Wealth Neutrality, Flypaper Effects, and School Funding in Ohio

A thesis submitted to the Miami University Honors Program in partial fulfillment of the requirements for University Honors with Distinction

by

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May 2005
Oxford, Ohio
ABSTRACT

WEALTH NEUTRALITY, FLYPAPER EFFECTS, AND
SCHOOL FUNDING IN OHIO

by Nicole Angeline Kozdron

Public K-12 schools in Ohio have traditionally relied primarily on locally generated revenues to fund their operation. Districts’ revenues are thus tied directly to local property tax bases, a system many deem inequitable. In recent years, state and federal revenues have supplemented local revenues to a large degree, though locally raised revenues still comprise approximately half of the total revenues districts receive. The constitutionality of Ohio’s school funding system has been challenged repeatedly since 1991. In 1997, 2000, 2001, and 2002, the Ohio Supreme Court ruled the school funding system unconstitutional on the grounds that it failed to provide “thorough and efficient” public education to all students. This thesis seeks to determine to what extent school funding in Ohio has changed since the DeRolph v. State rulings.

This thesis examines Ohio’s system of school funding before and after the first DeRolph v. State ruling in 1997. I analyze cross-sectional data about Ohio’s schools from 1992—five years before the Ohio Supreme Court’s first DeRolph ruling—and compare it to analogous data from 2000, three years after the Court’s declaration that Ohio’s school funding practices were unconstitutional. I find that revenues per student have become slightly more equal across districts in the wake of the DeRolph litigations. Using elasticity of per-student revenue with respect to median district income as a measure of “fairness,” I find that revenues per student have become considerably less unfair as well. I employ regression techniques to isolate “flypaper effects” in the response of local revenues to state and federal revenues; these effects may substantially alter the consequences of state and federal funding redistribution efforts.

These results indicate that per-student revenues available to Ohio school districts became slightly more equitable from 1992 to 2000. In general, increased state revenues “stick where they hit,” increasing total per-student revenues, especially in low-revenue districts.
Wealth Neutrality, Flypaper Effects, and School Funding in Ohio

by Nicole Kozdron

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Acknowledgements

Though the honors thesis is by design an individual scholastic endeavor, this project would not have been possible without the guidance and support of many others in my life. I want to thank my advisor, Dr. Dennis Sullivan, for his guidance, patience, and analytical assistance throughout this project. His expertise has been an invaluable asset and I feel I have learned much more because of it. I would also like to thank my readers, Dr. Katherine Durack and Dr. William Even, for their insightful comments and recommendations. Finally, I thank my friends and family for their continued support and encouragement during this and other projects I have undertaken.
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Introduction

The American public education system was founded in the eighteenth century on the cornerstones of local control and financing. Property taxes, traditionally the main source of revenue for localities, thus determined to a large extent the amount of funds communities could earmark for public elementary and secondary education. As they began to realize the progressively increasing and broad-reaching benefits of effective compulsory education, federal and state governments contributed larger sums to subsidize local schools, but locally generated revenues continued to comprise the majority of public education’s resources (Card & Payne, 2002, p. 2). According to renowned education economist Caroline Hoxby, the typical American school district raised more than 65 percent of its funds from a local tax base during the 1950s (Hoxby, 1998). Beginning in the late 1960s, litigious critics began to challenge the constitutionality of what they deemed fundamentally inequitable property tax-based school funding systems, arguing that property-rich districts were unfairly able to devote more resources to their schools than property-poor districts. Benchmark state Supreme Court rulings, like California’s *Serrano v. Priest* (1971), New Jersey’s *Robinson v. Cahill* (1973), and Connecticut’s *Horton v. Meskill* (1977), overturned the constitutionality of dozens of school financing systems and sparked waves of judicially and legislatively mandated school finance reform across the United States (Maxwell & Sweetland, 2002).

As Michael Heise (1995) demonstrates, there have been three fairly distinct “waves” of education finance reform. The first wave, initiated by the *Serrano* case,
mainly focused on the Equal Protection Clause in the U.S. Constitution, despite the local nature of the problems the suits were trying to resolve. This wave quickly subsided, however, after the U.S. Supreme Court ruled in 1973 that local finance mechanisms did not contravene the U.S. Constitution. The second wave began the same year with *Robinson v. Cahill*, which shifted the focus of attack to state constitutions. Again, lawsuits cited equal protection clauses, and again met only temporary success before this litigation avenue was closed off. The third wave of litigation began much later, in 1989, and again focused on state constitutions. This time, however, ambiguities in education provision clauses became the targets. For instance, Ohio’s Constitution proclaims that the Ohio General Assembly “will secure a thorough and efficient system of common schools throughout the state” but fails to define either “thorough” or “efficient” (Ohio Constitution, Article 6, section 2). Many of the third wave cases met with appreciable success; by 1996, 16 state supreme courts had overturned school funding formulas (Murray, Evans & Schwab, 1998, p.791).

The case most applicable to this paper is that brought by parent Dale DeRolph and five school districts against the state of Ohio in 1991. In the pattern of the third wave of school finance litigation, DeRolph argued that the state’s current funding system violated the “thorough and efficient” criteria mandated in the state constitution. Though each side differed in its opinion on funding constitutionality, “plaintiff and defense witnesses alike testified as to the inadequacies of Ohio’s school funding and the need for reform” (*DeRolph v. State*, 1997). The case ultimately reached the Ohio Supreme Court, which in 1997 ruled Ohio’s school funding system in violation of the “thorough and efficient”
clause. The court left the problem of resolving the unconstitutionality to the General Assembly, and the case reached the Ohio Supreme Court three more times (in 2000, 2001, and 2002) as DeRolph et al. argued that the General Assembly was making insufficient progress in developing a constitutional funding system. In its final ruling on the case, the Ohio Supreme Court observed that “the principal legislative response… has been to increase funding” and that the funding system’s “overreliance on local property taxes is the fatal flaw that until rectified will stand in the way of constitutional compliance” (DeRolph v. State, 1997). The Court did little to ensure the correction of the funding system’s “fatal flaw,” however, by simply reaffirming its 2001 ruling that state revenues should be distributed according to a foundation formula which ensures each district receives per-student revenues equal to an amount deemed adequate to effectively educate a student.

Many questions arise from the as yet unresolved DeRolph v. State legal saga¹: How unequal were school finances in the first place? Are school finances more equal now than they were before DeRolph? Are there any mechanisms the state legislature can employ to enhance equality? What other factors might cause disparities in local revenues raised? Is the state’s foundation formula “wealth neutral,” or do districts’ revenues vary systematically by district wealth? This paper seeks to investigate these questions by analyzing cross-sectional data about Ohio’s schools from 1992—five years before the Ohio Supreme Court’s first DeRolph ruling—and comparing it to analogous data from

¹ As of the writing of this paper, the Ohio Supreme Court has yet to declare Ohio’s funding system constitutional.
2000, three years after the Court’s declaration that Ohio’s school funding practices were unconstitutional.

The paper will proceed as follows. First, I review some of the recent economic literature on public school finance reform. I focus this review around Card and Payne (2002) because their investigational techniques largely inspired those used in this paper. Next, I examine the nature of revenue inequality across Ohio’s public schools by measuring and modeling inter-district inequality; as one might expect, I discover that revenues per student have become slightly more equal across districts in the wake of the DeRolph litigations. Then, using elasticity of per-student revenue with respect to median district income as a measure of “fairness,” I assess the “fairness” of the observed persistent revenue inequality and closely examine the wealth neutrality of per-student revenues. As the elasticity of per-student revenue with respect to district median income decreases, revenues become more wealth neutral and hence more “fair.” Not surprisingly, I find that revenues per student have become considerably more fair. The trend toward fairness seems to be driven both by more wealth-neutral local revenues and more redistributive state revenues. I investigate this trend by examining the “flypaper effect,” or the tendency of grant money to ‘stick where it hits,’ and assessing the role it plays in equalizing school funding. The substitution effect, or the tendency of a district to substitute the state funds it receives for its own locally generated funds, is the reverse of the flypaper effect; I investigate it as well. I find that the state and federal redistribution efforts are both aided and abetted by the flypaper and substitution effects.
Literature Review

Much of the school finance reform literature centers around a few key research questions: How much has school funding changed over the last 25 years? Did the courts play a significant role in this process? How did reforms change expenditure patterns in low- and high-spending public school districts? To generate answers to these broad questions, older articles in the research program have tended to scrutinize the effect of reforms in a particular state (usually California, the state where the school finance reform movement began) or the effects of reform on average per-pupil expenditures. More recent literature, namely that of Murray, Evans, and Schwab (1998) and Card and Payne (2002), builds upon the older literature to develop models that can analyze spending patterns across states as well as across districts.

