PROSPECTS FOR ACHIEVING EQUITY OR ADEQUACY IN EDUCATION: The Limits of State Aid in General Equilibrium[1]

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1. Introduction

When thinking about policy issues and giving advice to policy makers, economists often rely on intuitions emerging from partial equilibrium models. For many issues this seems perfectly appropriate, but sometimes the issues on which we are asked to provide advice are so fundamentally general equilibrium in nature that partial equilibrium thinking can yield misleading conclusions. Education policy is a prime example. State and local education policy does not simply impact the educational opportunities children in current schools will have. By being reflected in real estate markets and housing prices, these choices alter the incentives that guide decisions parents make in terms of where to live, which school – public or private – to send their children to, and how to participate in the political process as it affects education. General equilibrium price effects can be large, as can the mobility effects that cause and support them. Furthermore, since it is now widely believed that the composition of the student (and parent) population in a school is an important determinant of the level of educational quality produced in that school, these general equilibrium decisions may have large impacts on school quality even if public school spending does not change appreciably.

This paper therefore analyzes different types of state government aid to education within the context of a single generally equilibrium model whose structural parameters are set so as to be consistent with important features of data on housing prices, income distributions across districts, school spending levels and private school market activity. I will argue that an understanding of general equilibrium effects of state education policy is important not only for predicting the impact of various policy options but also for appreciating the economic root causes of the current inequities within public schools in

the US. Section 2 therefore begins with an overview of how local public finance models can help us understand what economic factors must be important in order for large inequities in public education to persist in equilibrium. Section 3 then provides a quick, non-technical overview of a model (fully developed elsewhere) that incorporates these economic factors and successfully replicates important features of the data. This model is then offered as a tool capable of analyzing different types of state aid to education.

I begin the policy analysis in Section 4 by reporting on results that compare the equilibrium outcomes under a fully decentralized, property tax financed public education system to those under a fully centralized, equalized and state-income tax funded system. What is striking in those policy simulations is how far even a policy that fully equalizes public school spending remains from one that equalizes educational opportunities for children. This is because housing market conditions continue to lead to large levels of segregation that impact non-financial inputs into local public schools. Similarly striking is the role played by private schools in these two extreme systems. The comparison between them allows us to get a sense of the limits of state intervention in producing equality within public schools as they are currently set up.

Section 5 proceeds to an analysis of more traditional grants in aid to public school districts. Such grants may take the form of block or matching grants, and each is analyzed in turn. Matching grants are in principle the better tool to raise either the overall level of school spending or the level in particular districts. However, one must consume these results with caution given that the levels of matching undertaken by the state government must themselves ultimately be subject to voter consent, and it is difficult to imagine that state voters will allow the price incentives embedded in matching grants to raise overall

spending levels much beyond what they desire. Block grants, on the other hand, have rather little impact in a general equilibrium world unless they are large or require s high level of maintenance of local tax effort. By not including the substitution effects inherent in matching grants, block grants aim to increase spending solely through income effects. However, given that – in a general equilibrium world – taxpayers must also fund these block grants through their state income taxes, these effects are much smaller than in a partial equilibrium context, and they may well be negative in high income districts. The general equilibrium prediction, then, is that block grants to local school districts are unlikely to have major impacts unless they are so large that local school budgets expand even if the local government reacts by reducing its own support for local schools to the minimum legally permitted level. Furthermore, simulations suggest that equalizing aid that is based on local fiscal capacity is likely to be considerably more effective if based on a matching rather than a block grant formula. This is in part due to general equilibrium price effects that tend to undermine equalizing state formulae when state aid is structured to be inversely related to local property wealth.

Finally, Section 6 concludes the analysis by focusing on a new proposal for state aid to education: giving state income tax revenues to parents in the form of a private school voucher rather than to school districts in the form of grants. Here I report on results that suggest large general equilibrium mobility and price effects for some types of vouchers and not for others. This links closely to the incentives of private school attending households to settle in poor public school districts to take advantage of depressed housing values. Vouchers cause general equilibrium effects by uncoupling the decision of where to live and where to send children to school. While the focus in the

policy simulations is strictly on vouchers, similar general equilibrium forces are likely to be important in other policies – such as charter and magnet schools – that move public education away from one where admission to a school is determined solely by the residential choice of parents.

2. Sources of Interjurisdictional Inequities

It is difficult to provide sound advice to state education policy makers without stepping back and first understanding the forces that have lead to the current levels of inequities and inadequacies in state public school systems. One way to identify the causal channels through which such inequities emerge is to attempt to imagine a world in which – despite having different levels of income and child ability – all households have equal access to the same level of public school quality. In this attempt, one quickly discovers that so long as admittance into a public school is based on where a child lives (as it is in most US states), and so long as we are open to the possibility that households will move if this improves their welfare, it is not at all easy to find realistic assumptions under which such perfect public school equity could in fact emerge as an equilibrium outcome.[2]

It is often assumed that local financing of public education is the primary culprit behind existing public school inequities. Conceptually, however, it is not immediate why this ought to be the case. Given that households can gain admittance to any public school by merely moving into that school's attendance area, how could inequities persist in equilibrium? Why do households not simply move until all public school quality differences disappear and equilibrium is reached? Is it merely the case that different

[2] For an early general equilibrium approach to this within an urban setting, see Inman and Rubinfeld (1979) who conclude that fundamentally it is household income inequality and free residential mobility in the presence of zoning that can explain persistent inequality in the provision of public services.

households value education differently and therefore sort into different districts -- much as some households like white bread and some like wheat, or is it possible to sustain high levels of inequality in public education even in a model in which all households agree on the value of education? If rich districts provide better public schools, why are the poor – assuming that they too value education - not "chasing the rich" by moving into their districts?

It is in the general equilibrium models of the local public finance literature that one finds answers to these questions. Simple models point to assumptions that are required in order for strong notions of equity to emerge in equilibrium, and more complicated models introduce the real-world forces that generate and support inequity in public education as the expected outcome. Once a model is rich enough to capture the forces that lead to the observed levels of inequity, it can then be used to analyze the likelihood that different types of policy proposals might succeed in alleviating inequities or at least guaranteeing minimum levels of adequacy. While one easy way to generate unequal levels of public education is to simply assume that households sort based on different intensities of preferences for education – and particularly that the poor care less about education than the rich, my view is that it is not fruitful to begin with such an assumption. Rather, I will begin below by seeking out models that can explain the emergence of inequities as well as incentives that prevent the "poor chasing the rich" phenomenon under the assumption that underlying preferences are shared among all households.

Income Differences

Just as equity-based court challenges to local school financing became important in the 1970's, Westhoff (1977) presented a simple model in which equilibrium differences in public service levels emerged not from differences in tastes but solely from differences in household incomes. Local jurisdictions were constrained to finance a public service through a proportional local income tax, and each jurisdiction could choose its most preferred tax rate (through majority rule voting). Under certain conditions, any stable equilibrium in this model has the feature that households would segregate voluntarily into jurisdictions with different tax rates and different public service levels simply because high income households demand more of the public service (and are willing to pay higher tax rates for it) than low income households. Much is missing from this very simple model, but it makes the useful point that income differences alone can generate "voluntary" interjurisdictional differences in public services in the presence of local income tax financing of those services.

