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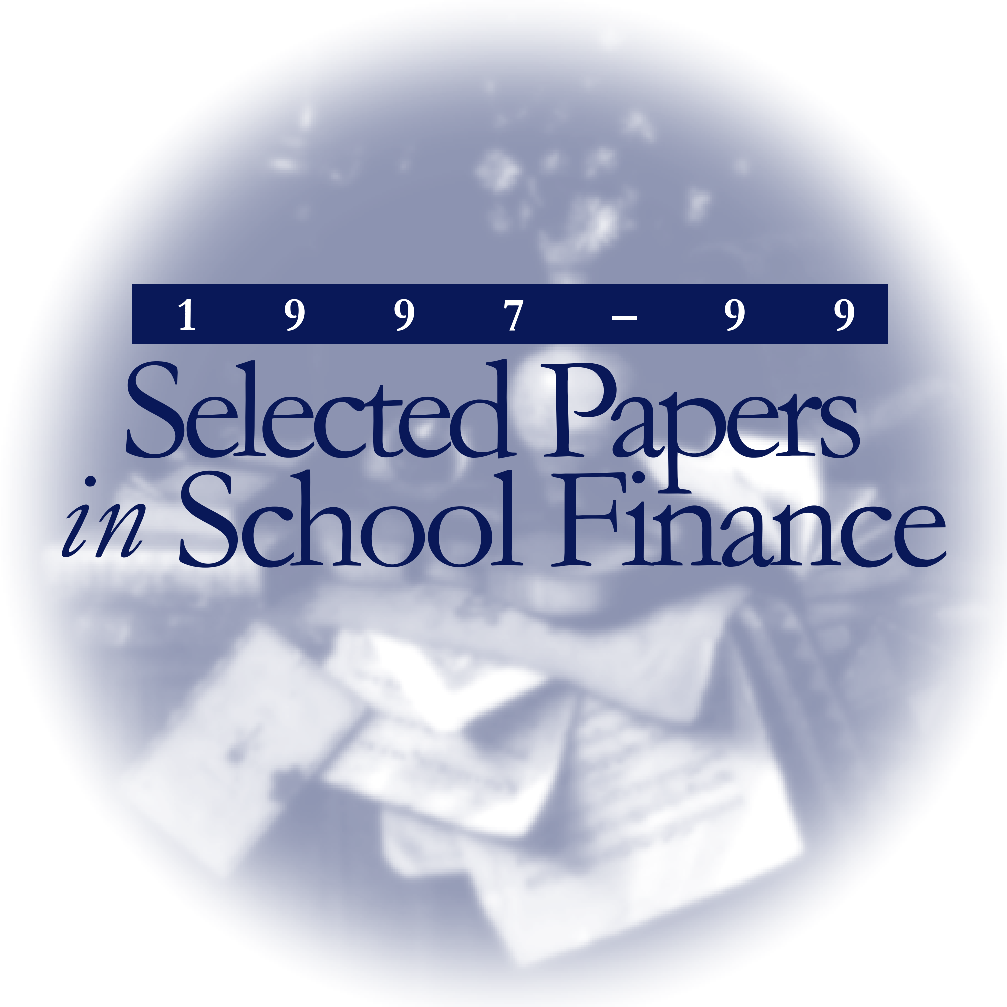

1997–99

Selected Papers *in* School Finance

U.S. Department of Education
Office of Educational Research and Improvement

NCES 1999-334

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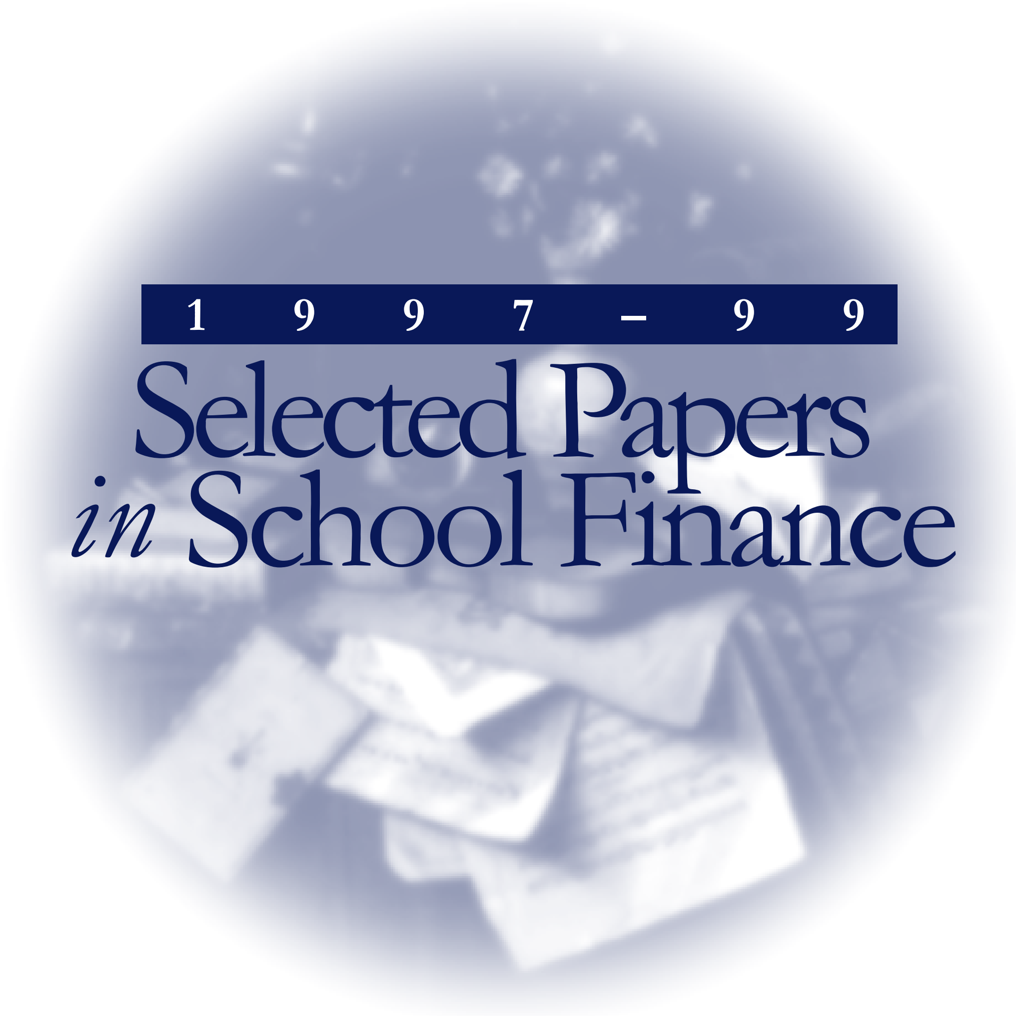

1997–99

Selected Papers *in* School Finance

William J. Fowler, Jr., Editor

U.S. Department of Education
Office of Educational Research and Improvement NCES 1999-334

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June 1999

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Dedication

In memory of Walter I. Garms, 1925–1989

This years Selected Papers in School Finance is dedicated to Walter I. Garms, who performed the magic of calculating the equity of state-school-aid formulas when personal computers were still in their infancy, and mainframes were laboriously difficult to use. He helped to explain the use of those rare equity measures, the Lorenz Curve and the Gini Index, in school finance research as early as 1975 (a decade before Berne and Stiefel's classic *The Measurement of Equity in School Finance*). Dr. Garms frequently collaborated with the most prestigious education finance scholars of the time, and produced a classic textbook with James Guthrie and Lawrence Pierce, *School Finance: the Economics and Politics of Public Education.* His concern revolved about three basic questions in school finance: Who should pay? Who should benefit? Who should govern? He was an expert witness in many of the school finance equity cases we now consider as turning points in education finance equity, including Serrano v. Priest, Robinson v. Cahill, and Levittown v. Nyquist.

Dr. Garms received his Ph.D. in 1967 from Stanford University. He taught in the Antioch, California schools from 1950 to 1958, later becoming an Assistant Superintendent for Business Services. As a professor of education, he taught at Teachers College, Columbia University from 1967 to 1972, and then at the University of Rochester from 1972–1987, becoming a dean. In 1987, he moved to the University of California, Berkeley, to be near his children.

Those of us who knew "Mickey" (as he was affectionately known) were always delighted by his quick humor, and the facile manner in which he explained terribly complex economic formulas and measurements in terms which were so readily understandable and memorable, even enjoyable. Only a few days before his unexpected death, there are those of us who remember him flying that tiny, one-engine Cessna plane of his to deliver necessities to Watsonville, California to those unfortunate victims of the October 17 San Francisco California earthquake. Those students of education finance who are seeking a role model for which to conduct themselves and their work need look no further than the professional and personal life Mickey lived.

Foreword

Jeffrey A. Owings, Acting Associate Commissioner

Elementary/Secondary and Libraries Studies Division

The National Center for Education Statistics (NCES) commissioned the papers in 1997–98 to address those educational finance issues of consuming interest to the education finance community. These papers address advances in measuring education inflation and adjusting for it; the emergence of a new focus upon spending at the school level; new, private sources of funding for public education; and a review of the state of the art of assessing educational productivity. The first two papers continue the NCES tradition of commissioning papers to address the measurement problems of the education finance research community. The other papers examine the relationship between school district and school spending, and private sources of funding public education of which surprisingly little is known. The final paper examines the existing attempts to estimate the cost of educational outcomes, and the implications for policymakers and researchers.

This compilation of papers is the fourth in the renewal of this series, which previously was discontinued in 1977. The papers are intended to promote the exchange of ideas among researchers and policymakers. Because the views are those of the authors, the papers may provoke discussion, replications, replies and refutations. If so, the publication will have accomplished its task, which is to raise the awareness of leading research in education finance.

Acknowledgments

The editor wishes to gratefully acknowledge the comments and suggestions of the reviewers: Andrew Kolstad, Michael P. Cohen, and Marilyn M. McMillen of the National Center for Education Statistics (NCES); and Ellen Bradburn and Mary Ann Wiehe of the Education Statistics Services Institute (ESSI). I also wish to acknowledge the contributions of Carol Rohr and Allison Pinckney of Pinkerton Computer Consultants, Inc. who incorporated the text, tables, and graphics into a published document, Rebecca Pratt, Ross Pfile, and Sonia Connor of Pinkerton Computer Consultants, Inc. who edited the manuscript, and Nikki Eberhardt-Smith of Pinkerton Computer Consultants, Inc. who designed the cover.

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William J. Fowler, Jr.
National Center for Education Statistics

About the Editor

William J. Fowler, Jr. is the director of the Education Finance Statistical Center (EFSC) at the U.S. Department of Education, National Center for Education Statistics (NCES). He specializes in elementary and secondary education finance and education productivity research. His recent work has focused on the application of geographic cost adjustments, and the development of deflators for education expenditures over time. His current work revolves about redesigning the NCES education finance collection to be more policy-relevant, and in designing Internet tools for the NCES education finance web site at URL http://nces.ed.gov/edfin.

Dr. Fowler has worked for NCES since 1987, before which he served as a supervisor of school finance research for the New Jersey Department of Education. He has taught at Bucknell University and the University of Illinois, and served as a senior research associate for the Central Education Midwestern Regional Educational Laboratory (CEMREL) in Chicago and for the New York Department of Education.

Dr. Fowler received the Outstanding Service Award of the American Education Finance Association in 1997, and served on its Board of Directors from 1992 to 1995. He serves on the editorial board of the Journal of Education Finance. He is a senior fellow in the Excellence in Government program.

Selected Papers in School Finance

Introduction and Overview

Introduction and Overview

William J. Fowler, Jr.
National Center for Education Statistics

The National Center for Education Statistics (NCES) commissioned the papers in this publication to address advances in measuring education inflation and adjusting for it, as well as to examine the emergence of a new focus on school spending, rather than school district spending, as well as new, private sources of funding for public education, and a review of the status of assessing educational productivity. The first two papers continue the NCES tradition of commissioning papers to address the measurement problems of the education finance research community. The other papers examine the relationship between school district and school spending, and private sources of funding public education, of which surprisingly little is known. The final paper examines the existing attempts to estimate the cost of educational outcomes, and the implications for policymakers and researchers. Before proceeding to precis these works, let us turn to exciting additions to the NCES web page in school finance.

What is new at NCES in education finance?

A primary concern of NCES is to report education finance data that address the needs of policy analysts and policymakers, as well as the needs of the education finance research community. Many persons wish to be notified of free NCES publications, CD-ROMs, or data sets when they become available. NCES has established an e-mail notification system that persons having access to the Internet may use to sign up for announcements of interest. Persons who have signed up for the service can cancel it at any time. Figure 1 shows the example of this service located at http://www.nces.ed.gov/newsflash.

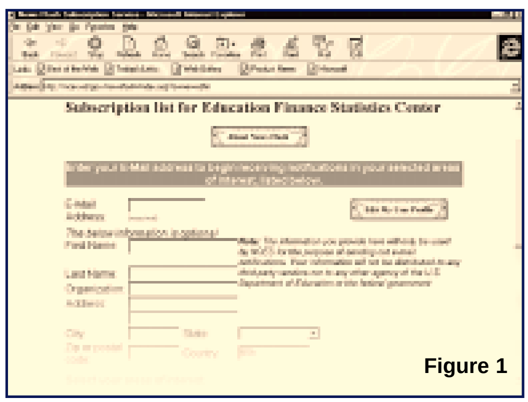

Figure 1

In another such effort, NCES has added a “Peer Search” Internet tool to the education finance web page [http://nces.ed.gov/edfin]. Once the “Peer Search” button is selected, located in the left frame of the web page (figure 2), type in the school district name inside the box provided (figure 3). Once you have chosen a school district, the “Peer Search” tool goes to NCES’ Common Core of Data (CCD) school district database and compares the

Screen shots from the newly added "Peer Search" website

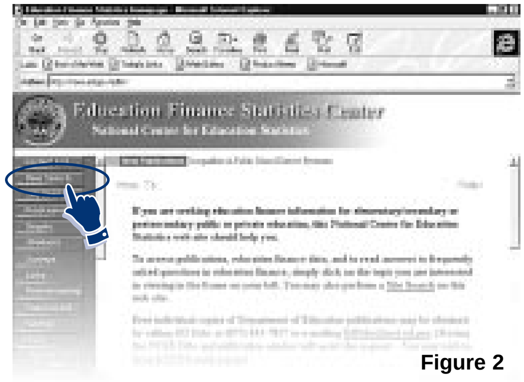

Figure 2

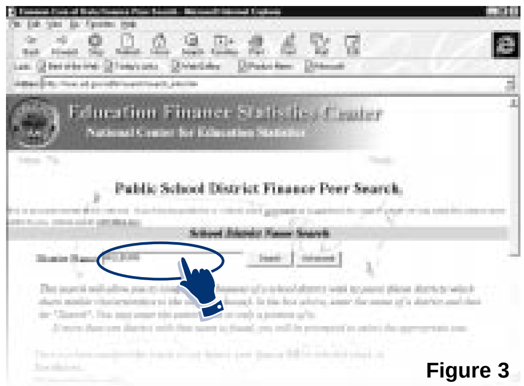

Figure 3

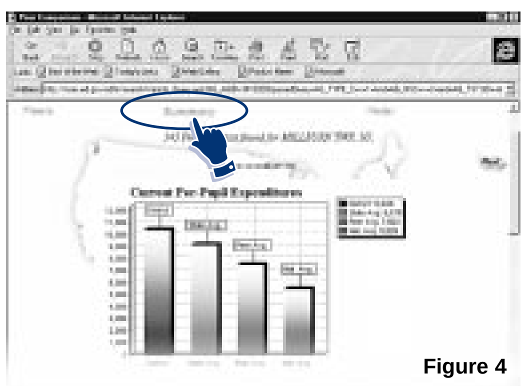

Figure 4

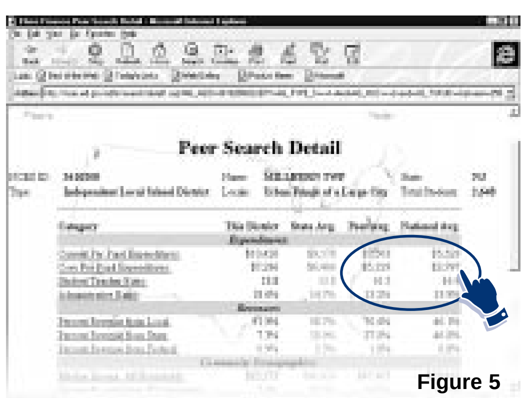

Figure 5

spending of the chosen school district with others that are similar in terms of size, wealth, pupil-teacher ratio, urbanicity, and school district type. Bar charts appear for each of the spending variables that are compared (figure 4). However, should you wish to see the actual values (figure 5), you may click on "Summary", located at the top or "Group Details" located at the bottom of the web page (figure 4).

The "advanced" button, shown when you select the school district (see figure 3), permits the user to modify the characteristics that are used to select school districts. For example, some users believe that school district spending should not be compared unless the characteristics of the students are included. The "advanced" function of the "Peer Search" tool permits the addition of such student characteristics as the percent minority or the percent in poverty to be added to the comparison. In this way, only districts with these student characteristics will be compared. Users may also click "help" at any time for assistance.

NCES wishes to solicit user feedback about the "Peer Search" Internet tool, and is constantly modifying it, based upon comments received. For example, one feature might be the ability to download the selected peer school district data.

A third innovation for NCES is that there is a one-stop place to obtain, free of charge, individual copies of any U.S. Department of Education publication (including CCD CD-ROMs). Called EDPUBS, the service can be reached by either calling (877) 433-7827 or by e-mailing EDPUBS@inet.ed.gov. It is helpful if you know the title and publication number of the publication you need. The EDFIN home page has a button to process a list of education finance publications; from this list you can view the title and NCES publication number as well as download a publication. However, printed copies are usually superior to copies printed from the EDFIN web site, and downloading a publication from the web site can be very time-consuming, depending upon the speed of your internet connection.

NCES anticipates revising the publication "Financial Accounting for Local and State School Systems, 1990" to modernize the accounting procedures, to incorporate principles of public school accounting, and to reflect such new procedures as programmatic and school-level accounting. NCES hopes that the new volume will be available for the year 2000.

A precis of the articles in this publication

The first paper, *Adjusting for Differences in the Costs of Educational Inputs*, by **Eric A. Hanushek,** the University of Rochester, discusses complexities in deflating educational revenues, desirable if an assessment in the productivity of the education sector is to be made. Although total educational spending has been rising, it may be the result of inflation. In order to understand whether real resources for education are increasing, inflation must be removed from the increase. Another use is to compare spending across states or districts, corrected for purchasing power. The question, of course, is how to make these adjustments.

The idea behind price indices is that they should provide an indication of how much more it costs today than yesterday to purchase the same amount of a given commodity.

Complications arise when the purchase of a commodity changes relative to other commodities, for example, if more pens are purchased than pencils for "writing instruments." Also, commodities change over time. In addition, if the "writing instruments" are purchased where competition does not flourish, the price may be excessive (think of military hammer prices).

Finally, services are more difficult to measure than commodities, such as hammers. As Hanushek asserts, these combined problems suggest developing reliable price indices for education will be difficult.

Hanushek reviews alternative proposals for inflation deflators, including the Net Services Index (NSI) and the Hedonic Price Index (hedonics, in this case, refers to the amenities in a school district). Hanushek explains that the NSI is designed to compare education prices with those in other service sectors expected to be similar to education. Hanushek has previously argued that the authors of the NSI have inadvertently provided evidence for a productivity collapse in education. The hedonic wage index of Chambers makes two advances, incorporating labor market factors (such as working in a high-crime area), and the discretionary choice of school districts to hire higher-quality staff. However, the Chamber's technique relies on a large NCES data set (Schools and Staffing Survey (SASS)) that samples teachers and principles periodically (currently, every five years). Thus, there are extensive analysis costs and only certain occasions to conduct such analyses, rather than a yearly measure. In addition, if there are unmeasured quality differences, they could change over time, and the index would be inaccurate. Since Chamber's results show instability over time, it is more difficult to determine how costs have changed between any survey years.

These conclusions lead Hanushek to propose a new approach, using either the Gross Domestic Product (GDP), or modifying the Chamber's approach by creating a generalized hedonic approach, utilizing the Current Population Survey (CPS), which, although it could not be used at the school district level, would be applicable at state, regional, and national levels. **Dan Goldhaber**, The Urban Institute, attempts to apply Hanushek's proposal in the next paper.

Goldhaber's paper, *An Alternative Measure of Inflation in Teacher Salaries,"* develops a cost index using data drawn from an annual survey of individuals from the labor market, the Current Population Survey (CPS). Using CPS data for all college graduates in 1987–88, 1990–91, and 1993–94, Goldhaber was able to compare his results to Chamber's. He combined that data with the U.S. Geological Survey, the National Weather Service, and the County and City Data Book. The hedonic methodology permits wages to be decomposed into the part attributable to individual characteristics (i.e., education, experience, sex) and that attributable to community characteristics (i.e., housing values, climate). In competitive labor markets, higher wages have to be paid for an absence of amenities. Goldhaber conducts his analysis, and finds that among discretionary factors (that is, those employers can choose among) wages rise at a decreasing rate with age, and are higher for those with higher educational attainment. White males earn 12 to 15 percent more than any other group. Married workers and union members also receive between 9 and 12 percent more in wages.

There are also community characteristics that cannot be changed or over which the school district has control. For example, a 10 percent increase in housing values drove wages up 1 percent. A 10 degree lower difference in annual temperature translated into 2 to 6 percent higher wages. *Most importantly, wages for individuals with the same set of characteristics varied across states and over time, holding constant some discretionary factors*. Goldhaber uses the following example:

> If the 1987 average starting salary for a teacher in Michigan was $25,000, it would only cost about $19,300 to hire a teacher with comparable skills in South Dakota but would cost about $31,200 to hire an equivalent teacher in Alaska.

Goldhaber also compares a variety of inflation measures and finds that they are within a few percent of each other. The two that differ the most are the NSI and the Chamber's hedonic index. Goldhaber compares his General Wage Index (GWI) with Chamber's, and he thinks one explanation might be the uncompetitive nature of teacher labor markets. He finds some evidence that teacher costs are higher in states with significant teacher bargaining power. Certainly, more research than this cursory evidence is needed, particularly in light of small sample sizes in some states.

This approach yields similar state wage rankings with the Chamber's approach. Since it is an annual survey, it permits annual updates, allowing researchers to see how teachers' salaries change over time. Its major drawback is that it cannot yield a school-district-level adjustment. However, CPS included county-level identifiers in 1996, which may permit us to revisit this issue.

Surprisingly, there has been little examination of spending in schools, particularly in relationship to their school district, perhaps because of the relative paucity of school-level finance data. What little research has been conducted has emphasized intra-district equity, rather than the causal factors explaining differences in spending between schools within a school district. **Amy Ellen Schwartz** New York University, examines in *School Districts and Spending in the Schools,* not only the distribution of spending across schools using 3,284 schools' and 586 districts' data from Ohio, but also the mechanisms for these differences. For example, can the differences be explained by size or other school characteristics, and to what degree is there agreement between districts on what should drive school spending? Schwartz also examines the largest nine school districts reporting data in Ohio, representing 17 percent of the children, since almost 56 percent of the school districts in Ohio (327) have four schools or fewer, and another 36 percent (212) have nine schools or fewer. Thus, only 8 percent, or 47 school districts, have 10 or more schools.

Unfortunately, the Ohio data set has few contextual variables for their schools, such as enrollment, free lunch and student ethnicity, and elementary, middle or secondary. Schwartz finds these few descriptive data only explain less than 30 percent of the variance in per pupil total spending or instructional spending. She finds that Ohio elementary schools receive less per pupil than high schools, and that per pupil spending declines with the size of the student body. She concludes that school spending is largely unexplained by school characteristics. When she controls for differences between districts, greater spending is directed at schools with more poor children (although the magnitude is small, less than $556 per one percentage point increase in poor students).

Schwartz finds that overall spending is higher in larger districts, but the disparities between grade-level schools also grows. High schools in her nine large districts (with more than 20 schools) receive at least $3,000 per student more than elementary schools. Total spending is better explained than instructional spending, and some school districts, such as Columbus, with 130 schools, and Toledo with 60 schools, seem to have a *de facto* funding formula. Although all district types direct greater spending to schools with a higher percentage of non-white students, the increment is greatest in the small districts. Schwartz concludes that a move to any statewide formula based upon the school characteristics currently in the state database would produce significant changes in the pattern of spending across Ohio public schools. For example, 65 schools (those currently spending the most) would be allocated over 30 percent less money than they currently spend.

A little-noticed change in school funding began in 1990 when a century-long growth in real resources came to an end. Local school districts, faced with revenue restrictions, turned to non-traditional sources of revenue, such as user fees; partnerships with postsecondary institutions; donations; volunteer services; interest earnings on investments; and the creation of educational foundations to promote giving from individuals and businesses. These nontax sources of revenue are not consistently reported by local school districts in their comprehensive annual financial reports. **Michael F. Addonizio,** Wayne State University, examines these nontraditional revenues, particularly in their impact in Michigan school districts in *New Revenues for Public Schools: Alternatives to Broad-Based Taxes.*

For the past century, public elementary and secondary education in the United States has enjoyed remarkably steady revenue growth, notes Addonizio. From 1890 to 1990, real expenditure per pupil increased at 3.5 percent per year, more than triple the growth of the Gross National Product (GNP) over this period, resulting in K–12 public school expenditures increasing from less than 1 percent of GNP in 1890 to 3.4 percent in 1990. This increase resulted from a combination of falling pupil-staff ratios, increasing real wages paid to teachers, the expansion of educational services for handicapped students, and rising expenditures outside the classroom. From 1990 to 1993, real spending grew only 0.6 percent. In part, this was due to increasing enrollments, the rapid growth of special education enrollments, and the passage of stringent tax and spending limits enacted by some 43 states. Traditionally, the “nontraditional revenues” have been of relatively small magnitude, consisting of only 7 to 9 percent of total revenues, although there has been evidence that it is the relatively wealthy school districts that enjoy this revenue.

Addonizio classifies the sources of nontraditional revenue. Under “Donor Activities” are direct donations, such as from corporations. An example might be the Safeway program to donate computers to schools. Perhaps the leading indirect donation is in school district foundations that are growing rapidly. According to the National Association of Educational Foundations (NAEF), by the year 2000, there will be 4,000 public school foundations throughout the country. Booster Clubs are an indirect donation that support programs, such as athletics, band, orchestra, and the like, and often donate equipment and uniforms. Enterprise activities have also always been present in schools, and consist of user fees (such as food service, student parking, pupil transportation, tuition fees for electives, textbooks, and extracurricular activities). Sale of school access and leasing of facilities and services are also well acknowledged.

As noted by Addonizio, although the Governmental Accounting Standards Board (GASB) has a draft to recognize the financial contributions of these "affiliated organizations," the statement has not become a "pronouncement," under which those school districts which follow Generally Accepted Accounting Principles (GAAP) would have to report "material" amounts.

Perhaps most interesting is Addonizio's analysis of the rise of educational foundations in Michigan after the passage of the Michigan school finance reform in 1994, and particularly in 1997, as the constraints on traditional revenue sources became binding on school districts. Although revenues have been quite modest, districts with foundations enjoy higher household income, higher achievement, and are larger than their nonfoundation counterparts, as well as largely nonminority districts. This raises concerns about school finance equity for poor and heavily minority school districts.