Card and Payne structure their analysis around various aid formulas, adhering to the established methods of the research program. Like Downes and Shah (1995), they estimate cross-state expenditures on education with multiple regression models. However, Downes and Shah (1995) study variation in average district expenditures across states, while Card and Payne (2002) instead analyze per-pupil expenditures. This slight difference in specification impacts the interpretation of coefficients but leaves little else changed. Card and Payne’s model is also similar to the one with which Murray, Evans, and Schwab (1998) examine inequality among districts; both models control for a set of “observable factors.” Card and Payne run their regressions using panel data on state level expenditures for the years 1977 to 1992. They classify the regressions according to
the timing of legislative actions, which they treat as exogenous to the model, and compare values across groups of regressions. Murray, Evans, and Schwab conduct a similar analysis by including a litigation dummy variable in their equation.

The school finance reform literature incorporates a standard set of simplifying assumptions into its models, which assume communities, composed of homogenous citizens, that provide optimum combinations of local public goods. Since each community is assumed to be composed of homogenous individuals, “Tiebout models” (Tiebout, 1956) allow researchers to account for the spending differentials across districts by assuming that one preference individuals sort by is their willingness to pay for public education. These Tiebout models allow researchers to acknowledge the observed socioeconomic homogeneity within most school districts while simultaneously appealing to the authority of one of the most-cited works in economic literature. Card and Payne (2002) cite the Tiebout model to rationalize “spending differentials across districts” (p. 56). Likewise, Silva and Sonstelie (1995) implicitly appeal to the Tiebout model in their analysis of local school spending patterns following Serrano v. Priest. Downes and Shah (1995), however, are the only researchers whose work I examined that caution “the median voter model may provide a particularly inaccurate characterization of decision-making at the state level” (p. 9). Silva and Sonstelie (1995) use the median voter model to justify the inclusion of a median family income variable in their regression, as do Card and Payne (2002) and Downes and Shah (1995). The income variable is certainly a relevant determinant of school spending given districts’ reliance on local revenues,
though its inclusion in regression models is often justified solely by appeal to the median voter model rather than tested by data.

While most of the literature focuses primarily on changes in school finances resulting from court-ordered legislation (Silva & Sonstelie, 1995; Downes & Shah, 1995; Murray, Evans, & Schwab, 1998), Card and Payne (2002) recognize that states not forced to change their systems may still have experienced equalization effects. In fact, their analysis concludes that court decisions had little independent effect on states’ decisions to overhaul the structures of their school finance systems. They carry this analysis further, finding that expenditures per student rose by approximately the same percentage in states where the court upheld the funding system as in those whose funding systems were overturned, though states without any sort of court decision experienced higher overall per-student expenditure growth (p. 60). This surprising result directly inspires my investigation of cross-district per-student expenditure differentials: if court decisions can differentially impact expenditures across states, their effects may also vary across districts within a state. Though Card and Payne’s analyses of Census of Government data provide my inspiration, I begin my analysis in the spirit of Murray, Evans, and Schwab (1998) by examining how per-student expenditures across Ohio districts changed after the imposition of finance reform.
Inter-District Inequality
How unequal were Ohio’s public school finances in the first place? Are public school finances more equal now than they were before DeRolph? To address the first of my research questions, it is necessary to model the inequality across Ohio school districts. To build a useful model, I impose a district budget constraint, calculate quantitative measures of inter-district inequality, and examine the possibility that the observed inequality of per-student revenues may not be “unfair.”

The District Budget Constraint
As a first approximation, one might expect school districts’ revenues to match their expenditures almost exactly. Before undertaking an analysis underpinned by the assumption of equal revenues and expenditures, I use Census of Governments data from 1992 and 2000 to compare districts’ revenues with their expenditures. As Table 1 indicates, the assumption is generally valid that school districts operate under the budget constraint

\[ E = L + S + F \]  

where E, expenditures, is equivalent to the sum of local revenues (L), state revenues (S) and federal revenues (F). In both years of my analysis, the mean revenues per student exceeded the mean expenditures per student in constant 2000 dollars. The difference

---

2 “Revenues” and “expenditures” refer to operating revenues and expenditures only. I exclude capital revenues and expenditures.
between mean revenues and mean expenditures increased from 1992 to 2000, indicating a
trend toward increased solvency or, at the very least, toward balanced budgets. The third
row of Table 1 highlights this trend; the mean district budget surplus increased fourfold
from $53 in 1992 to $213 in 2000. The mean surplus represents approximately 1% of
revenues in 1992 and about 2.5% of revenues in 2000. From this point forward the
analysis variable will be defined by budget constraint (1) as revenues per student rather
than actual expenditures per student. An advantage to this approach, as we shall see, is
that districts’ total revenues are the exact sums of the revenues they receive from local,
state, and federal sources.

Table 1. Expenditures and revenues per student.

<table>
<thead>
<tr>
<th></th>
<th>1992</th>
<th></th>
<th>2000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Deviation</td>
<td>Mean</td>
<td>Std. Deviation</td>
</tr>
<tr>
<td>Revenues per student (L+S+F)</td>
<td>5768</td>
<td>1615</td>
<td>7500</td>
<td>1966</td>
</tr>
<tr>
<td>Expenditures per student (E)</td>
<td>5715</td>
<td>2329</td>
<td>7287</td>
<td>1943</td>
</tr>
<tr>
<td>Surplus ((L+S+F)-E)</td>
<td>53</td>
<td>1251</td>
<td>213</td>
<td>1270</td>
</tr>
</tbody>
</table>

Districts with deficit (surplus<0)

<table>
<thead>
<tr>
<th></th>
<th>1992</th>
<th></th>
<th>2000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Deviation</td>
<td>Mean</td>
<td>Std. Deviation</td>
</tr>
<tr>
<td>Districts with deficit (surplus&lt;0)</td>
<td>-854</td>
<td>1650</td>
<td>-915</td>
<td>1355</td>
</tr>
</tbody>
</table>

Districts with surplus (surplus=0)

<table>
<thead>
<tr>
<th></th>
<th>1992</th>
<th></th>
<th>2000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Deviation</td>
<td>Mean</td>
<td>Std. Deviation</td>
</tr>
<tr>
<td>Districts with surplus (surplus=0)</td>
<td>565</td>
<td>435</td>
<td>634</td>
<td>938</td>
</tr>
</tbody>
</table>

1 All values are reported in constant 2000 dollars. Data are from the 1992 and 2000 Census of Governments.
2 218 districts faced operating deficits in 1992. The per-student deficit for a district in the 99th percentile was -$11, while a
district in the first percentile faced a per-student deficit of -$7,422. In 2000, 164 districts operated at a per-student deficit.
The per-student deficit for a district in the 99th percentile was -$2, while a district in the first percentile had a per-student
deficit of -$5,730.
3 386 districts enjoyed per-student surpluses in 1992. The per-student surplus for a district in the first percentile was $13,
while a district in the 99th percentile enjoyed a per-student surplus of $2,177. In 2000, 440 districts operated at a per-
student surplus. The per-student surplus for a district in the first percentile was $7, while a district in the 99th percentile
operated at a $5,172 per-student surplus.