Local Taxes of a Housing Good

Of course, few local school districts rely heavily on local income taxes, and much of what is interesting about local public finance happens in the context of land and housing markets. It thus became natural to ask whether Westhoff's result could be sustained in a model in which housing plays an important role and is taxed to fund local services. Epple, Filimon and Romer (1993) prove that it can. Modeling housing as a homogeneous consumption good that is supplied within each jurisdictions according to an exogenously specified supply schedule, they demonstrate that – under certain

assumptions – differences in income are again sufficient to sustain an equilibrium in which public service levels differ across jurisdictions. Tax-inclusive housing prices are higher in districts that provide public services, and low-income households "voluntarily" choose not to chase the rich into these districts because of these higher housing prices. While Westhoff requires local income taxes to support inequities in public service provision, Epple et. al. demonstrate that equilibrium housing good prices can do the same in the presence of local property taxes. Both get the equilibrium prediction that households will stratify perfectly into jurisdictions based on their income.[3]

Heterogenous Land/Housing Markets

Both Westhoff and Epple et. al. relied on somewhat restrictive assumptions on preferences in order to insure the existence of equilibria that exhibit inequities in public service provision. These assumptions become unnecessary when land and housing are modeled somewhat differently. Epple et. al. treat housing as a good similar to other goods in that it can be consumed in any quantity at any location (although its price varies along an exogenously specified, jurisdiction-specific supply schedule). Nechyba (1997a), on the other hand, models land and housing as already existing (rather than being built and torn down as demand changes). In that model, house/land quality differs within and across jurisdictions, and this quality distribution can be calibrated to give rise to house price patterns that reflect real-world patterns. This then generates jurisdictions that have different average land/house quality levels while at the same time allowing for overlaps in land/housing quality across districts. Equilibria with interjurisdictional differences in

[3] Epple and Platt (1998) extend this model to include different preference types as well as different incomes. This then produces two-dimensional stratification.

public service provision exist under much more general conditions in this model, and patterns of house prices and income levels within and across jurisdictions can more accurately reflect those observed in the real world (without resorting to the introduction of heterogeneous preferences).[4] The imperfect stratification that emerges is driven in large part by the inelastic housing market that is the foundation of the model – thus adding (to the previous explanation of household income differences) a new force that tends to produce inequities in public service provision: the existence of heterogeneous housing markets in different districts, with housing that is durable once built and thus difficult to alter.

Put differently, the only forces that cause households to segregate in the Westhoff and Epple et. al models are those connected with the local public sector – households segregate because their different income levels cause them to desire different levels of public services and local taxes. While retaining this force, Nechyba adds a segregating force that has nothing at all to do with the public sector – heterogeneous housing/land markets that will cause the rich to generally locate in different areas than the poor. Therefore, were the public sector eliminated from the models, there would be no segregated equilibrium in Westhoff and Epple et. al. while segregation would still occur (albeit at different levels) in Nechyba. How this exogenously specified heterogeneous housing stock emerged in the first place is not something that can be explained in the model. Given the durability of housing, however, whatever housing stock is present at the beginning of a policy simulation is likely to be important for some time – regardless of

[4] As in the previous papers, local tax rates are set by majority rule. The model allows either property or income taxes to serve as the local tax instrument, although property taxes are shown to be a dominant local tax strategy when local governments consider general equilibrium consequences of switching even partially to local income taxes (Nechyba, 1997b).

whether it had previously arisen by some historical accident or through deliberate zoning rules.

School Production

Thus far, we have talked of the "local public service" as a mere abstract local good, and implicitly we have assumed that its quality level is solely related to total local public spending and the size of the local population. For many public services – roads, for instance – this may be a good assumption. In the area of primary and secondary education, however, the assumption is empirically false. While disagreement persists regarding the degree of importance of financial resources in education production,[5] there is little disagreement that other inputs are at least as important and probably more so. These other inputs include teacher quality (which – due to union wage scales – is typically not correlated with teacher wages), peer abilities, parental monitoring, targeted contributions by parents, etc. For each of these inputs, there are good reasons to believe that their level in any particular school is correlated with parental income even if financial resources were fully equalized across all schools.[6] For purposes of this paper, we will refer to these effects together as "peer inputs" – i.e. inputs (other than financial resources in school budgets) that are correlated with peer household income.

[5] A long series of papers continues to investigate this, with an example of different positions taken by various authors in Burtless (1996).

[6] Loeb and Page (2000) demonstrate empirically that – given that public school teacher wages are typically based on rigid wage scales – good teachers tend to be rewarded not by additional income but rather by being assigned to higher income public schools. Ability is likely to be at least somewhat correlated with parental income (Solon, 1992; Zimmerman, 1992), and high income parents are more likely to monitor schools (McMillan, 1999) and to give their own resources (Brunner and Sonstelie, 1999). A related way of putting it is that poor districts tend to have greater fiscal need (in addition to less fiscal capacity) (Ladd, 1976).

Without the introduction of such non-pecuniary inputs into the local public service, interjurisdictional inequities in the provision of the public service could be eliminated in each of the general equilibrium models we discussed by simply centralizing funding and distributing it on a per capita basis. Indeed, a push toward centralization has been the main policy advocated by many who are concerned about equity within public education. Our brief overview of general equilibrium modeling of local public finance forces, however, suggests that local funding itself is not the primary problem. Rather, local funding combined with the ability of households to move generates equilibria in which housing market conditions support segregation of households by income. This segregation results in differential funding of public services *and* – to the extent that inputs into services like public education are non-pecuniary but correlated with parental income - in differential non-pecuniary inputs into the pubic service. Moving from local to central funding may equalize financial inputs but does not eliminate the segregating forces present in housing markets nor does it eliminate the incentive of high income households to find ways to segregate in order to take advantage of non-pecuniary inputs into school production. General equilibrium theory therefore predicts that fundamental interjurisdictional inequities in public education will persist under full equalization of school funding so long as non-pecuniary inputs (which we have called peer inputs) are an important component of school production. Results from three decades of equalization suggest this to be correct.[7]

[7] We should note that Westhoff's model (which lacks a housing market) is the only of the three models we discussed to predict full equalization of public service quality in the presence of centralized funding and non-pecuniary inputs. This is because high income households have no way to keep low income households out of their jurisdictions when there is no housing market to capitalize local conditions.