David H. Monk, Cornell University, and **Jennifer King Rice**, the University of Maryland, explore the current state of modern education productivity research, and its emerging implications for the financing of education in *Modern Education Productivity Research: Emerging Implications for the Financing of Education*. Their premise is that the education production function is a useful device for those striving to improve the performance of school systems, and closely related to the education cost function. Since it is necessary to understand the relationship between productivity and cost, that is where they begin. They assert:

> One of the dilemmas facing policymakers is the design of appropriate responses to evidence of inefficiency with the educational system.

Monk and King believe that much of the policymaking significance of resources lies in the potential ability of resources to shape and define desired outcomes. "Some resource combinations simply have higher productivity potentials than do others." The choice of the resource combination may be externally imposed, or arise out of "complicit behavior" by those associated with school districts. Thus, discrepancies can arise between the ideal and actual resource allocation practices.

Since the resources required for one student to learn can be affected by the characteristics of fellow learners, Monk and King first devise an ideal resource and cost distribution, and then contrast that to actual resource allocation practice. Their idea is to ask how much of the service in use will be required to overcome whatever lack of motivation there might be on the part of a student, a teacher, or both. If the wrong service delivery configuration is deployed, the cost of realizing the desirable outcome could become very large. As one example of the problem, they assert it would be inappropriate to hold a building-level administrator accountable for a school that is too small, and costly.

When Monk and King turn to existing attempts to estimate the cost of educational outcomes, they create a continuum from least dependent upon economics to the most dependant upon economics. They begin with "educator judgements" proceed through "hedonic wage models," the "cost of observed best practices," to "cost functions," which are the province of the most sophisticated econometric modeling. Monk and King believe there are good reasons to exercise caution in applying the most sophisticated techniques, because it is not clear if they generate trustworthy efficiency levels, particularly in the face of differences in real costs.

They conclude that education policymakers face contentious choices in a climate of limited resources, being responsible for making parsimonious resource decisions. It is in this climate that the distinction between actual practice and realistic best practice is most important.

> The greater the discrepancy in the cost associated with realistic best practice and actual best practice, the more productive the system can become.

Adjusting for Differences in the Costs of Educational Inputs

Eric A. Hanushek
University of Rochester

About the Author

Eric Hanushek is Professor of Economics and of Public Policy and Director of the W. Allen Wallis Institute of Political Economy at the University of Rochester. He joined the University of Rochester in 1978 and has previously been Director of its Public Policy Analysis Program and Chairman of the Department of Economics. From 1983 through 1985, he was Deputy Director of the Congressional Budget Office.

His research involves applied public finance and public policy analysis with special emphasis on education issues. His publications include *Improving America's Schools, Modern Political Economy, Making Schools Work, Educational Performance of the Poor*, and *Education and Race* along with other books and numerous articles in professional journals.

Born in Lakewood, Ohio, in 1943, he was a Distinguished Graduate of the United States Air Force Academy where he received his Bachelor of Science degree in 1965. In 1968, he completed his Ph.D. in economics at the Massachusetts Institute of Technology.

He had prior academic appointments at the U.S. Air Force Academy (1968–1973) and Yale University (1975–1978). He was president of the Association for Public Policy Analysis and Management in 1988-89. In 1997, he was selected to be a member of the International Academy of Education.

Selected Papers in School Finance

Adjusting for Differences in the Costs of Educational Inputs

Adjusting for Differences in the Costs of Educational Inputs

Eric A. Hanushek
University of Rochester

Various important policy decisions, fund allocations, and contractual provisions rely on the calculation of price differences, implying that the estimation and use of different price adjustment mechanisms have serious repercussions. Accordingly, controversies about the best way to proceed also exist. A simple but powerful example is the recent debates about the accuracy of the Consumer Price Index (CPI). There are not only technical disagreements but also political disputes owing to the important uses of the CPI in both public programs and private contracts.

The discussions about price adjustments in education, while mirroring the technical complexity, have not received the same public attention as the CPI debate, because their implications are considerably less. Nonetheless, the general issues have been widely discussed within the education sector. That discussion has been furthered by recent analyses by Chambers (1997) and by Mishel and Rothstein (1997).

Each of those analyses provides a combination of broad interpretation of the issues and of specific recommendations about how to proceed in the development of data series. At the same time, they emphasize different issues and make conflicting recommendations. This paper, which extends Hanushek (1997b), clarifies the points of disagreement and provides conclusions about how to proceed with price adjustments to education spending data.

Overview and Background

The necessity of making some adjustment for overall inflation levels in the economy is well understood. The federal government routinely produces a variety of price indices or deflators that can be used to compare nominal spending at different times. A similar set of indices can be used to compare prices and spending in different geographical areas at the same point in time.

Different deflators also exist for various commodities. It is common to see reports of how, for example, energy prices have increased more rapidly than those for food. Official price series exist for a wide range of different items.

Thus, the suggestion that price movements in education may not be the same as price movements elsewhere in the economy does not seem very surprising. Furthermore, it would seem natural to develop data that would permit estimation of how prices in education move relative to those elsewhere.

Perhaps the most important use of any price index for education, as emphasized by Mishel and Rothstein (1997), is to be a building block in assessing any changes in productivity in the education sector. For example, an enormous amount of attention has been given to "reforming" education, a concept rooted in the notion that better performance is possible, given the resources devoted to schools. Many alternative proposals have been made for this concept, and the organization and delivery of education has undergone considerable evolution. Total spending on schools has also risen dramatically (Hanushek and Rivkin 1997), so it would be useful to ascertain whether these changes have had the desired impact. A problem, however, is that one might have expected total spending to rise over time with general inflation. In such a case, it would be inappropriate to attribute the inflationary increases to reforms and inappropriate to gauge any changes in productivity by just the nominal increases in spending. A compatible price index could be employed to eliminate any general price increases so that attention would be focused on the specific reforms and their results.

[K]nowing the overall pattern of cost increases permits individual districts, individual states, and the nation to judge whether real resources for schools are increasing or decreasing and to make comparative statements about the rate of increase in specific areas versus the nation as a whole.

In general, knowing the overall pattern of cost increases permits individual districts, individual states, and the nation to judge whether real resources for schools are increasing or decreasing and to make comparative statements about the rate of increase in specific areas versus the nation as a whole. In other words, this information provides a way of judging the pattern of resource investments into schools.

A second use of price adjustments involves making cross-sectional comparisons of spending. Largely driven by equity concerns, interest in variations of expenditure across geographical areas has remained high for the past 25 years. While some consideration has been given to interstate variations in spending, the limited role of the federal government in funding schools and the lack of any federal court activity have combined to focus most attention on intrastate variations.[1] Because of special conditions in a given local area, the same set of school inputs may have differing costs. If this is the case, it is obviously difficult to compare spending across states or districts without correcting for differing purchasing powers.

The necessity of making adjustments for price differences is not controversial. The real issue is how these adjustments should be made. A number of alternative indices of price differences are currently available and regularly produced by the federal government. A wider range of possible indices have been proposed, and some of these focus on specific aspects of the education industry. In part because of the arcane nature of some of these discussions, confusion about both the issues and the best approach remain.

This paper aims at clarifying the issues in adjusting education data for price differences. In the course of this discussion, direct analysis of the recent papers by Chambers (1997) and by Mishel and Rothstein (1997) is provided.

Basics of Price Indices

Much of the discussion of price indices refers to aggregate data for the entire economy. The CPI and Gross Domestic Product (GDP) price deflator are well known aggregate price

[1] The U.S. Supreme Court effectively eliminated federal court involvement in school funding equity cases in its 1974 ruling in *Rodriguez v. San Antonio Board of Education.* The federal appropriations for schools have concentrated on compensatory education for disadvantaged students. In that determination, overall price variations that affect calculations of poverty rates are relevant, but variations in school spending have not been central to the funding, so education price indices would not play much of a role.

indices. These indices are designed to indicate how overall prices, or inflation, affect the ability to buy a market basket of consumer goods or of final output in the economy. The construction of such price indices is, however, affected by a number of difficult conceptual and data issues. The precise approach should also be related to the potential use of the index.

The idea behind price indices is that they should provide an indication of how much more it costs today than yesterday to purchase the same amount of a given commodity.[2] For example, if one considers standard wood-graphite pencils, one needs only compare the price per unit at two different times to develop an appropriate deflator; i.e., one would divide today's price by yesterday's price to determine how much prices had increased, and that would be our deflator, which could be used to put any purchase of pencils on common footing. In this example, the calculations are straightforward, and there would be no controversy.

Where do the complications arise? First, consider a price index for "writing instruments." If, in addition to wood-graphite pencils, there are also disposable ballpoint pens, the price index must consider the increases in both. It is natural to think of calculating a weighted average of the price increases in the two different commodities to arrive at the best price index, where the natural weights would be the purchases of the two. In this instance, there is also no difficulty or controversy as long as the same relative amount of the two commodities is purchased over time. But, if the purchases of, for example, pens rises over time relative to the purchases of pencils, a different price index will be calculated depending on whether initial purchases, ending purchases, or an average of the two are used to weight the observed price changes. This issue, which is discussed in Chambers (1997), is a classic one in the discussion of index numbers, and the implications of different choices are well understood. Specifically, because people might be expected to buy somewhat more of the writing instrument whose price is falling in relative terms, one would expect the relative purchases to change over time and in ways that lead directly to biases in the true increase in the prices of "writing instruments." There are practical difficulties in dealing with these problems, but the underlying concepts are clear.[3]

Second, commodities change over time. For example, writing instruments have evolved such that there are mechanical plastic-graphite pencils, roller-ball pens, and felt-tipped pens. As new products are introduced and as old products are improved, it is less clear how to compare prices of writing instruments over time. For example, a plastic-graphite mechanical pencil today costs more than a wood-graphite pencil did yesterday, but part of the increase in cost reflects quality improvements in pencils and part reflects simple price increases. These quality changes are very important in some commodities (e.g., computers), and correction for potential biases here requires sophisticated analysis. With sufficient information, for example, it is sometimes possible to disentangle price and quality changes through statistical means, such as estimation of hedonic price equations that indicate how various, more fundamental characteristics influence a commodity's price. (As discussed below, this approach is one proposed attack on developing price indices for education). At the same time, state-of-the-art analysis is expensive and difficult and frequently does not resolve all questions.[4]

The idea behind price indices is that they should provide an indication of how much more it costs today than yesterday to purchase the same amount of a given commodity.

[2] This discussion is framed in terms of changes over time. The fundamental concepts, however, apply equally to purchasing commodities at two different geographical locations. Differences between intertemporal and cross-sectional indices are discussed in subsequent sections.

[3] The "substitution bias" of fixed weight indices is one of the elements of the debates over the accuracy of the CPI.

[4] The treatment of quality changes is one of the most contentious areas in the discussion of possible revisions in the CPI. The best approaches to adjustments for quality change require large amounts of data and are infeasible for all of the detailed commodities that enter into to the CPI. Thus, considerable judgment is needed to decide how to approach this area.

> [I]t is difficult to define quality in a way that allows distinguishing over time among price changes, quantity changes, and quality changes.

Third, special problems arise when there are not effective competitive markets operating. The advantage of having commodities traded in competitive markets is that it is reasonable to presume that competition pushes prices toward the minimum feasible prices (which are generally the marginal costs of producing the commodities). With competition, the increase in observed purchase prices of the basic commodities provides the raw data for calculating price indices. Concerns about purchase prices are, however, particularly relevant for governmental purchases. For example, consider purchases of common claw hammers by the military. In the first period, the military may simply go to a hardware store and purchase its annual supplies at $20 per hammer. In the second, it may accept contractual bids in which, among other things, a variety of specifications for the precise character of the hammer are written into the bidding process—leading it to pay $700 per hammer in the second period. Is it reasonable to conclude that the price of hammers has increased by a factor of 35? Although a spending increase by a factor of 35:1 was observed, that may differ significantly from what has happened to the price of hammers. Some portion of the increase in actual expenditure per hammer may reflect quality differences, some portion might reflect the costs of doing business through the government's bidding process, and some portion might reflect excessive payments that exceed the minimum possible price in competitive markets. While the solution might differ by purpose of any analysis, one would typically accept the price increases in competitive markets for the same commodity as the correct data for calculating a price index. If there are no competitive markets for similar commodities, the appropriate approach requires generally very difficult analysis of the specific circumstances.

Fourth, special problems arise when considering services as opposed to goods in the economy. With goods in the economy, such as writing instruments, one can generally define the commodity that is being purchased and calculate unit prices for each individual element such as pens and pencils.

With services, it is more difficult. Consider, for example, analytical writings about education price indices. It is difficult to define precisely what the commodity is. The pages can be counted. They can be corrected for margins and font sizes. But it is difficult to define quality in a way that allows distinguishing over time among price changes, quantity changes, and quality changes. These problems have been long recognized, historically in terms of governmental services and more recently, with the rise of a variety of services in the private economy, in terms of the general service sector.

These separate issues have received attention in a variety of contexts. More important, each enters into the calculation of price indices for the education sector. The combination of all of the issues suggests that the problem of developing reliable price indices for education is likely to be very difficult. Before discussing the specific application of education price indices, it is useful, to consider issues of productivity and how they relate to price indices. Because, as described above, the measurement of productivity is a prime motivation behind the development of price indices, the discussion is more focused if put within that context.

Inputs, Outputs, and Productivity Growth

Productivity involves the relationship between inputs and outputs. Specifically, productivity is thought of as a change over time. If it takes fewer inputs to create a given level of output, one says that there has been productivity growth. If one observed real inputs and outputs, one could easily calculate productivity change. Unfortunately, it is not that simple, and the complications are the impetus for much of the consideration of price indices in education.

The previous discussion has made no distinctions between inputs to or outputs of production in the economy. While there are practical distinctions in their measurement (which will be discussed later), the basic concepts and issues considered above apply equally to price indices for inputs or outputs. A consideration of both input and output price indices does, nonetheless, pinpoint the key issues surrounding productivity. This consideration will also permit investigation of underlying conceptual issues about productivity growth in education and other service industries.

We often observe just total expenditure and not the quantities of inputs and outputs. Total expenditure is price multiplied by quantity of the good or service being considered. In order to consider productivity changes, it is necessary to consider how prices change, since total expenditure can increase because of an increase in real quantities or in prices. Price indices or price deflators are used to separate price changes from real changes.

Improvements in productivity imply that fewer inputs are required for producing one unit of the output (assuming that the quality of the good does not change). Over time, if we can accurately calculate the real value (i.e., inflation-adjusted value) of outputs and the real cost of inputs, growth in productively is directly related to how fast the real value of output grows relative to how fast the real cost of inputs grows. If the value of output grows at the same rate as the costs of inputs, productivity is constant. If the real value of output grows faster than the real costs of inputs, productivity is improving, and the growth in productivity can be calculated simply as the difference in these two growth rates. The opposite case, however, has proved more relevant for education, because the data have shown that real expenditure appears to be rising with no perceptible improvements in outputs—suggesting productivity declines.

The real growth in either output or inputs is typically calculated by deflating nominal total expenditures by an appropriate price index. For any given growth rate in nominal spending on inputs, a higher estimate of the growth in input prices implies that there is lower growth in real inputs. For any given growth in value of a unit of output, lower growth in real inputs implies a higher growth rate for productivity. This consideration provides a way of interpreting some of the more politically motivated discussions of educational price indices. If it is possible to show that the price of inputs has risen faster than the standard employed deflator for input prices suggests, the growth in productively would be larger than commonly estimated. In education, however, the discussion has more typically been one of falling productivity. Thus, more rapid increases in input prices (which imply that real inputs have risen less rapidly than thought) would imply that the productivity fall is less than people believe based on standard calculations.

While there are practical distinctions in their measurement . . . the basic concepts and issues considered above apply equally to price indices for inputs or outputs.

A simple example will help clarify the ideas. If spending per pupil increased by 8 percent and the general price level went up by 5 percent, we would calculate the real cost of inputs to have risen by 3 percent. If educational output were flat during the time, it is natural to say that productivity fell by 3 percent, because we need 3 percent more real inputs to produce the same output. If, however, input prices went up faster than calculated by the general price deflator, say 6 percent instead of 5 percent, it is natural to recalculate the decline in productivity to be 2 percent.

While the calculation of productivity change motivates the discussion of ensuring the use of appropriate price deflators, it neither explains why patterns of productivity change occur nor provides direct guidance on the choice of possible price deflators. Whenever talking about productivity, particularly in education and service sectors, some attention is typically given to arguments by Baumol

(1967) about the likely course of prices. Specifically, if service sectors are ones where productivity growth is necessarily low—say, for technological reasons—they will face cost pressures in the hiring of inputs. If there are other sectors in the economy which have more rapid improvements in productivity, they can afford to pay more for labor and other inputs. This will put the service sector with its low productivity change at a disadvantage, because everybody must pay the same price for labor in a competitive market but the service sector's output prices must increase more rapidly than those in the sector with productivity growth.

These arguments, explained in more detail in Hanushek (1997b), are irrelevant to the actual calculation of price indices. They merely provide a hypothesis about the kinds of changes in prices that might be seen over time.

[S]imply looking at the increase in total spending per student will not indicate what has happened to the value of a standard, quality-equivalent level of output.

The situation is more complicated if there are quality changes in outputs. The measure of value of output should be adjusted for any differences in quality per unit of output. To see why this is the case, consider education. If more inputs were applied to schools in order to improve the quality of student achievement (say, the level of mathematics or science proficiency), simply looking at the increase in total spending per student will not indicate what has happened to the value of a standard, quality-equivalent level of output.

The fortuitous advantage for calculating the data on price increases and productivity in the education sector is that quality appears flat in education over the past quarter century. While specific measures show some rises and falls for specific years, comparisons of the National Assessment of Educational Progress (NAEP) for reading, science, and mathematics show the 1970 levels and 1996 levels very close (Hanushek 1997b). If quality has not changed, it is possible to estimate the growth in productivity by subtracting the growth in spending per pupil from the growth in input costs per pupil. As Hanushek (1997b) shows, spending has risen considerably more rapidly than input costs, whether input costs are measured by the growth in CPI, GDP deflator, or wages of college graduates. Thus, productivity growth would be estimated as negative—i.e., productivity has fallen.

Arguments about the course of productivity change are, nonetheless, irrelevant to the consideration of how to develop indices of input prices or output prices. Thus, the specific recent proposals should be studied.

Net Services Index

Mishel and Rothstein (1997), expanding on the previous work of Rothstein and Miles (1995), have proposed deflating education expenditure by a price index that measures increases for a select part of services. This index, the Net Services Index or NSI, modifies the service component of the CPI by eliminating components for housing and medical care. The design apparently attempts to compare education prices with those in other sectors expected to have similar patterns of inputs to that of education.

As mentioned earlier, the measurement of price indices in the general service sector is particularly difficult, because it is difficult to hold quality constant. (Measurement of quality in the education sector, in contrast, is made relatively easy by the frequent testing of students.) Therefore, the Net Service Index (NSI), which is based on a composite measurement of output cost increases across different service sectors, will be subject to considerable uncertainty (or measurement error).

The price index per unit of output in the selected services represents the increase in input prices per unit of output minus the increase in productivity of the service sector. If the inputs used in these service industries are similar to those in education—which is apparently an underlying assumption behind the NSI—then differences in price increases in education and the NSI simply reflect differences in productivity growth. Rothstein and Miles (1995) and Mishel and Rothstein (1997) tend to interpret the NSI as an input deflator, which it is not. It does, however, provide a useful tool for comparing education to the prototypical example of a slow growing sector—the service industries. For this reason, Hanushek (1997b) points out that Mishel and Rothstein have inadvertently identified and provided strong evidence for the productivity collapse in the education sector.

Hedonic Price Indices

Chambers (1997) provides an alternative approach. He estimates hedonic wage indices for teachers and uses these to adjust prices for differing labor market attributes. This approach mirrors the methods often used to adjust for quality changes in a variety of products.

The basic approach is to use regression techniques to decompose teacher salaries into underlying characteristics that enter into salary determination. The idea is that a series of fundamental factors enter into the determination of salaries. Using variations in these factors across areas, it is possible to infer what each contributes to the salary that goes to an individual. Moreover, if this is a stable function over time, it is possible to distinguish between "quality" changes and "price" changes.

Consider the analogy of the price of computers. If one were to regress the price of a computer on the processor speed, the memory size, the hard disk size and speed, and other relevant attributes, one could estimate how each of the characteristics of the computer contributed to its price. Then, when one observes a new computer—one with different combinations of fundamental characteristics—one can estimate the price based on its underlying technological specifications and, by comparing to actual purchase price, can infer how much prices for a constant-quality computer have changed.

Chambers applies this approach to teacher salaries, which then become the largest component of an overall price index. He regresses teachers salaries from the Schools and Staffing Surveys (SASS) on characteristics of teachers and on other factors for schools and labor markets. A key element is distinguishing between discretionary factors (factors over which the schools have a choice) and cost factors (exogenous factors over which the schools have no choice). He estimates these relationships for each of the available SASS data sets *(1987–88*, *1990–91*, and *1993–94).*

This work makes two advances. First, it recognizes and incorporates school and labor market factors which influence salaries that must be paid (compensating differentials in the labor economics jargon). If school costs in one area are pushed up by factors outside of its control, such as being in a high-crime area, salaries in that area will be higher than in a low-crime area in *order to attract exactly the same quality* person. Similarly, factors about the school district, which must be taken as given by the school personnel, should be adjusted for, because salary differences arising from these should be considered when one tries to compare the price of teachers across districts.

Second, it distinguishes between choice variables of districts and other cost factors. For example, if a district decided to hire only people with Ph.D. degrees and thus paid high average salaries, one would not want to say that it faces a high price for teachers. Instead, one would want to see how the price for similar quality teachers varied and to eliminate decisions about what quality was bought.

The strength of this analysis is that it permits analysis of geographic price differences. Thus, if one is interested in comparing spending across states or different regions, the hedonic price index could be used to adjust for a variety of compensating differentials that affected different labor markets. The measure-

[I]f one is interested in comparing spending across states or different regions, the hedonic price index could be used to adjust for a variety of compensating differentials that affected different labor markets.

ment of geographic differences was originally the underlying motivation for this work.

There are, nonetheless, several issues that limit the usefulness of this analysis, particularly in a time series context. At the current time and with the currently available data, it would not provide a sufficiently reliable estimate for routine use in presenting educational spending data.

Sample Selection and Noncompetitive Markets

In other words, the lack of full interaction with competitive labor markets plus the possibility that quality can drift up or down makes the use of observed teacher salaries questionable.

The basic estimation is based on a sample of people employed in teaching in each of the years of the SASS survey. The design incorporates differences in teachers by experience, degree level, quality of undergraduate institution, and personal or demographic factors. If quality of teachers differs other than by these factors, there could be drift up or down in quality that is not considered in the analysis. In other words, unmeasured quality differences could change over time, so that the correction for just the measured discretionary factors could give an inaccurate picture of how prices are changing. This problem is especially relevant for judging teacher salaries, because past research does not suggest that teacher experience or teacher education levels are good measures of teacher quality (defined in terms of student outcomes); see Hanushek (1997a). It is not sufficient if one wishes to measure the quality-adjusted price of teachers simply to point to the fact that schools pay for these attributes. If anything, that complicates the analysis because it ensures that these attributes are correlated with salaries even if they have little to do with quality differences among teachers.

If the teachers in the sample are not representative of the population from which teachers could be drawn, there must be a presumption that the choices of schools do not vary over time, or at least that they do not vary in a systematic manner. On the other hand, this is unlikely because the relative price of college-educated workers has changed systematically over the past quarter century. It is natural to believe that schools make some adjustment in their choices to these changes (see Hanushek and Rivkin 1997).

The adjustment for the specific "discretionary" factors is a clear improvement over using only the average salaries (and making no adjustment). Nonetheless, given the general non-competitive nature of wage determination in the unionized or governmental bargaining situation, the reliance on observed salaries builds in a series of basic decisions by districts. These do not necessarily reflect competitive wages for college graduates or even for people with teacher's training. Moreover, since the quality differences among teachers or potential teachers are not readily observed by districts or by researchers, there is little reason to treat this as a completely separate labor market for purposes of calculating the prices of teachers. In other words, the lack of full interaction with competitive labor markets plus the possibility that quality can drift up or down makes the use of observed teacher salaries questionable. Hanushek and Rivkin (1997) demonstrate that the salaries paid to teachers have tended to drift over the past 40 years, but this drift has not been uniform over time or across males and females.

Instability over time

The estimated hedonic wage equations appear to vary considerably over time. While there are no formal tests of equality of the estimated relationships, either for all of the coefficients or a subset of them, it appears that the point estimates and the statistical significance changes noticeably across years.[5] This presents serious problems, because the estimated correction factors do not seem to mea-

[5] Judging the importance of any differences would require testing the sensitivity of estimated salaries to variations in coefficient values. This has not been done, but the differences look quantitatively quite large for some of the factors.

sure a constant set of quality or cost factors over time. This lack of stability makes it difficult to know how to interpret the basic equations. It also makes it difficult to infer how costs have changed between any survey years when a separate hedonic index is estimated.

An implication is that use of hedonic price indices is very restricted. It is not possible to fill in past price changes (before the 1987–88 SASS). Also, the future is highly dependent upon the continued collection of large and complete data sets.

Alternative Approaches

The two proposed indices—the hedonic-based cost of education index and the output measures of the NSI—seem inappropriate choices for the general measurement of price changes over time in education. Two alternatives seem much better.

Use of a general output deflator

The most straightforward approach would be to employ a general output deflator such as the CPI or the GDP deflator. These indices mark the changes in prices for a market basket of all consumer goods or of final consumer plus investment goods, respectively. As such, when education spending is deflated by one of these, they immediately indicate how much of the society's goods are being given up to purchase education.

This approach does not indicate productivity trends in the education sector because it does not compare real inputs into education with outputs. Nonetheless, it provides a useful benchmark for educational spending.

Note that this is not, however, the same as simply calculating the ratio of education spending to overall GDP. These calculations are suggested by Mishel and Rothstein (1997). This ratio would presumably be normalized by some measure of the number of students.[6] But, even if adjusted for the student population, it presumes that education should rise at the same rate as aggregate income. There is no reason why this assumption should enter into any calculations.

Comparing education spending to overall GDP is not the same as using a good output price index. Nor is there any practical advantage to doing this. The use of an output deflator is easy, because of the readily available time series of price changes. Therefore, there is no feasibility argument favoring the calculation of output comparisons through ratios to aggregate output, GDP, the CPI, or GDP deflator, and there is the distinct possibility that the GDP ratio will produce patterns that are the result simply of the pattern of GDP growth as opposed to real changes in education spending.

Comparing education spending to overall GDP is not the same as using a good output price index.

Generalized hedonic approach

Within the proposed hedonic methodology, it would seem superior to use salary data for entire labor markets. For example, if one thought of the potential supply of teachers as being all individuals with a college degree, it would be possible to calculate how these input prices changed over time. From the Current Population Survey it would be possible to make adjustments for crime and other exogenous factors at the state level. It would not be possible to make fine adjustments at the school or metropolitan area level, however, so the advantages of this approach are tempered by how important one feels differences in these finely constructed factors are.

This approach, which would incorporate part of the ideas of adjustments for exogenous local conditions, has the advantage of being independent of school district choices. Therefore, it is possible to estimate price differences

6 Because the student population has grown and shrunk at various points, it would not be appropriate to ignore the movements of the quantity of students. If per pupil spending is directly compared to GDP, it is unclear how the GDP figures should be modified, e.g., should it be GDP per capita or GDP per student?

without contaminating them by bargaining or hiring decisions.

This approach permits calculation of annual price adjustments in the future and of past changes from the mid-1960s. Therefore, it provides a readily available and low-cost way of developing an input cost index that adjusts for some of the geographic variations that might be important.