The data in Table 1 demonstrate that Ohio school districts’ revenues per student
increased 30% from 1992 to 2000. This growth represents a substantial improvement in
districts’ overall financial situations. Further evidence of financial improvement is the
increase in the number of districts running per-student revenue surpluses: 386 districts
ran surpluses in 1992, while 440 did so in 2000. Despite the seeming solvency of the average Ohio school district, stories about school financial crises continue to headline local newscasts and newspapers. Many of these stories raise the issue of funding disparities across districts. Two primary questions stem from these stories: first, whether school districts’ operating revenues differ significantly, and second, if indeed revenues do differ significantly, whether they do so in a “fair” or “unfair” manner.

The Inequality of Per-Student Revenues

The goal of this section is to characterize any changes in the inequality of per-student revenues across districts over the eight-year period of this study, during which significant legal strides toward educational equity were made. Because districts vary widely in size and enrollment, the use of per-student revenues provides a standardized basis for the calculations of inequality that follow.

There are numerous methods for calculating inequality; each has advantages and drawbacks. I calculate three measures of the per-student revenue inequality across districts: the coefficient of variation, the Gini coefficient, and the ratio of revenue at the 90th percentile to revenue at the 10th percentile. Each of these measures, reported in Table 2 below, provides a scale-free estimate of per-student revenue inequality across districts.

The Coefficient of Variation

The first measure of inequality reported in Table 2 is the coefficient of variation, or CV. The CV is calculated by dividing the standard deviation of per-student revenues by the mean value of per-student revenues. The nature of the CV calculation renders it sensitive
Table 2. Measures of per-student revenue inequality across Ohio school districts.  

<table>
<thead>
<tr>
<th></th>
<th>1992</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient of Variation</td>
<td>0.28000</td>
<td>0.26219</td>
</tr>
<tr>
<td>Gini coefficient</td>
<td>0.12181</td>
<td>0.11792</td>
</tr>
<tr>
<td>90/10 percentile ratio</td>
<td>1.625</td>
<td>1.597</td>
</tr>
</tbody>
</table>

Data are from the 1992 and 2000 Census of Governments. All calculations are weighted by district enrollment.

to extreme values. The CV values reported in Table 2 declined slightly from 0.2800 in 1992 to 0.26219 in 2000, suggesting a trend toward increased equality in per-student revenues across Ohio school districts.

The Gini Coefficient

The Gini coefficient is another commonly calculated measure of inequality. An index of inequality with its roots in Lorenz curve analyses, the Gini coefficient provides an answer to the query “how unequal is the distribution of per-student expenditures?” The Gini coefficient can be expressed by

\[
Gini = \frac{1}{2n^2} \sum_{i < j} |E_i - E_j|
\]

(2)

for all school districts \(i, j\) where \(n\) is the number of districts, \(\mu\) is the mean level of per-student revenue, and \(E_i\) represents the per-student revenue in district \(i\). As the expression above demonstrates, the Gini coefficient is calculated by summing the absolute difference between the per-student expenditures for every pair of districts in the state. The Gini

\[\text{\textsuperscript{3}}\text{ Several of Ohio’s K-12 public school districts are omitted from this analysis and subsequent analyses. Omitted districts include College Corner, which straddles the Indiana-Ohio border; North Bass, Middle Bass, and South Bass Island, whose isolation and small student populations limit my study’s applicability; and Winton Woods, C.R. Colbentz/National Trail, and Preble-Shawnee, for which data inconsistencies could not be resolved. See the Data Appendix for further information about the data.}\]
coefficient’s strength is that it permits analysis of the average difference in per-student expenditures between any randomly selected pair of school districts relative to the average per-student expenditure level for all state districts. Including ? in the calculation of the Gini coefficient serves to normalize the value, restricting its range to between zero and one. A Gini coefficient of zero indicates perfect equality, while a Gini coefficient of one indicates perfect inequality.

The Gini coefficient for the 1992 per-student revenues of Ohio public school districts has a value of 0.12181, which can be interpreted in the following manner: if two school districts were randomly selected and their per-student revenues were compared, the expected absolute difference between the values as a percentage of the mean could be expressed as twice the Gini coefficient. So for 1992, the expected absolute difference in per-student revenues between two randomly selected districts would be 

\[ (0.12181)(2)(5768) = 1405 \]

The value of the Gini coefficient in 2000 declined slightly compared to 1992, indicating a trend toward per-student spending equalization which mirrors that evidenced by the CV. However, the expected absolute difference in per-student revenues between two randomly selected school districts would be $1769, which is actually higher in constant 2000 dollars than the expected difference eight years prior. Because the Gini coefficient’s calculation renders it sensitive to changes around the middle of the distribution, this result is not particularly unexpected: the mean dollar value of revenues per student increased appreciably from 1992 to 2000, as Table 1 illustrated.
The 90/10 Percentile Ratio

The third measure of inequality I calculate is the 90/10 percentile ratio. As its name suggests, the 90/10 percentile ratio is simply the ratio of the per-student revenues of a district in the 90th percentile of the distribution and the per-student revenues of a district in the 10th percentile of the distribution. By construction, the 90/10 percentile ratio is relatively insensitive to extreme values outside of the 90th and 10th percentiles. A 90/10 percentile ratio of one indicates perfect equality; the higher the 90/10 percentile ratio, the higher the level of inequality inherent in the distribution. Values of the 90/10 percentile ratio for 1992 and 2000 are reported in Table 2. The 90/10 percentile ratio fell slightly, from 1.625 in 1992 to 1.597 in 2000, again indicating a weak trend toward per-student revenue equalization across districts. It is important to note, however, that the 90/10 percentile ratio in 2000 is still appreciably greater than one, supporting the popular conception that substantial inequality in per-student revenues persists across Ohio school districts despite concerted efforts to reduce it.

The Potential Unfairness of Inequality

The inequality measures presented above indicate that inequality in per-student revenues across Ohio school districts, while on the decline, remained persistent from 1992-2000. The question then becomes whether per-student revenues are determined in a ‘fair’ manner. Since the issue of fairness is a normative rather than positive one, it is impossible to fully address this question without first defining a standard of “fairness” for the purposes of this investigation.

For some, a fair determination of per-student district revenues would be a directive instructing that all districts collect exactly the same amount as all other districts
for each student they are instructing. Because of the varying costs of district operation across the state, however, this ‘fair’ distribution of revenue would result in unequal real per-student expenditures. Additionally, this notion fails to make the distinction between the ability of district residents to finance public schools and their willingness to do so. Districts composed of residents with high median incomes are certainly more able to support local schools than districts composed of low-income residents. However, the residents of high-income districts may be unwilling to delegate their tax dollars to public schools. Thus, the inequality we observe may not be arbitrary, connected to wealth, or otherwise unfair; it may simply reflect the preferences of district residents.

Perhaps a feasible operational definition of fair, then, is a situation in which the ability of a district to finance its schools is not the sole factor in the determination of locally generated per-student revenues. For funding to be fair by this metric, commonly called “wealth neutrality,” there should be no significant relationship between median family income and the revenues a district generates locally. More specifically, complete fairness in school funding will arise when the income elasticity of per-student revenues with respect to median family income is zero. The higher the income elasticity value, the less fair is the funding distribution.

The test for the existence of unfair inequality according to the criterion defined above is that the income elasticity of per-student revenues be significantly greater than

---

4 The State of Ohio school funding formula has historically included a “cost-of-doing-business” factor to mitigate this problem. A district’s cost-of-doing-business factor theoretically incorporates everything from transportation costs to local labor market conditions. Cost-of-doing-business factors are determined at the county level; the counties with the highest costs receive correspondingly higher state revenues. The most recent budget proposal called for the elimination of the cost-of-doing-business factor, but action on this issue was delayed.
zero. I use log-linear regressions to determine the income elasticity of districts’ per-student revenues. I run regressions for the two years of this study, 1992 and 2000, first with the simplest specification of

\[ \ln(\text{per-student revenues}) = \beta_0 + \beta_1 \ln(\text{median family income}) + \beta_2 \]  

(3)

then adding controls for a district’s region (suburban, urban, rural), its percentage of African-American residents (black), and the percentage of its children living below the poverty line (u18poor). The results from the regressions are reported in Table 3 below.

