and a separate component related to child ability.

- Private schools have two competitive advantages over public schools: they can set a level of per pupil spending (which is equal to tuition) that reflects the desire of parents more closely, and they can select from student applicants. This gives rise to the effect that private schools seek to "cream skim" from public schools by choosing only high peer quality households. At the same time, public schools have the advantage that they are free to anyone living within the district boundaries.[vi]

The strategy in the line of research from which this paper draws is to begin by assuming there are neither efficiency gains from increased competition nor any private school advantages in school production.[vii] While these assumptions can easily be relaxed, this paper documents the relative importance of general equilibrium effects in the absence of such factors. In other work I have demonstrated that an introduction of such effects – while changing the *absolute* predictions, does little to alter the *relative* importance of the general equilibrium effects (Nechyba, 2002a, forthcoming).

2.2. Using Data to Inform the Model

The data used to calibrate the model is from the New Jersey suburbs of New York City. School districts are divided into high income, middle income and low-income districts in such a way as to have roughly equal population in each of the three stylized categories. Average characteristics of districts falling into these three categories are used to represent the stylized high income, middle income

and low-income districts in the model. A complete description of the data sources is given in Nechyba (forthcoming).

In calibrating the model, the following stylized features are matched by the calibration algorithm:

- House and neighborhood quality parameters are set so as to replicate the distribution of house prices observed in the data. This calibration method implicitly incorporates the impact of local externalities and public amenities into the house quality parameters of the model. Table 1 provides the calibrated house quality parameters for each of the house types in the model.

- The income distribution is set to approximate the empirical distribution observed in the data. The child ability distribution is set so as to produce a 0.4 correlation with household income (suggested to be an upper bound in Solon (1992) and Zimmerman (1992)).

- Household utility weights placed on private consumption and school quality are set so as to replicate the correct levels of public school spending set through majority rule voting.

- A household's peer quality is determined by an equal weighting of the household's income with the child's ability level (in a Cobb Douglas process). Sensitivity analysis that varies the relative weights on child ability and household income shows that the relative magnitudes of general equilibrium effects are largely unaffected by this weighting.

- The school production function is assumed to have constant returns to scale but requires a minimum of $5,000 per pupil in expenditures.[viii] The weights placed on per pupil spending and peer quality inputs are set so as to replicate the levels of private school attendance we observe.[ix] The model implicitly assumes that peer contributions to school production are such that mixing of different peer quality students results in higher overall school quality than separating peers.

Finally, the benchmark model uses the New Jersey school financing formula, while the later simulations in Section 3 introduce new public school financing methods holding fixed the structural parameters calibrated with the New Jersey formula and New Jersey data. Table 2 provides some key features of the data and compares them to the replicated results from the benchmark equilibrium. Most of the features in the data are replicated well by the calibrated structural model, with the level of private school attendance in district 3 being one notable exception in part because the model does not include household incomes above $200,000. Such households would always choose private schools in the model, and their inclusion would eliminate half the difference between the actual and the predicted

private school attendance rates in district 3. Given that these households – were they included explicitly – would not be on the margin of either moving or changing schools under different policies, the results of the simulations in Section 3 would be largely unaffected by expanding the model to include such households.

2.3. Economic Forces Driving the Equilibrium[x]

Having determined the structural parameters to be used in policy simulations, it is now worthwhile to briefly explore with some stylized examples how general equilibrium forces unfold in the model. In order to focus on the link between public schools and residential housing markets, the first row of Table 3 therefore begins by simulating the distribution of households and housing prices when all households choose private schools and no public schools exist.[xi] The purpose is not to discuss this as a serious policy alternative but rather to determine where households would live and what prices they would pay for housing when there are no price distortions that arise from the coupling of public schools with residential location. The results suggest that a substantial amount of residential income segregation exists simply because of housing quality differences between districts.[xii]

The second and third rows of the table then report results from the other extreme: no private schools are permitted and only public schools operate (funded locally in row 2 and funded centrally in row 3). Thus, while no bundling between school and residential location choices exists in row 1, the bundling is complete in rows 2 and 3. This bundling – whether accomplished through a locally or a centrally financed system – introduces substantial distortions in housing prices. In poor districts, houses are depressed as they capture the low school quality (see Table 4) while in rich districts they are inflated due to high school quality. This then introduces substantial increases of segregation beyond what one would expect from inter-district housing differences alone (see row 1). *The precise method of financing public schools is thus quite secondary to the bundling of public schools with residential location and urban housing markets.*

Finally, rows 4 and 5 of Table 3 introduce the combination of a public and private system - - again for both locally and centrally financed public schools. The difference between rows 2 and 3 on the one hand and rows 4 and 5 on the other is striking: Not only does the introduction of private schools into a publicly financed system lessen income segregation, it actually causes income segregation in the model to become less than it would be simply due to housing quality differences between districts. When private schools are allowed, demand for housing in district 1 rises as private school attending households seek to take advantage of low housing prices that are (for them) not linked to poor public schools. Similarly, demand for housing in district 3 declines as some households who would pay high house prices when housing is bundled with public schools now "un-bundle" their choices by choosing private schools in the poor district where housing is cheap.

This raises the price of housing in poor districts relative to rich districts, but not to the point where it would be if housing were not connected to public school access (as in row 1). Thus, the new equilibrium provides incentives to middle and high income households to reside in poor districts while sending their children to private schools. Table 4 provides additional school-related information for each of these simulations.

While public finance institutions thus matter for such outcomes as public school quality differences across districts, the link between residential housing and public school access matters just as much if not more. Even under full financial resource equalization through centralized school financing, substantial inter-jurisdictional differences in public school quality remain – and they remain precisely because equalization takes place within an urban environment in which other economic forces are at work. Therefore, both public finance institutions and urban housing markets – as well as the interaction of public and private school markets – ultimately are key to an analysis of urban school policy. And, not only do these matter independently, they are likely to interact in important ways. Public school financing institutions, for instance, can strengthen or weaken the connection of public school access to residential location, and it can cause growth or shrinkage in the private school market. It is to these interactions that I now turn for different types of state public finance policies.

3. School Finance Policies: Partial vs General Equilibrium

In each section below, I begin with a fully decentralized public school system financed solely through local property taxes determined within each district through majority rule voting. I then consider the impact of different types of reforms under different assumptions about the responsiveness of households in the model. First, I report how public school spending, public school quality in each district, and average public and private school quality combined (in each district) change when no economic response by households occurs. Second, I consider how these outcomes change when household residential location and schooling choices are held fixed but voting behavior adjusts. Finally, I report the full general equilibrium outcome when households fully adjust and prices are allowed to change to support the new equilibrium. Two points are emphasized throughout: First, in some cases the general equilibrium responses are significant. Second, when policies result in households switching to or away from private schools, it may be important to consider the impact of reforms not just on the public school sector but rather on the overall education sector (including private schools).