Conclusions

Adjustment of spending in education for price differences is important in a variety of contexts. It is also difficult to do in general because of the possibility of quality changes in outputs and in inputs.

The proposed methods of price adjustment by Mishel and Rothstein (1997) and Chambers (1997) do not, in the author's opinion, provide reliable methods for deflating input spending on schools, although the reasons for their failure are quite different.

The Net Service Index of Mishel and Rothstein (1997) simply has nothing to do with education inputs. It is an output index for a portion of the service sector. As such, it may provide a way of assessing whether productivity decline in education is greater or less than might be expected on the basis of other service sectors. It cannot be used as a deflator of educational inputs.

The hedonic price index proposed by Chambers (1997) introduces several desirable concepts. Its application for general use in analysis over time is limited, however. It relies on salary increases in education, instead of on the changes in the relative costs of college-educated workers. It does not have good measures of quality differences among teachers, but instead uses explicit factors that are part of the hiring and bargaining process of schools. Also, it can only be constructed for years in which there are large surveys of teachers and schools. These factors indicate that this is not a candidate for more general use in deflating education spending.

A modified version of this hedonic analysis that relies on more general labor market information may provide an appropriate input deflator. The efficacy of such an index would, however, require more analysis.

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An Alternative Measure of Inflation in Teacher Salaries

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Introduction

The cost of educational inputs varies significantly by geographic area and across time. For example, costs are typically higher in large urban areas than in suburbs and towns, and educational costs tend to rise with inflation. If an urban and a suburban district spend the same amount per student, given the differences in the cost of educational inputs, it is likely that the suburban district is able to procure more or higher quality educational resources and, as a result, provide a higher quality of education. Likewise, the purchasing power of a given educational expenditure tends to fall over time due to inflation.

In the absence of information on the variations in cost of educational inputs, policymakers have a difficult time deciding on resource allocations. Furthermore, researchers cannot adequately adjust educational expenditures for differences in resource costs when conducting educational productivity analyses. Thus, an educational cost index is useful to gain a comprehensive understanding of what monies spent on education actually purchase given differences in educational resource costs across time and geographic areas.

Educational cost indexes can be used by policymakers and researchers to adjust *nominal* expenditures for inflation and geographical differences in prices. In doing so, it is possible to investigate the magnitude of differences in *real* educational expenditures at a point in time and across time. This permits policymakers and researchers to determine how educational resources are actually distributed across geographic areas as well as the productivity effects of educational spending. For instance, educational production function studies often examine the relationship between educational spending per pupil and student outcomes (test scores, graduation rates, etc.).[1] If there is significant variation (over time or across regions) in educational resource costs, using nominal spending per pupil would bias the resulting estimates.

Teachers' salaries typically constitute over 50 percent of school district budgets (U.S. Department of Education 1997a). As a result, a Teacher Cost Index (TCI) is the most significant component of an educational cost index. However, some of the standard approaches to adjusting for differences in teachers' salaries across school districts have potential problems. First, the labor market for teachers tends to be uncompetitive in certain

[1] For a review of such educational production function studies, see Hanushek (1986).

respects. As a result, wages may not reflect productivity, which can lead to statistical problems that result in poor estimates of real differences in educational resource costs. Second, microlevel data on teachers' salaries and other educational resources are collected periodically. An educational cost index should be updated annually in order to be a more useful tool.

The purpose of this research is to develop a cost index using data drawn from an annual survey of individuals from the broader labor market. Because this index uses annual data, it can be updated annually, allowing researchers to track more closely how a major component of educational costs (teachers' salaries) is changing over time. Furthermore, because this index is estimated using data from a broader segment of the labor market, it may be less subject to potential statistical problems arising from calculating an index estimated from a sample of only teachers.

The purpose of this research is to develop a cost index using data drawn from an annual survey of individuals from the broader labor market.

This paper begins with a review of the various price adjustment mechanisms that have been suggested and a discussion of an alternate approach that may be used to calculate a TCI using the Current Population Survey (CPS), a dataset that is collected monthly with annual reports on demographics, education, and income. Then there is a comparison of the results found in this report with results of previous work. The conclusion provides a summary and offers suggestions for further exploration in future work.

Background on Price Adjustment Mechanisms

Various price adjustment mechanisms have been suggested in the literature. Hanushek and Rivkin (1997) propose deflating educational spending by the gross domestic product (GDP) deflator, which provides a measure of the goods and services given up as a result of investment in education. The drawback to using the GDP deflator is that it is not necessarily a good measure to use if one wishes to calculate how the quality of teachers that can be purchased with a given salary has changed over time because the GDP includes numerous goods and services unrelated to education. Productivity growth in service industries, such as education, typically is slower than in other sectors of the economy. Thus, salaries may rise (with productivity growth) in some sectors of the economy without causing commensurate increases in output prices (inflation). Because salaries may increase relative to productivity to a greater extent in education than in other sectors of the economy, inflation may be higher in education than in the economy as a whole. In other words, inflation in the prices of educational inputs may exceed that calculated by an economy-wide measure, such as the Consumer Price Index (CPI). For example, it is well known that the cost of college tuition has increased considerably faster than the CPI over the last generation. However, school districts have to keep salaries competitive with other sectors of the economy to retain the same quality teachers. As a result, the use of a general GDP deflator would tend to overstate the investment in education in terms of the quality of labor purchased.

Mishel and Rothstein (1997) and Rothstein and Miles (1995) advocate a different price deflator. They suggest deflating education expenditures by a price index geared to be more specific to education prices. This index, termed the Net Services Index (NSI), is calculated by eliminating the housing and medical care components of the service component of the CPI. The authors note that inflation as measured by the net services index is higher than the inflation rate in the economy as a whole. As a result, when educational expenditures are deflated using this index, the growth rate in real educational spending appears to be smaller than when nominal educational spending is deflated by a more general GDP deflator. This methodology has several potential problems. Perhaps the most important is that it is difficult to hold quality constant, and, hence, the index may be subject to measurement error.

Chambers (U.S. Department of Education 1997a, 1998b) tries to address the problem of measuring the quality of educational inputs by using a statistical technique known as a Hedonic Wage Model. This model examines “the overall patterns of variation in the salaries and wages of certificated and non-certificated personnel” (U.S. Department of Education 1998b). He estimates this model at the school district level using three waves (1987–88, 1990–91, 1993–94) of the Schools and Staffing Survey. The most significant component of the index is the TCI because teachers’ salaries make up a large fraction of overall educational spending.

The regression methodology employed assigns dollar weights to the underlying characteristics, both teacher specific and location specific, that determine teachers’ salaries. Using the results, one can calculate how much it costs to hire a teacher with a given set of characteristics in one region relative to another and how these costs change over time.

This technique accounts for school districts having control over the types of teachers they hire and choosing to pay for differing sets of credentials. In other words, Chambers’s work allows for an apples-to-apples comparison between districts even if they employ teachers with different observable characteristics, such as degree level and experience. His methodology also reflects the general labor market factors that influence salaries. For instance, it might be expected that, all things being equal, school districts in temperate climates could offer lower salaries than school districts with inclement weather and still attract teachers of equal quality.

The potential problem with Chambers’s work is that teachers with similar observable characteristics (experience, degree level, etc.) may have very different unobservable qualities. In the labor market outside of education, differences in workers’ wages are thought to reflect differences in their productivity. But, teacher wages are set institutionally and, thus, may not reflect teacher quality (Hanushek 1997). Local administrators may be able to observe the subtle differences in quality; however, these differences are not observable in the data. As a result, we might expect that school districts paying higher wages can attract more energetic and more intelligent teachers, even though on average they have the same experience and degree level as schools in other districts. In the technical literature, this inability to adequately capture quality is known as an omitted variable problem. If unobservable teacher quality is correlated with observable characteristics, such as region or degree level, the estimated coefficients, and hence the TCI, are biased. Relatively little research has been conducted to determine the extent to which this issue arises in the context of teacher labor markets.[2]

The regression methodology employed assigns dollar weights to the underlying characteristics, both teacher specific and location specific, that determine teachers’ salaries.

Hanushek (1997) suggests two alternatives to deal with this problem. The first is to adjust teacher salaries with a general price deflator, such as the CPI or the GDP deflator. Education spending deflated in this manner would provide a measure of the goods and services society gives up to purchase education. The problem with this approach is that price indexes are not available on the state or school district level. Consequently, this method would allow for a comparison of educational spending in one year versus another, but not in one school district versus another. Furthermore, this approach may not allow researchers to gain much insight into how the true quality of educational inputs changes over time, given that productivity may grow more slowly in education than in other sectors of the economy. If this is the case, over time, a general price deflator would tend to overstate the quality of educational inputs purchased.

[2] See Goldhaber and Brewer (1997) for a detailed discussion of this issue.

The second alternative is to use information from the broader labor market to calculate a cost index rather than limit the analysis to teachers and teacher salaries. The underlying assumption in this approach is that school districts must pay wages that are competitive with the wages of college graduates in their area. If they do not, new college graduates and some top-quality teachers will be attracted to other occupations in which the economic rewards are greater.

Methodology and Data

Following Hanushek's suggestion, it was possible to estimate general hedonic wage models for all college graduates in 1987–88, 1990–91, and 1993–94.[3] This methodology allows us to decompose wages into the part attributable to individual characteristics (e.g., education, experience, and occupation) and the part attributable to community characteristics (e.g., crime rates, housing values, and climate conditions). In competitive labor markets, differences in community factors will influence wages. For instance, holding all else constant, communities with high crime rates would have to pay higher wages to compensate individuals for the monetary and psychological costs associated with living in high crime areas.

In competitive labor markets, differences in community factors will influence wages.

To perform this analysis, data drawn from several sources were used: the CPS, the *U.S. Geological Survey*, the *National Weather Service*, and the *County and City Data Book*.[4] The CPS is a nationally representative survey that includes individual wage information as well as detailed background characteristics, such as age, occupation, marital status, and education level. In addition, this dataset has state identifiers that provide a link with state-level community factors, such as crime rates, climate, and urbanicity.

The results from the hedonic wage models were used to calculate a General Wage Index (GWI) that illustrates how wages for individuals with a given set of characteristics vary across states and over time. In effect, we are predicting how much an individual in a given state would be expected to be paid relative to how much that same individual (or an individual with exactly the same observable characteristics) would make if he or she lived in a different state (or in a different year) that had a different set of characteristics.[5]

Although this methodology allows us to make adjustments for geographical variations in aggregate measures, such as crime, given the constraints of the data, it does not allow adjustments at the school district level as Chambers has done. However, to the extent possible, we replicate model specifications employed by Chambers' specification to compare state TCIs using each methodology.[6] In the analysis below, the correlation between the two indexes is examined to determine the extent to which the two measures differ in measuring educational inflation and variation in educational costs across states.

Results

The effects of the explanatory variables on the wage rate in 1987–88, 1990–91, and 1993–94 are listed in appendix table A-2.[7] To facilitate comparison of the results with U.S. Department of Education (1997a and 1998b), the specification of the wage models are similar to his. However, a test of the hypothesis that the explanatory variables have the same

[3] For more information on the Hedonic Wage Model methodology, see Chambers 1981.

[4] Data used in this analysis were provided by Jay G. Chambers. Variable definitions and sample statistics for selected variables are listed in the appendix.

[5] The specific model is described more formally in the appendix.

[6] Details on how the state-level wage index is calculated are reported in the appendix.

[7] Appendix table A-2 lists the estimated coefficients and gives their statistical significance.

effect on the wages of men and women was rejected.[8] This indicates that wage models should be estimated separately for men and women. Despite this result, we chose, for two reasons, to present only the model results that have men and women pooled in the sample. First, the calculated average state wage rankings did not change significantly when we estimated the wage models separately. Second, we wanted to compare our results with Chambers, who only estimates pooled models.

Following U.S. Department of Education (1998b), the discussion of the variables is then broken into a discussion of discretionary factors and cost factors. The discretionary factors represent those characteristics over which employers have some degree of choice. For instance, employers in a particular labor market have a choice about whether to hire employees with advanced degrees. Cost factors represent characteristics of communities, such as crime rates, that are expected to influence local wage rates but are outside the control of employers.

Discretionary Factors

In general, the effects of individual characteristics on wages are consistent with most labor market findings. For instance:

- Wages rise at a decreasing rate with age and are higher for those with greater educational attainment. For example, having an advanced degree resulted in a wage premium over a bachelor's degree of about 3.8 percent in 1987–88, 5.5 percent in 1990–91, and 7.6 percent in 1993–94.

- There is considerable variation in wages by race/ethnicity, with white males receiving higher wages than any other group. White males earned between 12 and 15 percent more than other males and between 8 and 25 percent more than females.

- Married workers and union members receive higher wages. Married men earned between 9 and 12 percent more than unmarried men, and married women earned between 1 and 3 percent more than unmarried women. Union members earned 12 to 13 percent more than non-union members.

Cost Factors

Several cost factors have a significant affect on wages. For instance, as might be expected, wages vary significantly with changes in the median value of housing. Roughly speaking, a 10 percent increase in housing values was associated with an increase in the wage rate of 1 percent. Likewise, wages tend to be lower in areas with more temperate climates, with a 10 degree difference in climate worth between 2 and 6 percent in wages. However, few other cost factors were statistically significant. Despite this, as a whole, they play an important in explaining patterns of variation in individual wages.[9]

Using the results from the hedonic wage models, we calculate the predicted wage in each state in each year. This illustrates how wages for individuals with a given set of characteristics vary across states and over time, holding constant all discretionary factors.[10] In other words, this is the wage rate that is required to hire individuals of comparable skill in different states (that have different cost factors).

Table 1 shows the predicted state wage and ranking (1 = highest wage; 51 = lowest wage) in a particular year. The top five high-wage

In general, the effects of individual characteristics on wages are consistent with most labor market findings.

[8] F-tests of the null hypothesis that the pooled (men and women) wage models (for 1987–88, 1990–91, and 1993–94) are not statistically different from the models estimated separately were rejected at the 1 percent level.

[9] An F-test of the null hypothesis that the coefficients of the cost factors are jointly equal to zero was rejected at the 1 percent level.

[10] Details on the method used to calculate the predicted wage are in the appendix.

Table 1.—Estimated hourly state wages and state wage rank, by year

	1987–88		1990–91		1993–94	
	Wage	Rank	Wage	Rank	Wage	Rank
National	**11.27**		**13.04**		**14.19**	
Alabama	10.40	34	11.91	30	13.05	34
Alaska	14.06	1	15.35	1	16.72	1
Arizona	10.68	27	12.23	25	12.81	38
Arkansas	9.32	48	10.66	46	11.80	47
California	12.38	3	14.47	3	15.92	2
Colorado	11.23	16	12.65	21	13.31	29
Connecticut	12.40	2	14.12	4	14.99	5
Delaware	10.38	35	12.86	18	14.96	7
District of Columbia	12.20	5	13.47	12	14.85	9
Florida	10.78	22	11.89	31	12.93	36
Georgia	11.30	13	13.42	13	14.32	15
Hawaii	11.20	17	13.98	6	15.53	4
Idaho	9.83	41	11.45	39	13.45	24
Illinois	11.26	15	13.55	10	14.54	12
Indiana	10.52	28	11.30	41	13.04	35
Iowa	9.47	46	—	—	—	—
Kansas	10.48	30	11.53	37	12.66	41
Kentucky	9.94	40	11.06	44	12.65	42
Louisiana	10.75	24	12.08	27	12.76	40
Maine	9.79	42	12.27	24	13.44	25
Maryland	12.00	6	14.07	5	14.48	13
Massachusetts	11.73	8	13.82	7	14.80	10
Michigan	11.28	14	13.59	9	14.31	16
Minnesota	10.78	20	12.64	22	14.05	18
Mississippi	9.13	50	11.23	42	12.15	45
Missouri	10.45	33	12.02	28	12.85	37
Montana	9.43	47	10.57	47	11.11	50
Nebraska	10.38	36	11.08	43	12.27	44
Nevada	11.37	11	12.01	29	14.16	17
New Hampshire	11.94	7	13.51	11	14.44	14
New Jersey	12.30	4	14.67	2	15.77	3
New Mexico	10.84	18	12.35	23	12.76	39
New York	11.72	9	13.80	8	14.98	6
North Carolina	10.47	32	11.84	33	13.39	28
North Dakota	9.18	49	9.88	50	11.70	49
Ohio	10.71	26	12.73	19	13.66	21
Oklahoma	10.48	31	11.79	34	12.48	43
Oregon	10.29	37	11.88	32	13.21	31
Pennsylvania	10.78	21	12.90	17	13.61	22
Rhode Island	10.51	29	13.37	14	13.81	20
South Carolina	10.80	19	12.97	16	13.47	23
South Dakota	8.70	51	10.38	48	12.12	46
Tennessee	9.76	43	11.44	40	13.14	33
Texas	11.42	10	12.67	20	13.84	19
Utah	10.75	23	11.48	38	13.41	27
Vermont	9.62	45	11.73	36	13.44	26

Table 1.—Estimated hourly state wages and state wage rank, by year–Continued

	1987–88		1990–91		1993–94	
	Wage	Rank	Wage	Rank	Wage	Rank
Virginia	11.33	12	13.08	15	14.61	11
Washington	10.74	25	12.22	26	14.93	8
West Virginia	9.71	44	10.34	49	13.29	30
Wisconsin	10.22	38	11.76	35	13.15	32
Wyoming	10.13	39	10.91	45	11.75	48

—The predicted wage for Iowa in 1990–91 and 1993–94 is omitted due to missing values of several of the cost factors.

SOURCE: Calculations by author.

states in the 1987–88 school year were Alaska, Connecticut, California, New Jersey, and the District of Columbia. In school years 1990–91 and 1993–94, Alaska, California, Connecticut, and New Jersey remain in the top five for all 3 years. The five states with the lowest wage costs in 1987–88 were South Dakota, Mississippi, North Dakota, Arkansas, and Montana. There is slightly less consistency in the low-wage ranking, with only North Dakota, Montana, and South Dakota remaining in the bottom five in all 3 years.

There are significant differences in wages between states. In the most extreme case, the estimated wage in Alaska is roughly 1.6 times the estimated wage in South Dakota. To put this in perspective, if the 1987 average starting salary for a teacher in Michigan was $25,000, it would only cost about $19,300 to hire a teacher with comparable skills in South Dakota but would cost about $31,200 to hire an equivalent teacher in Alaska.

General Wage Index

The predicted state wages listed in table 1 are used to create GWI for each state in each year. These indexes compare each state wage with the estimated 1987–88 national wage. Table 2 reports the GWI along with the percentage change, for individual states and the entire nation in wages from 1987–88, 1990–91, and 1993–94.

The calculated GWI shows the inflation rate in wages from 1987–88 to 1990–91 to be 15.7 percent and from 1990–91 to 1993–94 to be 8.8 percent. Over the entire period, 1987–88 to 1993–94, wages are calculated to have risen 25.9 percent. To gain some perspective of how this measure differs from other indexes used to adjust education expenditures, a comparison between various inflation adjustment indexes is presented in table 3. The comparison indexes are the CPI, the GDP deflator, the NSI, proposed by Mishel and Rothstein (1997) and Rothstein and Miles (1995), and two indexes calculated by Chambers (U.S. Department of Education 1997a): the Inflationary Cost of Education Index (ICEI), which includes teachers' salary costs as well as other educational costs (e.g. supplies and materials), and the teacher salary component of the ICEI. All indexes are scaled so that 1987–88 equals 100.

From 1987–88 to 1990–91, the GWI compares most closely with the CPI; however, there is little difference in any of the inflation measures. For 1990–91 to 1993–94, the GWI closely parallels the CPI. Over this period, there is considerably more variation in the various inflation measures, with the Teacher ICEA measure exceeding the GWI by about 15 percent and the NSI exceeding the GWI by almost 50 percent.

Table 2.—General wage index

	1987–88	1990–91	1993–94	Relative changes		
	Percentage of 1987 national	Percentage of 1987 national	Percentage of 1987 national	Percentage change 1987 to 1990	Percentage change 1990 to 1993	Percentage change 1987 to 1993
National	**100.0**	**115.7**	**125.9**	**15.7**	**8.8**	**25.9**
Alabama	92.2	105.6	115.7	14.5	9.6	25.5
Alaska	124.8	136.1	148.3	9.1	8.9	18.9
Arizona	94.7	108.5	113.7	14.6	4.8	20.0
Arkansas	82.7	94.6	104.7	14.4	10.7	26.5
California	109.8	128.3	141.3	16.8	10.1	28.6
Colorado	99.7	112.2	118.0	12.6	5.2	18.5
Connecticut	110.0	125.3	133.0	13.9	6.2	20.9
Delaware	92.1	114.1	132.7	23.9	16.3	44.1
District of Columbia	108.2	119.5	131.8	10.4	10.3	21.8
Florida	95.6	105.5	114.7	10.4	8.7	20.0
Georgia	100.2	119.1	127.0	18.8	6.7	26.7
Hawaii	99.4	124.1	137.8	24.9	11.1	38.7
Idaho	87.2	101.6	119.3	16.6	17.4	36.8
Illinois	99.9	120.2	129.0	20.4	7.3	29.1
Indiana	93.4	100.2	115.7	7.3	15.5	23.9
Iowa	84.1	—	—	—	—	—
Kansas	93.0	102.3	112.3	10.0	9.8	20.8
Kentucky	88.2	98.1	112.2	11.3	14.4	27.3
Louisiana	95.4	107.1	113.2	12.4	5.6	18.7
Maine	86.8	108.9	119.3	25.3	9.6	37.3
Maryland	106.4	124.9	128.5	17.3	2.9	20.7
Massachusetts	104.1	122.6	131.3	17.8	7.0	26.1
Michigan	100.1	120.6	127.0	20.5	5.3	26.8
Minnesota	95.7	112.1	124.6	17.2	11.1	30.3
Mississippi	81.0	99.6	107.8	23.0	8.3	33.2
Missouri	92.7	106.7	114.0	15.1	6.8	23.0
Montana	83.7	93.8	98.5	12.1	5.1	17.8
Nebraska	92.1	98.3	108.9	6.8	10.8	18.3
Nevada	100.9	106.6	125.6	5.7	17.9	24.5
New Hampshire	105.9	119.9	128.1	13.2	6.9	21.0
New Jersey	109.2	130.1	140.0	19.2	7.5	28.2
New Mexico	96.2	109.6	113.2	13.9	3.3	17.7
New York	104.0	122.4	132.9	17.7	8.6	27.7
North Carolina	92.9	105.0	118.8	13.0	13.1	27.8
North Dakota	81.4	87.6	103.8	7.6	18.5	27.5
Ohio	95.0	112.9	121.2	18.8	7.3	27.5
Oklahoma	93.0	104.6	110.7	12.6	5.8	19.1
Oregon	91.3	105.4	117.2	15.5	11.2	28.5
Pennsylvania	95.7	114.4	120.8	19.6	5.5	26.2
Rhode Island	93.3	118.6	122.5	27.2	3.2	31.3
South Carolina	95.8	115.1	119.5	20.1	3.9	24.7
South Dakota	77.2	92.1	107.5	19.3	16.8	39.3
Tennessee	86.6	101.5	116.6	17.1	14.9	34.6
Texas	101.3	112.4	122.8	10.9	9.2	21.2

Table 2.—General wage index–Continued

	1987–88 Percentage of 1987 national	1990–91 Percentage of 1987 national	1993–94 Percentage of 1987 national	Relative changes Percentage change 1987 to 1990	Percentage change 1990 to 1993	Percentage change 1987 to 1993
Utah	95.4	101.8	119.0	6.7	16.8	24.7
Vermont	85.3	104.1	119.2	22.0	14.6	39.7
Virginia	100.5	116.1	129.7	15.5	11.7	29.0
Washington	95.3	108.4	132.5	13.8	22.2	39.0
West Virginia	86.2	91.8	117.9	6.5	28.5	36.9
Wisconsin	90.7	104.3	116.6	15.1	11.8	28.6
Wyoming	89.8	96.8	104.3	7.7	7.7	16.1

—The predicted wage for Iowa in 1990–91 and 1993–94 is omitted due to missing values of several of the cost factors.

SOURCE: Calculations by author.

Table 3.—Comparison of alternate measures of inflation

Price deflator	1987–88 to 1990–91(%)	1990–91 to 1993–94 (%)	1987–88 to 1993–94 (%)
General Wage Index (GWI)	15.7	8.8	25.9
Consumer Price Index (CPI)	15.6	9.3	26.3
GDP deflator	15.5	8.1	24.8
Net Services Index (NSI)	15.5	13.0	30.5
Inflationary Cost of Education Index	15.0	9.9	26.4
Teacher ICEA	16.0	10.1	27.6

SOURCES: The GWI was calculated as described in the appendix. All other indexes are drawn from Chambers (U.S. Department of Education 1997a), tables III-1A and III-1B.

These differences have dramatic implications for the adjustment made to compare educational spending in one time period with another. For instance, the average expenditure per pupil in 1990–91 was $5,258 (in 1992 dollars) and in 1993–94 was $5,767 (in 1994 dollars; U.S. Department of Education 1998a). Inflating the 1990–91 spending to 1993–94 using the GWI suggests that the $5,258 was worth $5,721 in 1993–94, slightly less than the actual expenditures in that year. This suggests that actual educational expenditure was more than keeping pace with inflation in salaries. In contrast, the Teacher ICEA suggests the 1990–91 expenditure level was worth $5,789 in 1993–94, and the NSI suggests it was worth $5,942. Both of these adjustments indicate that actual expenditure was failing to keep pace with inflation in teachers' salaries. The differences between the GWI and Chambers' TCI are explored in more detail below.[11]

Comparison Between the GWI and Chambers' TCI

The GWI is compared with Chambers' TCI in several different ways. First, we report the correlation between the two indexes in each school year. Second, we report the correla-

[11] Chambers' TCI is the teachers' salary component of his Cost of Education Index.

tion between the indexes in the state rank in wages (in each school year and in the average state rank over the 3 years). Finally, we detail the correlation in the inflation calculation generated by each of the indexes.[12] Table 4 lists these results.

In each school year, the correlations between the two indexes and the state rankings are relatively high (over 0.8) and are statistically significant. This indicates that both measures of geographic cost differences tend to be consistent in the sense that both indexes show similar relative state rankings. In contrast, we find the correlation between the two inflation measures is not statistically significant (at the 5 percent level). Thus, there is not a high degree of similarity in the measures of inflation in individual states.

Given that there are some slight differences in model specification and that Chambers is using cost factors aggregated to the school district level, whereas in our model cost factors are aggregated to the state level, it is not surprising that there are some differences in magnitude between the two indexes and in state wage ranking. However, the differences in the inflation measures are more pronounced and it seems unlikely that these factors fully account for the discrepancies in the results.

One explanation for the divergence in findings is that the uncompetitive nature of teacher labor markets biases the estimates of the coefficients, which, in turn, leads to a biased TCI. Although it is difficult to determine empirically whether this is true, one might hypothesize that the degree of bargaining power of teachers in a state would be an important determinant of whether the effect of the cost factors affecting teacher salaries differs markedly from the effect of the cost factors on the labor market as a whole. All things equal, one might expect the two wage indexes to be of similar magnitude and show similar rates of inflation in states in which the teacher labor market is similar to the labor market as a whole and to diverge in states in which teachers have greater bargaining power. One check of this hypothesis is to examine the patterns to difference between Chambers' TCI and the calculated GWI to see if teacher costs tend to be higher in states with significant teacher bargaining power (e.g., strong teachers' unions) and if the wage increase in those states tends to outpace increases in wages in the broader labor market.