Table 3. Effects of district log median family income on log per-student revenues.

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>logmedfi</td>
<td>0.1357*</td>
<td>-0.0263</td>
<td>0.2502**</td>
<td>-0.0322</td>
<td>1.0690**</td>
<td>0.4164**</td>
</tr>
<tr>
<td></td>
<td>(0.054)</td>
<td>(0.034)</td>
<td>(0.072)</td>
<td>(0.051)</td>
<td>(0.098)</td>
<td>(0.067)</td>
</tr>
<tr>
<td>suburban</td>
<td>--</td>
<td>--</td>
<td>0.2473**</td>
<td>0.1569**</td>
<td>0.1049**</td>
<td>0.0576*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.040)</td>
<td>(0.027)</td>
<td>(0.035)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>urban</td>
<td>--</td>
<td>--</td>
<td>0.4324**</td>
<td>0.1864**</td>
<td>0.1538**</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.031)</td>
<td>(0.023)</td>
<td>(0.031)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>black</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.8326**</td>
<td>0.6181**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.110)</td>
<td>(0.080)</td>
</tr>
<tr>
<td>u18poor</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1.6739**</td>
<td>1.0929**</td>
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<td></td>
<td>(0.221)</td>
<td>(0.191)</td>
</tr>
<tr>
<td>n=604</td>
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<td>R2=0.0010</td>
<td>R2=0.2646</td>
<td>R2=0.1248</td>
<td>R2=0.4806</td>
<td>R2=0.3482</td>
</tr>
</tbody>
</table>

Standard errors are in parentheses. Table entries represent regression coefficients. ** indicates significance at the 99% confidence level; * indicates significance at the 95% confidence level. All dollar values included in regressions are reported in constant 2000 dollars. All equations are weighted for district enrollment.

A detailed description of the datasets I use, including variable definitions, means, and standard deviations, can be found in the Data Appendix.
The regression results are striking. The estimates from all three specifications suggest that per-student revenues became more fair—that is, less contingent on district income—during the 1990s. In the simplest specification, the income elasticity of per-student revenues in 1992 was 0.1357, indicating that a 1% increase in median family income resulted in a 0.13% increase in per-student revenues. By 2000, however, this significant relationship deteriorated such that it was no longer distinguishable from zero. When dummy variables controlling for districts’ degree of urbanization were included in the regression (rural is omitted), the income elasticity of per-student revenues declined even more dramatically—from 0.2502 to zero. Over the same time period, the differences in per-student revenues across districts of varying degrees of urbanization declined as well, though both urban and suburban districts continued to receive significantly more revenue per student than their rural counterparts into 2000. Adding controls for districts’ racial compositions and levels of poverty changed the results slightly, though the trend toward increased fairness remained robust. The additional controls made the income elasticity much more pronounced; in 1992, it exceeded unity and by 2000 had only declined to 0.4164, which is appreciably higher than the 1992 values in the simpler specifications. Interestingly, the effect of a district’s degree of urbanization was almost eliminated when the control variables for race and poverty were added.

Clearly, the level of poverty faced by a district influenced its revenues, though in what is perhaps a counterintuitive fashion: districts with higher percentages of students

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6 Correlations among race, poverty level, and income may lead to an overstatement of income elasticity in this specification.
living in poverty seemed to have higher revenues per student, *ceteris paribus*. This unexpected result may be evidence of attempts to equalize revenue distribution.

I draw two main conclusions from the results in Table 3. First, district per-student revenues became much less correlated with district median income from 1992 to 2000, providing evidence of increased concern for fairness in funding. Second, several other district characteristics significantly contributed to per-student revenues over this period, indicating the intricacy and complexity of the effects of the school funding process. This complexity may also be due in part to the system of fiscal federalism, which I explore in detail below.

**Fiscal Federalism and School District Revenues**

Since its introduction to the United States in the eighteenth century, public education has been considered a local public good. In the past, localities bore all the costs of educating their citizens but also accrued all the benefits associated with more productive citizens. Over time, however, as the mobility of the population increased, states began to recognize that they too benefited from the provision of public education. Many states, including Ohio, even inserted education clauses into their constitutions to ensure for the continued provision of public education. In 1980, the federal government created a stand-alone Department of Education from what was formerly the Health, Education, and Welfare Department with the expressed purposes of ensuring equal access to education and promoting educational excellence throughout the nation. Clearly, all three levels of government demonstrate interest in ensuring the continuation of public education. Which

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7 http://www.ed.gov/about/landing.jhtml?src=gu
level of government, then, should pay the costs of providing public education? How should the costs be distributed?

The answer lies in fiscal federalism, a system through which all three levels of government fund public education. Since most of the immediate benefits of public education are realized at the local level, localities are responsible for paying most of the costs. As shown in Figure 1, local revenues comprised the largest portion of the average district’s budget in both 1992 and 2000. However, it is clear that the state government also provided a sizeable share of revenues in both years. In fact, the state’s contribution increased five percentage points from 1992 to 2000, indicating that states found more value in education over this time period. One could also infer that the state’s higher proportional contributions parallel the greater emphasis on state oversight of schools during this time. Though the federal government also receives benefits from providing education, its share of per-student revenues remained constant at four percent from 1992 to 2000.

Figure 1. Sources of per-student revenues in the average Ohio district.

Data are from the 1992 and 2000 Census of Governments.
The Effect of Income on Revenues: A Decomposition

The discussion above illustrates an equalization trend in per-student revenues across school districts from 1992 to 2000. It also demonstrates that this trend could be the result of an adjustment in any or all of the sources of revenue. The properties of OLS estimation make it possible to examine each revenue source’s contribution to (or subtraction from) the observed convergence of per-student revenues.

To generate meaningful coefficients in dollar-for-dollar terms, I use a linear OLS specification, convert all monetary values to constant 2000 dollars, and scale down the median family income and revenue variables by a factor of 1000. I include the same explanatory variables reported in the third panel of Table 3 to ensure parallel results. The coefficients on median family income from my decomposition regressions are reported in Table 4.

The estimated coefficient on median family income in the local revenue regression declined 15%, from 0.0875 to 0.0749, indicating an appreciably less positive relationship between family income and school district revenues. Similarly, the relationship between state revenue and district median family income, slightly negative even in 1992, became much more significantly negative over the 1990s. The estimated coefficient on median family income in the federal revenue equation also became more negative, declining from –0.0009 to –0.0023. However, it is important to note that the coefficient in the federal revenue equation is an order of magnitude smaller than those in the local and state revenue equations.
Table 4. Decomposition of median family income coefficients.