3.1. Centralization and Equalization of Public School Financing

I begin in this section by investigating the partial and general equilibrium effects of an extreme change in public school financing – from a purely decentralized,

property tax finance system to one in which the state fully equalizes expenditures across districts and funds expenditures through a state income tax. Table 5 reports three key outcomes under the different assumptions regarding the responsiveness of households in the model. For each outcome, the local property tax equilibrium is reported next to the results for the policy change to facilitate comparisons.

First, consider the impact on spending. The simulation results labeled "No Behavioral Change" assume that the state government is able to maintain the pre-reform average spending in public schools but now spreads that spending equally across districts. The "Partial Equilibrium Voting" column, on the other hand, assumes that – holding voters fixed at their pre-reform location, equalized state spending has to be approved through majority rule voting. This effect by itself then lowers spending by approximately six percent because of the well known effect caused by the skewedness of the income distribution. Under decentralized voting, the median voter in each district is pivotal, while under state-wide voting, the median state voter determines the outcome. In a stylized Tiebout model, this implies that average spending in the state is determined by *mean* state income under decentralization while it depends on *median* income under centralization.[xiii] So long as the median is lower than the mean (which is the case in real world income distributions such as the one modeled in this exercise), this implies that majority rule will lead to lower average spending under centralization than under decentralization.

Finally, the third column labeled "Full General Equilibrium" shows an additional 1.5% drop in average spending in public schools when the full general equilibrium effects unfold. This additional decrease in spending is due to a reduction in overall private school attendance as public school finances are centralized – thus leading to an increase in public school attendance and a decline in per pupil spending. This increase in private school attendance under centralization is counterintuitive in the sense that most would expect the decrease in local choice from centralization to lead to an increase rather than a decrease in private school attendance. However, as demonstrated more fully in Nechyba (2003), the conventional intuition is incomplete because it does not consider two effects that may in fact lead to a decrease in private school attendance as financing of public schools is equalized. First, a *direct* effect occurs in the poor district where public school quality improves as a result of centralization and thus leads to switching away from private schools. Second, an *indirect* effect (which is twice the magnitude of the direct effect in the model presented here) unfolds through general equilibrium adjustments in housing prices. As the cost of housing rises in poor districts (because of higher prices due to better public schools and because of the de-coupling of tax burdens from location choice), households that previously chose private schools in part because it allowed them to consume cheap housing in poor districts now have less of an incentive to continue in the private sector. These two effects combine in the model to result in an increase in public school attendance under centralization – and thus a decline in per pupil spending.[xiv]

The next set of columns in Table 5 then reports the impact on perceived public school quality. Here, the differences between models that assume no behavioral change and those that fully incorporate all general equilibrium effects are not dramatic. In all cases, centralization leads to a narrowing of public school quality differences across districts - - primarily because of equalization of spending. As peer compositions within public schools change in the general equilibrium, little additional change takes place. The increase in public school quality in districts 1 and 2 between the partial equilibrium and the full general equilibrium is in the range of 2-3% and is due solely to an increase in peer quality in these schools as children previously in private schools in district 1 switch to public schools because of the general equilibrium effects in the housing market. In the case of centralization of public school financing, the main effects therefore seem centered around what happens to public school spending. And because of the decline in public school spending, overall public school quality (averaged across districts) declines by about 4% despite the increase in peer quality within the public schools.

The last set of columns in Table 5 tells a somewhat different story. These columns differ from the previous set in that they now include in the average district school quality figures the role of private schools within each district. First, note that, while *public school quality* in district 1 rises by 22% in the full general equilibrium model, *overall school quality* in district 1 rises by only 6% because private school attendance falls from 30% to 22.5% -- and this increase is half what it would be had we not considered the full set of behavioral changes implied by the general equilibrium model. Overall school quality for all children in the state declines by an amount roughly similar to the decline in public school quality, but the distribution of the decline is different when private schools are included. In particular, the ratio of *public* school quality in district 3 to that in district 1 declines by 50% (from 2.23 to 1.48), with this decline being disproportionately due to an *increase* in public school quality in district 1. The ratio of *overall* school quality in district 3 to that in district 1, however, falls by only 21% (from 1.53 to 1.26) but with this decline being disproportionately due to a *decrease* in overall school quality in district 3 (with only a small increase in district 1). *When viewed through the lens of only the public school system, centralization thus leads to a substantial narrowing of inter-district quality differences primarily because schools get better in poor districts. However, when viewed through the lens of the combined public and private school system, the narrowing of inter-district average school quality occurs primarily because of a reduction in school quality in the rich districts.*

3.2. State Grants-in-Aid

The extremes of full decentralization and full centralization modeled in the previous sections are rarely found in school systems in the U.S. Rather, most states have designed complicated formulae for determining state aid. This results

in “hybrid” systems of partial local funding (typically through the property tax) combined with some state funding (typically funded through state income or sales taxes). I therefore proceed in this section to providing some examples of state grant programs to investigate how partial and general equilibrium effects may impact an analysis of such hybrid systems. In particular, I begin with a comparison of state block grants (of $3,000 per pupil) to all school districts with a state matching grant program that requires roughly the same level of state funding. (The latter simulations match local spending by 40 cents for every dollar of local spending.) I then proceed to an analysis of more targeted state aid, again simulating both block and matching grants. It is well understood that block and matching aid have rather different built-in incentives, with the former giving rise to an income effect while the latter adds a substitution effect because it changes the relative price of funding local schools. In addition, however, these programs have general equilibrium effects that have not typically been treated in policy analysis. In each case, the results are presented (in Tables 6 and 7) in a format similar to that used in Table 5 of the previous section.

3.21. State Wide Grants

The top half of Table 6 provides simulation results for the introduction of a $3,000 per pupil state block grant to all districts. The first column in each sub-section (labeled “No Behavior Change”) simply assumes districts will spend an additional $3,000 per pupil with no change in voter or household behavior. Naturally, a large increase in public school (and overall school) quality would then take place. The second column in each subsection (labeled “Partial Equilibrium Voting) assumes voters now vote on local taxes knowing that the state will provide an additional income-tax funded grant, but no additional household behavior changes are allowed. In district 1, per pupil spending then falls back to its original level while it changes slightly in the other districts. As a result, overall public school quality rises slightly. Finally, the third column in each subsection (labeled “Full General Equilibrium”) includes household behavior changes – which include most notably a small shift out of private schools and into public schools[xv] accompanied by small changes in house prices that cause additional marginal adjustments in household location choices. The full general equilibrium effect on public school quality is marginal, with the exception of district 3 where the small switch of high peer quality households to public schools causes a significant increase in public school quality. Overall school quality changes similarly, for a small overall gain in school quality from the state block grant program. The inter-district variance in both public and overall school quality, however, increases.