Table 5 shows, for each state, the magnitude of difference between Chambers' TCI and the calculated GWI.[13] There are some significant differences in state TCIs. Based on

Table 4.—Correlation between the general wage index and Chambers' teacher cost index

	1987–88	1990–91	1993–94	1987–88 to 1990–91	1990–91 to 1993–94	1987–88 to 1993–94
Teacher wage index	0.841	0.863	0.829	—	—	—
State ranking	0.806	0.866	0.846	—	—	—
3-year average state rank	0.884			—	—	—
Measure of inflation	—	—	—	0.255	-0.200	0.002

— Not applicable.

NOTE: Iowa is not included in the 1990–91 or 1993–94 correlations due to missing values of several of the cost factors.

SOURCE: Calculations by author.

[12] State-level TCIs were obtained from Chambers.

[13] The GWI is subtracted from Chambers' TCI.

Table 5.—Chambers' teacher cost index versus the general wage index

	1987–88	1990–91	1993–94	Relative changes 1987 to 1990	1990 to 1993	1987 to 1993
Alabama	-0.94	-2.59	-4.43	-1.65	-1.55	-3.56
Alaska	26.95	19.69	19.54	-6.41	-1.23	-8.24
Arizona	6.46	8.25	12.61	0.84	3.40	4.80
Arkansas	4.37	3.97	3.55	-1.17	-0.86	-2.28
California	5.83	9.30	4.70	2.15	-4.02	-2.42
Colorado	-1.76	-0.28	6.22	1.73	5.82	8.48
Connecticut	-0.33	8.59	19.79	8.18	7.98	18.42
Delaware	8.69	3.33	-0.53	-7.38	-3.75	-12.96
District of Columbia	1.62	5.42	9.97	3.30	3.20	7.28
Florida	-0.37	8.77	5.74	9.63	-3.32	6.50
Georgia	-5.73	-10.52	-10.50	-3.92	0.66	-3.42
Hawaii	-2.84	-8.48	-12.08	-5.11	-2.31	-8.44
Idaho	3.29	2.60	-4.89	-1.37	-7.62	-10.39
Illinois	2.82	-2.17	4.80	-5.41	6.04	1.13
Indiana	-1.65	4.88	2.61	7.25	-2.87	5.08
Kansas	-5.26	-1.09	-1.15	4.98	1.50	7.19
Kentucky	-1.01	1.98	-0.47	4.09	-4.48	-0.49
Louisiana	-2.45	-2.45	-1.54	2.49	6.01	9.53
Maine	10.03	3.34	4.51	-12.66	-2.95	-17.20
Maryland	-4.62	-6.21	1.43	-1.50	7.47	7.11
Massachusetts	6.77	11.32	25.54	-1.30	2.41	1.42
Michigan	-0.02	-6.93	5.21	0.37	11.77	14.61
Minnesota	1.14	-0.97	-0.20	-3.62	5.14	1.82
Mississippi	8.18	1.06	0.90	-8.19	3.68	-4.64
Missouri	-0.27	-0.42	7.05	-2.22	1.17	-1.05
Montana	6.38	7.63	14.25	2.94	8.79	13.21
Nebraska	-5.66	0.39	0.38	5.84	0.49	7.01
Nevada	-3.76	8.95	-8.56	8.56	-7.15	1.93
New Hampshire	-6.17	1.37	6.15	5.73	-5.56	-0.49
New Jersey	2.87	2.38	13.29	2.39	3.19	6.45
New Mexico	-0.36	-0.23	2.64	4.34	12.37	19.11
New York	8.74	12.61	14.42	-3.51	-2.68	-6.88
North Carolina	-0.46	-0.41	-4.42	6.70	-3.97	2.82
North Dakota	5.44	9.15	-0.40	5.55	-9.17	-3.80
Ohio	2.12	-1.81	6.17	-7.44	-0.48	-8.52
Oklahoma	-3.03	-4.85	2.35	1.80	8.86	12.03
Oregon	5.02	8.06	4.54	-4.52	2.06	-2.75
Pennsylvania	2.87	0.48	11.55	-1.78	1.81	0.26
Rhode Island	11.44	7.55	22.60	-10.57	11.88	2.95
South Carolina	-3.44	-10.13	-6.73	0.45	11.09	13.83
South Dakota	7.05	3.79	-3.23	-5.73	-9.30	-17.25
Tennessee	4.54	2.16	-2.48	-3.32	-6.10	-10.77
Texas	-3.64	-2.69	-3.40	2.74	0.88	4.00
Utah	-0.94	7.42	0.30	5.58	-8.01	-2.48
Vermont	8.06	6.05	5.87	-6.34	-5.38	-13.49
Virginia	-3.12	1.49	-7.05	2.42	1.89	4.93
Washington	6.95	11.64	0.90	6.97	-17.89	-13.08
West Virginia	-0.37	7.10	-5.10	10.94	-17.45	-6.43
Wisconsin	4.24	4.24	4.01	0.13	2.36	2.87
Wyoming	4.49	11.44	9.72	6.65	3.41	11.06

SOURCE: Calculations by author.

the hypothesis above, one might expect Chambers' TCI to be larger than the GWI in northeastern states where a high percentage of school districts have collective bargaining (98.1 percent), and similar in south central and southwestern states where fewer school districts have collective bargaining arrangements (about 10 percent) (U.S. Department of Education 1996). There is some evidence that this pattern exists. The average differential (across all years) between Chambers' TCI and the GWI in the northeastern states is 24.6, and the average differential in the south central and southwestern states is -0.8.[14] Clearly, the value of the two indexes are more similar in states that have a lower percentage of school districts with collective bargaining. Although this is only cursory evidence, it does suggest a link between unionization and the estimate of the TCI. However, there are a multitude of possible explanations for the observed differences, given the extent to which the labor markets in these regions differ.[15] In addition, the sample sizes in some states are relatively small, which can lead to unstable estimates of state-level wages.

The potential problem is that teacher labor markets are not fully competitive; therefore, an index calculated using a sample of only teachers may misrepresent the true cost of hiring a teacher, of given attributes, in one labor market versus another ...

Conclusion

In this study, we have calculated a cost index derived from an annual labor market survey, the CPS, that contains individuals both within and outside the teaching profession. This extension of Chambers's work on TCIs along the lines suggested by Hanushek (1997) can be considered a preliminary attempt to deal with a potential statistical problem associated with using observed teacher salaries as the dependent variable in a hedonic wage regression. The potential problem is that teacher labor markets are not fully competitive; therefore, an index calculated using a sample of only teachers may misrepresent the true cost of hiring a teacher, of given attributes, in one labor market versus another (and the changes in cost over time).

A comparison between our results with Chambers' TCI shows that both samples yield similar state wage rankings; however, the GWI measure of wage inflation in the United States as a whole is more similar to the CPI than to Chambers' TCI. There are also some significant differences between the two indexes in state-level inflation measures. We offer cursory evidence that these observed differences are a result of significant differences in the bargaining power of teachers and the bargaining power of those in the labor market as a whole. There are plausible alternative explanations for the observed differences, so it would be premature to jump to the conclusion that the differences are due to uncompetitive teacher labor markets. Given the magnitude of the differences between the two indexes in measuring inflation in individual states, additional study to reconcile the findings reported here with those of Chambers is warranted.

A second benefit of using the CPS is that it permits annual updates of the index, which allows researchers to more closely track how a major component of educational costs (teachers' salaries) is changing over time. The drawback to using this survey has been that, although it allows us to make adjustments for geographical variation in aggregate measures, such as crime, given the constraints of the data we cannot make adjustments at the school district level as Chambers has done. However, starting in 1996, the CPS included county-level identifiers. These identifiers allow re-

[14] The northeastern states are Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. The south central and southwestern states are Alabama, Arkansas, Kentucky, Louisiana, Missouri, Oklahoma, Tennessee, and Texas.

[15] Although it is outside the scope of this study, one way to determine what factors are driving the observed differences in cost indexes is to regress the difference between the two indexes on a vector of state-level variables, such as the demographic composition of the state and the degree of competitiveness of labor markets in the state.

searchers to link community cost factor information at the county level (rather than the state level). In turn, this permits researchers to calculate county-level TCIs and to study in greater detail the factors contributing to the differences between Chambers' TCI and the calculated GWI.

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Appendix

Details on Data and Methodology

Model Specification

The specific model we estimate takes the following form:

$$W_{ijt}=\alpha_{0t}+\alpha_{1t}D_{it}+\alpha_{2t}C_{jt}+\alpha_{3t}S_{t} + \varepsilon_{ijt}$$

where t is the year, W_{ij} is the wage for individual i in state j, D_i is a vector of individual specific characteristics (age, experience, degree level, occupation), C_j is a vector of community cost factors (crime rate, unemployment rate, urbanicity), and S_t is a vector of state dummy variables. The estimated coefficients from this model (α_{0t}, α_{1t}, α_{2t}, and α_{3t}) will be used to calculate TCIs for each state in each of the 3 years.[16]

Construction of the Data and Sample Statistics

The sample used was restricted in a number of ways. First, we eliminated anyone from the sample who did not have at least a bachelor's degree. We did this because we wanted to construct a sample of individuals who would be eligible to teach in public schools and this excludes those who have less than a bachelor's. We also eliminated individuals who reported only working part time, those with hourly wage rates below the national minimum wage, and those whose wage appeared to be an outlier (based on the frequency distribution of wages within the occupational classification code).[17] Table A-1 lists sample statistics and data sources for all variables.

Calculation of Cost Indexes

To calculate a GWI for a particular state for a particular year, we hold constant the discretionary factors that influence salaries (they are set at the mean of the sample), set the cost factors equal to the mean value in the state for which we are calculating the cost index, and set the state dummy variable for the state in question equal to one. More formally, the wage for state j in year t is:

$$\overline{W}_{jt}=\alpha_{0t}+\alpha_{1t}\overline{D}_{it}+\alpha_{2t}\overline{C}_{jt}+\alpha_{3t}S_{t}$$

where $\overline{W}_{ijt}$ represents the wage for state j in year t, $\overline{D}_{it}$ represents the overall sample mean of the discretionary factors, C_{jt} represents the mean values in state j of the cost factors, and S_{jt} equals 1 for state j in year t. The estimated national wage is calculated, using the above formula, and setting all variables (including those in C and S) to the sample mean for a particular year.

Using the 1987–88 estimated national wage as a base, the GWI for state j in year t is:

$$GWI_{jt}=\frac{\overline{W}_{jt}}{\overline{W}_{87-88}}$$

[16] All regressions and sample means are weighted by the variable *earnwt*, which represents the number of individuals in the population, and the standard errors of the coefficients are multiplied by a scalar adjustment (1.8940 for 1987, 1.9925 for 1990, and 1.8402 for 1993) for the survey design. Details on the weighting variable and the scalar adjustment are detailed in Chambers's work (U.S. Department of Education 1997b).

[17] The elimination of outliers is consistent with the construction of the sample used by Chambers (U.S. Department of Education 1997b).

Table A-1.—Sample statistics

Variable name	Mean 1987	Mean 1990	Mean 1993
Log of hourly wage	2.422	2.568	2.653
Individual Characteristics			
1 if divorced or widowed	0.086	0.089	0.093
1 if married and spouse is present	0.604	0.592	0.597
1 if married and separated from spouse	0.021	0.026	0.024
1 if female and married	0.188	0.195	0.206
1 if veteran	0.169	0.134	0.119
1 if black male	0.045	0.041	0.045
1 if Hispanic male	0.022	0.025	0.025
1 if other race male	0.036	0.037	0.038
1 if white female	0.303	0.311	0.324
1 if black female	0.035	0.038	0.041
1 if Hispanic female	0.015	0.015	0.015
1 if other race female	0.025	0.029	0.029
Age	36.237	36.707	37.623
Cost Factors			
Distance to nearest central city (in miles)	22.994	23.270	23.488
Mean temperature over the past 30 years	56.366	56.439	56.529
Civilian labor force (county) unemployment rate	6.152	4.774	6.244
Natural log of county population	13.096	13.097	13.125
Natural log of county population density	6.504	6.502	6.515
Natural log of MSA population density	6.011	6.017	6.033
Percentage change (1980–1990) in county population	12.932	13.562	13.790
Natural log of median housing value in county	11.560	11.549	11.538
Violent crime rate (per 100,000) in county	645.510	751.127	950.476

SOURCE: Calculations by author.

Table A-2.—Coefficient estimates for general wage index models

Variable name	1987–88	1990–91	1993–94
Discretionary factors			
Intercept	-1.410	-1.310	-1.447
	(1.185)	(1.304)	(1.238)
Individual characteristics			
1 if divorced or widowed	-0.010	0.020	0.003
	(0.025)	(0.027)	(0.025)
1 if married and spouse is present	0.109*	0.093*	0.116*
	(0.018)	(0.020)	(0.019)
1 if married and separated from spouse	-0.006	-0.020	0.017
	(0.042)	(0.043)	(0.041)
1 if female and married	-0.081*	-0.058*	-0.107*
	(0.025)	(0.027)	(0.025)
1 if veteran	0.052*	0.066*	0.017
	(0.019)	(0.022)	(0.021)
1 if black male	-0.123*	-0.147*	-0.128*
	(0.029)	(0.034)	(0.030)
1 if Hispanic male	-0.128*	-0.158*	-0.152*
	(0.040)	(0.043)	(0.040)
1 if other race male	-0.128*	-0.154*	-0.144*
	(0.033)	(0.036)	(0.033)
1 if white female	-0.129*	-0.126*	-0.085*
	(0.020)	(0.022)	(0.021)
1 if black female	-0.178*	-0.219*	-0.137*
	(0.036)	(0.038)	(0.035)
1 if Hispanic female	-0.160*	-0.217*	-0.196*
	(0.051)	(0.057)	(0.052)
1 if other race female	-0.224*	-0.249*	-0.197*
	(0.042)	(0.044)	(0.041)
Age	0.159*	0.145*	0.139*
	(0.058)	(0.060)	(0.057)
Age^2	-0.004*	-0.004*	-0.003
	(0.002)	(0.002)	(0.002)
Age^3	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Age^4	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
1 if respondent has an advanced degree	0.038*	0.055*	0.076*
	(0.014)	(0.015)	(0.016)
1 if respondent is a union member	0.136*	0.116*	0.123*
	(0.021)	(0.023)	(0.022)
1 if non-union but covered by a union contract	0.015	0.035	0.015
	(0.036)	(0.038)	(0.042)
1 if paid by the hour	-0.244*	-0.238*	-0.262*
	(0.014)	(0.015)	(0.014)
1 if state local government worker	-0.008	-0.005	-0.007
	(0.028)	(0.031)	(0.027)
1 if federal government worker	0.112*	0.076*	0.135*
	(0.033)	(0.037)	(0.033)

Table A-2.—Coefficient estimates for general wage index models–Continued

Variable name	1987–88	1990–91	1993–94
Main job category			
Building/ground maintenance/repair	-0.047	-0.031	-0.047
	(0.039)	(0.044)	(0.042)
Security services	0.190*	0.211*	0.257*
	(0.049)	(0.055)	(0.051)
Health and student services	-0.023	-0.009	0.050
	(0.040)	(0.043)	(0.040)
Teaching aid	-0.287*	-0.252*	-0.288*
	(0.095)	(0.114)	(0.095)
Other paraprofessional	-0.198*	-0.198*	0.007
	(0.060)	(0.063)	(0.065)
Transportation/delivery/vehicle mechanic	0.068	0.016	-0.019
	(0.042)	(0.048)	(0.045)
Accountant/management related	0.128*	0.101	0.104*
	(0.058)	(0.066)	(0.052)
Industry category			
Mining	0.175*	0.233*	0.329*
	(0.065)	(0.082)	(0.074)
Construction	0.084*	0.069	0.013
	(0.045)	(0.048)	(0.047)
Manufacturing nondurables	0.106*	0.110*	0.051
	(0.031)	(0.034)	(0.029)
Manufacturing durables, metals	-0.017	-0.028	-0.053
	(0.052)	(0.062)	(0.069)
Durables, nonmetals	-0.139	0.014	-0.134
	(0.102)	(0.151)	(0.143)
Transportation	0.106*	0.173*	0.071
	(0.041)	(0.044)	(0.041)
Communication	0.066	0.120*	0.036
	(0.044)	(0.050)	(0.042)
Utilities and sanitary services	0.221*	0.230*	-0.055
	(0.046)	(0.053)	(0.104)
Wholesale trade	0.075	0.052	0.049
	(0.041)	(0.044)	(0.040)
Retail trade	-0.129*	-0.136*	-0.182*
	(0.036)	(0.039)	(0.033)
Finance, insurance, real estate	0.086*	0.099*	0.048
	(0.032)	(0.035)	(0.030)
Business services	0.052	0.050	-0.039
	(0.034)	(0.038)	(0.033)
Repair services	-0.171*	-0.031	-0.169
	(0.091)	(0.094)	(0.097)
Health and hospital services	0.109*	0.077	-0.002
	(0.040)	(0.043)	(0.038)
Elementary/secondary/private	-0.065	-0.148	-0.104
	(0.127)	(0.137)	(0.130)
Other services	-0.008	0.013	-0.027
	(0.031)	(0.034)	(0.028)

Table A-2.—Coefficient estimates for general wage index models–Continued

Variable name	1987–88	1990–91	1993–94
Broad occupation category			
Managerial	0.193	0.287*	0.327*
	(0.109)	(0.120)	(0.112)
Professional specialty	0.377*	0.450*	0.510*
	(0.095)	(0.103)	(0.101)
Technician and related	0.300*	0.373*	0.448*
	(0.095)	(0.103)	(0.102)
Sales	0.218*	0.284*	0.336*
	(0.096)	(0.104)	(0.103)
Administrative support	0.101	0.148	0.229*
	(0.094)	(0.103)	(0.101)
Service	-0.046	0.037	0.060
	(0.096)	(0.104)	(0.103)
Precision production	0.218*	0.255*	0.306*
	(0.094)	(0.103)	(0.101)
Operators, fabricators, and laborers	-0.005	0.036	0.082
	(0.094)	(0.102)	(0.100)
Cost Factors			
Distance to nearest central city	0.001	-0.001	0.000
	(0.001)	(0.001)	(0.001)
Distance to nearest central city squared	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Mean temperature over the past 30 years	-0.004	-0.002	-0.006
	(0.004)	(0.004)	(0.004)
Civilian labor force (county) unemployment rate	-0.001	0.007	-0.001
	(0.006)	(0.010)	(0.007)
Natural log of county population	0.029	0.043	0.094
	(0.134)	(0.148)	(0.139)
Natural log of county population squared	0.000	-0.001	-0.003
	(0.005)	(0.005)	(0.005)
Natural log of county population density	0.024	-0.048	0.010
	(0.066)	(0.076)	(0.073)
Natural log of county population density squared	-0.003	0.005	-0.002
	(0.005)	(0.006)	(0.005)
Natural log of Metropolitan Statistcal Area (MSA) population density	0.026	0.001	-0.004
	(0.024)	(0.026)	(0.025)
Natural log of MSA population density squared	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)
Percentage change (1980–90) in county population	0.000	0.001	-0.001
	(0.001)	(0.001)	(0.001)
Natural log of median housing value in county	0.092*	0.106*	0.109*
	(0.037)	(0.044)	(0.039)
Violent crime rate (per 100,000) in county	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Alaska	9.987	0.050	1.368
	(7.716)	(3.837)	(3.863)
Arizona	-0.052	-0.047	-0.073
	(0.088)	(0.099)	(0.086)

Table A-2.—Coefficient estimates for general wage index models–Continued

Variable name	1987–88	1990–91	1993–94
Arkansas	-0.055	-0.058	-0.059
	(0.097)	(0.107)	(0.093)
California	-0.058	-0.038	-0.017
	(0.073)	(0.086)	(0.076)
Colorado	-0.035	-0.040	-0.132
	(0.089)	(0.099)	(0.088)
Connecticut	-0.058	-0.011	-0.101
	(0.089)	(0.103)	(0.096)
Delaware	-0.135	-0.006	0.011
	(0.127)	(0.142)	(0.130)
District of Columbia	0.044	-0.039	0.063
	(0.135)	(0.159)	(0.143)
Florida	-0.002	-0.067	0.002
	(0.073)	(0.085)	(0.071)
Georgia	-0.004	0.058	0.039
	(0.079)	(0.093)	(0.078)
Hawaii	0.041	0.088	0.136
	(0.115)	(0.132)	(0.116)
Idaho	-0.091	-0.013	-0.047
	(0.145)	(0.148)	(0.130)
Illinois	-0.099	-0.032	-0.067
	(0.087)	(0.098)	(0.087)
Indiana	-0.036	-0.064	-0.069
	(0.084)	(0.095)	(0.082)
Iowa	-0.091	—	—
	(0.100)	—	—
Kansas	-0.025	-0.030	-0.073
	(0.089)	(0.100)	(0.086)
Kentucky	-0.064	-0.067	-0.058
	(0.091)	(0.101)	(0.092)
Louisiana	0.052	0.013	0.000
	(0.085)	(0.096)	(0.083)
Maine	-0.180	-0.010	-0.145
	(0.137)	(0.155)	(0.142)
Maryland	-0.031	0.020	-0.052
	(0.074)	(0.086)	(0.075)
Massachusetts	-0.129	-0.044	-0.124
	(0.086)	(0.098)	(0.096)
Michigan	-0.041	0.044	-0.048
	(0.087)	(0.099)	(0.090)
Minnesota	-0.112	-0.047	-0.103
	(0.099)	(0.110)	(0.100)
Mississippi	-0.076	0.010	-0.012
	(0.091)	(0.109)	(0.092)
Missouri	-0.056	-0.046	-0.098
	(0.078)	(0.088)	(0.075)
Montana	-0.051	-0.073	-0.235
	(0.162)	(0.178)	(0.165)
Nebraska	-0.043	-0.039	-0.125
	(0.117)	(0.122)	(0.110)

Table A-2.—Coefficient estimates for general wage index models–Continued

Variable name	1987–88	1990–91	1993–94
Nevada	0.067	-0.086	0.005
	(0.133)	(0.135)	(0.125)
New Hampshire	-0.048	0.008	-0.118
	(0.121)	(0.136)	(0.130)
New Jersey	-0.052	0.005	-0.028
	(0.075)	(0.087)	(0.080)
New Mexico	0.043	0.033	-0.041
	(0.111)	(0.124)	(0.120)
New York	-0.114	-0.045	-0.098
	(0.078)	(0.090)	(0.081)
North Carolina	-0.038	-0.025	-0.021
	(0.072)	(0.084)	(0.069)
North Dakota	-0.068	-0.092	-0.151
	(0.176)	(0.180)	(0.179)
Ohio	-0.080	-0.006	-0.074
	(0.078)	(0.089)	(0.077)
Oklahoma	0.016	0.011	-0.051
	(0.081)	(0.092)	(0.081)
Oregon	-0.079	-0.061	-0.097
	(0.092)	(0.105)	(0.086)
Pennsylvania	-0.114	-0.017	-0.103
	(0.076)	(0.087)	(0.077)
Rhode Island	-0.175	-0.029	-0.131
	(0.116)	(0.133)	(0.131)
South Carolina	0.022	0.097	0.029
	(0.081)	(0.095)	(0.077)
South Dakota	-0.144	-0.059	-0.101
	(0.168)	(0.186)	(0.169)
Tennessee	-0.094	-0.060	-0.029
	(0.077)	(0.087)	(0.074)
Texas	0.043	-0.006	0.045
	(0.063)	(0.076)	(0.063)
Utah	-0.059	-0.100	-0.082
	(0.106)	(0.118)	(0.105)
Vermont	-0.178	-0.064	-0.129
	(0.158)	(0.174)	(0.153)
Virginia	-0.038	-0.039	-0.025
	(0.078)	(0.089)	(0.080)
Washington	-0.139	-0.105	-0.053
	(0.088)	(0.099)	(0.088)
West Virginia	-0.065	-0.103	0.007
	(0.125)	(0.135)	(0.133)
Wisconsin	-0.139	-0.032	-0.132
	(0.102)	(0.115)	(0.102)
Wyoming	0.078	-0.044	-0.157
	(0.210)	(0.220)	(0.217)

Table A-2.—Coefficient estimates for general wage index models–Continued

Variable name	1987–88	1990–91	1993–94
Adjusted R^2	0.442	0.414	0.424
Sample size	13,777	14,596	14,101

— The predicted wage for Iowa in 1990–91 and 1993–94 is omitted due to missing values of several of the cost factors.

* Indicates coefficient is significant at the 5 percent level.

NOTE: Standard errors are shown in parentheses.

SOURCE: Calculations by author.

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School Districts and Spending in the Schools

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About the Author

Amy Ellen Schwartz is an Associate Professor at New York University's Wagner School of Public Service, specializing in public finance, policy analysis and applied econometrics. Prior to joining the Wagner faculty in 1992, she was an Assistant Professor of Economics at Tufts University. She earned at BS from Cornell University in applied economics and a Ph.D. in economics from Columbia University. She has consulted on various issues of public finance and policy for government and not-for-profit organizations, including the ACLU, the Campaign for Fiscal Equity and the New York City Board of Education. Her current work includes projects on the public finance of education in New York State and Ohio, the measurement of efficiency in public schools, and the use of performance measures for guiding resource use decisions. Her taxation related research she has looked at the taxation of cigarettes and alcohol, the child care tax credit, intergovernmental aid, and property tax limitations; spending related research has focused on the measurement, provision and demand for local government services. A major project completed in 1996 evaluated the impact of public capital and state infrastructure investment on income and employment and on economic performance in the manufacturing sector, in particular. Professor Schwartz's work has been published in a variety of academic and professional journals including *The American Economic Review*, *The Journal of Public Economics*, *The National Tax Journal*, *Public Finance Quarterly* and *Regional Science and Urban Economics*.

Selected
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School Districts and Spending in the Schools

School Districts and Spending in the Schools

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Introduction

While recent school reform movements have embraced a wide range of policies and programs, an important feature of many of the proposed reforms is decreasing the control wielded by school districts over the level and pattern of spending by individual schools. Hill et al. 1997; and Odden and Busch 1997, are among those who argue forcefully for financing education through a system in which schools operate under contracts with districts and funding comes in the form of block grants based upon the number and characteristics of students the school enrolled. At the extreme, it has been suggested that schools should receive funding and contracts directly from the state, and school districts should be relegated to performing oversight functions. Such a "block grant" system would result in a different distribution of spending in either (or both) of the following ways. First, a state-wide formula would eliminate (or ameliorate) the differences in per pupil spending across school districts. Second, to the extent that the state's allocation formula differs from the *de facto* formulae now used by individual districts, a statewide program would lead to changes in resource allocation across schools within districts. While there is much research into the interdistrict variation in spending (see, for example, Berne and Stiefel 1984), there is relatively little research into the intradistrict variation in spending across schools. The emerging research in this area—such as Stiefel et al. 1998—has focused, to some extent, on measuring equity, rather than on investigating the factors driving the intradistrict variations. This paper evaluates the distribution of spending across schools using 1995–96 school and district level data for Ohio to analyze the distribution of spending across public schools. The *de facto* formulae describing this distribution are estimated and the differences in these formulae across school districts are investigated. Thus, this analysis provides insight into the impact of a change to block grant funding on the distribution of spending across schools in Ohio.