Conditions for Perfect Interjurisdiction Equality in Public Education

We began this section by asking under what conditions we could envision a world in which – despite the reality of the existence of household income inequality and the tendency of households to move to improve their welfare – school quality could be equal across public schools that admit students through geographic districting. Our reading of the local public finance literature suggests two such conditions: First, funding for public education must be centralized and equalized across schools; and second, financial inputs must be the only inputs that matter in producing school quality. The first of these conditions is a policy choice; the second is not. Given the empirical evidence in support of the proposition that, even if financial resources are important, other (non-pecuniary or peer) inputs into schools are substantially more important in the production of school quality, and given that these peer inputs are correlated with parental income, this second condition is empirically invalid. As a result, geographic income segregation that arises in housing market equilibrium is certain to support continued large interjurisdictional inequities even as school funding is more equalized – thus pointing to a fundamental limit to how much equalization is likely to arise through the political process.

3. A Structural General Equilibrium Model

As suggested in the introduction, this paper will attempt to use a single general equilibrium model to draw some lessons on the general equilibrium impacts of different forms of state intervention into primary and secondary education. This model has been developed in a series of papers over the past several years, and many of the results pulled together in this paper derive from this previous research. The strength of the underlying

structural model is that it allows us to accurately replicate a number of stylized features of public schools and local public finance in the real world. It therefore provides a benchmark model that includes the economic forces that have led to current inequities in public education, and it allows us to gauge the relative importance of competing general equilibrium effects as different policy simulations are conducted. The theoretical details of this model are fully spelled out in Nechyba (1997a, 1999), and the details of data calibration are given in Nechyba (2000, forthcoming, 2002b). Below I will therefore provide only a brief description of the main features of the computational version of the model used for the simulations in this paper after noting that it contains the very forces identified in the previous section as likely economic forces responsible for current inequities in public education.

The model 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. Preferences of all households are assumed to be identical[8] but incomes, house endowments and abilities differ across households (with income imperfectly correlated with child ability). Houses are divided exogenously into neighborhoods (where all houses and neighborhood characteristics are of equal quality

[8] 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 Dougles functional forms represent typical starting points – and therefore they feature prominently on both the preference and the technology side of this model.

within a neighborhood), and collections of neighborhoods form school districts.[9] Schools produce educational quality by combining per pupil spending with peer inputs,[10] and all schools – public and private – face the same production technology. Per pupil spending levels in public schools are determined through majority rule voting over local property taxes in a locally financed system and through voting over state income taxes in a state financed system. Spending in private schools, on the other hand, is set by each school so as to maximize profits (which are zero in competitive equilibrium). Admission eligibility to the single public school in each district is determined solely based on whether a student lives within the district boundaries. Private schools, on the other hand, are allowed to set a minimum peer quality level below which they will not accept any student. Thus, 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. At the same time, public schools have the advantage that they are free to anyone living within the district boundaries.[11]

In calibrating this model to real world data, the following stylized features are matched by the calibration algorithm: House and neighborhood quality parameters are set

[9] The computable version of the model has 3 districts and 5 neighborhoods in each district, with the house quality (k_{dh}) distribution across neighborhoods in each district calibrated so as to yield housing price distributions that replicate those observed in the data.

[10] 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. A minimum of $5,000 per pupil expenditure is assumed to be necessary in order for a school to open. "Peer input" is a combination of child ability and parental income, with child ability weakly correlated with parental income. The parameter ρ is calibrated so as to replicate the private school attendance rates observed in the data.

[11] 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.

so as to replicate the distribution of house prices observed in the data; the income distribution is set to approximate the empirical distribution observed in the data; the 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; and the production function weights placed on per pupil spending and peer quality inputs are set so as to replicate the levels of private school attendance we observe. Table 3 provides some stylized facts in the data and compares these to the predictions of the calibrated computer model.[12]

4. General Equilibrium under Local and State Financing

We begin our discussion of state aid to education by comparing two very opposite ways of financing public schools: (1) a fully decentralized, property tax financed system, and (2) a fully centralized, equalized and income tax financed system. We will do this in the context of the model described in Section 3 with production and preference parameters calibrated to New Jersey data. In each of the systems we analyze, spending levels are determined through majority rule – with local residents voting on local spending (financed through proportional property taxes) under the first system and statewide majority rule voting determining equalized spending levels under the second. While few states are contemplating either of these extreme alternatives, this analysis can help establish a benchmark of just how much of an improvement in educational equity

[12] One notable missing aspect of the model is the lack of an explicit labor market. This is not a large shortcoming within the static context of the current model but becomes important in models that attempt to link school finance explicitly to economic growth and future generation income inequality (see, for example, Fernandez and Rogerson. (1998)).

might be possible given the underlying economic differences faced by households residing in different geographic areas and facing different economic realities.

Table 4.1 begins by comparing the equilibrium outcomes under a fully decentralized system and those under a fully centralized system to the equilibrium observed under the hybrid New Jersey system. The first row of the table presents per pupil spending figures which clearly follow the expected pattern: the highly unequal spending pattern under local property tax financing is ameliorated by state intervention under the New Jersey system and eliminated under a centralized state income tax system. If spending were all that mattered in schools, a centralized system – under the assumption that the political process would permit resources to be truly equalized – could thus fully eliminate all inequities in public education. As argued in previous sections of the paper, however, the actual production process in public education differs substantially from one in which only per pupil spending matters. The second row of Table 4.1 therefore presents the level of peer inputs under the three systems of public school financing. As expected, peer inputs are distributed unequally across the three districts, but no discernable amelioration of this unequal distribution arises from more centralized school spending. This then translates in the third row of Table 4.1 into continuing interjurisdictional differences in public school quality even as school spending is fully equalized under state funding.[13]

The next two rows in the table assess the average impact of different systems of public school financing on schools. Others (Silva and Sonstelie, 1995) have pointed out

[13] It should be noted that the proper interpretation of "school quality" in this model is parental perceptions of quality. Parents may care about spending in schools for a variety of reasons having little to do with academic achievement – and thus spending can be an important factor entering parental choices on education even if it has little correlation with SAT scores, graduation rates, etc.

that – in a stylized model in which school districts are composed of a single type of household, majority rule will result in less overall per pupil spending under state financing than under local financing so long as the income distribution is skewed such that the mean is above the median.[14] Given that the model uses the skewed income distribution in the data, a similar result is expected here and indeed appears – with spending under state equalization seven percent lower than under both local funding and the New Jersey system. This lower overall investment in education under centralization is almost fully responsible for the 4 percent lower school quality in the next column of Table 4.1.

Finally, the remaining rows of the table provide some additional details of the three equilibria. Segregation persists at roughly similar levels under all three types of public school financing. Similarly, the level of private school attendance does not change dramatically, although the geographic pattern of private schools does change. The relationship between private school attendance and centralization of public school finance is treated thoroughly in Nechyba (forthcoming) where the initially counterintuitive prediction of slightly lower private school attendance under equalized state financing is explained as the result of general equilibrium price effects. While these effects are not readily apparent in the average district property values, they become more apparent when the opportunity cost of a house of equal quality but located in different districts is analyzed.

[14] The logic behind this prediction is straightforward: If each district is composed of a single type, then that type's most preferred spending level will result in each district under decentralized majority rule. Thus, the average spending in the state is simply the average of the most preferred spending levels in the population – which is predicted by mean income. Under centralization, on the other hand, the median income voter (assuming no private schools) determines the spending level. Thus, if the median is less than the mean, state financing results in less spending than local financing.