What are marginal changes for block grants turn into much more significant changes under a matching grant program that results (in full equilibrium) in the same level of state spending as a $3,000 block grant. Again, the initial column simply assumes that local taxes remain constant under the block grant, but because of the substitution effect arising from the change in the relative price of

public school spending, the "naïve" initial estimates of spending increases are essentially correct for districts 2 and 3. Only in district 1 does public school spending not rise as much when political adjustments by voters are taken into account (primarily because the constraint of a minimum spending level of $5,000 was initially binding on district 1.) Thus, the partial equilibrium political adjustment predicts substantial increases in public school quality, especially in districts 2 and 3. Finally, the full equilibrium adjustment results in additional large changes. With public school quality increasing in all districts, substantial switching from private schools into public schools as well as migration of previous private school attending households from poor districts to wealthier districts takes place as house prices adjust to reflect changes in public schools.[xvi] However, the decline in private school attendance in district 1 does not result in a large influx of high peer quality households into district 1 public schools because over two thirds of those leaving the private schools in district 1 migrate to other districts to use public schools there. Thus, the full equilibrium simulations suggest small additional increases in public school quality in districts 1 and 2 and large increases in district 3. Overall school quality (which incorporates the impact of the disappearance of good private schools) actually drops by 12% in district 1 (even though public school quality rises by almost 9 percent), while it increases by over 30% in district 3.

The primary message from Table 6, then, is that *universal state aid programs that are not targeted to struggling districts may result in some overall improvements in school quality but may simultaneously cause significantly larger inequities across districts*. A $3,000 block grant raises public school quality by barely 3% in district 1 while raising it by over 10% in district 3. Similarly, overall school quality (including that provided by private schools) falls slightly in district 1 while rising by over 9% in district 3. For matching grants the results are even more dramatic. Partial equilibrium results that do not incorporate the general equilibrium household adjustments in residential location and private school choice tend to understate these effects.

3.22. Targeted State Aid

Table 7 then turns to grants specifically targeted to poor public school districts – those represented by district 1 in the model. The top part of the table reports results from a $7,000 per pupil block grant to district 1 public schools, while the lower part focuses on results from an equally funded matching grant targeted only to district 1 with the aim of achieving the same level of spending in district 1 public schools as would emerge from the $7,000 targeted bock grant. Districts 2 and 3 remain funded solely through local property taxes.

Column 1 in each subsection again assumes no adjustment by voters or households. It is noteworthy that even under this "naïve" assumption – implying an increase of fully $7,000 (under the targeted block grant) in per pupil spending in district 1 with no change in spending in other districts, public school quality in

district 1 would still not have risen to the level of public school quality in districts 2 and 3 (which spend considerably less). The calibrated production function of the model gives a substantial role to spending in public schools, but *there is a limit in how much spending alone can accomplish*. Furthermore, the political adjustment (holding all other household behavior fixed) implies that spending from heavily funded state programs targeted at poor districts will rise considerably less than dollar for dollar.

Since programs modeled in Table 7 are strictly targeted to only the poor district, one might initially think that a partial equilibrium analysis may in fact not fall far short of a more general equilibrium approach. This, however, does not seem to be the case. In fact, a series of general equilibrium effects is set off by the introduction of such targeted grant programs causing the effects of these programs to spill over into private school markets, housing markets and public schools in other districts. Specifically, with schools improving substantially in district 1 under the partial equilibrium assumptions, and with property taxes falling as states pay for public schools, depressed housing prices rise in that district. This causes marginal private school attending households (previously residing in district 1 to take advantage of low house prices to send their children to private schools) to emigrate to other districts – often switching to their public schools and replacing residents that valued schooling less.[xvii] Substantial declines in private school attendance then occur particularly in district 1 but also in districts 2 and 3 as public schools there improve both through more spending (because of a larger political constituency for schools) and a better public school peer group. Despite the state block grant being targeted solely at district 1, the general equilibrium model predicts increases in per pupil public school spending of 10%-16% in the other districts. This spending increase is accompanied by in increase in public school peer quality within districts 2 and 3 (from households who previously attended private schools in district 1), pushing public school quality in those districts up by between 12% and 15%. Public school quality in district 1, on the other hand, is virtually unchanged from its partial equilibrium level as only few households switch from private schools in district 1 to the public school in that district.

Compared to results for a universal $3,000 block grant analyzed in Table 6, the targeted $7,000 block grant in fact achieves universally preferable outcomes in terms of school quality (while requiring significantly less state funding.) This is not the case under a partial equilibrium model where only district 1 experiences a higher public and overall school quality under the larger targeted program than under the smaller universal grants. However, when the full general equilibrium effects are taken into account, both public and overall school quality levels are substantially higher in *all* districts under the targeted program. *The significantly larger general equilibrium effects for the targeted program arise precisely because the program is targeted – and thus causes larger relative price changes than a non-targeted program.*

An additional surprising result appears when targeted block grants are compared to targeted matching grants that result in the same level of public school spending in district 1. Since matching grants continue to require local property tax effort, general equilibrium increases in housing prices in district 1 are more muted, thus setting off smaller overall general equilibrium effects. While private school attendance also falls by similar magnitudes, the decline is different because it involves significantly less migration between districts than what arises under a targeted block grant. Average public school and overall school quality then do not change nearly as much as under a targeted block grant aimed at achieving the same increase in public school spending in district 1. *Thus, while partial equilibrium adjustments in public school quality are more dramatic under a matching formula, general equilibrium adjustments are significantly larger under block grants. Overall, then, it seems that extending the analysis of school finance reforms from a partial to a general equilibrium context becomes more important the more targeted the aid programs are and the more they contain block rather than matching elements.*

3.3. State-Funded Vouchers

A final set of state funded school reforms that is gaining increasing attention encompasses the state funding of private school vouchers or other state funded choice programs.[xviii] Table 8 focuses on state income tax funded private school vouchers. For this set of school finance policies, the general equilibrium effects are more immediately apparent and have been explored in more detail elsewhere (Nechyba 1999, 2000, 2002a,b, forthcoming). In this section I simply illustrate the impact of two types of vouchers, both set at $2,500 per pupil. The first type is unrestricted with any household eligible, while the second type is restricted to only those households residing in poor districts.[xix] For purposes of the analysis that follows, a voucher is defined as a state subsidy of $2,500 or the full private school tuition (whichever is lower) for households choosing to send their child to a private school.