Background

The public finance theories of fiscal federalism and public expenditure determination indicate that school districts play an important role in determining the level of spending by school districts. According to this view, school district budgets reflect the demands of voters within the jurisdiction; demand, in turn, depends on the income, wealth, demographics and preferences of the voters, on the cost of providing education and, of course, on the state and federal funding they receive. The implication is that we should expect there to be variations in spending across districts which reflect the variations in these fundamentals. The much-lamented inequity in education spending across school districts in the United States is, to a large degree, a reflection of local control.[1]

Although the public finance models described above provide a strong theoretical foundation for understanding district level expenditures, and there has been much work investigating the determinants of expenditures, the empirical literature has been relatively silent about the determination of spending on schools within districts—reflecting, in large part, the scarcity of school-level spending data. As has been well documented and described by a variety of authors (see, for example, Rubenstein 1997; or Cooper 1993), resource allocations within districts derive from the interplay of myriad political, economic, and institutional factors. The patterns of spending that emerge from such a process (in which individual districts allocate spending to their own schools) are likely to be quite different than the pattern that would emerge from the sort of block grant funding that has been proposed. According to the proposed method, a block grant would be awarded by the state directly to schools in an amount which would be determined by some relatively straightforward formula based on enrollment, the level of the school (elementary, middle, high) and including, perhaps, some "weighted per-student formulas providing extra funding for disadvantaged pupils." (Hill et al. 1997, 4.) To the extent that district formulae would differ from an adopted state-wide formula in the relative weights assigned to various factors, the move to a statewide formula would involve changes in the distribution of resources within districts. For example, while some districts may allocate greater funding to high schools relative to elementary schools, others may direct greater resources to elementary schools. Thus, if resources are allocated using a statewide formula, the distribution of spending within some districts will change significantly.

Interestingly, there has been relatively little research in the United States into the distribution of spending across schools within their districts and the positive and normative impacts on school spending, performance, and educational outcomes. With the exception of the recently published Clark and Toenjes 1997, there is a dearth of research into the factors underlying the distribution of resources between schools within their districts. This gap is due, at least in part, to the scarcity of good school-level resource data. Relatively recent data collected for Ohio schools for the 1995–96 school year will allow us to address some of these lacunae. The objective of this study is to investigate the factors that determine school level spending, the differences (or similarities) in the importance of these factors across school districts in order to gain insight into the likelihood and impact of adopting a statewide block grant finance formula.

Interestingly, there has been relatively little research in the United States into the distribution of spending across schools within their districts and the positive and normative impacts on school spending, performance, and educational outcomes.

[1] At the same time, local control may contribute to greater efficiency. To the extent that families are mobile and can choose between school districts competing for their children, local control may put pressure on schools to operate more efficiently. Further, it may result in the efficient "matching" of families into districts offering the kinds of schools they prefer and are willing to pay for. Of course, this efficiency "gain" comes at a price: local control as practiced in most of the United States has generally entailed considerable inequity.

More specifically, the objective of this research is to develop and empirically investigate the *de facto* "formulae" by which spending is allocated across school districts in Ohio and the factors determining the differences in these formulae. Specific research questions that are addressed include: Are allocations relatively constant across schools *within districts*, adjusting for enrollment, school organization or a set of characteristics of the students? To the extent that there are differences across districts, can they be explained by differences in the size of the school district or its urbanization? As an example, are the urban school district formulae different than those characterizing spending in suburban districts? The purpose of these analyses will be to draw lessons from the varied experience of the Ohio schools about the role of school districts in determining school level resources. The paper begins by exploring *de facto* spending formulae characterizing spending in all schools, then turns to a more detailed analysis of the formulae for a sample of the largest school districts. Finally, the impact of the adoption of a hypothetical state-wide formula is simulated.

Data

Defining the Sample

We use data from 3,284 schools and 586 districts operating in Ohio during the 1995–96 school year. These include financial data from the Ohio Department of Education "Expenditure Flow Model" (EFM) and Educational Management Information System (EMIS) and data on test scores, inputs (such as numbers of teachers, teacher experience, etc.), enrollment and demographic and socioeconomic characteristics from EMIS. All data are for the academic year 1995–96. (See table 1 for brief descriptions of the variables and table 2 for descriptive statistics.)

The Expenditure Flow Model records expenditures in five categories for 4,169 buildings in 654 districts. Our analysis excludes 802 buildings because they are vocational schools (69), special needs schools (25), "other facilities" (70), and central offices (638).[2] The remaining school buildings were matched to data from the EMIS system, which provides a broader range of information about Ohio school districts and school buildings. District information includes revenues by source, degree of urbanization (rural, small town, urban, major urban, and suburban), and some socioeconomic variables describing the characteristics of the population and the students. Building level files include information on student performance on various tests, enrollment and attendance, teacher experience, salary and certification data, school organization (elementary, middle, or high school) and grade span, and some demographic and socioeconomic characteristics describing the students and the staff in the school. While EMIS files provided data for 612 districts and 4,245 buildings, matching the EFM spending data to them resulted in the exclusion of an additional 83 buildings for which EMIS data were unavailable. The implication of this procedure is that 68 districts were excluded from the analysis—generally because they were one building districts providing special needs/vocational education.

The resulting analysis sample contains 586 districts and 3,284 buildings: 2,058 elementary schools (62.7 percent), 569 middle schools (17.3 percent) and 657 high schools (20 percent). Elementary school enrollment totals 785,913, while middle school enrollment is

The purpose of these analyses will be to draw lessons from the varied experience of the Ohio schools about the role of school districts in determining school level resources.

[2] Note that the Cincinnati school district and the 79 schools within it are not included in the analysis because EFM spending data were unavailable. According to correspondence with Dr. Matthew Cohen at the Ohio Department of Education, Cincinnati data were prorated, so that all 79 buildings were shown to have identical spending. Thus, the district total was the only entry included in the file for this district.

Table 1.—Definitions for model variables

Enrollment	
EFMADM	Building average daily membership
EFMSQ	EFMADM squared
School Characteristics	
ES	Dummy variable indicating elementary school
MS	Dummy variable indicating middle school
HS	Dummy variable indicating high school
DUMFLE	Dummy variable indicating the availability of free lunch data
Resources	
BINSPUP	Per pupil spending on instruction
BTOTPUP	Building total per pupil spending
TCHPUP	Total employees divided by average daily membership
Student demographic data	
NONW	Percentage of children who are non-white
PFLCHP	Percentage of children who are free lunch eligible
District characteristics	
SMDIST	Dummy variable indicating small district (5 to 9 schools)
MLDIST	Dummy variable indicating medium to large district (10 schools or more)
STRUR	Dummy variable indicating small town or rural district
URBAN	Dummy variable indicating urban or major urban district
SUB	Dummy variable indicating suburban district

SOURCE: All data were provided by the Ohio Department of Education. EMIS (Education Management Information System) and EFM (Expenditure Flow Model) 1995–96 data were downloaded from the Ohio Department of Education homepage.

310,776, and high school enrollment is 503,159.[3]

A Statistical Portrait of Ohio Schools

As shown in table 2, while total per pupil spending averages $4,936 (BTOTPUP), it spans a wide range in Ohio. The least amount spent was only $2,346 while the most spent was $13,622—almost six times more. Per pupil expenditures for instruction (BINSPUP) averaged roughly $3,127 in 1995–96, ranging from a low of $1,443 to a high of $8,848.

Additional analyses reveal that, on average, elementary schools spent roughly $4,750 per student during the 1995–96 school year

[3] The analysis sample was constructed in a fashion similar to that employed by Sherman and Best (1996) in their research on school-level expenditures in Ohio in 1992–93. Sherman and Best's study focuses on approximately 3,600 schools in 607 "regular" K–12 districts in Ohio; for example, "only elementary middle, and secondary schools with an enrollment greater than zero were included in the file for analysis" (page 41).

Table 2. Descriptive statistics for model variables

Variable	N	Mean	Minimum	Maximum
		Full sample		
Enrollment				
EFMADM	3,284	487.16	41.00	2,517.00
School characteristics				
ES	3,284	0.63	0.00	1.00
MS	3,284	0.17	0.00	1.00
HS	3,284	0.20	0.00	1.00
DUMFLE	3,284	0.56	0.00	1.00
Resources				
BINSPUP	3,284	3,126.96	1,443.16	8,848.20
BTOTPUP	3,284	4,936.09	2,346.29	13,621.98
TCHPUP	3,283	0.09	0.00	0.54
Student demographic data				
NONW	3,284	15.01	0.00	100.00
PFLCHP	1,828	31.96	0.00	98.76
District characteristics				
SMDIST	3,284	0.41	0.00	1.00
MLDIST	3,284	0.30	0.00	1.00
STRUR	3,284	0.40	0.00	1.00
URBAN	3,284	0.38	0.00	1.00
SUB	3,284	0.22	0.00	1.00
		Big nine school districts		
Enrollment				
EFMADM	494	560.44	154.00	2,030.00
School characteristics				
ES	494	0.70	0.00	1.00
MS	494	0.17	0.00	1.00
HS	494	0.12	0.00	1.00
DUMFLE	494	0.99	0.00	1.00
Resources				
BINSPUP	494	3,611.10	2,406.44	8,848.20
BTOTPUP	494	5,763.99	3,831.36	12,466.43
TCHPUP	494	0.09	0.05	0.26
Student demographic data				
NONW	494	54.20	0.60	100.00
PFLCHP	494	56.87	2.50	98.66
District characteristics				
SMDIST	494	0.00	0.00	0.00
MLDIST	494	1.00	1.00	1.00
STRUR	494	0.00	0.00	0.00
URBAN	494	1.00	1.00	1.00
SUB	494	0.00	0.00	0.00

SOURCE: Author's calculations.

of which about $3,095 (65 percent) per student was instructional spending. At an average $5,185 per student, middle school spending exceeds elementary school spending by about $435; total spending in high schools, at $5,304, is higher than in middle schools.

Interestingly, although in Ohio there are far more elementary than high schools, the variation in spending is greatest across high schools. (As an example, the coefficient of variation (CV) is 24.04 for per pupil spending in all categories for high schools, compared to a CV of 19.75 for elementary schools.) Although difficult to interpret, greater homogeneity in elementary school spending may reflect a broader social consensus about elementary school education and a greater attention to ameliorating inequities in elementary schools than in high schools.

There are relatively few variables describing the socioeconomic characteristics of the student and parent bodies...

There are relatively few variables describing the socioeconomic characteristics of the student and parent bodies used in the analysis, largely due to limitations in data availability. At the building level, only student ethnicity is reported and there are limited data available on the percentage of students who are free lunch eligible (PFLCHP); approximately 56 percent of the schools in the sample reported data on the percentage of students who are eligible for free lunch. On average, 15 percent of the students in a school building are non-white (NONW), and, for those schools reporting, approximately 32 percent of the students are eligible to receive free lunch. There is, of course, substantial variation in the characteristics of the student body across schools and districts. While some schools have virtually no low-income children, in some schools, almost all of the children are poor.

We utilize information on the "urbanization" and the size of the school district in which each school operates. Three dummy variables describe urbanization. Forty percent of the schools are in small town or rural districts (STRUR), 22 percent in suburban districts (SUB) and 38 percent in urban districts (URB). Three dummy variables distinguish districts by size: 29 percent of schools are in very small districts with fewer than 5 schools, 41 percent of the schools are in small districts (SMDIST) which have 5 to 9 schools; and the remaining 30 percent of the schools are in medium to large districts (MLDIST) with 10 or more schools.

It should be noted that the unit of analysis for this study is the building and *not* the district. The district level data have been merged into the building level file and the district level variables are used to characterize the district in which the school operates. For example, the SMDIST average shows that 41 percent of the schools in the state operate in a school district which has 5 to 9 schools and *not* that 41 percent of the school districts have 5 to 9 schools. In fact, the average school district in Ohio has about 6 schools.

The Big Nine School Districts

As described in greater detail below, some of the analyses—the estimation of district-specific formulae—are performed using a smaller sample of schools, specifically, the 494 in the largest nine school districts reporting data—Akron, Canton, Cleveland, Columbus, Dayton, Parma City, Southwestern, Springfield and Toledo. Total enrollment is 276,855 representing roughly 17 percent of the children in the sample. The largest of these is Columbus, with 131 schools; the smallest is Springfield with only 20 schools. District specific formulae are estimated only for these nine districts for the following reason. While in principle a *de facto* spending formula could be estimated for every school district in the state, in practice, it is neither feasible nor reasonable. Most of the school districts in Ohio are very small. As shown in table 3, almost 56 percent of the school districts in the analysis sample have four schools or fewer. Another 36 percent have between 5 and 9 schools; 38 districts, representing 6.5 percent of the sample have between 10 and 19 schools and *only 9 districts have at least 20.* As expected,

Table 3.—District size analyses—Frequency distributions

District size	Number of districts	Percent	Number of pupils	Percent
Total	**586**	**100%**	**1,599,848**	**100%**
1–4 Schools	327	55.8%	414,892	25.9%
5–9 Schools	212	36.2%	642,964	40.2%
10–19 Schools	38	6.5%	265,137	16.6%
20 or more schools	9	1.5%	276,855	17.3%

SOURCE: Author's calculations.

these 9 districts are all urban districts and differ significantly from the other 577 districts in the sample. Spending in the "big nine" is higher, averaging approximately $800 more than the average district in the state. Big nine schools have a higher percentage of non-white and poor children—more than 50 percent of the children in the average big nine school are non-white and more than 50 percent are eligible for free lunch.

The policy implication of the preponderance of small districts is that in small districts, district administrators could easily design a formula for allocating spending across their schools that mirrors or re-creates the current distribution of spending, should they so desire. Using relatively simple computations, a formula based on a small number of factors could be derived by "working backward" from the allocation the district prefers. Specifically, the number of factors that a district would need would be exactly equal to one less than the number of schools. For example, a district with four schools could derive a formula to allocate spending in any pattern they prefer by appropriately choosing an intercept and coefficients on three factors. While it is also possible to do so in larger districts, the number of factors required increases with the number of schools in the district, increasing both the computational difficulty and the difficulty of designing a credible formula. (Although it seems plausible that a formula based on ten factors describing the characteristics of a school and its student body could potentially be implemented, a formula based upon, say, the fifty or sixty factors that would be necessary for a larger district seems considerably less plausible.)

To the extent that districts are small enough to design formulae to maintain the status quo, a move to formula or block grant funding would affect spending and performance only if (1) the current distribution of spending is not, in fact, what they prefer but is a perverse result of the system, (2) the overall level of spending of the districts is changed, or (3) the schools have been operating inefficiently because the district policies are misconceived—that is, districts have been misallocating resources within schools because, for example, they have inferior information. (Of course, a move to formula funding could affect spending in larger districts for these same reasons as well.) While it is entirely possible that districts would prefer a different distribution than they have, the magnitude of this problem is unknown and answering it would require an analysis that is beyond the scope of this paper. (There are important conceptual and practical difficulties posed by addressing these types of questions.) On the other hand, it seems less likely that districts would choose a higher spending level for their schools if the only change is to formula funding within an individual school district. If the state were to run a block grant system of equal financing across the state, however, we might expect this effect to be fairly important.

De Facto Spending Formula

A Statewide Formula

The centerpiece of the empirical work is a *de facto* resource allocation formula that is estimated for schools across Ohio. The underlying notion is that this formula captures the "strategy" or "formula" by which, intentionally or otherwise, resources are allocated across schools. More specifically, *de facto* resource allocation formulas are estimated in which the amount of spending per pupil in school *i* in district *j* (Y_{ij}) in various categories will be "explained" by the available school level data X_{ij}. These are: enrollment (EFMADM), the square of enrollment (EFMSQ) included to allow for returns to scale, dummy variables distinguishing elementary (ES) and middle schools (MS) from high schools (HS), the percentage of the students who are non-white (NONW) and the percentage of the students who are eligible for free or reduced-price lunches (PFLCHP), as a measure of poverty. Since this last variable is only available for 56 percent of the schools in the analysis, a dummy variable, DUMFLE, is also used, indicating whether or not the free lunch eligibility data are available. (Although it would be preferable to include variables describing the population of disadvantaged students in that school—such as percentage with limited English proficiency—Ohio does not report these at the school level, only at the district level.) Brief definitions of the variables used are shown in table 1 and descriptive statistics for these variables are presented in table 2.

[T]he *de facto* spending formula is not a cost function, nor is it an expenditure function.

Mathematically, the *de facto* spending formula may be written as:

$$(1) \quad Y_{ij} = a + b\, X_{ij} + e_{ij}.$$

where *a* and *b* represent parameters to be estimated and *e* is a standard error term.[4] The coefficients can be interpreted as indicating the increase in per pupil spending in school *i* that is due to a one unit increase in X_{ij}. For example, the coefficient on PFLCHP would indicate the increase in school per pupil spending that would accrue due to a one percentage point increase in the percentage of a school's students that are eligible for free lunch. These regressions are estimated for both instructional spending only and for total spending. The first set of regressions provides a description of the pattern of school-level spending across the state of Ohio, ignoring any district level variables. Thus, these might be viewed as capturing the extent to which school spending now conforms to a parsimonious statewide "formula."[5]

Notice that the *de facto* spending formula is not a cost function, nor is it an expenditure function. The estimation of a cost function would require data on the prices of inputs, adjust for the quality and characteristics of output, and rely on an assumption that observed spending reflects cost-minimizing behavior. An expenditure function, on the other hand, would include variables that determine the demand for public spending on education—such as income, intergovernmental aid, and the costs of providing education, etc.

The results of estimating equation (1) for per pupil instructional spending and total spending are shown in the first two columns of table 4. The regressions indicate that a relatively modest share of the variation in spending is explained by the observed variables describing differences in the schools. Approximately 28 percent of the variation in per pupil instructional spending and 30 percent of per pupil total spending is explained by variation in the included variables.

[4] As an alternative, log-linear formula regressions were run. The results were qualitatively similar.

[5] In practice, any formula for block grant funding of schools would include more variables describing the particular characteristics of the students, personnel, organization, etc. of individual schools. Clearly, the absence of such data in currently available data sets points to the need to develop accounting and administrative systems before any "direct-to-school" funding formula is implemented.

Overall, Ohio elementary schools receive less per pupil than high schools—$126 less on instructional purposes and $838 dollars less overall. While middle schools spend more on instruction (approximately $94 more) they spend less overall, indicating non-instructional spending is significantly lower in middle schools relative to high schools.

The negative coefficient on enrollment in both the instructional and total spending regressions indicates that per pupil spending declines with the size of the student body, reflecting, perhaps, the economies of scale that accrue as, for example, the salary of the principal is spread out over a larger student body. The positive coefficients on the square of enrollment (EFMSQ) indicates that the magnitude of this effect declines somewhat as school size increases. Notice, however, that although these coefficients are statistically significant, their magnitudes are quite small. Thus, while gaining more students may decrease per pupil spending, the effect is likely to be on the order of a few dollars per student. Similarly, while school funding increases significantly with the

Table 4.—Parameter estimates for de facto spending equations—Full sample

	OLS		District effects	
Independent	(1)	(2)	(3)	(4)
variable	BINSPUP	BTOTPUP	BINSPUP	BTOTPUP
INTERCEPT	2,977.9197***	5,524.2275***		
	(43.1656)	(71.5847)		
ES	-126.2893***	-838.3121***	-291.3306***	-1,114.7745***
	(29.5036)	(48.9280)	(25.1736)	(37.9080)
MS	93.6230***	-260.3720***	-29.9064	-452.0455***
	(32.991)	(54.7149)	(26.2421)	(39.5170)
EFMADM	-0.3864***	-1.4681***	-0.6925***	-1.9479***
	(0.0937)	(0.1555)	(0.0867)	(0.1305)
EFMSQ	0.0002***	0.0006***	0.0003***	0.0007***
	(0.0001)	(0.0001)	(0.0000)	(0.0001)
NONW	12.3414***	24.7571***	2.3058***	5.7394***
	(0.6126)	(1.0159)	(0.8558)	(1.2887)
DUMFLE	394.6961***	550.5152***	-14.0179	16.5387
	(26.0151)	(43.1428)	(60.1533)	(90.5825)
PFLCHP	-3.8040***	-9.9930***	4.2053***	5.8305***
	(0.7076)	(1.1735)	(0.7986)	(1.2026)
F	184.06	202.71	9.53	13.01
R^2	0.2823	0.3022	0.6770	0.7411
No. of Observations	3,284	3,284	3,284	3,284

* Indicates significance at the 10 percent level.
** Indicates significance at the 5 percent level.
*** Indicates significance at the 1 percent level.
NOTE: Standard errors in parentheses.
SOURCE: Author's calculations.

percentage of non-white students, the effect of a one percentage point increase in non-white students would only increase per pupil spending by $24.

The coefficient on DUMFLE, the dummy variable denoting whether free lunch eligibility data are available, is positive, significant, large, and generally consistent across schools in a district. The obvious implication is that the availability of data is not random—it is systematically related to higher spending. In fact, the schools for which free lunch data are available are quite different from those for which data are unavailable. They are larger, have more non-white students, and are more frequently found in larger, urban districts. Schools with free lunch data available average 523 students, approximately 24 percent of whom are non-white; their districts average 28 schools, 59 percent of which are in urban areas. Schools for which the data were unavailable average 442 students, approximately 4 percent of whom are non-white, have an average district size of 5 schools, only 11 percent of which are urban. Thus, DUMFLE acts, at least in part, as a proxy for large urban school districts, which have a higher percentage of students in poverty. Consequently, the coefficient on FLCHP should be interpreted with caution. Given the availability of the free lunch data—that is, conditional on DUMFLE=1—the coefficient on PFLCHP indicates that spending *decreases* with the percentage of students who are poor, as indicated by their eligibility for free lunch. That is, spending is higher in schools reporting free lunch eligibility data, however, the magnitude of the premium decreases with the percentage of students who are eligible. Clearly, better, more comprehensive data are required to fully understand or satisfactorily describe the relationship between spending and poverty at the school level in Ohio.

An implication of this analysis is that, when viewed from a state perspective, spending in the schools reflects a considerable variation that is not explained by simple school characteristics. This is, of course, to be expected. Since school spending is largely determined by districts, much of the variation in spending reflects differences in the overall spending level across districts.

Controlling for Interdistrict Differences in Spending

The analysis proceeds by controlling for these district-specific effects to focus on the factors explaining the intradistrict variation in spending. The simple *de facto* spending formula in equation (1) is augmented to allow each district its own intercept term—that is, allowing *a* to vary across districts—in order to control for the interdistrict variation in overall spending. More specifically, equation (1) is augmented by a series of district-specific dummy variables, a_j:

$$(2)\ Y_{ij} = a_j + b\,X_{ij} + e_{ij}.$$

Notice that the inclusion of the district effects in (2) effectively controls for any district-specific characteristics—including but not limited to overall district spending—that do not vary across schools within a single district. Thus, the estimates tell us about the impact of the X_{ij} controlling for district differences in policies, revenues, demographics, location, etc. The result of the estimation of equation (2) is a *de facto* spending formula that controls for the interdistrict variation in school spending, etc.

Parameter estimates for equation (2) for both instructional and total spending, reported in columns (3) and (4) of table 4, indicate that the district dummies are important. The spending regressions with the district dummies explain a much larger share of the variation in spending—R^2s are 0.68 and 0.74—although roughly one-third of the variation in instructional spending and a quarter of the variation in total spending remains unexplained. (An F-test indicates the district dummies are jointly significant at the 1 percent level.) Further, the inclusion of the district dummies has important effects on the coefficients of the other explanatory variables.

As before, elementary schools are seen to receive less money than high schools, but here, the magnitude of the effect is larger—per pupil spending for elementary schools trails high school spending by $1,115 overall, $291 of which is instructional spending. While the regressions again indicate that middle schools receive less money than high schools, instructional spending is now shown to be insignificantly different in middle schools compared to high schools.

The coefficients on enrollment are also of the same signs, and, although they are of a somewhat larger magnitude, they remain small. In contrast, the coefficients on the percentage of non-white students are substantially smaller, suggesting that within individual districts the percentage of non-white students is less important in determining spending than it is in determining overall district spending. One reason may be that there is less variation in the representation of non-white students within school districts than between school districts.

As expected, the coefficient on DUMFLE is insignificant in the presence of the district-specific dummies. This reflects the fact that, for the most part, the availability of the free lunch data is determined by the district. Thus, the district dummies capture most of the variation in DUMFLE. However, the dummy is not perfectly collinear with the district dummies because there are some districts for which free lunch eligibility data are only available for some of the schools.

Particularly interesting in these estimates is that the coefficient on the percentage of free lunch eligible students has a positive, rather than a negative sign. The implication is that, controlling for the differences between districts, greater spending is directed at schools with more poor children, although the magnitude of the effect is fairly small. Here, spending per pupil increases by less than $6 for a one percentage point increase in poor students.

Spending Formulae for the Big Nine Districts

Given the importance of the district in allocating spending, we then turn to estimating spending regressions for individual districts. Unfortunately, as described above, most of the school districts in Ohio are quite small, which precludes the estimation of the *de facto* spending formulae, for the following reason.

[C]ontrolling for the differences between districts, greater spending is directed at schools with more poor children, although the magnitude of the effect is fairly small.

In a district with a very small number of schools any distribution of spending can be *perfectly* characterized by a *de facto* spending formula based on the explanatory variables used in this analysis.[6] Mechanically, this is a familiar result from statistics. If the number of observations equals the number of independent variables, then the R^2 equals 1. Although it is possible—mechanically—to estimate these equations in *small* districts, it is not particularly meaningful. Thus, we estimate these equations for only the largest districts.

Before estimating district specific regressions, we estimate equations (1) and (2) using only data on the big nine districts. Since almost all of the schools in these districts had data on free lunch eligibility, DUMFLE is not included in the regression. The results of the estimation, shown in table 5, indicate some important differences between the pattern of spending in all of the districts and the pattern of spending in only these districts. First, as previously shown in table 2, overall spending is higher in the larger districts. Second, the disparities in spending between elementary

[6] For a regression with an intercept and six explanatory variables it is, of course, impossible to estimate coefficients without at least eight observations—here, given by the number of the schools in the district.

and high schools and also between middle schools and high schools is much larger. All things being equal, high schools receive more than $3,000 in per pupil spending than elementary schools in the big nine districts. As in the previous regressions, these estimates indicate that spending decreases with size of the student body, and increases with the representation of poor children. Finally, the results indicate that school level spending is only partially explained by these variables. R^2s indicate that only about one-third of the variation in instructional spending is explained by these variables, and even in the "best performing" model of total spending that includes the district effects, the regressors explain only 57 percent of the school spending. These suggest that there are substantial differences in these formulae across the big nine districts, even after controlling for the overall level of spending and other common district effects. That is, much of the variation in spending is not explained by the variation in the regressors in a model that constrains the coefficients on all of the regressors (except the intercept) to be the same across districts. Thus, we turn to estimating district-specific spending formula.

Table 5.—Parameter estimates for de facto spending equations—largest nine districts only

	OLS		District effects	
Independent variable	(1) BINSPUP	(2) BTOTPUP	(3) BINSPUP	(4) BTOTPUP
INTERCEPT	4,828.6033***	9,018.8923***		
	(188.2172)	(261.8408)		
ES	-1,378.4843***	-3,008.8722***	-1,524.7977***	-3,184.8867***
	(130.3939)	(181.3992)	(128.3354)	(173.8430)
MS	-616.7774***	-1,519.3803***	-698.9154***	-1,588.5161***
	(123.4369)	(171.7209)	(118.2344)	(160.1602)
EFMADM	-1.8001***	-3.8074***	-2.0937***	-4.2892***
	(0.3145)	(0.4376)	(0.3079)	(0.4171)
EFMSQ	0.0005***	0.0009***	0.0005***	0.0011***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
NONW	2.1915*	3.8802**	-0.5204	0.6465
	(1.2724)	(1.7701)	(1.3248)	(1.7945)
PFLCHP	9.9275***	12.2321***	7.5956***	12.8891***
	(1.6106)	(2.2406)	(1.6690)	(2.2608)
F	41.26	73.45	25.57	45.41
R^2	0.3379	0.4761	0.4287	0.5713
No. of Observations	492	492	492	492

* Indicates significance at the 10 percent level.
** Indicates significance at the 5 percent level.
*** Indicates significance at the 1 percent level.
NOTE: Standard errors in parentheses.
SOURCE: Author's calculations.