<table>
<thead>
<tr>
<th></th>
<th>Local Revenue</th>
<th></th>
<th>State Revenue</th>
<th></th>
<th>Federal Revenue</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>medfi</td>
<td>0.0875**</td>
<td>0.0749**</td>
<td>-0.0079*</td>
<td>-0.0210**</td>
<td>-0.0009*</td>
<td>-0.0023**</td>
</tr>
<tr>
<td></td>
<td>-0.009</td>
<td>-0.007</td>
<td>-0.003</td>
<td>-0.007</td>
<td>-0.001</td>
<td>-0.001</td>
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<tr>
<td>suburban</td>
<td>0.5936**</td>
<td>0.7692**</td>
<td>-0.076</td>
<td>-0.4989**</td>
<td>0.0327**</td>
<td>0.0243</td>
</tr>
<tr>
<td></td>
<td>-0.176</td>
<td>-0.169</td>
<td>-0.069</td>
<td>-0.168</td>
<td>-0.011</td>
<td>-0.016</td>
</tr>
<tr>
<td>urban</td>
<td>0.7965**</td>
<td>0.6094**</td>
<td>-0.2818**</td>
<td>-1.0506**</td>
<td>0.0163</td>
<td>0.0361*</td>
</tr>
<tr>
<td></td>
<td>-0.16</td>
<td>-0.559</td>
<td>-0.062</td>
<td>-0.169</td>
<td>-0.01</td>
<td>-0.016</td>
</tr>
<tr>
<td>black</td>
<td>2.3374**</td>
<td>3.9547**</td>
<td>1.1868**</td>
<td>1.7170**</td>
<td>0.4989**</td>
<td>0.4604**</td>
</tr>
<tr>
<td></td>
<td>-0.562</td>
<td>-0.559</td>
<td>-0.219</td>
<td>-0.557</td>
<td>-0.036</td>
<td>-0.053</td>
</tr>
<tr>
<td>u18poor</td>
<td>-0.2149</td>
<td>-0.4539</td>
<td>3.0270**</td>
<td>8.4725**</td>
<td>1.1878**</td>
<td>2.1046**</td>
</tr>
<tr>
<td></td>
<td>-0.95</td>
<td>-1.158</td>
<td>-0.369</td>
<td>-1.152</td>
<td>-0.061</td>
<td>-0.109</td>
</tr>
<tr>
<td>R2</td>
<td>0.4193</td>
<td>0.4782</td>
<td>0.5211</td>
<td>0.451</td>
<td>0.8664</td>
<td>0.8621</td>
</tr>
<tr>
<td>n</td>
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<td>604</td>
<td>604</td>
<td>604</td>
<td>604</td>
<td>604</td>
</tr>
</tbody>
</table>

The dependent variables are, from left to right, local per-student revenues, state per-student revenues, and federal per-student revenues. All values used in the regressions are weighted for district enrollment and are reported in constant 2000 dollars. ** indicates significance at the 99% confidence level; * indicates significance at the 95% level.

By imposing the budget constraint (equation (1)) as a strict equality,

$$L_{medfi} + S_{medfi} + F_{medfi} = E_{medfi}$$  (4)

where E, L, S, and F are as defined earlier and the respective betas are as shown in Table 4. Subtracting the coefficients for 1992 from the ones for 2000 yields

$$L_{medfi} + S_{medfi} + F_{medfi} = E_{medfi},$$  which is  (5)

$$(0.0749 - 0.0875) + (0.0079-0.0210) + (0.0009-0.00023) = E_{medfi},$$ or  (6)

$$(-0.0126 ) + (-0.0131) + (-0.0014) = E_{medfi} = -0.0271.  (7)$$
As equations (6) and (7) demonstrate, increasingly wealth-neutral local and state revenues made approximately equal contributions to the significant reduction in \( E_{medfi} \). Though local revenues make up the most sizable portion of total revenues, changes in the wealth neutrality of state revenues also have an appreciable impact on overall wealth neutrality, particularly as state revenues’ share of total revenues increases (see Figure 1). The effect of the nearly threefold decrease in the coefficient on federal revenues—it fell from 0.0023 in 1992 to 0.0009 in 2000—is mitigated by its relatively small contribution to total school district revenues. In fact, the relationship between income and federal revenue is an order of magnitude smaller than those between income and state or federal revenues. Its relatively wealth-neutral starting value of 0.0023 also detracts from the impact its change can have.

Despite obvious progress toward more equitable revenue distribution, a positive relationship between per-student revenues and a district median family income persists across Ohio districts. The next section extends the analysis of district per-student revenue inequality by exploring a potentially important aspect of per-student revenue inequality in Ohio’s schools: the flypaper effect.
The Flypaper Effect
Are there any mechanisms the state legislature can employ to enhance equality? The state legislature may be able to exploit certain economic phenomena to improve the likelihood its new funding methods will lead to increased equality. Flypaper and substitution effects are two such phenomena that, when properly motivated and structured, can lead to increased per-student revenue equality. I explore the flypaper and substitution effects by characterizing the flypaper effect and examining the impact it and substitution effects have on local per-student revenues.

Characterizing the Flypaper Effect
In the simple median voter model of taxpayer behavior, a dollar of revenue a school district receives from the state should have the same effect as a dollar increase in district personal income. However, the empirical literature since Gramlich (1977) has consistently demonstrated that grants have a far greater impact on spending behavior than corresponding increases in income; in particular, categorical grants-in-aid (governmental revenue transfers allocated for a specific purpose) stimulate spending much more than is predicted by the median voter model. This phenomenon is called the “flypaper effect”: grant money “sticks” to the programs to which it was directed.

The flypaper effect can be described as the difference in the impact of government spending based on changes in grants compared to changes in personal income. The flypaper effect appears frequently in the school finance literature. Data repeatedly demonstrate that, even as state governments make larger contributions to
school funding (mandated or not), local revenues per student tend to be larger as well (Card & Payne, 2002; Murray, Evans, & Schwab, 1998), indicating a substantial flypaper effect rather than mere substitution of funds. A simple example one could consider to illustrate the flypaper effect is that of a child (the school district) who receives a gift certificate from his parents (the state). He had planned on using his own money (local revenues) to purchase a computer game. Instead of purchasing the game with the gift certificate and using his own money for something else, a child influenced by the flypaper effect would combine some of his money with the gift certificate and splurge on a better computer game. This simple example demonstrates the complexity the flypaper effect adds to school finance reform: each dollar of federal or state revenue could just replace a dollar of local revenue, potentially jeopardizing the state’s per-student revenue equalization efforts. The key word, though, is potentially: if state (and federal) grants are redistributive, which they tend to be, then equalization efforts will only be effective if flypaper effects are present. Furthermore, school districts do not necessarily respond uniformly to state and federal funding; for example, if poorer districts experience flypaper effects while richer ones experience substitution effects, the flypaper effect could enhance redistribution efforts. I explore this issue further in the next section.

Local Revenues and the Flypaper Effect
While the values reported in Table 4 plainly indicate that state revenues became more fairly determined from 1992 to 2000, they do not clearly explain why inequity persists. Since Card and Payne (2002) found that the flypaper effect played a relatively large role in across-state public school funding inequity, it is logical to investigate its role in
perpetuating per-student revenue inequality across Ohio’s public school districts. Such an investigation begs two primary questions: How much state and federal aid is “sticking where it hits,” benefiting Ohio’s students? Does the pattern of flypaper effects serve to enhance or to undermine the redistributive efforts of the state and federal grants?

The only component of districts’ total revenues susceptible to the flypaper effect is local revenue. The state and federal aid each district receives are independently calculated by mathematical formulas prior to the fiscal year in which they are distributed and thus cannot be affected by the amount of local revenue generated during the same year. Accordingly, state and federal revenues are treated as exogenously determined variables in the analyses that follow. Local revenues, while in large part determined by the residents of a district via levies and tax rates, are partially determined by the amount of state and federal revenues a district receives. To examine the influence of per-student state (srpercap) and federal (frpercap) revenues on local per-student revenues (lrpercap), I use OLS regression. For ease of analysis, I convert all monetary values to constant 2000 dollars, and scale down the median family income and revenue variables by a factor of 1000. Because state and federal grants may affect local revenues in districts with different

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8 In 2000, Ohio used the Foundation SF-3 Formula to calculate the amount of revenue the state would contribute to each district. The SF-3 Formula determines the state’s share by generating a base cost to educate a student in a particular district; variables comprising the base cost include enrollment (average daily membership), the cost-of-doing-business factor, and a pre-set amount the state has designated as sufficient to provide an “adequate basic education” for each student. The expected local contribution of each district is subtracted from the base cost, and the residual amount is the state’s share. The expected local contribution of each district is computed by multiplying the district’s income-adjusted property valuation by 0.023, generating the amount the district “should” be able to levy independently. Because the SF-3 includes a local term, one could effectively argue that state revenues are not exogenously determined. However, the local term is an expected rather than actual one; districts are not obligated to raise exactly 2.3% of their property value in local revenues. Because of the uncertainty associated with any given district’s actual contribution, I maintain the assumption that state (and federal) per-student revenues are exogenously determined for the purposes of this analysis.
median incomes differently, I create two interaction variables, state_interact (srpercap*medfi) and fed_interact (frpercap*medfi). The regression coefficients on these interaction terms will characterize the nature of the cross-sectional flypaper effect that may exist across Ohio’s districts.