The first two columns under each sub-section of Table 8 differ slightly from those in the previous tables while the rest of the table follows a similar format. In particular, columns labeled "Little Behavioral Change" allows private schools to adjust tuition levels (and thus spending levels) in response to the introduction of the voucher, but no adjustment on the part of households or voters is allowed. Columns labeled "No Migration Equilibrium" allows for both the adjustment of political choices by households and the formation of new private schools to meet any additional demand by households seeking to switch from public to private schools in response to the voucher. However, no migration is permitted under this set of simulations. Finally, columns labeled "Full General Equilibrium" report simulations that allow for all household choices to change, including most importantly the choice over residential location.

The difference between a partial and a general equilibrium model are perhaps starkest for the case of private school vouchers. Since no additional state money is provided to public schools, no change in public school spending occurs under the first column in both voucher scenarios. With households permitted to switch to private schools in the second column (labeled "No Migration Equilibrium"), the potential for a change in per pupil spending in public schools emerges as those households that switch to private schools are assumed to no longer support taxes going to public schools. However, only in district 1 do any households switch to private schools. Since public schools in district 1 are already spending the minimum per pupil ($5,000), no further erosion in public school spending is possible.[xx] Public school quality, however, falls slightly in district 1 as higher peer quality families exit the public schools. At the same time, overall school quality increases in district 1 as the average quality of new private schools is higher than the public school quality. Similar increases in overall school quality occur in districts 2 and 3 even though no household switches to private schools because existing private schools raise their spending slightly[xxi] in response to the introduction of vouchers. Since only households in district 1 switch from public to private schools as a result of a voucher universally available in all districts, results are identical for the partial equilibrium simulations when vouchers are targeted only to district 1.

While partial equilibrium effects are therefore small, the general equilibrium effects reported in the last column of each subsection are quite large and driven almost solely by migration effects and house price adjustments. Given the depressed housing prices in district 1 (and the similarly inflated housing prices in district 3), *the model does not predict large increases in private school attendance unless households interested in switching from public to private schools are able to move in order to take advantage of lower housing prices when making the switch.* Thus, marginal households in districts 2 and 3 previously were willing to pay inflated housing prices in order to gain access to good public schools but are now more easily able to afford private school tuition. As a result, there is no reason for them to continue to pay relatively high housing prices when more housing of the same quality is available in district 1 at lower prices. Private school attendance in district 1 therefore increases dramatically (from 30% to 62.5% under the universal voucher and from 30% to 70% under the targeted voucher) primarily because of high peer quality households leaving public schools in districts 2 and 3 to reside in district 1 to use the voucher. Increases in private school attendance in districts 2 and 3 are more modest.[xxii]

One of the more notable findings from this line of research is that the feared negative impact of vouchers on public schools is strongest not in districts where the bulk of private school vouchers are used (district 1) but rather in districts from which the switchers from public to private school originate. Their loss in districts 2 and 3 causes declines in public school peer quality as well as declining political support for public schools (in district 3). While public school quality thus falls by 8% in district 1 under universal vouchers, it declines by 26% in district 2 and by

12% in district 3. Even more dramatically, under a voucher targeted solely to district 1, public school quality falls by 13 percent in district 1 – a modest effect compared to declines of 40% and 26% in districts 2 and 3. The impact on district 2 is particularly large because residents of district 2 can more easily find appropriate housing choices in district 1 as they switch to private schools than can residents of district 3 (because the house quality distribution of district 1 overlaps more with that of district 2 than with that of district 3.) *Migration and general equilibrium price effects then cause cream skimming by private schools to disproportionately impact public schools in districts other than those in which the vouchers are used, particularly middle income districts.* And, as in the previous section, these general equilibrium effects are stronger when the policy is targeted.

While it is certainly the case that the impact of private school vouchers on public schools is of independent importance, the last column of the table – reporting results for overall school quality (including private schools) – is nevertheless striking. Because of the disproportionate use of vouchers in district 1, average school quality in district 1 actually surpasses average school quality in district 2 and comes remarkably close to that of district 3. Given the results for public school quality, this clearly masks an enormous heterogeneity in school quality within the poor district between private and public schools. Nevertheless, if good private schools – and high peer quality households that choose them, have independent positive impacts (which are not modeled) on communities, the last column of the table may hold important other lessons for urban policy makers.

Although these results are striking, the importance of general equilibrium effect in general and in the case of vouchers in particular should not be all that surprising. Local policymakers have long been aware of the close connection between residential housing markets, local school quality and local tax rates. Each of the policies analyzed above has altered this connection in some way and has thereby given rise to general equilibrium effects that are often absent from policy analysis. In the case of vouchers, these effects are particularly large in comparison to partial equilibrium effects because vouchers most directly impact the key reason we identified in Section 2 for why public schools can be so different in equilibrium. This reason was found in the bundling of residential housing and school choices – a bundling that arises because of residence-based admission to local public schools. Vouchers, more than any other policy, un-bundle this connection by making it easier for households to separately choose housing and school quality. If the bundling is important (as I argued it must be), then unbundling must be important as well. The same forces play a similar but less dramatic role for the other types of school finance reforms we have analyzed.

Finally, it is noteworthy that overall (public and private) school quality is shown to decline with private school vouchers. This is a direct result of two assumptions in the model: First, the model assumes no competitive gains from increased competition. As noted earlier, if such an effect were included in the model (as in Nechyba (forthcoming)), the general equilibrium effects emphasized in this paper

remain while overall school quality would increase (as would public school quality in each district if the competitive effect is sufficiently large). Second, the role of peer inputs into the school production model is specified in such a way as to cause average school quality to increase (all else being equal) the more households with different peer quality mix within schools. Since private schools seek to skim high peer quality households from public schools, an increase in private school attendance implies less mixing of household types within schools. Again, it is shown elsewhere (Nechyba, forthcoming) that the general equilibrium effects emphasized here do not change if this model of peer inputs into school production is altered to make less mixing efficient -- but overall school quality would then increase with higher private school attendance.

4. Perceived and Real Limits of the Analysis

While the computational approach used in this paper provides a powerful engine for analyzing questions of the kind tackled here, the approach has inherent limits. Any structural model that attempts to merge all of the relevant economic forces for urban school policy must by definition make explicit assumptions that are almost certainly only crude approximations of complex real world processes. While – in the words of one commentator on this work – the engine that drives the analysis can be "intoxicating" by providing explicit numerical estimates for policy alternatives, it is thus not appropriate to interpret the results too literally. The advantage of the approach is that it provides a single, internally consistent method for comparing policies and tracing partial and general equilibrium effects, and it therefore provides a useful guide for thinking about the *relative* quantitative importance of different real world economic forces. At the same time, the assumptions made in the process of modeling complex forces are tenuous enough to recommend caution in interpreting results as firm *absolute* predictions.