Note that the opportunity cost of a house under local property taxation includes both the price of the house as well as the tax payments owed on that house. The opportunity cost of the same house under centralized state income taxation, on the other hand, is simply the price of the house and does not include any tax payments which are now independent of the residential location choice of the household. The last row of Table 4.1 gives the opportunity cost of the same quality house ($k_{dh} = 0.93$) in all three districts under both local and state financing. Under local financing, the cost of the same house in district 1 is 45% of what it would be in district 3, while under state financing, this percentage rises to 63%. Put differently, under state income tax financing of schools, the relative price of the same quality house in district 1 rises by over 70 percent. Parents who choose to send their children to private schools therefore have a substantially greater incentive to locate in district 1 under local property tax financing (even if housing options in that district are less than ideal) than they do under state income tax financing. Thus, private school attendance is high in district 1 under local financing and falls under state financing not only because public schools are improving in district 1 but, more importantly, because general equilibrium price effects make locating in district 1 much less attractive. Similarly, private school attendance in district 3 rises as a result of centralization not only because public schools are getting worse but also because housing is getting relatively cheaper for those who previously located in poor districts and sent their children to private schools from there.[15] However, not all of the previously private-school attending households that migrate to districts 2 and 3 under centralization continue to choose private schools since public school quality in those districts is better. This,

[15] Nechyba (forthcoming) reports that roughly two thirds of the change in the private school attendance pattern is in fact due to the general equilibrium price effects and not the change in public school quality.

then, accounts for the slight decline in overall private school attendance under centralization.

Segregation and Property Values under Local and State Financing

Table 4.2 (adapted from Nechyba (2002b)) investigates the link between school finance and segregation a bit further. The first row in the table assumes no public school sector and thus fully eliminates any distortion of residential location choices from public sector choices regarding taxes and school quality. Thus, this row provides a benchmark that gives the levels of income segregation that are expected simply from differences in housing quality across school districts. The remainder of the table then provides evidence on the degree to which the public and private school sectors contribute to changes in the level of segregation one would expect merely from housing markets.

Rows two and three eliminate the private sector and fully focus on distortions from public financing of schools. Spatial income segregation increases dramatically, and this effect is large regardless of whether public school funding is through local property taxes or is equalized through central state income taxes. As one crude measure of income segregation, one can compare the ratio of average incomes in district 3 to average incomes in district 1. This ratio increases by 86% and 56% under local and state public school funding (respectively) over what would be expected simply from interjurisdictional differences in housing quality. Rows four and five then add the presence of a private school sector back into the model – and segregation levels decline dramatically as private school attending households take advantage of depressed housing values in poor school districts. In fact, comparing rows four and five to row one suggests

that the mix of private and public schools causes residential segregation (as measured by the ratio of district 3 to district 1 average income) to *decline* by roughly 20% over what would be expected from interjurisdictional differences in housing quality – regardless of whether financing of the public sector is through state income taxes or local property taxes.

Thus, while public school financing introduces a residentially segregating force, it also causes house prices to be depressed in poor districts and inflated in rich districts as these prices capitalize local public school quality. These price effects then result in a desegregating force when private schools are added to the model – because private school attending households who tend to have middle to high levels of income take advantage of depressed housing prices in poor districts. This further results in an increase in house prices in poor districts and a decline in house prices in rich districts – implying corresponding increases and decreases in the tax bases of the respective districts (at least under local taxation). Thus, while above average income, private school attending households in poor districts do not add to peer inputs into the public schools, their presence does add to local tax bases and the fiscal capacity of poor districts to finance public schools.

5. State Grants-in-Aid

Section 4 presented a full general equilibrium comparison between two extremes – a fully centralized and a fully decentralized public school system. We now proceed to considering some more hybrid systems that include a mix of income tax and local property tax funding. These hybrid systems assume local voting on property taxes under

the assumption that voters know of the exogenously specified state aid formula composed of block and matching grant components. A block grant program is simply a vector $\mathbf{b}=(b_1,b_2,b_3)$, where b_i is the per pupil block grant from the state for each student in public schools in district i. Similarly, a matching grant program is defined by a vector $\mathbf{m}=(m_1,m_2,m_3)$, where m_i is the matching rate given to district i. This notation as well as the results reported below are based on work first reported in Nechyba (forthcoming, 1996).

Table 5.1 begins by reporting equilibrium outcomes under block and matching grants that apply equally to all districts. Such universal grants are textbook responses of higher level governments to aid in the internalization of local externalities, and their aim is typically to raise the overall level of spending on a particular local public good. This is in contrast to more targeted grants that are analyzed in Table 5.2. Grants of that type are more likely a response to equity considerations that arise from "too little" spending on a public good in poor districts. Most real world aid formulae – such as that for New Jersey that was used to calibrate the model - are clearly a combination of these. The exercise in this section, however, is to isolate different effects of universal and targeted components of block and matching grants, which is why the tables report results from these more stylized versions of state aid.

Uniform State-Wide Grants

It is well understood that block grants give rise only to income effects while matching grants give rise also to substitution (or price) effects. Thus, one can demonstrate in a partial equilibrium setting that equally funded matching grants will

typically result in higher levels of local spending than block grants (Oates, 1972). In a general equilibrium setting, income effects are smaller because taxpayers have to pay for the state aid program through higher taxes.[16] Table 5.1 confirms this partial equilibrium intuition in a general equilibrium setting. The last column of the table provides the average cost of the state aid program per (public and private school) family as an indication of state taxpayer burdens. The range of the state aid costs is similar for the block and matching programs focused on in the table. At the same time, the average per pupil spending on public schools changes little as the state introduces block grants, while average spending rises dramatically as matching grants become large. Average school quality in the state follows a similar pattern.

While universal matching grants are therefore substantially more effective at raising the overall level of spending on education, such universal grants have significantly worse equity properties than similarly funded block grants. The ratio of district 3 to district 1 spending on public education falls as block grants become large while it rises for matching grants. While spending rises in all districts under the universal matching grant, it rises at a faster rate in the wealthier district – thus resulting in the larger district 3 to district 1 spending ratio.[17] For block grants, on the other hand, districts essentially lower local per student funding by roughly the amount of the per pupil block grant *unless the block grant is binding on local budgets*.[18] There are two possible ways in

[16] In fact, for high income districts, income effects are negative as they pay a disproportionate share of the statewide block grant program.

[17] As pointed out by one of the discussants of this paper, this result hinges on the implicit elasticity assumptions embedded in a Cobb-Douglas preference framework.