District Specific Spending Formulae

Table 6 presents the results of estimating spending formulae for the nine districts in the sample having at least twenty schools—Akron, Canton, Cleveland, Columbus, Dayton, Parma City, Southwestern, Springfield and Toledo. The largest is Columbus, with 130 schools, and the smallest is Springfield, with only 20. Overall, total spending per pupil is better explained than instructional spending (that is, R^2s are higher). The results indicate that, despite important differences in the magnitudes of the coefficients of the variables in these formulae, there is some agreement on the signs of these formulas. That is, policymakers in these districts seem to share some degree of agreement about which of these factors should lead to more generous funding of the schools and which should lead to less generous funding. For example, in all of these districts, elementary schools receive significantly less funding than high schools, and middle schools are either somewhere in between or insignificantly different from high schools. In general, per pupil resources decrease as enrollment increases, as fixed expenses are spread over larger numbers of pupils. In all districts except Akron (in which spending is lower in schools with more nonwhite students) the representation of nonwhite students did not have a significant impact on spending. Finally, to the extent that poverty matters, districts direct greater resources toward schools with a greater representation of poor children. This agreement provides some encouragement that a consensus might be reached about a statewide formula.

An important implication of these regressions is that in some districts, school spending conforms fairly closely to what might be a spending formula. In Canton, with 24 schools, for example, almost 90 percent of the variation in total spending is explained by the regression. In Parma with 21 schools or Southwestern with 23 schools, the formula explains roughly 80 percent of the variation in total spending. Even Columbus, with its 130 schools, and Toledo with 60 schools, shows a *de facto* spending formula that explains about 70 percent of the variation in total spending. Of course, in other districts, spending is quite poorly explained by these school level variables. In Cleveland and Dayton, the *de facto* spending formulae explain only about one-third of total spending and even less of the instructional spending.

Interestingly, as mentioned above, total spending conforms more closely to a formula than does instructional spending. If, in fact, school districts rely on formulas only to allocate teachers, as is sometimes claimed, one would expect that it would be the reverse—instructional spending should be better explained by student counts. Of course, the factors included in these regressions may be different from those used by the schools in practice and/or the regressions may be misspecified in some other way.

Interestingly, ... total spending conforms more closely to a formula than does instructional spending.

Extending the Statewide Formula

The results of estimating the district specific regressions provide evidence that the formula describing the allocation of resources differs across districts—even across these relatively similar districts—thus suggesting that additional exploration into the differences in the formula is warranted. To fully investigate the interdistrict differences in formulae and the factors driving those differences would require a sophisticated behavioral model that explicitly models the determinants of the formula at the district level. Unfortunately, the data are insufficiently rich (in particular, there is an insufficient number of schools in many of the districts) to allow the use of the more sophisticated techniques.[7]

[7] In principle, Hierarchical Linear Modeling or a random coefficients specification could be employed to investigate these further. However, the large number of districts for which there are only a small number of schools limits both the power and usefulness of these techniques. These techniques could be usefully employed to an analysis focusing on a larger, perhaps national, sample of large school districts.

Table 6.—Parameter estimates for de facto spending equations, by district

Independent variable	Akron (1) BINSPUP	Akron (2) BTOTPUP	Canton (3) BINSPUP	Canton (4) BTOTPUP	Cleveland (5) BINSPUP	Cleveland (6) BTOTPUP
INTERCEPT	4,519.0523***	7,988.1835***	5,743.6122***	9,436.0988***	5,175.0495***	9,259.7223***
	(341.1020)	(514.5590)	(748.0420)	(806.0094)	(740.1437)	(908.0027)
ES	-1,127.2139***	-2,402.5861***	-2,415.9646***	-3,964.0370***	-1,620.8029***	-3,192.3169***
	(331.6388)	(500.2836)	(501.4096)	(540.2650)	(471.3010)	(578.1884)
MS	-654.0481**	-1,072.7380**	-1,098.9023***	-2,059.3137***	-764.2917*	-1,478.6874***
	(285.3450)	(430.4485)	(358.8110)	(386.6161)	(436.3912)	(535.3614)
EFMADM	-1.5930*	-3.9265***	-1.0262	-2.7155**	-3.4306***	-5.5805***
	(0.8733)	(1.3174)	(0.9812)	(1.0572)	(0.9141)	(1.1214)
EFMSQ	0.0004	-0.0015	-0.0000	0.0004	-0.0011**	-0.0016**
	(0.0008)	(0.0012)	(0.0004)	(0.0004)	(0.0005)	(0.0006)
NONW	-5.0342**	-5.0425*	-1.1676	-1.0745	2.5956	3.9820
	(1.9721)	(2.9749)	(3.3607)	(3.6211)	(4.4838)	(5.5007)
PFLCHP	15.5205***	24.4612***	7.0341*	13.5203***	19.9706**	20.4686**
	(3.0855)	(4.6545)	(3.7929)	(4.0868)	(8.2651)	(10.1396)
F	6.56	13.55	15.56	24.94	5.05	10.12
R^2	0.4357	0.6145	0.8460	0.8980	0.2256	0.3686
No. of Observations	58	58	24	24	111	111

Table 6.—Parameter estimates for de facto spending equations, by district–Continued

	Columbus		Dayton		Parma City	
Independent variable	(1) BINSPUP	(2) BTOTPUP	(3) BINSPUP	(4) BTOTPUP	(5) BINSPUP	(6) BTOTPUP
INTERCEPT	6,111.3256***	11,141.9698***	4,393.5750***	8,251.3905***	5,495.1887***	9,596.5269***
	(432.3797)	(590.4067)	(891.5791)	(1,712.3147)	(759.2797)	(1,188.0938)
ES	-2,144.2415***	-4,274.3882***	-397.2438	122.0382	-1,937.3469***	-3,788.7045***
	(218.1352)	(297.8598)	(839.1119)	(1,611.5492)	(610.9838)	(956.0457)
MS	-982.9600***	-2,085.5601***	92.5501	1,005.5239	-743.6241	-1,983.6109
	(202.1321)	(276.0077)	(815.6971)	(1,566.5802)	(525.9792)	(823.0334)
EFMADM	-2.9631***	-6.4364***	-0.6678	-7.2854**	-1.5760	-2.5714
	(1.0778)	(1.4718)	(1.5355)	(2.9490)	(1.1139)	(1.7430)
EFMSQ	0.0006	0.0015	0.0015	0.0047	0.0004	0.0005
	(0.0009)	(0.0012)	(0.0005)	(0.0028)	(0.0006)	(0.0009)
NONW	-1.5265	-0.9117	3.4245	6.8238	-10.0827	-34.1053
	(2.7304)	(3.7284)	(3.2894)	(6.317)	(34.7044)	(54.3042)
PFLCHP	9.5413***	14.7500***	-5.4779	-1.7465	12.8651	24.5498
	(2.4725)	(3.3762)	(4.9069)	(9.4238)	(25.0543)	(39.2041)
F	22.01	44.90	2.32	3.22	6.93	8.81
R^2	0.5178	0.6866	0.2680	0.3372	0.7481	0.7906
No. of Observations	130	130	45	45	21	21

Table 6.—Parameter estimates for de facto spending equations, by district–Continued

Independent variable	Southwestern (1) BINSPUP	Southwestern (2) BTOTPUP	Springfield (3) BINSPUP	Springfield (4) BTOTPUP	Toledo (5) BINSPUP	Toledo (6) BTOTPUP
INTERCEPT	4,480.3934***	9,023.5325***	5,302.1603***	7,996.9847***	4,871.3147***	8,570.3755***
	(468.9389)	(581.0380)	(1,414.7587)	(1,766.9947)	(210.0626)	(388.1443)
ES	-1,016.3088***	-3,005.7030***	-1,157.2649	-2,093.8784	-1,368.5551***	-3,226.8649***
	(304.2385)	(376.9663)	(1,027.0635)	(1,282.7741)	(180.7755)	(334.0290)
MS	-476.4134*	-1,634.6487***	-982.4226	-1,349.4673	-686.6151***	-2,286.4558***
	(256.8550)	(318.2558)	(972.1263)	(1,214.1590)	(197.1574)	(364.2988)
EFMADM	-1.6926**	-3.8363***	-4.0928**	-4.9090**	-0.4332	0.0526
	(0.7422)	(0.9196)	(1.6036)	(2.0028)	(0.5847)	(1.0803)
EFMSQ	0.0005	0.0009**	0.0015	0.0018	-0.0003	-0.0014*
	(0.0003)	(0.0004)	(0.0010)	(0.0013)	(0.0004)	(0.0007)
NONW	10.9220	-3.3316	-0.5967	-3.3611	-0.0625	2.3005
	(19.8617)	(24.6096)	(6.9547)	(8.6863)	(1.5667)	(2.8948)
PFLCHP	2.3559	10.5796	5.6112	10.1729	1.2388	3.3896
	(8.1444)	(10.0913)	(5.4745)	(6.8376)	(2.1681)	(4.0061)
F	2.39	12.58	2.86	3.48	18.23	23.23
R^2	0.4722	0.8250	0.5692	0.6161	0.6736	0.7245
No. of Observations	23	23	20	20	60	60

* Indicates significance at the 10 percent level.
** Indicates significance at the 5 percent level.
*** Indicates significance at the 1 percent level.
NOTE: Standard errors in parentheses.
SOURCE: Author’s calculations.

Instead, we employ a fairly simple method to investigate the extent to which the coefficients of the formula differ across types of districts—we interact each of the variables in the formula with dummy variables indicating whether a school is in an urban (URBAN) school district, whether the school is in a small town or rural district (STRUR), whether it is in a medium- to large-size district (MLDIST), having 10 schools or more, or a small district (SMDIST), having 5 to 9 schools. The omitted categories are suburban districts and very small districts.

The results of these regressions are shown in table 7. (An F-test of the joint significance of the interaction effects indicates significance at the one percent level.) The first two columns report the results of estimating the formula including the four dummies and interacting them with the model variables. In the second two columns, only the interactions are included because the included district effects are collinear with the dummies.

These regressions describe significant differences in the formulae across different district types. Urban, suburban, and small town/rural districts differ from one another—as indicated by the significance of the coefficients on the URBAN and STRUR variables—and small and very small districts seem to be characterized by different formulae than medium to large districts—as suggested by the significance of the coefficients on MLDIST. Overall, suburban districts spend the most, urban districts spend less, and small town/rural districts spend the least. Conditional on urbanization, however, it is the largest districts that spend the most, small districts spend the least, with the very smallest districts in between.

Interestingly, the other coefficients in the formula also differ by district type. Although all district types direct greater spending to schools with a higher percentage of non-white students, the increment is least in urban districts—the coefficient on URBAN is significant and negative. At the same time, all districts spending less money per pupil in larger schools—the effect is somewhat more modest in urban and small town/rural districts. Larger enrollment does not lead to a significant increase in spending in small town/rural districts, although this may be due to the limited variation in school sizes within these districts.

As before, spending is lower in elementary schools than middle schools and, in turn, lower in middle schools than high schools. Overall, however, this differential is greatest in medium- to large-size suburban districts, more modest in urban districts, and fairly small in small town/rural districts with fewer than 10 schools. Finally, the estimates of the coefficients on PFLCHP indicate that, on average, schools with a higher proportion of poor children receive less money in all but the medium to large districts.

Regressions were also run including district effects, and the results are reported in columns (3) and (4) of table 7. Recall that including the district effects precludes the inclusion of other district characteristics directly. Thus, the dummy variables for urbanization and district size are only included as interactions with the other included variables. As seen previously, these regressions summarize the factors explaining the intradistrict variations in spending since the district effects control for the interdistrict variations.

Again, the regressions reveal some systematic differences in spending patterns. Both medium- to large-size and small-size districts direct more resources to schools with a greater proportion of non-white students. Also, larger schools receive fewer resources per pupil than smaller schools, but there is no significant difference in the magnitude of the effect across district types. The same general pattern holds for elementary, middle, and high schools, although there are some differences in magni-

Although all district types direct greater spending to schools with a higher percentage of non-white students, the increment is least in urban districts...

Table 7.—Parameter estimates—Extended model—De facto spending equations—Full sample

Independent variable	OLS (1) BINSPUP	(2) BTOTPUP	District effects (3) BINSPUP	(4) BTOTPUP
INTERCEPT	*4,553.4104****	*8,159.1161****		
	(139.3830)	*(231.3253)*		
URBAN	*-1,018.4175****	*-2,160.7477****		
	(145.2759)	*(241.3253)*		
STRUR	*-1,647.9954****	*-2,705.4696****		
	(131.8863)	*(219.0832)*		
SMDIST	*-161.8296*	*-206.7852*		
	(111.2710)	*(184.8380)*		
MLDIST	*432.1111***	*1,151.9429****		
	(174.5420)	*(289.9406)*		
NONW	*16.0468****	*31.2119****	*-13.2571*	*-23.4058*
	(2.6228)	(4.3569)	(10.7425)	(15.7845)
STRUR	0.2872	-7.0875	7.8073	5.1830
	(4.0829)	(6.7823)	(7.1146)	(10.4538)
URBAN	-6.5752***	-19.0635***	-3.9050*	-7.8621
	(1.5200)	(2.5250)	(3.2023)	(4.7054)
MLDIST	-3.5311	1.3415	17.6927*	33.6018**
	(2.4889)	(4.1345)	(10.6727)	(15.6819)
SMDIST	0.3597	6.1570	14.0803	28.4378**
	(2.5106)	(4.1705)	(10.6637)	(15.6687)
EFMADM	-1.9836***	-3.9618***	-1.5426***	-3.1494***
	(0.3855)	(0.6403)	(0.4098)	(0.6021)
STRUR	1.3936***	1.8891***	-0.0114	-0.4427
	(0.3262)	(0.5418)	(0.3003)	(0.4412)
URBAN	0.5760***	1.9078***	-0.5879*	-0.4001
	(0.2542)	(0.4222)	(0.2410)	(0.3541)
MLDIST	0.3448	-0.3964	0.3543	-0.0946
	(0.3999)	(0.6643)	(0.4327)	(0.6357)
SMDIST	0.4855	0.5192	1.1998***	1.4357
	(0.3455)	(0.5740)	(0.3823)	(0.5618)

Table 7.—Parameter estimates—Extended model—De facto spending equations—Full sample–Continued

Independent variable	OLS (1) BINSPUP	(2) BTOTPUP	District effects (3) BINSPUP	(4) BTOTPUP
EFMSQ	0.0007**	0.0013***	0.0009**	0.0016***
	(0.0003)	(0.0005)	(0.0003)	(0.0005)
STRUR	-0.0005**	-0.0004	0.0001	0.0006
	(0.0025)	(0.0004)	(0.0002)	(0.0003)
URBAN	-0.0001	-0.0004*	0.0003*	0.0003
	(0.0001)	(0.0002)	(0.0001)	(0.0002)
MLDIST	-0.0003	-0.0002	-0.0006*	-0.0008
	(0.0003)	(0.0005)	(0.0003)	(0.0005)
SMDIST	-0.0003	-0.0003	-0.0008**	-0.0001**
	(0.0003)	(0.0005)	(0.0003)	(0.0005)
ES	-707.5554***	-1,958.9138***	-513.2042***	-1,584.6805***
	(74.8695)	(124.3696)	(66.0931)	(97.1142)
STRUR	679.8894***	1,319.3973***	433.4258***	859.1444***
	(77.8072)	(129.2496)	(69.7761)	(102.5257)
URBAN	495.9085***	1,154.7443***	122.3482	382.3880
	(95.2695)	(158.2570)	(90.5423)	(133.0386)
MLDIST	-680.6373***	-1,273.5738***	-810.1362***	-1,410.8970***
	(110.6982)	(183.8865)	(100.9590)	(148.3444)
SMDIST	-5.9507	-2.2596	12.2332	61.4425
	(65.4877)	(108.7850)	(58.4423)	(85.8724)
MS	-353.7326***	-1,121.4861***	-285.8409***	-994.8553***
	(81.9766)	(136.1755)	(67.3776)	(99.0015)
STRUR	270.0398***	576.9025***	137.4509	310.1056
	(83.8020)	(139.2078)	(68.7854)	(101.0701)
URBAN	372.1169***	812.9524***	156.9567	369.1622
	(94.9849)	(157.7843)	(81.1824)	(119.2856)
MLDIST	-345.4480***	-634.3706***	-367.4975***	-592.8579***
	(112.6973)	(187.2073)	(96.2041)	(141.3578)
SMDIST	85.8688	177.4243	95.8330*	11.2975***
	(72.8828)	(121.0694)	(61.3524)	(90.1483)

Table 7.—Parameter estimates—Extended model—De facto spending equations—Full sample–Continued

Independent variable	OLS (1) BINSPUP	OLS (2) BTOTPUP	District effects (3) BINSPUP	District effects (4) BTOTPUP
PFLCHP	-11.0030***	-17.1926***	13.6810***	27.1694***
	(3.0684)	(5.0971)	(4.5869)	(6.7397)
STRUR	4.8865*	8.8392*	-9.7229***	-16.0579***
	(2.7983)	(4.6484)	(3.7540)	(5.5160)
URBAN	5.3212**	7.3072*	-6.5873**	-14.0577***
	(2.4905)	(4.1371)	(3.0890)	(4.5388)
MLDIST	10.2722***	13.7422***	-0.3487	-2.2029
	(2.1439)	(3.5614)	(3.7608)	(5.5260)
SMDIST	2.6571	-1.8254	-0.6484	-7.0508
	(1.9430)	(3.2276)	(3.5519)	(5.2190)
DUMFLE	218.4468***	266.6123***	-60.3693	72.8194
	(31.1797)	(51.7941)	(60.8923)	(89.4723)
F	68.58	72.64	10.96	15.70
R^2	0.4250	0.4391	0.7168	0.7838
No. of Observations	3284	3284	3284	3284

* Indicates significance at the 10 percent level.
** Indicates significance at the 5 percent level.
*** Indicates significance at the 1 percent level.
NOTE: Standard errors in parentheses.
SOURCE: Author's calculations.

tudes. There are, however, significant differences in the estimated effect of increased poverty among the students. These regressions indicate that, holding the district characteristics constant, schools with a greater proportion of poor children receive greater spending. The magnitude of the impact is greatest in suburban districts (approximately $27 more in per pupil spending for every one percentage point increase in the percentage of students free lunch eligible) but still significant in urban districts ($13) and small town/rural districts (approximately $11). The coefficient does not vary significantly with the size of the district.

Simulating a Statewide Spending Formula

Although the spending formulas estimated above are clearly simplistic—a more realistic formula would include additional variables describing the special educational needs of students, the relative costs of purchased inputs, etc.—these estimates can be used to gain insight into the impact of allocating spending according to a statewide formula. Thus, we use the parsimonious spending regression in column (2) of table 4 to estimate the total spending per pupil that would be allocated to each of the 3,284 schools in Ohio.

More specifically, "formula spending" is found as the amount of spending predicted by the regression for each school. Next, we compute the change in spending that would result as the difference between predicted and actual spending. Since this change is, in fact, the prediction error or residual of the regression, the changes in spending average to zero across schools, by construction.[8] That is, the average school should neither gain nor lose money if spending was allocated according to this formula. Of course, there are significant changes in the distribution of spending. Perhaps most important, although disparities in spending would not disappear, they would be significantly ameliorated. As an example, while current spending ranges from a low of $2,346 per pupil to a high of $13,622, formula spending would be significantly more compressed—the lowest spending school would spend $3,820 and the highest spending school would spend $7,637. (The standard deviation would shrink from 1,089 to 599.)

As shown in table 8, under such a formula, most schools would see relatively modest changes in spending. Roughly half would see spending changes of less than 10 percent and roughly 80 percent will see changes less than 20 percent. Measured in dollar terms, roughly half will see changes in per pupil spending of less than $500 and roughly 80 percent will experience changes of less than $1,000 per pupil. Of course, a significant number of schools would see large spending changes. Most of those will be increases; however, there are those that would see significant decreases. For example, 65 schools would be allocated more than 30 percent *less* money than they currently spend. As expected, these are the schools that currently spend substantially more than most of the schools in the state.

Notice that this simulation suggests that there would be substantial opposition to the adoption of such a statewide formula. Although high spending school communities may be willing to accept some redistribution in order to achieve greater equity across schools and districts within the state, it seems unlikely that they would support a formula such as this that would substantially change their own spending. At the same time, those who would gain money are quite likely to support finance reform and the frequencies in table 8 indicate that they are in the majority—almost 55 percent of the schools in the sample (enrolling roughly 55 percent of the students) experience gains, rather than losses.

Thus far, this paper has considered a radical change in the financing of public schools—the move from district control of the distribution of spending to state control. Although this has considerable appeal, the political obstacles to enacting such a reform are unlikely to be overcome quickly. A more realistic policy would be to reallocate the state funding currently provided to schools in order to effect a distribution of spending that most closely approximated the preferred distribution. That is, reduce or eliminate state aid to schools identified as spending "too much" by the formula and increase state aid to those spending "too little." For 1,351 of the 1,486 schools that would lose money in formula financing, the necessary cutback could be accomplished by reducing or eliminating state aid currently received. However, the incentive implications for local revenue raising by schools are serious and problematic. Given these limitations, adopting such a modified formula system would lead to a substantial reduction in disparities in spending overall—the standard deviation for the modified formula approach is 700, which is higher than the 598 of formula spending, but still quite a bit lower than the 1,089 of the current system. (Since mean spending is roughly the same for all three distributions, the coefficients of variation would show the same pattern.) The reduction in the

Although high spending school communities may be willing to accept some redistribution in order to achieve greater equity ... it seems unlikely that they would support a formula ... that would substantially change their own spending.

[8] More important, perhaps, is that overall spending remains relatively constant—in large part because enrollment is included among the regressors.

Table 8.—Distribution of spending changes if hypothetical state-wide formula were adopted

	Frequency	Percent
(A)		
Total	**3,284**	**100.0%**
Spending gains		
30.01 percent or more	191	5.8%
20.01–30 percent	261	7.9%
10.01–20 percent	538	16.4%
0–10 percent	808	24.6%
Spending declines		
0–10 percent	768	23.4%
10.01–20 percent	477	14.5%
20.01–30 percent	176	5.4%
30.01 percent or more	65	2.0%
(B)		
Total	**3,284**	**100%**
Spending gains		
$2000.01 or more	15	0.5%
$1,500.01–$2,000	69	2.1%
$1,000.01–$1,500	232	7.1%
$500.01–$1,000	588	17.9%
$0–$500	894	27.2%
Spending declines		
$0–$500	733	22.3%
$500.01–$1,000	420	12.8%
$1,000.01–$1,500	164	5.0%
$1,500.01–$2,000	81	2.5%
$2,000.01 or more	88	2.7%

SOURCE: Author’s calculations.

range of spending would not, however, shrink as significantly as under formula financing. Again, the “bottom” is brought up—from $2,346 to $3,820—but, since the highest spending schools received little state funding to begin with, spending at the top is relatively unchanged—the new maximum of $12,829 is only marginally lower than the current $13,621 and nowhere near the $7,636 recommended by the formula.

Conclusions

This paper uses school and district level data from Ohio for 1995–96 to analyze the distribution of spending across schools and districts to inform the policy debate regarding block grant funding for public schools. The results have indicated that the patterns of spending across and within school districts in the state of Ohio vary substantially. These differences are driven by both differences in the schools and by differences in the districts in which these schools operate. Districts differ not only in their average spending, but also in the way that they distribute spending between elementary, middle and high schools, for example. There appears, however, to be some modicum of agreement across districts about which of these factors ought to trigger greater spending and which should trigger less spending. At the same time, the regressions reveal a fair amount of diversity in the size of the response—whether due to differences in enrollment, student poverty, etc.

As noted above, the regressions indicate that the combination of interdistrict variation in the overall level of spending and the intradistrict variation in the allocation across schools results in a spending system in which only about 30 percent of the variation in spending is explained by a set of factors that should play an important role in any spending formula that might be adopted—enrollment, the grade level served by the school (elementary, middle or high school), and the percentage of non-white students or those eligible for free lunch. Thus, a move to any statewide formula based upon these characteristics would be likely to produce significant changes in the pattern of spending across Ohio public schools. Clearly, there are variables not included in this formula (due to limitations in data availability) that could be expected to be included in any adopted formula—such as those describing the special educational needs of students or describing the costs of purchased inputs, etc. Thus, while moving to a system of state-level block grant funding might have an intuitive appeal, such a system would differ substantially from the current system, in that it would likely standardize both the level and distribution of spending across districts. A straightforward simulation indicates that a shift to allocating spending according to a statewide spending formula would significantly reduce the disparities in spending between the highest and lowest spending schools and much of the redistribution could be accomplished by re-allocating state aid money. While such a policy change would likely be opposed by schools experiencing spending declines, simulations suggest that since more schools (enrolling more students) gain, there may be sufficient political will to adopt such broad finance reforms. An intermediate plan, that would redistribute only state funding now allocated to public schools according to the formula, might be more politically palatable to those who favor local control. Such a program would still direct substantial cuts to a large number of schools, but would not constrain schools in their locally financed spending, offering school districts the opportunity to offset the loss of state aid with additional local tax revenue.

Clearly, these results are only suggestive and much additional work is warranted to inform the policy community. As the push to school-level financing and control continues, it is advantageous to look to the lessons offered by the varied actual experiences of school districts within an individual state to guide these policy decisions. This paper offers progress in that direction.

[W]hile moving to a system of state-level block grant funding might have an intuitive appeal, such a system would differ substantially from the current system, in that it would likely standardize both the level and distribution of spending across districts.

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New Revenues for Public Schools: Alternatives to Broad-Based Taxes

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About the Author

Michael F. Addonizio is Associate Professor of Educational Administration at Wayne State University. His research interests include elementary and secondary education finance and educational productivity. His recent work has focused on nontraditional sources of school revenue, the equity and adequacy effects of school finance reform in Michigan, and the relationship between class size and student achievement.

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Introduction

Although discussions of public elementary and secondary education in the United States often include calls for greater financial commitment to our schools, K–12 education enjoyed steady and substantial growth in real resources over the century-long period ending in 1990 (Hanushek and Rivkin 1997; Guthrie 1997). Nearly all of the school revenue of this period was raised from a set of broad-based state and local taxes, with the relative shares of state and local tax revenues changing substantially. Revenues from local taxes, almost exclusively property taxes, have fallen from more than 80 percent of the total in the 1910–30 period to about 45 percent by the mid-1990s, whereas state contributions, raised primarily by sales taxes and personal and corporate income taxes, have risen from less than 20 percent in the 1910–30 period to nearly 48 percent by 1995. Federal funding, never a substantial share of total public school revenue, has risen from negligible levels during the pre-1930 era to about 7 percent by 1995 (Howell and Miller 1997). In sum, varying combinations of broad-based local, state, and federal taxes provided U.S. public schools with steadily rising support over this extended period.

This century-long trend of steady revenue growth, however, came to an abrupt halt in 1990 (Hanushek and Rivkin 1997), although both school enrollments and expectations for academic achievement continued to rise. To meet their students' and communities' expectations in the face of essentially flat real revenues from traditional tax sources, local school districts in recent years have turned increasingly to nontraditional sources of revenue. These nontax sources of revenue, which are not consistently reported by local school districts in standard financial statements, include user fees; partnerships with postsecondary schools, government agencies, and private businesses; donations; volunteer services; interest earnings on investment of school resources; and the creation of educational foundations to promote giving from individuals and businesses. New sources of revenue may also come from new forms of school choice.