4.1. Some Common Concerns and Misunderstandings

Some of the caution arises from technical details such as implicit elasticities embedded in functional form assumptions of preferences and production. The empirical literature has often not provided a firm sense of what these elasticities should be, and the approach therefore takes standard functional forms as a starting point. Sensitivity analysis suggests that the relative magnitudes of general and partial equilibrium results are unlikely to change dramatically as these implicit assumptions are changed. Similarly, concerns may arise from the assumption that housing stocks are taken as given in the model and do not change as general equilibrium effects cause migration of some households within and across districts. In other work (Nechyba 1999, 2000, forthcoming) I have argued that, while such concerns are certainly valid, the assumption actually tends to understate the kinds of general equilibrium effects highlighted in most of this paper. Thus, as housing stocks are more flexibly modeled, general equilibrium effects are likely to become more rather than less important.

The same is true for a concern that non-school related externalities from migration are not explicitly modeled as migration takes place. Some commentators, for instance, have mistakenly argued that the model assumes too high a willingness of households to move for lower housing costs because the model does not take into account such factors as the characteristics of neighbors, other neighborhood amenities, etc. Since housing prices are used to calibrate benchmark housing and neighborhood quality levels, all such factors *are* taken into account in the initial benchmark model because all such factors would indeed be capitalized into prices. While it is true that the model then holds non-school related neighborhood externalities fixed as migration occurs, any movement of high-income households into low-income areas would tend to *raise* non-school related neighborhood quality – thus increasing rather than decreasing the migration effects highlighted in many of the simulations. Thus, to the extent that policies like private school vouchers cause high-income households in the model to move to low income districts, the model *understates* rather than *overstates* the willingness of households to move. It is only in simulations where migration occurs from poor to rich areas that the exclusion of changes in neighborhood externalities would bias the general equilibrium results upward.

Finally, many of the results reported here highlight general equilibrium effects that include migration of households between districts as well as switching behavior from public to private schools or vice versa. Such effects would not emerge if households generally faced high moving costs, and concerns may arise that general equilibrium effects in the model depend too much on the assumption of an absence of such costs. I view such concerns as very valid in the short run but largely unimportant in the long run for urban economies in the U.S. American households move often – typically for reasons other than schools. Such moves occur because of job-related changes or because changes in family size or income dictate a discrete change in housing consumption. The appropriate interpretation of the mobility behavior observed in this paper is one that emphasizes that – as families move for a variety of reasons, the economic environment in which they make their new housing decision matters. School policy changes that environment – and thus alters the way in which housing and schooling decisions are simultaneously made as families find themselves moving for reasons that may have little to do with schooling. Given the frequency with which American families move, the "long run" in which these general equilibrium effects become important may then not be very long at all.

4.2. Some Effects that are Not Modeled but Might Be Important

Other concerns may arise from the fact that certain possible effects that are sometimes claimed but are not at this point firmly established empirically are excluded from the analysis reported here. For instance, the simulations reported here do not include a "competitive productivity effect" in public schools from increased private or public school competition. In other work (Nechyba 2002a, forthcoming) I have shown that the presence and *relative* size of the general

equilibrium effects highlighted in this paper are not affected by the inclusion of such a competitive effect, although the *absolute* value of school quality predictions *does* depend on it. Thus, in simulations of private school vouchers, for instance, public and overall school quality may well improve with vouchers if competition causes productivity gains in public schools (Nechyba, forthcoming), but the simulations reported in this paper do not show such an improvement because the competitive effect is not modeled. Similarly, it is sometimes argued that decentralized school finance results in better use of local information and thus higher school productivity than centralized finance. Again, while this may certainly be the case, the effect is not modeled here and may therefore affect the *absolute* value of some of the outcome variables even as the *relative* importance of partial and general equilibrium effects remains roughly the same.

Two additional features of the real world that are not modeled should add to our skepticism of the immediate applicability of the absolute predictions of the model to contemporary urban settings. First, the model currently does not include any heterogeneity in household preferences. In some sense, this is in part a strength of the current approach because it keeps out of the analysis any unnecessary appeal to preference heterogeneity in explaining heterogeneous outcomes within the public school sector. At the same time, however, measurable characteristics such as religious preferences of households are important determinants of school choices made by households. In fact, when religious heterogeneity is added to the model used in this paper, structural estimates demonstrate that this heterogeneity carries considerable explanatory power (Ferreya, 2002). Second, it is difficult to ultimately provide true predictions of the impact of school policies in urban settings unless not just income heterogeneity but also racial heterogeneity are modeled explicitly. The inclusion of race in the model used in this paper, however, remains – to the best of my knowledge -- a project for future research.

5. Conclusions

The approach taken in this paper has allowed for an explicit comparison of partial and general equilibrium effects from school finance policy reforms in a single, internally consistent framework that can successfully replicate important features of the data under current school finance policies. On a number of occasions, the approach has led to the conclusion that general equilibrium effects may alter conclusions drawn from a partial equilibrium analysis in surprising and large ways. This implies that school finance policy cannot easily be analyzed without explicitly taking the link to housing markets and private school markets into account. Furthermore, when analyzing the politics of school reform, it may be the case that policy change (or lack thereof) arises not so much because of the impact of such change on schools but rather because of the implied general equilibrium effects on housing values and thus household wealth distributions. In the case of vouchers, for instance, high-income residents in good school districts could suffer substantial capital losses while low-income residents in poor school district might experience capital gains.

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Table 1: Housing Quality Parameters in the Model

	House 1	House 2	House 3	House 4	House 5
District 1	0.820	0.882	0.930	0.978	1.021
District 2	0.872	0.930	1.002	1.032	1.085
District 3	0.930	0.950	1.063	1.182	1.267

Note: These values represent k_{dh} values in the utility functions $u(d,h,c,s) = k_{dh}c^{\alpha}s^{\beta}$ discussed in endnote vii. They were first reported in Nechyba (2003) and are discussed in more detail there.

Table 2: NJ Benchmark Equilibrium vs Data

	District 1		District 2		District 3	
	Model	Actual	Model	Actual	Model	Actual
Property Values[i]	$117,412	$157,248	$205,629	$192,867	$292,484	$271,315
Average Income	$31,120	$30,639	$46,216	$45,248	$65,863	$67,312
Public School Per Pupil Spending	$6,652	$6,702	$7,910	$7,841	$8,621	$8,448
Fraction Raised Locally	0.52	0.52	0.77	0.77	0.87	0.87
Peer Inputs	0.2684	---	0.4701	---	0.6521	---
Public School Quality	0.4322	---	0.6178	---	0.7803	---
% Attending Private Schools	20%	21%	23%	23%	13%	20%

[i] Property values are converted from annual flows (calculated in the computational model) using a 5.5% discount rate.