Local revenues per student are related to two broad categories of variables: financial variables and political (public choice) variables. Restricting our attention to the financial variables and ignoring the error term, we can write the equation

\[ Lrpercap = \beta_0 + \beta_1 \text{medfi} + \beta_2 \text{srpercap} + \beta_3 \text{frpercap} + \beta_4 \text{state_interact} + \beta_5 \text{fed_interact}. \] (8)

To study the flypaper effect in its entirety, we must examine the response of local per-student revenues to changes in both state and federal per-student revenues. Taking the first partial derivative of \( Lrpercap \) with respect to \( srpercap \) allows us to decompose any state-revenue induced flypaper effects into two parts—a portion not correlated with district median income and a portion that is:

\[ \frac{\partial Lrpercap}{\partial srpercap} = \beta_2 + \beta_4 \text{medfi}. \] (9)

The aggregate effect of per-student state revenues on local revenues, as demonstrated in equation (9), is \( \beta_2 + \beta_4 \text{medfi} \). The strength of this relationship for the average district can be readily calculated by evaluating equation (9) at the mean value of the median family income for each year. We might expect \( 0 > [\beta_2 + \beta_4 \text{medfi}] > -1 \), a slight substitution effect—as state revenues increase, local revenues fall but less than dollar for
dollar. For 1992, the mean district median income is $43,529, \(^9\) so using this value and the coefficients as reported in Table 5 below, the value of equation (9) is \(-0.829\), in line with our expectations. In 2000, the mean district median income rose to $51,072; the value of equation (9) is \(-0.543\), substantially less than the value in 1992. This value indicates the continued, though weakening, presence of an overall substitution effect for the average district.\(^10\)

The sign on \(?_4\) determines whether the partial substitution effect serves to increase or decrease the effect of the state grant on overall wealth neutrality. If \(?_4=0\), then the effects of state revenues are entirely wealth neutral. If \(?_4\) is positive, it tells us that the effects of per-student revenues on local per-student revenues are larger when median family income is larger. This would indicate an inequality-promoting flypaper effect. If \(?_4\) is negative, it tells us that the effects of state per-student revenues on local per-student revenues are smaller when median family income is larger. If median family income is sufficiently large, the negative value of \(?_4\cdot\text{medfi}\) can offset a positive value of \(?_2\) and result in a substitution effect for that high-income district—as state revenues per student are larger, local revenues per student are smaller. In fact, with estimates of \(?_2\) and \(?_4\) that take opposite signs, we can calculate the level of district median family income at which the substitution effect sets in, which will be termed the ‘critical value of median family income’:

\(^9\) This value is reported in constant 2000 dollars. See the Data Appendix for the mean and standard deviation values of all variables.  
\(^10\) The effects of federal per-student revenue can be analyzed in the same fashion. We expect a smaller overall effect—either substitution or flypaper—from federal revenues, though, because they comprise a substantially smaller portion of each district’s total per-student revenues than state revenues do.
The critical value of median family income tells us the median income threshold above which school districts substitute state revenues for those they have been generating themselves. Thus, it would seem that the critical value of median family income characterizes the ability of a district to provide adequate per-student revenues on a local basis. However, the ability to provide revenue is not synonymous with the willingness to do so. Voters in a district may prefer to delegate their scarce tax dollars to other programs or services; voter willingness to support school levies, then, also appreciably impacts the per-student revenues available to a district and thus must be controlled for in regression analysis.

I include the same controls for district characteristics as reported in Table 3: degree of urbanization (suburban, rural), percentage of African-American residents in a district (black), and the percentage of children in poverty (u18poor). Because local per-student revenues are determined by political as well as financial factors, I add a sampling of public choice, or voter behavior, variables. These public choice variables include demographic characteristics that could plausibly influence voters’ willingness to approve school levies. All of the public choice variables I use are present in the empirical literature which motivated this research: Card and Payne (2002) or Murray, Evans, and Schwab (1998).

The first demographic characteristic I account for is age. Some percentage of district residents (under18) are under the age of 18 and thus not eligible to vote.
However, these same residents are those who attend school; their numbers may impact eligible voters’ willingness to support public education. I also control for the percentage of district residents over the age of 65 (over65) because these voters may systematically differ from younger ones when deciding on school levies. Another demographic characteristic that may influence the decision a voter makes is the level of education s/he attained. I divide residents into four categories of educational attainment: the percentage who attained less than a high school diploma or G.E.D. (omitted), the percentage who attained a high school diploma as its terminal degree (perchs), the percentage who attended some college but did not receive a degree (quitcoll), and the percentage who attained at least a four-year degree (perccoll). The final public choice variable I include is the percentage of households in a district with children under age 18 (hhchild). I report my regression results in Table 5 below.

As expected, the public choice variables significantly impacted the amount of local per-student revenues a district received. In both 1992 and 2000, the percentage of African-American residents in a district had a strong impact on local revenues. Even after controlling for the degree of urbanization and the poverty level, districts with larger percentages of African-Americans were able to raise statistically significant but only slightly larger amounts of local revenue per student in both years. In 2000, for instance, each percentage point increase in African-American residents led to an additional $2.83 per student. I find this positive (albeit relatively small) relationship particularly interesting because of the very low African-American population in the average Ohio district, approximately 3.7%. The only other public choice variable that significantly
Table 5. Factors influencing local revenues per student.

<table>
<thead>
<tr>
<th>Factor</th>
<th>1992</th>
<th></th>
<th>2000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>medfi</td>
<td>0.1196***</td>
<td>(0.018)</td>
<td>0.1438***</td>
<td>(0.131)</td>
</tr>
<tr>
<td>srpercap</td>
<td>0.1044</td>
<td>(0.349)</td>
<td>1.4686***</td>
<td>(0.164)</td>
</tr>
<tr>
<td>frpercap</td>
<td>0.1002</td>
<td>(1.599)</td>
<td>-3.4230***</td>
<td>(1.143)</td>
</tr>
<tr>
<td>state_interact</td>
<td>-0.0214**</td>
<td>(0.008)</td>
<td>-0.0394</td>
<td>(0.004)</td>
</tr>
<tr>
<td>fed_interact</td>
<td>0.0173</td>
<td>(0.039)</td>
<td>0.0926***</td>
<td>(0.027)</td>
</tr>
<tr>
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<td>0.1017</td>
<td>(0.166)</td>
</tr>
<tr>
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<td>(0.154)</td>
</tr>
<tr>
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<td>(0.588)</td>
<td>2.8254***</td>
<td>(0.563)</td>
</tr>
<tr>
<td>u18poor</td>
<td>-0.5703</td>
<td>(1.217)</td>
<td>-5.2415***</td>
<td>(1.400)</td>
</tr>
<tr>
<td>under18</td>
<td>0.4421</td>
<td>(4.110)</td>
<td>9.6695***</td>
<td>(3.354)</td>
</tr>
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<td>over65</td>
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<td>1.7397</td>
<td>(1.811)</td>
</tr>
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<td>perchs</td>
<td>-0.8842</td>
<td>(1.520)</td>
<td>-5.5419***</td>
<td>(1.547)</td>
</tr>
<tr>
<td>quitcoll</td>
<td>-2.4061</td>
<td>(1.563)</td>
<td>-5.4482**</td>
<td>(2.170)</td>
</tr>
<tr>
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<td>(1.422)</td>
</tr>
<tr>
<td>hhchild</td>
<td>-10.1544***</td>
<td>(2.724)</td>
<td>-14.9809***</td>
<td>(2.446)</td>
</tr>
</tbody>
</table>

n=604   R2=0.6161  n=604   R2=0.6675

Table entries represent regression coefficients. Standard errors are in parentheses. *** indicates significance at the 99% confidence level, ** indicates significance at the 95% confidence level, and * indicates significance at the 90% level. All dollar values included in regressions are reported in constant 2000 dollars. All equations are weighted for district enrollment.