This paper will examine the sources of these nontraditional revenues, the institutional arrangements by which these revenues are raised, and the legal restrictions placed on these revenue-raising activities. This paper will also assess the extent of public reporting of such revenue and review the proposed reporting standards of the Governmental Accounting Standards Board (GASB) regarding these revenues. Finally, the activities and impact of local educational foundations in Michigan will be examined and comparisons will be drawn between foundation and nonfoundation districts in terms of educational and socioeconomic characteristics.

National trends in K–12 public school spending are summarized in the section titled "National Trends in Public School Spending." The rise of nontraditional revenue for the support of public elementary and secondary schools is discussed in the "Sources of Nontraditional Revenue" section, along with specific sources of such revenues. The work of the GASB regarding these revenues and comments on the extent to which states collect such revenue data from local school districts is reviewed in the "Donor Activities" section. In the "Enterprise Activities" section, public school revenue and expenditure trends in Michigan since the adoption of constitutional limits on taxes and expenditures in 1978 are examined. The "Shared or Cooperative Activities" section begins a detailed examination of nontraditional revenue for Michigan public schools, including trends in revenue collections since 1988–89 as reported in local district financial reports and key findings from a survey of local education foundations. This section also compares foundation and nonfoundation districts on selected socioeconomic and educational variables. A model of local education demand to test for behavioral differences between residents of foundation and nonfoundation districts in Michigan is presented in the "Reporting Nontraditional Revenue" section; empirical results are presented in the "Public School Revenue Trends in Michigan" section. Conclusions regarding the equity effects of nontraditional revenue, particularly local foundation revenue, and the extent to which such revenues are, and should be, included in standard school district financial reports are presented in the "Nontraditional Revenues for Michigan Public Schools" section.

For the past century, public elementary and secondary education in the United States has enjoyed remarkably steady revenue growth.

National Trends in Public School Spending

For the past century, public elementary and secondary education in the United States has enjoyed remarkably steady revenue growth. Hanushek and Rivkin (1997) report that real expenditures per pupil increased at 3.5 percent per year over the entire period of 1890–1990, with total annual expenditures rising from $2 billion to more than $187 billion, in constant 1990 dollars, over this period. This nearly 100-fold increase is more than triple the growth of the U.S. gross national product (GNP) over this period, with K–12 public school expenditures increasing from less than 1 percent of GNP in 1890 to 3.4 percent in 1990. This increased spending resulted from a combination of falling pupil–staff ratios, increasing real wages paid to teachers, the expansion of educational services for special education students, and rising expenditures outside the classroom, including spending on central administration, plant maintenance, and pupil transportation (Hanushek and Rivkin 1997).

Since 1990, however, the growth rate in per pupil expenditures appears to have fallen precipitously. Although real spending per pupil grew at a rate of 3.75 percent in the 1980s, the growth rate from 1990 to 1993 was a mere 0.6 percent (U.S. Department of Education 1995). This lower growth rate is due, in part, to the return of growth in school enrollments, which have been rising nationally since 1981. Furthermore, resulting fiscal pressures on public schools are exacerbated by the steady growth of the special education population, for whom financial support is mandated by federal law. As noted by Meredith and Underwood (1995), cost containment is of only secondary importance in the special education paradigm. Under the Individuals with Disabilities Act (IDEA), school districts must provide every special education child with a free, appropriate education regardless of cost to the district. On average, per pupil expenditures for special education equal approximately 2.3 times per pupil expenditures for regular education (Chaikand et al. 1993). Moreover, the special education population continues to grow more rapidly than the general student population, rising from 11.6 percent of total enrollment in 1990 to 11.9 percent in 1992.[1]

These pressures on regular education funding are exacerbated by stringent tax and spending limits enacted in a number of states (Mullins and Joyce 1996; Mullins and Cox 1995).

As of 1994, 43 states specifically limited local revenues and expenditures by means considered more constraining than full disclosure—truth in taxation measures that require public discussion and specific legislative action prior to enactment of tax rate or levy increases (Mullins and Cox 1995). Twelve states have set overall property tax rate limitations. Thirty states limit tax rates levied by specific types of local governments. Twenty-five states limit local tax levies, 6 states limit the growth in assessments, 3 states limit general revenue growth, 8 limit expenditure growth, and at least 17 have some form of full disclosure requirement (Mullins and Joyce 1996).[2] Mullins and Joyce (1996) examined the effects of tax and expenditure limitations (TELs) using pooled, cross-sectional, time-series models of state and local spending and observed a diminished use of broad-based taxes at the local level and a "dramatic increase in reliance on user charges and miscellaneous revenue sources from both state and local governments." As revenue growth from broad-based taxes slowed and enrollments grew, public schools increasingly sought revenue from alternative sources.

Sources of Nontraditional Revenue

Public school districts across the United States have long attempted to identify and tap into so-called nontraditional sources of revenue. The term "nontraditional" appears to stem not from a limited history of school revenue raised from sources other than broad-based taxes but from their relatively small magnitude. Research into the collection of these revenues dates to at least the early 1980s. Meno (1984) categorizes these efforts to augment traditional, broad-based tax revenues into three types of activities: donor activities, including the solicitation of goods, services, and money; enterprise activities, involving the selling or leasing of services and facilities; and shared or cooperative activities, whereby functions are pooled with other agencies or organizations to lower costs. Other nontraditional initiatives include the investment of school resources and the pursuit of new government funds through grant writing (Pijanowski and Monk 1996). Schools and school districts have enjoyed limited and uneven success in raising revenues from these sources. Potential budget impacts of 7 percent to 9 percent have been reported for public schools in regional studies of alternative revenues (Meno 1984; Picus et al. 1995; and Salloum 1985). Although the motivation of such revenue-raising efforts is often some degree of fiscal stress, some evidence suggests that relatively wealthy school districts enjoy greater success in tapping into these revenue sources than do their less-affluent counterparts. Thus, these revenues may exert a mild disequalizing effect (Addonizio 1997).

As revenue growth from broad-based taxes slowed and enrollments grew, public schools increasingly sought revenue from alternative sources.

Donor Activities

Direct Donations. Meno (1984) characterizes donor activities as any activities intended to raise funds, goods, or services from nongovernment sources. These donations can take the form of direct district fund-raising from individuals or from corporations and foundations. Resources raised in this fashion

[1] Because of the mandated status of special education, the expansion of special education in either scope or intensity would take a larger share of any new revenue in times of slow budget growth.

[2] Mullins and Joyce (1996) note the difficulty in assessing the degree of constraint imposed by these limitations. Mechanisms such as local popular or legislative votes, authorization by state tax commissions and state legislatures, and charter and constitutional revisions are provided to suspend the provisions of these constraints and, depending on their comprehensiveness, circumvention is more difficult in some cases than in others. Comparisons across and within states are further complicated by variations in the definition of the property tax base, in assessment practices, and in the exclusion of various revenue and expenditure categories (e.g., long-term debt, fees, and charges) from the limitations.

may consist of large single donations for a specific purpose. For example, the Beloit public schools in Wisconsin received $440,000 from a local foundation to buy microcomputers as part of an experimental program in computer education (Meno 1984). Other examples of direct donor activity include an enrichment fund established by local businesses and community members in the Tuscon (Arizona) Unified School District, the funding of a dental prevention model in the Wichita city schools by the American Dental Association, and the support of a health education project in the North Glenn (Colorado) School District by the Gates Foundation (Meno 1984; Maeroff 1982).

Although reliable national figures are not available, the National Association of Educational Foundations estimates that by the year 2000 there will be 4,000 public school foundations throughout the United States.

Indirect Donations: School District Foundations. School districts in recent years have turned increasingly to an alternative type of donor activity—the indirect donation of funds through local district educational foundations, which are nonprofit organizations created to receive donations for the district. For example, in Michigan, 153 such nonprofit organizations have been established by local districts to raise revenue for curriculum improvements, enrichment activities, capital projects, and instructional materials, and also to strengthen links between schools and communities. Furthermore, this activity in Michigan appears to be part of a growing national trend. Although reliable national figures are not available, the National Association of Educational Foundations (NAEF) estimates that by the year 2000 there will be 4,000 public school foundations throughout the United States (NAEF 1996).

Districts may create foundations through which money can flow to fund a variety of school activities. Examples of large, urban districts taking this approach include San Francisco, Washington, D.C., Dallas, and Oakland, California (Meno 1984). Alternatively, foundations may be created for a single purpose. For example, the Escondido County Union High School District in California established a foundation following passage of Proposition 13 to support its interscholastic athletics program (Meno 1984). In New York City, parents in an affluent area raised money to retain a popular teacher whose job was threatened by budget cuts (Anderson 1997).

Although the scope of such foundation activity across the United States has yet to be accurately measured, the rise of these organizations is not surprising in light of the slowing of revenue growth for public schools. This development, however, has not been viewed with universal approval. Concern has focused on the possible disequalizing effects of foundation revenue. Virtually every state allocates school aid to local districts by means of equalizing formulas designed to offset disparities in local fiscal resources.[3] Local education foundations have raised concerns that they may exacerbate fiscal disparities. For example, political economist and former U.S. Labor Secretary Robert Reich has characterized these organizations as “another means by which the privileged are seceding from the rest” (Pollack 1992). The impact of local education foundations on school finance equalization efforts in Michigan is examined in the section titled “Nontraditional Revenues for Michigan Public Schools.”

Indirect Donations: Booster Clubs. In addition to school district foundations, schools rely on booster clubs to support specific activities. Club members develop fund-raising strategies, including networking with local businesses, and coordinate their efforts with the school activities they support. Club activities may focus on a single school or an entire district. School programs enjoying the support of boosters include athletics, band, orchestra, chorus, debate, and drama (Meno 1984). Booster volunteers, who are often

[3] Nationally, states provided 46 percent of K–12 public school revenues in 1993–94, with most aid distributed so as to offset differences among local districts in the ability to finance education. The sole exception is New Hampshire, where state aid comprises a mere 7 percent of K–12 public school revenue. Local property taxes, on the other hand, provide 90 percent of school revenue, while federal sources provide the remaining 3 percent (Gold et al. 1995).

school parents, frequently obtain donations of school supplies (e.g., equipment, uniforms) from local vendors who are then provided commercial access to the students through advertising in school venues and publications (Pijanowski and Monk 1996). In addition, members often make direct cash or in-kind contributions to support school activities and associated staff (e.g., end-of-season gifts or bonuses for coaches). Although anecdotal evidence suggests that booster activities are widespread across U.S. public schools, research in New York state revealed that many school officials were not familiar with booster club activities associated with their schools (Pijanowski and Monk 1996).

Enterprise Activities

User Fees. Under these arrangements, users of school-provided programs or services are required to pay for those services. Examples of fee-based arrangements are driver education programs, swimming instructions, school supplies, athletics, and pupil transportation. However, as a growing number of schools have considered the imposition of fees for educational supplies or services, these fees have been challenged on federal and state constitutional grounds and state statutory provisions.[4] Restrictions on the enforcement of school district fee policies are largely a matter of state law, as federal courts generally defer to state authorities in these matters (Dayton and McCarthy 1992).

According to a 1991 survey of state departments of education, only eight states allow local public schools to charge fees for required textbooks (Hamm and Crosser 1991).[5] Many more states, however, allow fees for general school supplies and services. This same survey found 29 states permitting equipment fees, 20 states permitting lab fees, and 20 states allowing fees for field trips. Other permitted fees included general supplies (12 states), workbooks (15 states), and pencils and paper (11 states; Hamm and Crosser 1991).

Tuition fees are generally prohibited for required courses offered during the academic year. Furthermore, although fees for elective and summer school courses have been allowed in the past, they have been subject to legal challenge in recent years (Dayton and McCarthy 1992).[6] On the other hand, fees for extracurricular activities have become more widespread in recent years. A total of 23 states allow fees for participation in school clubs and 21 states allow fees for participation in interscholastic sports (Hamm and Crosser 1991). Thirty-four states permit fees for pupil transportation, although these fee revenues are relatively small (Wassmer and Fisher 1997). Many local school boards provide fee waivers for children of low-income families.[7] Although many states permit the use of fees for "auxiliary" services, local school districts have used them only minimally. User charges provided only 3.2 percent of school district revenue in 1977, and then declined to 2.8 percent of revenue in 1991 (Wassmer and Fisher 1997).[8]

[A]s a growing number of schools have considered the imposition of fees for educational supplies or services, these fees have been challenged on federal and state constitutional grounds and state statutory provisions.

Leasing of Facilities and Services. Local school boards often raise revenue by leasing facilities to community organizations or private enterprises. In some instances of se-

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4 For an analysis of the constitutional challenges to school fee policies, see Dayton and McCarthy 1992.

5 These eight states are Alaska, Illinois, Indiana, Iowa, Kansas, Kentucky, Utah, and Wisconsin.

6 Historically, courts have held that summer school fees were constitutional because summer school was not considered part of a student's entitlement to a free public education. However, as more states establish minimum competency testing programs for promotion and graduation and require summer school attendance for students who fail these exams, summer school may be increasingly viewed as part of a student's entitlement. Furthermore, although fees for elective courses have been upheld by the Supreme Courts of New Mexico and Montana, the Supreme Court of California held that all educational activities must be free (Dayton and McCarthy 1992).

7 As Dayton and McCarthy (1992) note, low-income families may choose to withdraw from user financed activities rather than face the potential embarrassment of seeking a waiver.

8 Wassmer and Fisher (1997) observe that, although U.S. school districts employ user fees only minimally, as much as $30 billion in expenditures on auxiliary services could be funded through fees.

verely declining enrollments, districts have leased entire buildings to private tenants (Pijanowski and Monk 1996).[9] Districts also lease excess space to public agencies in exchange for services to be provided to students, school staff, and neighborhood residents (Meno 1984). In addition to leasing property, some districts raise revenue by leasing services. Examples include selling food services or computer support (e.g., business services, test scoring) to private nonprofit organizations or private schools, and the sale of transportation services to public nonprofit organizations or government agencies (Meno 1984; Pijanowski and Monk 1996).

School districts sometimes seek to share operating costs by establishing cooperative programs with other governmental agencies, private nonprofit or community organizations, colleges or universities, or businesses.

Sale of School Access. The sale of access to school markets, generally through advertising on school property or in school publications, is another means by which public schools generate revenue. Examples include the sale of advertising on school buses in New York City and advertising on homework handouts in California (Pijanowski and Monk 1996). School districts also sell concessions to businesses for various services such as student pictures and vending machine operations. Perhaps the most well-known example of the sale of school access is the arrangement between Whittle Communications Channel One and local school districts whereby, in exchange for about $50,000 worth of programming and equipment (including a satellite dish, recorders, and television sets), students are exposed to daily news broadcasts that include some advertisements. In 1995, over 8 million students in approximately 12,000 schools received daily broadcasts from Channel One. This audience comprises approximately 40 percent of the students in the 6th through 12th grades nationwide (Johnston 1995).[10]

Shared or Cooperative Activities

School districts sometimes seek to share operating costs by establishing cooperative programs with other governmental agencies, private nonprofit or community organizations, colleges or universities, or businesses.

Governmental Agencies. Examples of these activities include the use of public buildings for instruction, the shared use and cost of recreational facilities (e.g., pools, gymnasiums), and sharing transportation vehicles with local governmental agencies (Pijanowski and Monk 1996). According to Meno (1984), the most common shared activity between schools and governmental agencies involves the running of local parks and recreation departments, including the shared use and maintenance of playing fields and grounds. Although most of the arrangements are intended to be fiscally neutral for both parties, there are exceptions. For example, the Merced City (California) School District provides use of playing fields and grounds to the parks and recreation department. In return, the department makes a yearly contribution to the district's capital account for fields and grounds that exceeds the district's additional operating costs (Meno 1984).

Higher Education. These partnerships include opportunities for high school students to take courses at local community colleges or 4-year institutions in lieu of high school courses. Under such cooperative arrangements, students would not pay tuition, and the college would enjoy free use of school district staff.[11] Meno (1984) identifies a number

[9] Examples include a credit union in Southfield (Michigan) public schools, a dating service in the Hazelwood (Missouri) School District, and the rental of playing fields and locker facilities to professional sports teams for preseason training camp by the Phoenix (Arizona) public schools (Meno 1984).

[10] Despite its broad list of subscribers, Channel One is not without its critics who cite its intrusive nature and the perceived school endorsement of advertised products. As of 1992, the highest subscription rates were found in Michigan, Ohio, Pennsylvania, and Texas. On the other hand, Channel One is banned in California, Massachusetts, New York, North Carolina, and Washington (Greenberg and Brand 1993).

[11] Such arrangements, of course, may also be competitive. In Michigan, for example, high school students may enroll in courses at community colleges and public universities with tuition paid from a *pro rata* share of state school aid, that is, in effect, a transfer from the local school district to the postsecondary institution.

of school districts that participate in graduate student internship programs with local universities. For example, local colleges may place psychologist interns in public schools, where they perform standard school district functions under district supervision but at a substantially lower cost to the district as compared with regular staff costs.

Private Nonprofit Agencies. School districts often share excess space with local social service providers. Rather than charge the provider for a share of the cost of facility maintenance, the district makes the space available in return for social services provided to students at no charge. As Pijanowski and Monk (1996) note, the ability of local schools to negotiate such arrangements may assume more importance as greater demands are placed on local schools for social services.

Business and Industry. Schools often rely on business partnerships to share operational, instructional, and programmatic costs. Businesses, in turn, are given an opportunity to enter schools and classrooms. Schools benefit by gaining access to the expertise of business officials who have the opportunity to shape educational programs to meet needs of the business community (Monk and Brent 1997). Such cooperative arrangements date back to at least the 1960s. For example, New York City schools have long maintained cooperative efforts with local businesses and industry to assist students as they enter the labor force. Activities include work-study, job placement, career guidance, basic skill training, remedial education, and curriculum development (Meno 1984).

A common result of school outreach to the private sector is school adoption. In return for donations of money or service, business employees receive training in teaching techniques, use of athletic facilities, and access to students for marketing research (Pijanowski and Monk 1996).

Reporting Nontraditional Revenue

Although revenue from enterprise, cooperative, and direct donor activities are generally reported in standard local school district financial reports, revenues from indirect donor activities are not. The apparent rise in the number of local education foundations and, to a lesser extent, booster clubs, and the dearth of information regarding revenue levels raised from these sources has been noted by the Governmental Accounting Standards Board (GASB 1994). GASB, established as an arm of the Financial Accounting Foundation in 1984 to promulgate standards of financial accounting and reporting with respect to activities and transactions of state and local governmental activities, has noted the rise of "affiliated organizations"; that is, organizations that are not themselves governmental entities but exist for the purpose of raising resources for such entities. According to GASB standards, affiliated organizations should be considered a part of the "financial reporting entity" and subject to the same public reporting requirements that apply to the governmental entity. Examples of such affiliated organizations arguably include school district foundations and, possibly, booster clubs. GASB Statement No. 14, *The Financial Reporting Entity,* defines that entity as consisting of not only the primary government but also "organizations for which the primary government is financially accountable" and "other organizations for which the nature and significance of their relationship with the primary government are such that exclusion would cause the reporting entity's financial statements to be misleading or incomplete" (GASB 1994). The statement cited a nonprofit fund-raising corporation affiliated with a college as an example of an organization that should be evaluated as a potential component unit subject to governmental reporting standards that apply to the financial reporting entity. However, the statement

[A]ffiliated organizations should be considered a part of the "financial reporting entity" and subject to the same public reporting requirements that apply to the governmental entity.

[A]n "affiliated organization"... meets the following criteria: The organization has separate legal standing... The affiliation with a specific primary government is set forth in the organization's articles of incorpation... [and] The affiliation with a specific primary government is set forth in the organization's application to the Internal Revenue Service for exemption from payment of federal income tax pursuant to Internal Revenue Code...

did not provide specific guidance for identifying these "affiliated organizations" (GASB 1994).[12]

In December 1994, GASB published a draft of a proposed statement that would establish a definition for affiliated organizations and financial reporting guidance for those organizations. According to the draft, an "affiliated organization" is one that meets the following criteria:

1. The organization has separate legal standing, where neither direct association through appointment of a voting majority of the organization's governing body nor fiscal dependency exists.

2. The affiliation with a specific primary government is set forth in the organization's articles of incorporation—for example, by reference to the name of the primary government in describing the purposes for which the organization was established.

3. The affiliation with a specific primary government is set forth in the organization's application to the Internal Revenue Service for exemption from payment of federal income tax pursuant to Internal Revenue Code (IRC) 501(c)(3)—for example, by reference to the name of the primary government in response to any of the questions contained in the exemption application—and the organization has been granted that exemption.

According to the draft, the affiliated organization should be reported as a component unit of the primary government "if the primary government has the ability to impose its will on that organization or there is a potential for the organization to provide specific financial benefits to, or impose specific financial burdens on, the primary government." The draft also states in a footnote that an affiliated organization should be reported as a component unit of the primary government "if the nature and significance of the relationship with the primary government are such that exclusion would cause the primary government reporting entity financial statements to be misleading or incomplete." The draft would require that an affiliated organization component unit be included in the financial reporting entity "by discrete presentation" and provides guidance for reporting transactions between the primary government and the component units of affiliated organizations, based on the form of those transactions. In response to critical comments from public school booster clubs and parent–teacher organizations (PTOs), the exposure draft was withdrawn and, at the time of this writing, is being revised by GASB staff. Although the revised statement is expected to exempt small PTOs and booster clubs from the financial reporting requirements, local school district education foundations will likely be subject to new disclosure requirements. Such foundation activity has been particularly widespread in California and Michigan (Brunner and Sonstelie 1997; Addonizio 1997).

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[12] This omission is explicitly noted in a subsequent GASB Proposed Statement: "Under the financial accountability criteria established in Statement 14, the inclusion of legally separate organizations in the reporting entity is based on either the appointment process or fiscal dependency. Certain entities, however, are affiliated with legally separate organizations, created for the specific purpose of providing financial assistance or other types of support to their programs without meeting the financial accountability criteria defined in Statement 14. This occurs particularly among colleges and universities; it also occurs among hospitals, museums, elementary and secondary education institutions, and other types of organizations. Because of the methods used to create and administer some of these organizations, the nature of their relationship is different from what has been set forth in the Statement 14 "financial accountability" criteria...The Board believes that, despite the absence of direct association through the appointment process or fiscal dependency, the relationships between the primary government and some of these organizations are such that either financial accountability exists through other means or exclusion would render the statements of the financial reporting entity misleading or incomplete...The Board concluded that in certain circumstances these relationships make an affiliated organization an integral part of the primary government reporting entity. The Board also concluded that financial reporting could best recognize the nature of this relationship (in the absence of direct association through the appointment process of fiscal dependency) through discrete presentation of the affiliated organization on the face of the financial reporting entity's financial statements" (GASB 1994, 7–8).

Public School Revenue Trends in Michigan

Prereform Period. Trends in state and local revenue per pupil from 1981–82 through 1992–93, in constant 1992–93 dollars, are presented in table 1.

As table 1 reveals, total per pupil revenue fell in 1982–83 and 1983–84, as Michigan (and the United States) weathered a recession that began in 1979 and persisted until 1983. Real revenue then rose slowly through 1985–86, and increased a robust 9.6 percent in 1986–87. Following a modest 1.2 percent increase in 1987–88, revenue rose by fully 14.5 percent in 1988–89. The rate of real growth then fell steadily from 1989–90 through 1992–93, turning negative in that year. This decline in real per pupil revenue growth, combined with flat or falling enrollments in many Michigan school districts and increasing academic expectations as reflected by more challenging state assessments of pupil achievement in reading, writing, mathematics, and science, and an achievement-based school accreditation program created by the legislature in 1994, led some districts to search for nontraditional sources of support.

Michigan School Finance Reform. In 1994, the Michigan legislature enacted the state's most sweeping fiscal reforms in more than 20 years, reducing property taxes, increasing the state share of school funding, and substantially reducing local discretion regarding school taxation and expenditure decisions. On the allocation side, the new legislation replaced a 20-year-old district power equalizing (DPE) school aid formula and numerous categorical grants with a foundation formula that closely regulated local per pupil revenue. Each district's 1993–94 combined state and local base revenue for school operations became the basis for determining its 1994–95 foundation allowance. The major components of a district's base revenues were local *ad valorem* property taxes, DPE aid, and most state categorical aid.

The new state formula substantially constrained per pupil revenue growth for high-

Table 1.—Real state and local revenue per pupil, 1981–82 through 1992–93 (constant 1992–93 dollars)*

Year	Local revenue	State revenue	Total revenue
1981–82	$2,933	$1,577	$4,510
1982–83	2,862	1,452	4,314
1983–84	2,835	1,427	4,262
1984–85	2,884	1,563	4,446
1985–86	2,832	1,654	4,486
1986–87	3,103	1,814	4,917
1987–88	3,114	1,859	4,973
1988–89	3,732	1,963	5,695
1989–90	3,919	2,039	5,958
1990–91	4,065	2,096	6,160
1991–92	4,170	2,154	6,324
1992–93	4,163	2,150	6,313
Percent change	+41.9	+36.3	+40.0

*Revenue was deflated by the implicit deflator for state and local government spending.
SOURCE: National Education Association, as reported in Gold et al. 1995.

spending districts.[13] Furthermore, the state-imposed constraint on per pupil revenue growth was designed to become binding on more local districts in the 1995–96 fiscal year and beyond. This constraint is imposed on local districts in the form of a state basic foundation allowance set at $5,000 for 1994–95 and indexed annually to nominal school aid fund revenue per pupil. This basic allowance has risen slowly, from $5,000 in 1994–95 to $5,153 in 1995–96, $5,308 in 1996–97, and $5,462 in 1997–98. Local districts at or above the basic foundation allowance receive an absolute dollar increase in their district foundation allowances equal to the dollar increase in the basic foundation allowance.[14] Districts below the basic foundation allowance in 1995–96 and subsequent years receive increases up to double that amount. As the finance system is currently designed, the number of local districts subject to this constraint will rise each year, as relatively low-spending districts are boosted to the basic foundation allowance and then locked in at that level.

As the finance system is currently designed, the number of local districts subject to this constraint will rise each year, as relatively low-spending districts are boosted to the basic foundation allowance and then locked in at that level.

Aggregate Revenue Trends. The financial position and revenue levels of a local district also depend, of course, on its enrollment levels. Given the universal practice of allocating state aid on a per pupil basis, recipient local districts with excess capacity and rising enrollments enjoy positive marginal revenue and negligible marginal costs, whereas districts with falling enrollments face declining revenue and the need to lower variable costs, principally staff costs. Although aggregate school district revenues and expenditures will differ according to net changes in district fund balances, total operating expenditures provide some indication of the fiscal constraints facing local districts. Nominal and real total current operating expenditures (TCOP) for Michigan's local school districts from 1978–79 through 1996–97 are presented in figure 1. These data indicate a period of fiscal stress well before the implementation of Proposal A in 1994. Beginning in 1979–80, real TCOP declined 4 consecutive years and did not regain the 1979–80 level until 1991–92. Indeed, over the entire period examined, which begins with the first year of the implementation of Michigan's constitutional tax and expenditure limitation amendment, TCOP rose only about 1 percent annually in real terms.[15]

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13 The foundation formula guaranteed each local district a per pupil allowance that ranged from the $4,200 minimum to a maximum of $6,660, provided the district levied a local property tax rate of 18 mills on nonhomestead property. Specifically, local districts with 1993–94 base per pupil revenue below $4,200 are raised either to $4,200 or to $250 over their 1993–94 level, whichever is greater. Districts between $4,200 and $6,500 in 1993–94 received a per pupil increase varying linearly from $250 at $4,200 to $160 at $6,500. Finally, local districts with 1993–94 base per pupil revenue in excess of $6,500 were allowed an increase of up to $160 per pupil if local voters approved hold harmless millage sufficient to raise the additional revenue. This local millage is levied against homesteads to a maximum of either 18 mills or the district's prior year millage vote, whichever is less.