Table 3: Housing Markets, School Institutions and Residential Segregation

Private Schools Allowed	Public School Financing	Average District Income			Average District Property Value		
		Dist. 1	Dist. 2	Dist. 3	Dist. 1	Dist. 2	Dist. 3
Yes	None	$25,700	$50,175	$67,325	$158,327	$227,189	$266,474
No	Local Prop. Tax	$17,628	$39,647	$85,925	$101,683	$204,075	$392,402
	State Inc. Tax	$19,875	$42,250	$81,075	$102,086	$220,725	$387,549
Yes	Local Prop. Tax	$29,725	$50,262	$63,212	$123,224	$211,729	$294,825
	State Inc. Tax	$29,891	$51,309	$67,325	$118,486	$226,345	$316,308

Note: Values in this table are derived from portions of Table 3 in Nechyba (2002a) and Table 3 in Nechyba (forthcoming), with property values converted from annualized flows using 5.5% discount rate. This table also appears in Nechyba (2002b).

Table 4: Public and Private Schools in Stylized Systems

Private Schools Allowed	Public School Financing	Public School Quality			% Attending Private Schools		
		Dist. 1	Dist. 2	Dist. 3	Dist. 1	Dist. 2	Dist. 3
Yes	None	***	***	***	100%	100%	100%
No	Local Prop. Tax	0.3239	0.6024	0.9521	0%	0%	0%
	State Inc. Tax	0.3940	0.6244	0.9022	0%	0%	0%
Yes	Local Prop. Tax	0.3674	0.6192	0.8183	30%	20%	10%
	State Inc. Tax	0.4616	0.6316	0.6841	22.5%	17.5%	15%

Table 5: From Decentralized Local Property Taxation to Centralized Income Taxation and Equalized Spending

	Public School Per Pupil Spending				Average Public School Quality				Average School Quality (including Private Schools)			
	Local Property Tax Equilibrium	Centralized Tax, Equalized Spending			Local Property Tax Equilibrium	Centralized Tax, Equalized Spending			Local Property Tax Equilibrium	Centralized Tax, Equalized Spending		
		No Behavioral Change[i]	Partial Equilibrium Voting[ii]	Full General Equilibrium		No Behavioral Change[i]	Partial Equilibrium Voting[ii]	Full General Equilibrium		No Behavioral Change[i]	Partial Equilibrium Voting[ii]	Full General Equilibrium
District 1	$5,000	$7,731	$7,309	$7,195	0.3674	0.4618	0.4484	0.4616	0.5421	0.6082	0.5989	0.5755
District 2	$7,326	$7,731	$7,309	$7,195	0.6192	0.6370	0.6184	0.6316	0.6853	0.6995	0.6847	0.6904
District 3	$10,215	$7,731	$7,309	$7,195	0.8183	0.7070	0.6864	0.6841	0.8314	0.7313	0.7127	0.7267
All Districts[iii]	$7,731	$7,731	$7,309	$7,195	0.6204	0.6122	0.5943	0.5960	0.6863	0.6797	0.6654	0.6642

[i] This column assumes that the state income tax rate is set so as to keep average public school spending equal to what it is under decentralization.
[ii] This column assumes that voters approve a state income tax rate used to fund all public schools equally, but no household behavior changes are permitted.
[iii] This row calculates average statewide values. For public school figures, this is a weighted average of the remainder of the column where the weights are the fraction within each district that attend public schools. For overall school figures (the last set of columns), it is simply an average of the previous values in the columns.

Table 6: Grants-in-Aid: State Income Tax Funded Block and Matching Grants Provided Equally to All Districts

	Public School Per Pupil Spending				Average Public School Quality				Average School Quality (including Private Schools)			
	Local Property Tax Equilibrium	$3,000 Universal Block Grant			Local Property Tax Equilibrium	$3,000 Universal Block Grant			Local Property Tax Equilibrium	$3,000 Universal Block Grant		
		No Behavioral Change[i]	Partial Equilibrium Voting[ii]	Full General Equilibrium		No Behavioral Change[i]	Partial Equilibrium Voting[ii]	Full General Equilibrium		No Behavioral Change[i]	Partial Equilibrium Voting[ii]	Full General Equilibrium
District 1	$5,000	$8,000	$5,000	$5,000	0.3674	0.4704	0.3674	0.3781	0.5421	0.6142	0.5421	0.5384
District 2	$7,326	$10,326	$7,281	$7,267	0.6192	0.7415	0.6172	0.6042	0.6853	0.7831	0.6837	0.6756
District 3	$10,215	$13,215	$10,861	$10,545	0.8183	0.9368	0.8451	0.9056	0.8314	0.9309	0.8556	0.9098
All Districts [iii]	$7,731	$10,731	$7,958	$7,834	0.6204	0.7357	0.6298	0.6511	0.6863	0.7761	0.6938	0.7079
	Public School Per Pupil Spending				**Average Public School Quality**				**Average School Quality (including Private Schools)**			
	Local Property Tax Equilibrium	Equivalently Funded Matching Grant			Local Property Tax Equilibrium	Equivalently Funded Matching Grant			Local Property Tax Equilibrium	Equivalently Funded Matching Grant		
		No Behavioral Change[iv]	Partial Equilibrium Voting[ii]	Full General Equilibrium		No Behavioral Change[iv]	Partial Equilibrium Voting[ii]	Full General Equilibrium		No Behavioral Change[iv]	Partial Equilibrium Voting[ii]	Full General Equilibrium
District 1	$5,000	$7,000	$5,824	$5,373	0.3674	0.4383	0.3980	0.3992	0.5421	0.5917	0.5635	0.4821
District 2	$7,326	$10,256	$10,386	$10,062	0.6192	0.7388	0.7437	0.7575	0.6853	0.7810	0.7849	0.7880
District 3	$10,215	$14,301	$14,421	$14,042	0.8183	0.9765	0.9808	1.0951	0.8314	0.9738	0.9809	1.0934
All Districts [iii]	$7,731	$10,823	$10,569	$9,944	0.6204	0.7419	0.7317	0.7601	0.6863	0.7822	0.7764	0.7878

[i] This column assumes that any state block grant to the district simply raises total spending in the district by the amount of the block grant.
[ii] This column assumes that voters approve a new local property tax rate after learning of the state aid program.
[iii] This row calculates average statewide values. For public school figures, this is a weighted average of the remainder of the column where the weights are the fraction within each district that attend public schools. For overall school figures (the last set of columns), it is simply an average of the previous values in the columns.
[iv] This column assumes that local property taxes remain unchanged as the matching program is introduced and that the matched funds are simply spent on local public schools.