[18] This is not quite accurate because the model does include a small flypaper effect because of a change in median voters as funding shifts from local property to state income taxes. In particular, it turns out that the ratio of income to property holding in the data is skewed in such a way that local voters will indeed choose more local spending if part of the spending is covered by state income tax funded block grants even if no net resources have been added to the community. Furthermore, it should be pointed out that empirical

which such binding of local budgets may come about (and only of these is modeled here): First, the size of the grant may simply be so large that spending will rise even if local governments lower their taxes for schools to zero; and second, grants may require a minimal local tax effort above zero. Unless states require local governments to continue contributing exactly as they did before, low levels of the block grant then have little impact on total statewide spending. In the simulations presented here, there is no requirement that local governments contribute anything on their own – which implies that only as block grants become large ($7,000 in Table 5.1) do they begin to bind on district 1's budget – thus forcing district 1 to spend more on education so long as negative local taxes are not permitted. This leads to a decline in the ratio of district 3 to district 1 spending as block grants become large.[19] Were state grant systems to require a minimum local tax contribution above zero, the grant size at which local budgets begin to bind would, of course, be lower – and spending differences between rich and poor districts would begin to narrow with smaller universal grants.[20]

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studies have claimed to find larger flypaper effects than what this model predicts – and to the extent that these effects are real, this model under-predicts the effectiveness of block grants to raise per pupil spending.

[19] An interesting general equilibrium side effect of block grants is that relative property values in district 1 *decline* because of less demand from private school attending families. This is because as schools are increasingly funded through state income taxes that support the block grants, there is less of an advantage for private school attending households to settle in districts that spend little on public education (since state income tax burdens are independent of residential location.) At the same time, the effects are different from a fully state funded (and equalized) system of the type discussed above. Despite the fact that block grants increasingly lead to a largely state financed system, they also leave room for *local discretion* that is exercised by high income districts in the form of supplemental (property tax financed) spending. While a move toward state financing through block grants therefore leads to the same decrease in private school attendance in poor districts as a move toward an equalized state system would, it does not lead to a corresponding increase in private school attendance in the rich districts because of this added local discretion. (For more details on the relationship between different forms of centralization and private school attendance, see Nechyba (forthcoming).)

[20] A caveat to this is that – even with explicit requirements for local governments to maintain some local contribution to education, such governments may find other ways of shifting budget categories to make it appear that they are maintaining local tax effort in order to obtain grants. For instance, public park spending may be shifted to local education budgets. The greater the required local tax effort and the greater the size of the grant, the more incentive the local governments have to be creative in this way. To the extent that

While these simulations suggest that statewide grants – particularly those relying on matching incentives – can be a powerful policy tool to elicit higher overall spending on public education, these results must be consumed with some caution. The simulations in this section specify an *exogenous* institutional relationship between state and local spending – some combination of matching rates and block grants – and then proceed to investigate general equilibrium consequences of local voting behavior under that institutional arrangement. The model does not claim the institutional arrangement itself to be an endogenous result – which should lead us to question whether matching grants that result in the dramatic increases in overall spending could be politically feasible. The answer would seem to rest on whether there indeed are inter-district spillovers that states can effectively internalize. If so, then the incentives embedded in matching grants could indeed represent a political solution to a prisoner's dilemma in which each jurisdiction commits to an efficiently higher level of spending. If, however, voters are unaware of such spillovers (or they simply do not exist), it would be difficult to find a political economy explanation of how any state grant system could politically survive and lead to large increases in overall spending.

Targeted State Grants

While statewide grants of the type discussed above are motivated by a general desire to increase overall spending on education, targeted grants typically are motivated more by equity concerns. Table 5.2 reports on the equilibrium impact of block and matching grants targeted solely at district 1 – the poorest district in the model, and as in

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this happens, the assumption of no required local tax effort is better for analytic purposes even if actual state grants have local tax effort requirements.

the case of universal grants, it is assumed that no local tax effort is required as a condition for the state grant.

While targeted block grants of the kind modeled here clearly do have welfare benefits for district 1 residents (in the sense that a portion of their funding for public schools now comes from other districts), it does not lead to appreciable increases in school spending in the district until the amount of the block grant becomes binding on local budgets. For low levels of the targeted grant, district 1 simply responds by lowering local property tax rates – and only once those have reached zero does education spending increase dramatically. As a result, just as in the case of universal block grants, the ratio of district 3 to district 1 spending (and quality) does not fall dramatically unless block grants are large.[21] As in the case of universal grants, this may happen with smaller levels of targeted grants if states can find effective ways of imposing a condition that local governments contribute from their own tax sources in order to qualify for grants. Targeted matching grants, on the other hand, are much more effective at lowering the difference in spending between rich and poor districts continuously as they are phased in from low matching rates to high ones.

District Power Equalizing

Thus far, we have assumed that block or matching programs are exogenously fixed. However, state aid may be linked to key local fiscal variables that are thought to represent the level of fiscal capacity or fiscal need. For instance, the notion of "district power equalization" favors linking matching grants inversely to local property values.

[21] Ironically, overall state spending on public education actually rises faster under targeted rather than statewide grants because there is less of a negative income effect on rich districts given that the total income tax required is lower under targeting.

This introduces an additional general equilibrium component to the policy discussion because it opens the possibility that the very existence of a state aid program may alter property values in such a way as to undo the intended effects of the program (Inman and Rubinfeld, 1979). More precisely, if districts with low average property values receive disproportionately larger matching rates, this in itself is likely to raise equilibrium property values – which in turn will reduce the matching rates of the state grant program.

Simulations with models of the type used here, however, suggest that there is a limit to the size of this general equilibrium effect, although it can still be large for certain types of district equalizing formulae. Essentially, this model differs from others in that large differences in house prices are built in even in the absence of any public sector activity (as seen in the first row of Table 4.2). These differences are due to inter-district differences in existing housing stocks which limit the extent to which district power equalizing aid (based on local property wealth) could undermine its own formula through general equilibrium price effects. At the same time, the degree to which different forms of equalizing aid can impact private school demand for housing turns out to be important to how much the equalizing impact of aid may be undone by general equilibrium price effects when aid is based on local property wealth.

Consider the last column of Table 5.2 in which general equilibrium effects of grants targeted to district 1 are reported. This column gives the ratio of property wealth in district 3 to that in district 1. As expected, for both block aid and matching aid that is targeted to district 1, the difference in property value narrows as aid levels increase. Despite the fact that per pupil spending levels in district 1 rise much faster under matching aid (because of the substitution effects discussed above) and despite the fact

that spending differences between the districts narrow considerably faster as a consequence, property values converge more rapidly under block aid. The reason for this is the role played by the private sector.

Under targeted block aid, an increasing fraction of local spending on public education is financed through state income taxes that are paid regardless of where a household settles, and property taxes in district 1 decline. Thus, in terms of the incentives of private school attending households, district 1 becomes increasingly attractive as targeted, state-financed block aid replaces local property taxes. Thus, in addition to the upward pressure on property values in district 1 from the subsidy from taxpayers in other districts to public school attending households in district 1, there is increasing demand for property in district 1 from private school attending households as targeted block aid increases in district 1. Both of these are less of a factor under matching aid where local property taxes are a perquisite for any state aid.