affected per-student revenues raised locally in 1992 was the percentage of district households with children. However, its effect was strongly negative; the coefficient on hhchild was -10.1544, indicating that each percentage point increase in households with children led to a decrease in local revenues per student. The coefficient on hhchild
became even more negative in 2000, taking on a value of -14.9809. Its move toward more negative values was mirrored by several other public choice coefficients, which changed from statistically indistinguishable from zero in 1992 to significantly negative in 2000. Public choice variable coefficients following this trend include u18poor (-5.2415 in 2000), perchs (-5.5419 in 2000), quitcoll (-5.4482 in 2000), and perccoll (-2.6640 in 2000).

The most striking results from the regressions are the estimated relationships among monetary variables. The relationship between median family income and local revenues became more positive from 1992 to 2000; the coefficient rose from 0.1196 to 0.1438, an increase significant at the 99% level. Though this result appears to be in direct contradiction to the significant declines reported in Table 4, it is important to note that the relationship between local revenues and median income we are estimating now is more complex than that estimated earlier. The effect of median income on local per-student revenues can be calculated by taking the first partial derivative of local per-student revenues with respect to median income, or

$$\frac{\partial \text{lrpercap}}{\partial \text{medfi}} = \beta_{\text{medfi}} + \beta_{\text{interacts}*\text{srpercap}} + \beta_{\text{interactf}*\text{frpercap}}. \quad (11)$$

For the average district in 1992, then, the value of equation (11) was 

$$(0.1196) + (-0.0214*2.354) + (0*0.235) = 0.0692.$$ 

This value, though slightly lower than the 0.0875 reported in Table 3, is still positive, indicating a slight flypaper effect—for each dollar of per-student revenue the average district received from the state and federal governments, its local per-student revenue grew by approximately seven cents. In 2000,
the value of equation (11) was $(0.1438) + (0*3.3878) + (0.0926*0.3210) = 0.1735$. This value is more than twice the value in 1992, indicating a much stronger flypaper effect— for each dollar of per-student revenue the average district received from the state and federal governments in 2000, its local per-student revenue grew by approximately 17 cents. These results indicate that the average district is responding to redistributive state and federal revenues by increasing its local contributions; for redistribution to be an effective means of per-student revenue equalization, then, we would expect the value of equation (11) to be larger for districts with smaller-than-average median incomes and smaller—indeed, even negative—for districts in the upper half of the median income distribution.

Because the coefficients on frpercap and fed_interact are both significant and opposite in sign in 2000, it is meaningful to calculate the critical value of median family income using equation (10). The critical value of median family income with respect to the effects of federal per-student revenues in 2000 was $(|3.4230|/|0.0926|)*1000=$36,965. All districts with median incomes below this critical value (which is significantly less than the 2000 mean district median family income of $51,072) would experience flypaper effects in response to larger federal per-student revenues, increasing their total per-student revenues relative to the mean. The range of median family incomes only extends down to $25,036 in 2000, implying that a relatively narrow range of school districts experienced flypaper effects. All districts with median incomes above the critical value would experience equalizing substitution effects. These results are in line with the expectation formulated in the previous paragraph.
The results in Table 5 and the discussion above reveal that both the flypaper effect and the substitution effect played significant roles in equalizing per-student revenues across Ohio’s school districts in 1992 and 2000. State revenues in 1992 generated a strong equalizing substitution effect in per-student local revenues, while federal revenues in 2000 generated equalizing flypaper and substitution effects. Despite these equalizing tendencies, Table 5 also demonstrates that the unfairness of per-student revenue determination—defined as wealth non-neutrality—was significantly larger in 2000 than in 1992. Public choice variables, particularly those describing educational attainment and age, also had much larger impacts on local per-student revenues in 2000 than they did in 1992. In 2000, but not in 1992, higher levels of education in a district correlated with lower local revenues, as did, oddly enough, the percentage of households with school-aged children.
Conclusion

The character of Ohio school funding changed appreciably over the course of the 1990s. In the wake of the 1997 *DeRolph* court decision, the Ohio General Assembly revised the state revenue foundation formula in an attempt to correct funding inequalities. My analysis suggests that these revisions may have contributed to a general trend of per-student revenue equalization over the 1990s. I found that, despite the persistence of cross-district inequality, revenues per student became slightly more equal across school districts from 1992 to 2000. Additionally, using elasticity of per-student revenue with respect to median district income as a “fairness” metric, I discovered that revenues per student have become considerably less unfair, in large part due to increasingly redistributive state and federal revenues. Like inequality, however, unfairness remains present across many districts. Nevertheless, it appears, superficially, that the *DeRolph* litigations contributed to the observed equalization of per-student revenues.

However, flypaper and substitution effects were also important factors in per-student revenue equalization. The presence and strength of these factors varied with both funding source and district median income: the response of local revenues state revenues were largely influenced by flypaper effects, while their responses to federal revenues display appreciable substitution effects. Districts with high median incomes were most likely to experience substitution effects, and those near the bottom of the income distribution experienced the most significant flypaper effects. Public choice variables seemed to have a significant impact on local revenues, particularly in 2000, indicating
that willingness to finance public schools is indeed an important complement to the
ability to do so. However, neither flypaper effects, substitution effects, nor public choice
variables fully explain the persistent per-student revenue inequality observed across Ohio
public school districts. Thus, it is likely that unobserved district heterogeneity plays a
substantial role in the observed inequality of per-student revenues. Unobservable
heterogeneity may include varying degrees of response to *DeRolph v. State*, but it
remains difficult to assess the degree to which *DeRolph v. State* alone contributed to the
observed trend of decreasing per-student inequality from 1992-2000. Though my
evidence clearly indicates that Ohio school funding is moving towards equity, the causes
of this shift remain ambiguous.
References


DeRolph v. State, 97 Ohio St.3d 434, 2002-Ohio-6750.

DeRolph v. State (1997), 79 Ohio St.3d 297.


**Data Appendix**

I employ data from three different sources to create a custom dataset for my analyses. I choose variables on which to collect data in light of the literature’s selections. Specifically, I use data from the Ohio Department of Education, the National Center for Educational Statistics, and the Census of Governments to find variables similar to those used in Card and Payne’s and Murray, Evans, and Schwab’s analyses. In this appendix I discuss the three datasets I use and the modifications I make to create my custom dataset. I also provide summary statistics for the data in Table 6.

**Ohio Department of Education Data**

I acquire data on Ohio school district typological classifications from the Ohio Department of Education’s (ODE) Data Web page, http://www.ode.state.oh.us/data/. The ODE identifies nine typological groups, dividing Ohio’s public school districts into categories on the bases of, among other things, location relative to metropolitan areas (rural, suburban, urban), mode of economic livelihood (agricultural, small town) and poverty rates (very low, low, high, very high).