Table 7: Grants-in-Aid : State Income Tax Funded Block and Matching Aid Targeted only to District 1

	Public School Per Pupil Spending				**Average Public School Quality**				**Average School Quality (including Private Schools)**			
	Local Property Tax Equilibrium	$7,000 Block Grant to District 1			Local Property Tax Equilibrium	$7,000 Block Grant to District 1			Local Property Tax Equilibrium	$7,000 Block Grant to District 1		
		No Behavioral Change[i]	Partial Equilibrium Voting[ii]	Full General Equilibrium		No Behavioral Change[i]	Partial Equilibrium Voting[ii]	Full General Equilibrium		No Behavioral Change[i]	Partial Equilibrium Voting[ii]	Full General Equilibrium
District 1	$5,000	$12,000	$7,000	$7,000	0.3674	0.5817	0.4383	0.4457	0.5421	0.6758	0.5647	0.5704
District 2	$7,326	$7,326	$7,326	$8,496	0.6192	0.6192	0.6192	0.6883	0.6853	0.6763	0.6763	0.7350
District 3	$10,215	$10,215	$10,215	$11,211	0.8183	0.8183	0.8183	0.9369	0.8314	0.8319	0.8319	0.9416
All Districts[iii]	$7,731	$9,773	$8,314	$9,026	0.6204	0.6829	0.6411	0.7047	0.6863	0.7280	0.6910	0.7490
	Public School Per Pupil Spending				**Average Public School Quality**				**Average School Quality (including Private Schools)** (match=1.98)			
	Local Property Tax Equilibrium	Equivalent Matching Grant (match=1.98)			Local Property Tax Equilibrium	Equivalent Matching Grant (match=1.98)			Local Property Tax Equilibrium	Equivalent Matching Grant		
		No Behavioral Change[iv]	Partial Equilibrium Voting[ii]	Full General Equilibrium		No Behavioral Change[iv]	Partial Equilibrium Voting[ii]	Full General Equilibrium		No Behavioral Change[iv]	Partial Equilibrium Voting[ii]	Full General Equilibrium
District 1	$5,000	$9,938	$7,824	$7,021	0.3674	0.5269	0.4647	0.4721	0.5421	0.6537	0.6102	0.5578
District 2	$7,326	$7,326	$7,326	$8,461	0.6192	0.6192	0.6192	0.6423	0.6853	0.6853	0.6853	0.6997
District 3	$10,215	$10,215	$10,215	$9,324	0.8183	0.8183	0.8183	0.7855	0.8314	0.8314	0.8314	0.7855
All Districts[iii]	$7,731	$9,171	$8,555	$8,277	0.6204	0.6669	0.6488	0.6380	0.6863	0.7235	0.7090	0.6810

[i] This column assumes that any state block grant to the district simply raises total spending in the district by the amount of the block grant.
[ii] This column assumes that voters approve a new local property tax rate after learning of the state aid program.
[iii] This row calculates average statewide values. For public school figures, this is a weighted average of the remainder of the column where the weights are the fraction within each district that attend public schools. For overall school figures (the last set of columns), it is simply an average of the previous values in the columns.
[iv] This column assumes that local property taxes remain unchanged as the matching program is introduced and that the matched funds are simply spent on local public schools.

Table 8: Universal and Targeted State Income Tax Funded Private School Vouchers

	Public School Per Pupil Spending				**Average Public School Quality**				**Average School Quality (including Private Schools)**			
	Local Property Tax Equilibrium	$2,500 Voucher			Local Property Tax Equilibrium	$2,500 Voucher			Local Property Tax Equilibrium	$2,500 Voucher		
		Little Behavioral Change[i]	No Migration Equilibrium[ii]	Full General Equilibrium[iii]		Little Behavioral Change[i]	No Migration Equilibrium[ii]	Full General Equilibrium[iii]		Little Behavioral Change[i]	No Migration Equilibrium[ii]	Full General Equilibrium[iii]
District 1	$5,000	$5,000	$5,000	$5,000	0.3674	0.3674	0.3522	0.3393	0.5421	0.5481	0.5623	0.6318
District 2	$7,326	$7,326	$7,326	$7,645	0.6192	0.6192	0.6192	0.4930	0.6853	0.6963	0.6963	0.6187
District 3	$10,215	$10,215	$10,215	$9,555	0.8183	0.8183	0.8183	0.7299	0.8314	0.8452	0.8452	0.7396
All Districts	$7,731	$7,731	$7,731	$8,012	0.6204	0.6204	0.6160	0.5739	0.6863	0.6965	0.7013	0.6634
	Public School Per Pupil Spending				**Average Public School Quality**				**Average School Quality (including Private Schools)**			
	Local Property Tax Equilibrium	$2,500 Voucher to District 1			Local Property Tax Equilibrium	$2,500 Voucher to District 1			Local Property Tax Equilibrium	$2,500 Voucher to District 1		
		Little Behavioral Change[i]	No Migration Equilibrium[ii]	Full General Equilibrium[iii]		Little Behavioral Change[i]	No Migration Equilibrium[ii]	Full General Equilibrium[iii]		Little Behavioral Change[i]	No Migration Equilibrium[ii]	Full General Equilibrium[iii]
District 1	$5,000	$5,000	$5,000	$5,000	0.3674	0.3674	0.3522	0.3247	0.5421	0.5481	0.5623	0.6137
District 2	$7,326	$7,326	$7,326	$6,346	0.6192	0.6192	0.6192	0.4435	0.6853	0.6963	0.6963	0.5973
District 3	$10,215	$10,215	$10,215	$8,333	0.8183	0.8183	0.8183	0.6503	0.8314	0.8452	0.8452	0.6794
All Districts	$7,731	$7,731	$7,731	$7,115	0.6204	0.6204	0.6160	0.5271	0.6863	0.6965	0.7013	0.6368

[i] The only behavioral change permitted under these simulations is for existing private schools to alter their tuition level in response to the voucher.
[ii] Households can choose to switch to private schools and vote differently in the political process, new private schools can form and existing private schools can alter their tuition policies.
[iii] All household and private school choices can change in response to the changed economic environment.

Endnotes

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[i] A preference-based explanation for the existence of systematic public school quality differences is problematic so long as it remains divorced from an economic model of the local public finance and urban sector within which schools operate. In the absence of horizontal differentiation among schools, so long as all parents would prefer better schools to worse schools (even if the intensity of that preference differs across parents), all parents would in fact choose the best available public school for their child because no tuition is charged in public schools to select among parents who may value quality more than others. It is only when heterogeneous preference models are embedded into local public finance and urban models that less extreme heterogeneity can play a constructive role in identifying causes for public school quality differences (as, for example, in Epple and Sieg (1999)). Information-based explanations for differences in public school quality, on the other hand, are most plausible as stand-alone explanations for quality differences that are temporary rather than systematically present for long periods. While it may well be the case that reforms need to take account of the fact that information may be processed differently by different families, it becomes problematic to assume that some parents are consistently misinformed about which schools are good and which not when these differences persist over long periods.