The general equilibrium forces that may undermine an equalizing state aid formula based on local property wealth are therefore substantially greater if the equalizing formula relies on block rather than matching aid. In fact, for similarly costly targeted state aid programs in Table 5.2, differences between property values in the rich and poor district narrow twice as quickly for block aid as for matching aid. Given that the aim of equalizing state aid is to narrow spending differences in education and not property value differences, it is therefore quite straightforward that equalizing state aid ought to rely solely on matching components and not on block aid unless state governments can find effective ways to link block aid to minimum levels of local tax contributions to education.

6. State Aid for Choice

While most state aid has typically taken the form of grants to local governments, recent policy debates have increasingly included talk of using a portion of state aid to increase parental choice – particularly for those whose choices under the current system are limited. In this section, we therefore focus on a final set of policies that extend private school choice through the use of state income tax funded vouchers. As in the case of grants to districts, these state-funded aid programs can be universal in nature or can be targeted to either low-income parents or parents whose children attend low-performing public schools. The argument in favor of a universally available voucher typically rests on the hypothesis that inefficiencies in public schools can be remedied through increased competition (Friedman, 1962), while the argument for targeted vouchers arises from the same equity concerns that have fueled many of the court challenges to inequities in public education.[22]

The general equilibrium effects of this very different type of state aid to education have been investigated in Nechyba (1999, 2000, 2002a) and are linked closely to our previous discussion of the role of private schools in the absence of vouchers (see Table 4.2). Within the context of a residence-based public school system that exhibits large differences in school quality across districts, housing prices are depressed in low performing public school districts and inflated in high performing districts. For parents that choose private schools (and who therefore can choose housing independently of schooling), this produces strong incentives to locate in under-performing public school

[22] In fact, some have suggested that courts specifically mandate an immediate remedy of vouchers to plaintiffs from badly performing and badly funded public schools (Nechyba and Heise, 2000).

districts. Thus, if state aid is used in part to fund private school vouchers, new private schools are likely to emerge in low performing public school districts where housing for middle income households is available. The resulting migration will tend to raise average incomes and tax bases in poor districts while lowering them in wealthy districts. While this does not guarantee that public schools in poor districts themselves will improve in quality, it does provide fiscal benefits to homeowners in poor districts while providing additional options currently not available. Furthermore, to the extent that the public school system declines in quality because of "cream skimming" by private schools, these mobility effects tend to be spread across schools in all districts, not just in those where private schools arise. In fact, the simulations reported below suggest that – for modest levels of vouchers - the adverse impact on public schools tends to be greatest in wealthier districts.

Tables 6.1 and 6.2 provide general equilibrium results for three types of state-financed vouchers that differ in terms of who is eligible to use them. Part (a) of each table represents outcomes from vouchers for which every resident of the state is eligible; part (b) represents outcomes from vouchers restricted to residents of district 1 – the low performing district; and part (c) represents the outcome of vouchers restricted to households earning less that $25,000 per year. Table 6.1 presents results assuming that all funding for public schools comes from local property taxes, while Table 6.2 assumes the New Jersey financing system for public schools.

The two sets of tables provide fairly similar qualitative messages. For modest levels of vouchers (i.e. vouchers under $4,000), most of the increase in private school attendance occurs in the poorest district. Average per pupil funding of public schools

does not change dramatically, and the difference between the highest spending and lowest spending public school narrows for modest levels of vouchers except when they are targeted only to low income households (panel (c) of the tables). Average public school quality falls, but so do differences in school quality between rich and poor districts. The net cost of all vouchers in general equilibrium is negative because of the savings in public school spending from lower public school populations.

As first pointed out in Nechyba (1999, 2000), much of what is observed in these tables is due to residential mobility. In response to depressed housing values in district 1, parents that switch to private schools as a result of vouchers tend to migrate to the better neighborhoods in district 1 – thus raising property values and average community income. Households that have the most to gain from private schoolings are those with high peer quality, which implies that public schools suffer lower peer inputs. However, since much of the increase in private school attendance from vouchers results from households who move from public schools in districts 2 and 3 to private schools in district 1, high peer inputs are drawn disproportionately from districts 2 and 3 – thus causing disproportionately larger declines in school quality in those districts. Furthermore, since private school attendees tend to have higher incomes and thus demand higher levels of public school spending when they are in the public system, districts 2 and 3 also suffer declines in per pupil spending as the median voter in those districts shifts. These migration induced outcomes from vouchers are similar for universally available vouchers (panel (a)) and vouchers restricted to residents of district 1 (panel (b)) because – even when eligibility is not restricted to residents of district 1, most parents that switch to private schools want to do so from the cheaper houses available in that district. Only

when vouchers are targeted to low income households does general equilibrium migration cease to be an important factor.

When voucher levels become high (i.e. $4,000 and above), public schools in district 1 begin to suffer dramatic declines in quality as both spending and – more importantly – peer inputs become very low and few children remain in the public schools. It is at that point that the simulations suggest a dramatic widening in the gap between public school quality in district 1 and 3 that had been shrinking as lower levels of vouchers were introduced. These results suggest an important tipping point in terms of voucher size – a tipping point after which public schools in poor districts may suffer unacceptably large declines in quality.

Much of this analysis of vouchers is, however, subject to some major caveats. In particular, as suggested elsewhere (Nechyba (forthcoming)), these simulations can be viewed as "worst case" scenarios because of the implicit assumptions built into the model. First, public schools are assumed to be using resources efficiently throughout these simulations – thus assuming away any positive competitive response to increased competition from the private sector. Second, the model assumes no gains from a less heterogeneous student population which tends to take shape in especially poor public schools as voucher levels increase – thus assuming any potential gains from greater curriculum targeting to particular peer groups. And third, the model assumes a perfectly inelastic supply of housing which causes each immigrant to a district to replace a current resident. As a result, the private school attending immigrants into district 1 replace relatively high peer input households that previously attended the local public schools – thus lowering peer inputs in local public schools. In many real world cities, private school

immigrants may, however, end up occupying previously vacant land and therefore cause less of this pressure on local public schools. Each of these assumptions tends to bias the results in favor of declines in overall public school quality and/or increases in inequality within the public school system. Nechyba (2002a) demonstrates that, under empirically plausible extensions of the model, modest levels of private school vouchers may in fact cause increases in public school quality at the same time as the overall variance in public schools quality declines. However, regardless of additional assumptions about school competitiveness or targeting of curricula, Nechyba (2000a,b) demonstrates in the context of this model that the general equilibrium and migration effects are qualitatively and quantitatively similar. The only difference that emerges as school competitiveness and curriculum targeting assumptions are added to the model is that overall public school quality falls less (or rises) under vouchers.