My primary interest in the ODE typological classifications stems from my desire to control for district location as a factor in per-student revenue determination. However, to isolate this information, I have to make several modifications to the dataset. ODE methodology uses income as a district categorization tool; districts are classified on the basis of poverty rates and modes of economic livelihood. Unless I restrict the ODE dataset, I risk introducing redundancy into my models because I account for economic
<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable Name</th>
<th>1992</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median family income/1000</td>
<td>medfi</td>
<td>43.5288</td>
<td>51.0724</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(11.5718)</td>
<td>(13.0226)</td>
</tr>
<tr>
<td>Local revenue per student/1000</td>
<td>lrpercap</td>
<td>3.1788</td>
<td>3.7913</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.90323)</td>
<td>(1.8997)</td>
</tr>
<tr>
<td>State revenue per student/1000</td>
<td>srpercap</td>
<td>2.3536</td>
<td>3.3878</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.6504)</td>
<td>(1.8583)</td>
</tr>
<tr>
<td>Federal revenue per student/1000</td>
<td>frpercap</td>
<td>0.2355</td>
<td>0.3210</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.1383)</td>
<td>(0.2116)</td>
</tr>
<tr>
<td>Location control: suburban</td>
<td>suburban</td>
<td>0.2533</td>
<td>0.2533</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.4353)</td>
<td>(0.4353)</td>
</tr>
<tr>
<td>Location control: urban</td>
<td>urban</td>
<td>0.1937</td>
<td>0.1937</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.3955)</td>
<td>(0.3955)</td>
</tr>
<tr>
<td>Percentage of black residents</td>
<td>black</td>
<td>0.0305</td>
<td>0.0369</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0796)</td>
<td>(0.0897)</td>
</tr>
<tr>
<td>Percentage of children in poverty</td>
<td>u18poor</td>
<td>0.1401</td>
<td>0.1114</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0989)</td>
<td>(0.0793)</td>
</tr>
<tr>
<td>Percentage of residents under 18</td>
<td>under18</td>
<td>0.2724</td>
<td>0.2599</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0311)</td>
<td>(0.0314)</td>
</tr>
<tr>
<td>Percentage of residents over 65</td>
<td>over65</td>
<td>0.1222</td>
<td>0.1339</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0321)</td>
<td>(0.0336)</td>
</tr>
<tr>
<td>Percentage of residents with h.s. diploma</td>
<td>perchs</td>
<td>0.4150</td>
<td>0.4144</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0898)</td>
<td>(0.0991)</td>
</tr>
<tr>
<td>Percentage of residents with some college</td>
<td>quitcoll</td>
<td>0.2189</td>
<td>0.1848</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0532)</td>
<td>(0.0330)</td>
</tr>
<tr>
<td>Percentage of residents with bach. degree</td>
<td>perccoll</td>
<td>0.1322</td>
<td>0.1717</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.1016)</td>
<td>(0.1222)</td>
</tr>
<tr>
<td>Percentage of households with children</td>
<td>hhchild</td>
<td>0.3997</td>
<td>0.3436</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0554)</td>
<td>(0.0497)</td>
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</table>

All monetary variables reported in constant 2000 dollars. Standard deviations are in parentheses. n=604 for all variables.
factors by including controls for district median income and the percentage of children in poverty. To eliminate economic redundancy, I simply condense the ODE’s nine typological groups into three. I discard two groups in their entireties: group zero, “College Corner/Island Districts” and group eight, “JVS.” The four districts included in group zero are so anomalous—College Corner straddles the Indiana-Ohio border and the island districts have very few students—that including them in my analysis would affect my overall results. Group eight consists solely of Joint Vocational School districts and thus is irrelevant to my analysis of public school districts serving grades K-12. I combine group one, two, and three (Rural/Agricultural—high poverty, low median income; Rural/Agricultural—small student population, low poverty, low-to-moderate median income; Rural/Small Town—moderate to high median income) into one group based solely upon their degree of urbanization: rural. Similarly, I combine groups four and five (Urban—low median income, high poverty; Major Urban—very high poverty) into one group, urban. I combine the final two groups, Urban/Suburban—high median income, and Urban/Suburban—very high median income, very low poverty, into a single group, suburban.

Only one set of typology data was available, so I only have one observation for each district. The component of typology data most likely to change significantly over my analysis period, however, would be the economic component, which I exclude anyway. Thus, I believe the typology groups accurately reflect the degree of urbanization of Ohio’s districts, the information I seek to control for. Though the typology data were updated in 2004, the ODE used Census 2000 data to do so; I too use Census data in the
development of my dataset, so I am confident the typological data is compatible with my
dataset for both years of my analysis.

National Center for Education Statistics Data
The National Center for Education Statistics (NCES), through its 1990 Census Mapping
Project and Census 2000 School District Demographics Project, maps Census
demographic data onto school district boundaries. These data are available at
http://nces.ed.gov/surveys/sdds/. I collect data on districts’ racial compositions, poverty
statistics, age structures, levels of educational attainment, median income, and population
distributions.

I collect my data in the spirit of Card and Payne (2002) and Murray, Evans,
Schwab; I gather data similar to those they used from all three of my sources, though I
often simplify or re-format the data I acquire from NCES and thus diverge from their
models slightly. I keep my analysis of race simple by restricting my data collection to
include percentage of Native Americans in their analysis, the population of Ohio is such
that including Native American data would have a negligible effect on the analysis at
best. I also exclude a variable controlling for Hispanic population because of the debate
over whether the category is one of race or ethnicity and the changing nature of the
Census’ classification.

I also strive to keep my analysis of districts’ age structures and educational
attainment simple. Simplicity is easily imposed upon age structure data: I examine only
those residents near the top and bottom of the age distribution—those over 65 and those
under 18, who are most likely to have age-specific needs and preferences. I collect educational attainment data for adults; the NCES age cut-off for adults changed from 21 in 1990 to 25 in 2000, though I believe the results will be relatively comparable. I merge the male-female data provided by NCES into four categories of educational attainment that contain adults of both genders: no high school diploma, high school diploma, some college (no degree) and college degree (4-year college or professional degree). In my analyses, I omit the group of adults with no high school diploma. Murray, Evans, and Schwab (1998) use data on the average education of adults in a district, but the nature of the data I use are such that categorical variables are more practical.

Though income data are available from ODE, I collect median income data from NCES to capture both its dynamic nature and its value in multiple years: NCES income data are drawn from two U.S. Censuses, while ODE data are readily available for 1999 only. Both Card and Payne (2002) and Murray, Evans, and Schwab (1998) included median income data in their analyses; median income is preferable to average income because of its resistance to outlying values. To ensure the comparability of my income numbers, which are reported in nominal terms, I convert all values to 2000 dollars using chain-type indices for state and local government expenditures, Table B-7 from February 2002 Economic Report of the President.

Census of Governments Data
My source of district financial data—namely revenues and expenditures—is the Census of Governments (COG). Although the COG is only conducted in years that end in two or seven, the Public Elementary-Secondary Education Finance Data Web page, available at
http://www.census.gov/govs/www/school.html, provides financial data for every year from 1992 to 2003. COG data are commonly used in the school finance literature; both Card and Payne (2002) and Murray, Evans, and Schwab (1998) utilize COG data in their analyses. The COG proves particularly useful for me because it provides data on the three component parts of total revenue: local, state, and federal. I convert all values to 2000 dollars using chain-type indices for state and local government expenditures, Table B-7 from February 2002 *Economic Report of the President*. Because I collect data from 1992 rather than 1990 (which would match my NCES data), I match the 1992 financial data from the COG to the 1990 demographic data from the NCES and operate under the assumption that although the demographic variables will be slightly different, their ordinal rankings should remain fairly stable. Murray, Evans, and Schwab (1998) use a similar matching method in their analysis.

**Merging Datasets**
I collect data from three different sources, so before I begin my analyses I compile them into one collective dataset. The NCES and COG data are indexed using several code numbers, one of which is called the NCESID. Because the NCESID is consistent across the two datasets for both years of interest, I use the NCESID to merge my COG data with my NCES data. The ODE data are indexed by a different number, the IRN. However, the last five digits of the NCESIDs used in the COG and NCES data correspond exactly to the IRN identifier the ODE uses. I merge the ODE data into the COG/NCESID dataset using the last five digits of the IRN. After discarding obviously inconsistent data points, I am left with observations for 604 of Ohio’s school districts.