[ii] Even when public schools are open for enrollment from outside the district, the better public schools are typically permitted to claim capacity constraints to prevent entry into the school from outside the district. It is noteworthy, for instance, that the Milwaukee school choice program is actually one that allows choice by inner city parents of suburban public schools – and offers financial incentives for those schools to accept students from outside. In the end, however, the program became a private school choice plan because no suburban school agreed to accept children eligible in the program.

[iii] The empirical literature suggests that this correlation between non-pecuniary inputs and household income as well as the value of such non-pecuniary inputs into production is significant. One standard assumption is that child ability is (imperfectly) correlated with household income – thus providing a non-pecuniary input to high-income schools. Teacher quality – while perhaps not costing more due to state collective bargaining agreements, tends to be higher in high income districts (Loeb and Page, 2000). And parental involvement and monitoring of public schools is significantly correlated with parental income (McMillan, 1999).

[iv] The functional form of the utility function is $u(d,h,c,s) = k_{dh}c^{\alpha}s^{\beta}$, where d indicates school district, h indicates house type or neighborhood, c indicates private consumption and s indicates school quality. The parameters α and β are calibrated so as to replicate per pupil spending levels in the data as those emerging from majority rule voting. Any choice of utility function such as this necessarily introduces implicit assumptions about behavioral elasticities, with Cobb Douglas forms such as this being no exception. As elasticities change, so will the magnitudes of the simulation results in tables such as those reported in this paper. In making benchmark functional form assumptions, Cobb Douglas functional forms represent typical starting points – and therefore they feature prominently on both the preference and the technology sides of this model.

[v] The school production function is $s=f(x,q)=x^{\rho}q^{(1-\rho)}$ where x is per pupil spending and q is average peer inputs in the school (with a minimum of $5,000 per pupil expenditure assumed to be necessary in order for a school to open.) Although the school production function literature is engaged in a debate over the degree to which financial resources (per pupil spending) matter for outcomes like test scores and graduation rates (see, for example, Hanushek (1999) and Krueger (1999)), this debate is not immediately relevant to the approach taken here as this approach defines school quality more broadly in terms of parental perceptions of school quality. While spending may or may not matter for narrower school outcomes, there exists ample evidence that parents place importance on school spending. In the context of this structural model, a lack of spending in the production function would result in equal spending in all schools – and would furthermore give such an advantage to private schools that public schools could not survive.

[vi] In practice, the main advantage that is important for private schools is the ability to set peer inputs. Note that the specification of the private school sector implicitly assumes a perfectly elastic supply of private schools – that is, if a private school of particular characteristics is demanded and can make positive (or zero) profits, it will be supplied. The private school market modeled here therefore represents a long-run market, with short run effects likely to include fewer private school market changes than predicted by the model.

[vii] Hoxby (2000) finds evidence for a competitive effect on public school productivity, and Neal (1997) documents higher productivity in Catholic schools for at least some populations.

[viii] The minimum expenditure requirement has two justifications: First, it is likely that states indeed require an implicit minimum spending level even when funding is purely local. Second, the computational algorithm to determine the equilibrium of the model becomes significantly more efficient if extremely low out-of-equilibrium spending levels are ruled out.

[ix] This determines precisely the relative weight that households in the model place on spending versus peers: if too much weight is placed on spending, private schools do not have a sufficient competitive advantage to be able to survive; on the other hand, if too much weight is placed on peer quality, private schools have too much of an advantage – thus not allowing the model to accurately replicate observed levels of public school attendance.

[x] This sub-section draws heavily on the discussion in Nechyba (2002b).

[xi] It should be noted that there always exists such an equilibrium (without public schools) in the model. This is because households are assumed to choose their political support for public schools after selecting whether to attend a private or a public school. In the absence of public schools, all households choose private schools. Given that they choose private schools, they will show now support at the ballot box for public schools.

[xii] Note, however, that because the model does not address the question of how housing quality stocks arose in the first place, this does not mean that the first row of Table 3 illustrates the level of segregation we would have had if no public school distortions had ever entered into the construction of housing. Rather, it simply demonstrates expected segregation levels in the absence of public school distortions *given* current housing quality in different districts.

[xiii] Under a stylized Tiebout model, residents segregate into districts based on their type – and districts are therefore homogeneous. Thus, within each district all households agree on the spending level and each household consumes its most preferred spending level. When decentralized spending levels are then averaged across the state, the average state spending level is simply the average of the most preferred spending levels by households. In a state election, on the other hand, households disagree on the best spending level, and the median household in the state is pivotal (assuming no exit from or entry into the private school sector).

[xiv] It should be noted that the model would predict an increase in private school attendance under centralization if centralization also led to a decline in public school efficiency (as is sometimes argued in the literature). In fact, the model – combined with empirical results in the literature -- suggests that it may indeed be likely that public school spending becomes less efficient the more spending is centralized and equalized. More precisely, radical centralization and equalization of public school spending seems to be correlated with higher private school attendance (as, for example, in California). The model of this paper suggests this could only happen if in fact an additional effect of decreasing public school productivity was at play.

[xv] Private school enrollment in districts 1 and 3 drops by 2.5 percentage points.

[xvi] Private school attendance drops by over 50% in district 1, from 30% to 12.5%, In districts 2 and 3, it drops by 50%.

[xvii] Private school attendance falls from 30% to 22.5% in district 1, from 20% to 15% in district 2 and from 10 percent to 7.5 percent in district 3.

[xviii] While this is not explicitly explored here, publicly funded charter schools – to the extent that they do not base admission on residential location -- would have general equilibrium effects similar to those reported here for private school vouchers.

[xix] The latter type of voucher (targeted to districts) is one that has been proposed at the national level by the Bush administration and has been passed at the state level in Florida.

[xx] In models where local public school spending is not at its minimum level, private school vouchers could actually have the effect of raising per pupil public school spending despite a decline in political support for

public schools because the existing public school budget is spread over fewer school children when many in the district attend private schools. In effect, the exit of some families into the private market makes per pupil spending cheaper – therefore acting like a matching grant for voters who continue to send their children to public school.

[xxi] The increase in spending in existing private schools is predicted to be small because the $2,500 voucher only gives rise to a small income effect for households who already choose private schools.

[xxii] Under both types of vouchers, private school attendance rises to 40% in district 2. In district 3, private school attendance rises from 10 to 12.5% under the universal voucher but does not rise under the targeted voucher.