7. Conclusion

Viewing state aid to primary and secondary education through the lens of a general equilibrium model that is capable of replicating the status quo gives no clear answers as to how exactly state aid ought to be structured. While state financing of public education can indeed cause spending differences to disappear, this is not likely to produce anything close to an elimination of school quality differences in a system where public school admissions are based on residential districting. State aid in the form of grants can most effectively generate increases in spending on public education if the aid is based on a matching rather than a block aid formula or if a block aid formula includes relatively high levels of required minimum local tax efforts, and equalizing aid based on local

property wealth (or fiscal capacity) is less likely to be undermined by general equilibrium adjustments in local wealth if it is based on matching aid. Alternatively, state aid to parents to enable them to more easily choose private alternatives to public schools provides the advantage that it allows for a severing of the residential housing and school choices, but cream skimming by private schools may produce overall declines in public school quality. These declines – to the extent that they happen - are likely to be spread across all public schools in a general equilibrium world, and are unlikely to be primarily focused on public schools in poor districts where private school vouchers are likely to have the greatest following. Other forms of state intervention to increase parental choice – through charter and magnets schools, for instance – may have similar general equilibrium effects.

While the "ideal" state aid package is likely to contain elements of all these programs, all are limited by the general equilibrium forces that this paper has explored and discussion of all is informed by a better understanding of the role of general equilibrium forces in generating current public school inequities. Ultimately, as Inman and Rubinfeld (1979) suggested some time ago, inequities in public services have much to do with the link between residential location and school service consumption, with the fact that households have vastly different resources at their disposal, with the rigidities in housing quality differences between political districts (whether this happened through benign historical forces or activist local zoning), and with the reality that households are willing to move to improve the welfare of their families. When the public service we are concerned about is public education, there is the additional factor that quality schools are produced not primarily through financial inputs but more importantly by other "peer"

inputs that correlate with income. While centralization of financing of public education can play an equalizing role, the residential segregation of households seems unlikely to be undone by changes in public financing of schools. Furthermore, public education is different from other public services in that an active private school market plays an important role in the general equilibrium economy – and its response to state aid in some cases strengthens and in other cases weakens the intent of state policy makers. The general equilibrium nature of the issues involved in school finance debates and their link to local public finance issues further imply that other types of policies – such as housing vouchers for poor families – may have equally large impacts on education quality and may need to enter more explicitly into the education finance debate. Ultimately, state policy makers concerned with inequities in public school access and quality must look beyond mere spending difference to local incentives, housing markets, school district boundary setting and new ways of admitting students to certain schools (like charter and magnet schools, and private schools supported through vouchers.)

One concluding note of caution is perhaps in order. The results reported in the tables of this paper are derived from simulations based on a model informed by real world data – but the numbers themselves are not data from the real world. Rather, they are the best predictions we can offer using a single model capable of incorporating many of the important economic forces that real policies are likely to encounter. In the words of one of the commentators on this paper, simulation models can become "seductive" devices and create a false confidence that we now know more than we actually know. Real policies will be introduced into worlds more complicated than the already complicated stylized world of this model, and impacts of real policies will likely be

different in different contexts depending on the particulars of the affected area. The numbers generated in this paper should therefore not be interpreted too literally – they can help guide our thinking; they can reveal effects and trends we may not have thought of in our partial equilibrium models; they can even provide useful comparisons of policies and develop intuition with regard to likely magnitudes of policies. In all these ways, they can help guide the kinds of questions policy makers and empirical researchers should ask, but they cannot ultimately substitute for serious empirical analysis of policies as they unfold in more complicated settings.

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Table 3: PREDICTIONS VERSUS DATA

	Representative School Districts		
	Low Income (d=1)	Middle Income (d=2)	High Income (d=3)
Mean Land Value Predicted Mean Land Value	$157,248 $117,412	$192,867 $205,629	$271,315 $292,484
Median Household Income Predicted Mean Household Inc.	$30,639 $31,120	$45,248 $46,216	$67,312 $65,863
Per Pupil Spending Predicted Per Pupil Spending	$6,702 $6,652	$7,841 $7,910	$8,448 $8,621
Fraction Choosing Private S. Predicted Fraction in Private S.	0.21 0.20	0.23 0.23	0.20 0.13
Fraction Raised Locally Fraction Raised Locally in Model	0.52 0.52	0.77 0.77	0.87 0.87

Table 4.1: THE LIMITS OF EQUALIZATION

	Decentralized System plus NJ State Formula			Decentralized Local Property Tax			Centralized State Income Tax		
	Dist. 1	Dist. 2	Dist. 3	Dist. 1	Dist. 2	Dist. 3	Dist. 1	Dist. 2	Dist. 3
Per Pupil Spending	$6,652	$7,910	$8,621	$5,000	$7,326	$10,215	$7,195	$7,195	$7,195
Peer Inputs	0.2684	0.4701	0.6521	0.2613	0.5142	0.6404	0.2826	0.5469	0.6470
School Quality	0.4322	0.6178	0.7803	0.3674	0.6192	0.8183	0.4616	0.6316	0.6841
Average Spending	$7,753			$7,731			$7,195		
Average Quality	0.6152			0.6204			0.5960		
District Income	$31,120	$46,216	$65,863	$29,725	$50,262	$63,212	$29,891	$51,309	$62,000
Property Values	$117,412	$205,629	$292,484	$123,224	$211,729	$294,825	$118,486	$226,345	$316,308
% Private	20%	22.5%	12.5%	30%	20%	10%	22.5%	17.5%	15%
Cost of Same House	---	---	---	$120,366	$199,721	$266,608	$129,957	$184,759	$207,950

Source: Tables 2, 3, 5a,b,c in Nechyba (2002a), Table 3 in Nechyba (2002b) and Table 5 in Nechyba (forthcoming), as well as some calculations performed independently. Property values reported in these tables are converted here from annualized flows using 5.5% discount rate.

Table 4.2: CENTRALIZATION 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

Source: Portions of Table 3 in Nechyba (2002b) and Table 3 in Nechyba (2002a), with property values converted from annualized flows using 5.5% discount rate.

Table 5.1: UNIVERSAL, INCOME TAX-FINANCED STATE GRANTS

Table 5.1a: Universal Block Grants

$b_1=b_2=b_3$	Percent in Private Schools			Average State Spending	Dist 3/ Dist 1 Spending	Average School Quality	Dist 3/ Dist 1 Quality	State Aid per Family
	Dist 1	Dist 2	Dist 3					
$0	30%	20%	10%	$7,731	2.043	0.6204	2.229	$0
$3,000	27.5%	20%	7.5%	$7,834	2.109	0.6508	2.394	$2,450
$5,000	27.5%	20%	7.5%	$7,409	2.002	0.6032	2.204	$4,083
$7,000	22.5%	17.5%	7.5%	$8,321	1.515	0.6571	1.887	$5,892

Table 5.1b: Universal Matching Grants

$m_1=m_2=m_3$	Percent in Private Schools			Average State Spending	Dist 3/ Dist 1 Spending	Average School Quality	Dist 3/ Dist 1 Quality	State Aid per Family
	Dist 1	Dist 2	Dist 3					
0.0	30%	20%	10%	$7,731	2.043	0.6204	2.229	$0
0.2	22.5%	12.5%	7.5%	$9,232	2.675	0.7214	3.037	$1,320
0.4	12.5%	10%	5%	$9,944	2.613	0.7599	2.744	$2,581
0.6	10%	10%	2.5%	$10,764	2.891	0.8175	3.097	$3,734
0.8	0%	5%	0%	$12,107	3.348	0.9088	3.429	$5,291

Source: Adapted from Table 6 in Nechyba (forthcoming), with some additional calculations.

Table 5.2: TARGETED, INCOME TAX-FINANCED STATE GRANTS

Table 5.2a: Targeted Block Grants

b_1 (b_2=b_3=0)	Percent in Private Schools			Average State Spending	Dist 3/ Dist 1 Spending	Average School Quality	Dist 3/ Dist 1 Quality	Dist 3/ Dist 1 Wealth
	Dist 1	Dist 2	Dist 3					
$0	30%	20%	10%	$7,731	2.043	0.6204	2.229	2.394
$3,000	35%	20%	10%	$7,610	1.942	0.6126	2.360	1.909
$5,000	40%	17.5%	10%	$7,891	2.036	0.6329	2.491	1.609
$7,000	22.5%	15%	7.5%	$9026	1.602	0.7048	2.101	1.531

Table 5.2b: Targeted Matching Grants

m_1 (m_2=m_3=0)	Percent in Private Schools			Average State Spending	Dist 3/ Dist 1 Spending	Average School Quality	Dist 3/ Dist 1 Quality	Dist 3/ Dist 1 Wealth
	Dist 1	Dist 2	Dist 3					
0.0	30%	20%	10%	$7,731	2.043	0.6204	2.229	2.394
0.2	32.5%	20%	10%	$7,723	2.047	0.6164	2.296	2.273
0.4	30%	20%	10%	$7,862	1.882	0.6275	2.207	2.064
0.6	25%	15%	10%	$8,121	1.720	0.6419	2.122	1.982
0.8	15.5%	15%	7.5%	$8,190	1.491	0.6336	1.780	1.871

Source: Adapted from Table 7 in Nechyba (forthcoming), with some additional calculations.

Table 6.1: STATE INCOME TAX FUNDED VOUCHERS (UNDER DECENTRALIZED PUBLIC SCHOOL FUNDING)

Table 6.1a: Universal Voucher Eligibility

Voucher Amount	Percent in Private Schools			Average State Spending	Dist 3/ Dist 1 Spending	Average School Quality	Dist 3/ Dist 1 Quality	Net Cost of Voucher
	Dist 1	Dist 2	Dist 3					
$0	30%	20%	10%	$7,731	2.043	0.6204	2.229	$0
$1,000	40%	27.5%	10%	$7,774	1.954	0.6044	2.245	-$161
$2,500	62.5%	40%	12.5%	$8,012	1.911	0.5739	2.151	-$286
$4,000	87.5%	82.5%	30%	$8,072	1.878	0.4813	2.419	-$828
$5,000	100%	100%	37.5%	$9,696	***	0.5321	***	-$206

Table 6.1b: Eligibility Restricted to District 1 Residents

Voucher Amount	Percent in Private Schools			Average State Spending	Dist 3/ Dist 1 Spending	Average School Quality	Dist 3/ Dist 1 Quality	Net Cost of Voucher
	Dist 1	Dist 2	Dist 3					
$0	30%	20%	10%	$7,731	2.043	0.6204	2.229	$0
$1,000	37.5%	25%	10%	$7,476	1.908	0.5453	2.110	-$390
$2,500	70%	40%	10%	$7,115	1.667	0.5271	2.003	-$1,332
$4,000	100%	40%	17.5%	$6,606	***	0.4607	***	-$1,714
$5,000	100%	40%	19.8%	$6,589	***	0.4653	***	-$1,439

Table 6.1c: Eligibility Restricted to Low Income Households

Voucher Amount	Percent in Private Schools			Average State Spending	Dist 3/ Dist 1 Spending	Average School Quality	Dist 3/ Dist 1 Quality	Net Cost of Voucher
	Dist 1	Dist 2	Dist 3					
$0	30%	20%	10%	$7,731	2.043	0.6204	2.229	$0
$1,000	30%	20%	10%	$7,731	2.043	0.6204	2.229	$0
$2,500	45%	20%	10%	$7,905	2.029	0.6194	2.460	-$131
$4,000	82.5%	25%	7.5%	$8,320	1.960	0.6456	3.330	-$320
$5,000	100%	25%	10%	$8,509	***	0.6761	***	-$255

Source: Adapted from Table 5a in Nechyba (forthcoming), with some additional calculations.

Table 6.2: STATE INCOME TAX FUNDED VOUCHERS (UNDER NEW JERSEY FORMULA)

Table 6.2a: Universal Voucher Eligibility

Voucher Amount	Percent in Private Schools			Average State Spending	Dist 3/ Dist 1 Spending	Average School Quality	Dist 3/ Dist 1 Quality	Net Cost of Voucher
	Dist 1	Dist 2	Dist 3					
$0	20%	22.5%	12.5%	$7,753	1.296	0.6153	1.805	$0
$1,000	32.5%	22.5%	15%	$7,725	1.207	0.6035	1.767	-$175
$2,500	40%	27.5%	22.5%	$7,502	1.150	0.5645	1.716	-$330
$4,000	67.5%	40%	30%	$6,914	1.556	0.4773	2.339	-$753
$5,000	100%	82.5%	32.5%	$7,385	***	0.4220	***	-$656

Table 6.2b: Eligibility Restricted to District 1 Residents

Voucher Amount	Percent in Private Schools			Average State Spending	Dist 3/ Dist 1 Spending	Average School Quality	Dist 3/ Dist 1 Quality	Net Cost of Voucher
	Dist 1	Dist 2	Dist 3					
$0	20%	22.5%	12.5%	$7,753	1.296	0.6153	1.805	$0
$1,000	35%	22.5%	12.5%	$7,869	1.226	0.5971	1.698	-$182
$2,500	47.5%	30%	15%	$7,695	1.197	0.5534	1.616	-$614
$4,000	82.5%	42.5%	15%	$7,408	1.623	0.5019	2.460	-$1,280
$5,000	100%	47.5%	17.5%	$7,430	***	0.5093	***	-$1,321

Table 6.2c: Eligibility Restricted to Low Income Households

Voucher Amount	Percent in Private Schools			Average State Spending	Dist 3/ Dist 1 Spending	Average School Quality	Dist 3/ Dist 1 Quality	Net Cost of Voucher
	Dist 1	Dist 2	Dist 3					
$0	20%	22.5%	12.5%	$7,753	1.296	0.6153	1.805	$0
$1,000	20%	22.5%	12.5%	$7,753	1.296	0.6153	1.805	$0
$2,500	20%	22.5%	12.5%	$7,753	1.296	0.6153	1.805	$0
$4,000	40%	22.5%	12.5%	$7,899	1.264	0.6089	2.046	-$140
$5,000	67.5%	20%	10%	$7,698	1.710	0.6121	2.783	-$427

Source: Adapted from Table 5c in Nechyba (forthcoming), with some additional calculations.