14 The annual change in the basic foundation allowance is determined by a final index, which may be written as follows:

$I = (R_t/R_{t-1})(M_{t-1}/M_t)$

where I = final index

R_t = total school aid fund revenue in current year

R_{t-1} = total school aid fund revenue in prior year

M_{t-1} = total pupil membership in prior year

M_t = total pupil membership in current year

The annual basic foundation allowance is determined by:

$BF_t = BF_{t-1} * I$

where BF_t = current year basic foundation

BF_{t-1} = prior year basic foundation

The local foundation allowance for an individual district is determined as follows:

$LF_t = LF_{t-1} + 2b—[(b\text{-}\$50) * (LF_{t-1}—\$4{,}200) / (c—\$4{,}200)]$

where LF_t = district's current year foundation allowance

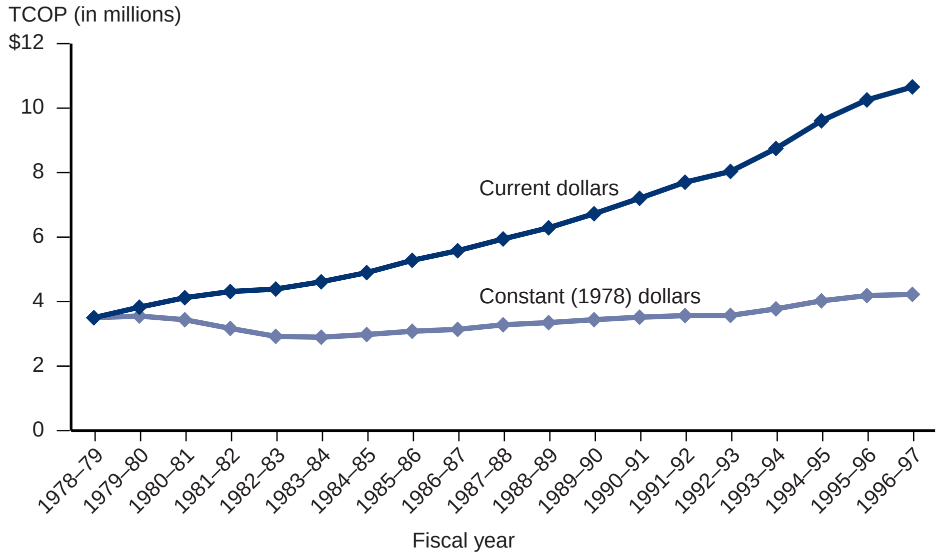
LF_{t-1} = district's prior year foundation allowance

$b = BF_t - BF_{t-1}$ = current year increase in basic foundation allowance

$c = BF_t$ = current year basic foundation allowance

15 Popularly known as the "Headlee Amendment" after its author Richard Headlee, this constitutional amendment limited both local property taxes and total state tax collections.

Figure 1.—Total current operating expenditures (TCOP) for local school districts in Michigan, 1978–79 through 1996–97



SOURCE: Expenditure data obtained from the Michigan Department of Education, Local District Financial Reports. TCOP is General Fund Total Expenditures less expenditures for capital outlay and community services. Inflation indices obtained from the State Tax Commission of the Michigan Department of Treasury.

Nontraditional Revenues for Michigan Public Schools

Tracking the growth of nontraditional revenues in Michigan public schools is made difficult by the lack of complete and uniform reporting by local districts and consistent time-series data. One source of consistent, but historically limited, time-series data is Michigan's Common Core of Data (CCD) for school years 1988–89 through 1995–96. These data are summarized in table 2.

Nontraditional local revenue includes fees for transportation and student activities; investment earnings; direct donations; and revenues from food services, tuition, summer school, community service, and rentals. It does not include indirect donations, such as those from local education foundations. Note the reduction in "total local revenue" effected by Proposal A, beginning in 1994–95.

As table 2 indicates, reported nontraditional revenue for Michigan school districts has been fairly substantial, accounting for nearly 6 percent of revenue from all sources, down from nearly 8 percent in 1988–89, and more than 20 percent of all local revenue in the postreform period. Moreover, these reported revenues do not include indirect donations, consisting largely of revenue raised by local education foundations. The extent of such foundation activity and associated revenue levels are examined in the next section.

Local Education Foundations in Michigan. Generally, a foundation is a nonprofit, tax-exempt entity with a board of trustees engaged in raising, managing, and disseminating resources for one or more designated purposes, such as charitable, religious, literary, scientific, or educational. Foundation trustees are generally selected from the local community and focus on raising resources, whereas directors implement policies and programs.

Table 2.—Michigan Common Core of Data, 1988–89 through 1995–96, share of nontraditional revenue ($ in millions)

Year	Total local revenue	Total revenue all sources	Nontraditional local revenue		
			Amount	Total local	All sources
1988–89	$ 5,190.430	$7,733.780	$ 598.645	11.53%	7.74%
1989–90	5,656.011	8,394.587	598.872	10.59	7.73
1990–91	6,098.938	9,054.147	627.728	10.29	6.93
1991–92	6,473.874	9,659.095	544.571	8.41	5.64
1992–93	6,802.640	10,766.136	651.660	9.58	6.05
1993–94	7,210.467	10,827.773	639.060	8.86	5.90
1994–95	3,159.482	11,925.311	658.171	20.83	5.52
1995–96	3,431.365	12,698.697	711.321	20.73	5.60

SOURCE: Michigan Department of Education.

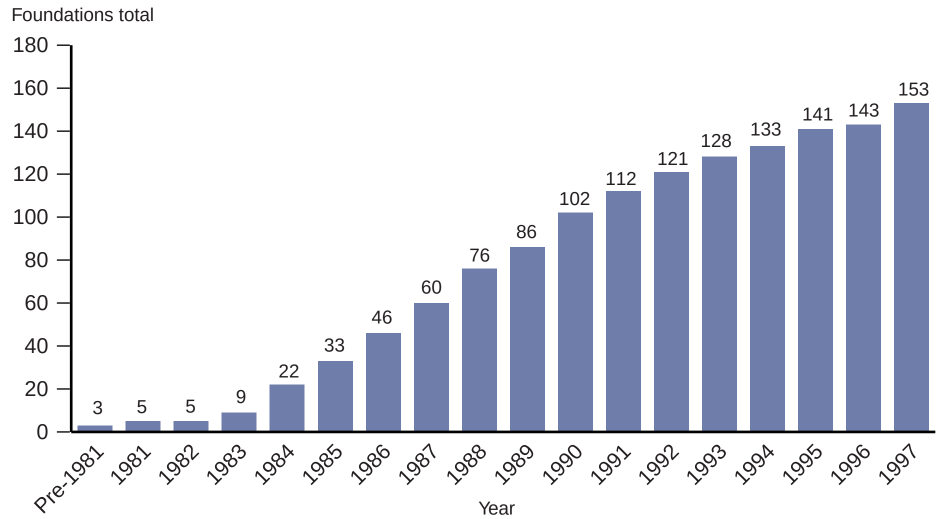
Creating a local education foundation in Michigan is relatively simple. Organizers file a four-page Articles of Incorporation form, along with a $20 fee, with the Corporation Division, Corporation and Securities Bureau, Michigan Department of Commerce, as required by Michigan's Nonprofit Corporation Act (P.A. 162 of 1982). Foundations generally begin operations within 4 to 6 months of filing articles, and often exist alongside booster and parent groups that also raise funds for the local public schools. Although their fund-raising activities may overlap (e.g., raffles, sales, etc.), foundations often focus on developing partnerships with corporations, individual major donors and other foundations, and seek planned gifts through wills and memorials. Grants are often made to teachers for innovative instructional practices, visual arts, and technology, areas seldom supported by booster groups. Furthermore, education foundations usually limit grants to items not normally part of the local school district budget.

Surveying Foundations in Michigan. Local educational foundations in Michigan were identified through a key word search of files of both the Corporation Division, Corporation and Securities Bureau, Michigan Department of Commerce, and the Charitable Trust Division of the Michigan attorney general's office. A total of 153 local education foundations was identified. A questionnaire was then mailed to each foundation and, as a follow-up, to each associated local school district superintendent. A profile of the foundations and the respondents is presented in figure 2 and table 3.

As figure 2 indicates, the formation of local education foundations accelerated during the period of 1984 through 1993, a period marked by variable growth in real per pupil revenue from traditional sources. The greatest annual increases in the number of local foundations occurred in 1988 and 1990, when real state and local per pupil revenue rose 1.1 percent and 4.4 percent, respectively. Formation of new foundations slowed in 1994, when Michigan reformed its school funding system, and accelerated again in 1997 as the constraints on traditional source revenue imposed by the reforms became binding on more local districts. The survey data summarized in table 3 reveal that local education foundations are generally found in suburban and rural school districts. Annual foundation revenues, however, have been quite modest, averaging a mere $17,024 in 1994–95 among responding districts. Revenue levels have varied considerably across these districts, as indicated by the relatively large coefficients of variation for the district groups.

Comparison of Foundation and Non-Foundation Districts. Although total foundation revenues to date have been modest, the presence of a local education foundation pro-

Figure 2.—Educational foundations in Michigan



SOURCE: Michigan Department of Consumer and Industry Services.

Table 3.—Profile of local education foundations responding to survey

Year established	Years of operation	Number of foundations: Urban	Suburban	Rural	Total
1995	1	1	1	1	3
1994	2	0	1	2	3
1993	3	1	2	1	4
1992	4	0	2	3	5
1991	5	1	3	4	8
1990	6	0	0	1	1
1989	7	0	1	0	1
1988	8	0	2	2	4
1987	9	0	2	3	5
1986	10	1	4	4	9
1985	11	1	2	2	6*
1984	12	2	1	0	3
1983	13	0	0	0	0
1982	14	0	0	1	1
1981	15	0	0	1	1
Total	**—**	**7**	**21**	**25**	**54**
Average foundation revenue, 1994–95		$51,915	$16,915	$9,851	$17,024
Maximum		$100,000	$65,000	$36,200	$100,000
Minimum		0	0	0	0
Standard deviation		46,802	15,611	8,521	21,489
Coefficient of variation		0.9015	0.9229	0.8650	1.2623

— Not applicable.

*One foundation did not respond to urban/suburban/rural question.

SOURCE: Survey of Local Education Foundations; author's calculations.

vides a potential source of supplemental revenue for and suggests a heightened community interest in local public schools. To begin testing for educationally relevant differences between foundation and nonfoundation districts, one-way analysis of variance (ANOVA) was used to compare the mean values of selected district revenue measures, household economic characteristics, district size, and measures of student achievement of each district group. The foundation districts consist of all 153 districts identified through the state databases described above, not merely the survey respondents. These mean values and associated significance levels are presented in table 4.

As table 4 indicates, districts with educational foundations, on average, enjoy higher unrestricted public revenue per pupil, greater enrollments, higher household income, and higher student achievement than their nonfoundation counterparts. Foundation districts also allocate a lower proportion of their expenditures on general administration, whereas spending shares for instruction and school administration are roughly equal across the two district groups. The differences in the group means are statistically significant for all remaining variables except tax base per pupil and 10th grade reading achievement. Some differences are striking. For example, household incomes are more than 20 percent higher, on the average, in foundation districts as compared with their nonfoundation counterparts. Foundation districts also have a lower percentage of children eligible for free and reduced-price lunch under the National School Lunch Act and lower Federal Chapter 1 (now renamed Title I) expenditures than their nonfoundation counterparts. Furthermore, the average percent of students earning satisfactory scores on the Michigan Education Assessment Program (MEAP) are significantly higher among foundation districts on five of the six measures.

These results, although not unexpected, raise concerns regarding the equity in the distribution of educational resources across local school districts in Michigan. Michigan, along with virtually every other state, has adopted state school aid formulas designed to distribute more state aid to local districts with

Table 4.—Comparison of foundation and nonfoundation district means of selected measures of revenue, expenditures, household income, enrollment, and pupil achievement: One-way ANOVA

Variable	Foundation	Nonfoundation	P-value
Household income	$29,336	$24,359	< 0.0001
Percent subsidized lunch	23%	30%	< 0.0001
Tax base per pupil	$116,937	$114,483	0.7748
Math achievement grade 4	64.60%	60.66%	0.0023
Math achievement grade 7	53.11%	48.65%	0.0024
Math achievement grade 10	38.72%	35.64%	0.0116
Reading achievement grade 4	45.18%	40.95%	0.0005
Reading achievement grade 7	37.40%	33.98%	0.0030
Reading achievement grade 10	45.11%	43.44%	0.1567
Enrollment	4.267	2,605	0.0421
Chapter 1 revenue per pupil	$109.59	$163.17	0.0130
Unrestricted public revenue per pupil	$5,336	$5,148	0.0537
Percent spending for instruction	61.33%	61.22%	0.7770
Percent spending for school administration	6.00%	5.94%	0.6610
Percent spending for general administration	2.73%	3.75%	<0.0001

SOURCE: Compiled by author with published data from the Michigan Department of Education and the Michigan Department of Treasury. Data are for the 1994–95 fiscal year, except for 1993 household income.

relatively low fiscal capacity, generally measured in terms of taxable property wealth per pupil. Furthermore, state categorical grant programs such as special education, compensatory education, and bilingual education are designed to target additional resources to local districts with relatively large concentrations of low-income children and other children who are educationally at risk. The rise of local educational foundations in relatively high-expenditure and high-income districts may offset, to some degree, the equity effects of the state's school aid system. Furthermore, students enrolled in foundation districts were overwhelmingly white, with an unweighted average of 91 percent among these districts, thus raising additional equity concerns. These concerns are mitigated, however, by the relatively small financial contributions of the local educational foundations, averaging $17,024 in 1994–95 among responding school districts. These effects may be further mitigated by the relatively large foundation contributions made to urban districts, which are generally property poor.

A Model of Local School District Spending

The demand for education spending is assumed to be derived from a median-voter, majority-rule model where it can be shown that, under certain conditions, a community's effective demand for education will be that of its median income voter (see Bergstrom and Goodman 1973).[16]

If the price of private goods x is denoted by p, the individual's budget constraint with private income Y is:

$$Y = p_x + T(1-F) \quad (1)$$

where T = local property taxes

F = the proportion of local property taxes offset by the deductibility of property taxes from state and federal income taxes

Property taxes are supplemented by lump-sum and matching aid to cover the total cost of local public education. Furthermore, the median voter pays only a fraction of the total local cost, based on the voter's share of total taxable property in the school district. Thus, the tax obligation of the median voter is given by:

$$T = [c(1-s)-k](V_m/V_t) \quad (2)$$

where c = total cost of public education in district

k = lump-sum aid paid to district

s = state share of additional dollar of educational expenditures

V_m = median household property valuation

V_t = total property valuation of district

Substituting (2) into (1) and rearranging, the median voter's budget constraint becomes:

$$Y + k(V_m/V_t)(1-s) = p_x + [c(1-s)(V_m/V_t)](1-F) \quad (3)$$

Thus, the total income of the median voter consists of private income and the voter's share of lump-sum aid received by the district, while the voter's price of education is the marginal cost of increasing education expenditures per pupil by one dollar.

The median voter is assumed to maximize a utility function $U = U(x, c)$ subject to the budget constraint given by (3). A demand function for local public education can then be derived in terms of price and income. A simple model of education demand is:

The demand for education spending is assumed to be derived from a median-voter, majority-rule model where it can be shown that...a community's effective demand for education will be that of its median income voter.

[16] From 1973 through 1993–94, Michigan required direct voter approval of local school taxes. Since 1994–95 district spending levels under the foundation system were linear transformations of prior year spending (see Addonizio et al. 1995) and local school districts serve a single purpose, 1994–95 district expenditures are likely to conform to the predictions of a median-voter model.

$$E = b_0 + b_1\, PRICE + b_2\, INCOME + b_3\, FREE + b_4\, ENROLL + b_5\, \%INSTR \quad (4)$$

where *E* = educational expenditures per pupil as determined by local voters

PRICE = marginal tax price faced by the district's median voter

INCOME = median family income in the district

FREE = percent of children in district eligible for free or reduced price lunch under the national school lunch act (a proxy for educational need)

ENROLL = total district membership (to test for economies of scale in the supply of education)

%INSTR = percent of operating expenditures allocated to instruction

[R]esidents of foundation districts spend more per pupil from public (tax) sources than nonfoundation district residents…

Marginal Tax Price. A district's marginal tax price of school spending is the cost to the district's median voter of increasing per pupil spending by one dollar. In a guaranteed tax base (GTB) aid system, used in Michigan in 1993–94 to establish foundation spending levels for 1994–95 and subsequent years, the matching rate *(m)* for a local district is the state share of an additional dollar in locally financed educational expenditures. This matching rate, in combination with district enrollment and the median voter's share of the local district property tax base, determines the marginal tax price:

$$PRICE = n(V_m/V_t)(1/(1+m)) \quad (5)$$

where *n* = number of students in the district

V_m = average residential state equalized valuation (SEV) in the district (proxy for median household SEV)

V_t = total SEV of the district

m = $\{(V^* - V_i)/V_i\}$ if the district receives GTB formula aid, 0 otherwise

V^* = nominal GTB formula SEV per pupil guarantee

V_i = district's SEV per pupil

Data. The data on local school district enrollments, expenditures, SEV, and free and reduced-price lunch eligibles were obtained from the Michigan Department of Education. The data on district average household income were obtained from the Michigan Department of Treasury.

Empirical Results

The model of school expenditures (equation 4) is estimated with tax price term PRICE calculated according to equation 5. Descriptive statistics for each variable are presented in table 5. To test for behavioral differences between residents of in-formula and out-of-formula districts, dummy variables are used for the intercept and for each independent variable. The equations are estimated by weighted least squares, where the weighting factor is the square root of the number of families in the school district.[17]

As shown in table 5, residents of foundation districts spend more per pupil from public (tax) sources than nonfoundation district residents, an expected finding in light of their lower tax price for school spending. Average household income is fully 19.5 percent higher in foundation districts, whereas the percent of pupils eligible for free and reduced-price lunch is 30.8 percent higher in nonfoundation districts. Mean enrollment is higher among foundation districts, whereas enrollments vary more among nonfoundation districts.

[17] Because sampling theory reveals that the error term will be a function of the size of the population tested (heteroscedasticity), ordinary least squares would be an inappropriate estimation technique (see, for example, Kmenta 1971, 322–26).

Table 5.—Variables associated with public school expenditures: Descriptive statistics 1994–95				
	Foundation districts		Nonfoundation districts	
Variable	Mean	Standard deviation	Mean	Standard deviation
Expenditure (E)	5,316	934	5,152	1,021
PRICE	0.55	0.23	0.86	0.44
INCOME	29,099	8,027	24,349	7,811
FREE	23.02	13.97	30.10	16.15
ENROLL	4,187	4,362	2,602	9,500
%INSTR	61.25	3.65	61.25	4.73
Sample size	152		382	

SOURCE: Compiled by author with published data from the Michigan Department of Education and the Michigan Department of Treasury. Data are for the 1994–95 fiscal year, except for 1993 household income.

The regression results reveal structural differences in the demand for public school spending across the two voter groups. As noted in table 6, the coefficient on DUMMY has the expected positive sign and is statistically significant, indicating a preference for higher public school spending on the part of foundation district residents that is not explained by price, income, enrollment, or high educational need (i.e., FREE). The coefficient on PRICE has the expected negative sign but is statistically insignificant. The coefficient on D*PRICE, however, is negative and significant, indicating more price-elastic demand for school spending on the part of foundation district residents. Estimated point price elasticities of demand, calculated at mean per pupil expenditure levels and marginal tax prices, are -0.3097 for foundation district voters and -0.0049 for voters in nonfoundation districts.[18]

The coefficient on income has the expected positive sign and is significant at the 0.01 level. The coefficient on D*INCOME is insignificant, however, indicating that the relationship between income and desired school spending does not vary across district groups. The positive and significant coefficient on ENROLL (P-value of 0.000) and the insignificant coefficient on D*ENROLL indicate the absence of scale effects among both district groups. The coefficient on FREE is negative but insignificant (P = 0.607). In contrast, the negative and significant sign on D*FREE indicates a negative relationship between school spending and concentrations of low-income children among foundation districts. Within this district group, higher spending among high-income and high tax base (i.e., low PRICE) districts may swamp the effects of compensatory spending in less affluent foundation districts. Finally, the coefficient on %INSTR is negative and significant, whereas the coefficient on the associated DUMMY variable interaction term is insignificant, suggesting that high-spending districts in both groups allocate more resources to noninstructional purposes at the margin.

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[18] The estimated price elasticity of demand for education spending for the combined sample obtained from a natural log form of spending model is approximately equal to the point elasticities reported above. This estimated expenditure equation is:

$$\ln E = \ln 5.72 - .1294 \ln PRICE + .2699 \ln INCOME$$
$$(.21) \quad (.0130) \qquad\qquad (.0207)$$

Adj. $R^2 = .278$

The small standard errors indicate that the coefficients are statistically significant at the 0.01 level. This log form is a popular functional form for economic models because each slope coefficient may be interpreted as the (constant) elasticity of the dependent variable with respect to the independent variable (see, for example, Kelegian and Oates 1981, 102–4).

Table 6.—WLS regression coefficients for Michigan school district expenditure equation, 1994–95

Independent variable	WLS coefficient	P-value
Constant	9,243.36	0.000
	(806.72)	
DUMMY	2,937.08	0.050
	(1,496.28)	
PRICE	-29.396	0.501
	(43.618)	
D*PRICE	-2,965.406	0.000
	(3,30.275)	
INCOME	0.0406	0.000
	(0.010)	
D*INCOME	-0.0027	0.876
	(0.017)	
ENROLL	0.0088	0.000
	(0.002)	
D*ENROLL	0.0049	0.690
	(0.012)	
FREE	-236.37	0.607
	(459.85)	
D*FREE	-2,170.61	0.010
	(842.95)	
%INSTR	-8,263.69	0.000
	(992.80)	
D*%INSTR	1,238.14	0.524
	(1,942.18)	

Adj. R^2 = 0.426

NOTE: Standard errors in parentheses.

SOURCE: Compiled by author with published data from the Michigan Department of Education and the Michigan Department of Treasury. Data are for the 1994–95 fiscal year, except for 1993 household income.

Summary and Conclusions

Since the beginning of this decade, public schools in the United States have been faced with a dramatic slowing of per pupil revenue growth, although school enrollments and expectations for academic achievement continue to rise. To meet community expectations, school districts in recent years have turned increasingly to nontraditional sources to supplement revenues from broad-based taxes. Such revenues are raised through donor activities, enterprise activities, and cooperative activities. Indirect donor activities are undertaken by school booster clubs and, increasingly, by means of a new form of nonprofit organization, the educational foundation. In Michigan, 153 such nonprofit organizations have been established by local districts to raise revenue for curriculum improvements, capital projects, instructional materials, and enrichment activities, and to strengthen links between schools and communities. This activity in Michigan is representative of activity nationwide.

Although the rise of these organizations is not unexpected in light of the slowing of revenue growth and rising expectations for public schools, this development has not been viewed with universal approval. The equalization of educational opportunities for all children, regardless of the wealth of their respective local communities, has long been an important goal of education policymakers. Virtually every state allocates school aid to local districts by means of equalizing formulas designed to offset disparities in local fiscal resources. Local education foundations have aroused concern that they may exacerbate the very fiscal disparities public policy seeks to reduce. Moreover, state authorities are generally unaware of the scope of revenue-raising activities of foundations and booster clubs, because such revenues are rarely included in standard school district financial reports.

The Michigan research revealed that total foundation revenues to date have been modest, averaging a mere $17,024 per participating district in 1994–95. However, striking differences were found between foundation and nonfoundation districts, with average household income among the former group exceeding the latter by more than 20 percent. The foundation districts, as a group, also have a lower percentage of children eligible for free and reduced-price lunch under the National School Lunch Act, greater per pupil revenues from traditional tax sources, and higher measures of student achievement in reading and mathematics, as measured by the MEAP. Furthermore, students enrolled in foundation districts were overwhelmingly white, with an unweighted average of 91 percent across these districts. Again, however, these equity concerns are mitigated somewhat by the relatively small financial contributions of the local educational foundations.

In general, the demand for goods and services, including education, depends on price, income and tastes. An ANOVA found price and income to differ significantly between the foundation and nonfoundation district groups. Furthermore, the estimated school expenditure model revealed some difference in taste preferences for school spending between residents of the two district groups. The substantial per pupil spending differences across the groups were partially explained by differences in price, income, enrollment levels, and concentrations of low-income children.

In light of these findings, it appears that the rise of local education foundations in Michigan has not measurably negated that state's efforts to reduce interdistrict disparities through the reform of public funding mechanisms. This result could change, however, as state funding reform continues to constrain per pupil revenue growth in historically high-spending and high-income districts and as such districts seek additional revenue from nontraditional sources.

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Modern Education Productivity Research: Emerging Implications for the Financing of Education

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Introduction

The advent of high performance standards has renewed efforts to understand and enhance the productivity of educational systems. Analysts are struggling to grasp the resource implications of these standards in the face of inadequate conceptualizations of educational productivity, imperfect data, and inadequately developed statistical tools and research methods. Despite these difficulties, progress is being made, and analysts are beginning to move from relatively simple input-outcome examinations to studies that explicitly tie outcomes to costs. The purpose of this paper is to assess this progress and to make suggestions for next steps.

Our starting point is the premise that the education production function is a real and potentially very useful tool for those concerned with improving the performance of schooling systems. Closely related to the education production function is the education cost function, and some of the most interesting contemporary education productivity research is being conducted from the cost perspective (e.g., Duncombe, Ruggiero, and Yinger 1996 and Imazeki and Reschovsky 1998). Therefore, it is important to understand the dual nature of the relationship between productivity and cost, and this paper begins with a conceptual model of these elements. It is particularly important to distinguish among the various sources of cost in a productivity framework. These distinctions are important from a policy perspective because school finance adjustments tend to evolve in a piecemeal approach in which the goal is to address a particular element of cost (e.g., the marginal cost associated with educating students with special needs, or costs associated with geographical differences in the cost of living). Some recent cost studies are more oriented around the development of comprehensive cost measures that subsume the various components. The interplay between the emerging comprehensive cost indices and the existing panoply of source-specific school finance adjustments needs to be examined, and a primary purpose of this paper is to prompt additional work of this kind.

The conceptual model also serves as a useful organizing device for the subsequent review and critique of cost and productivity studies. We show how the various studies differ with respect to the elements of cost–productivity that are being examined, and we are able to assess the progress that is being made toward developing a set of credible indicators of effectiveness and cost that will be of use to policymakers. We begin with a focus on the various attempts that have been made to estimate costs and then turn to the work that has been done on the productivity of a key educational input—namely, teacher quality. We reason that any satisfactory attempt to grapple with the resource implications of high performance standards will need to deal explicitly with the existing knowledge about the available indicators of teacher quality and learning outcomes for students.

One of the dilemmas facing policymakers is the design of appropriate responses to evidence of inefficiency within the educational system.

One of the dilemmas facing policymakers is the design of appropriate responses to evidence of inefficiency within the educational system. Suppose, for example, cost-effectiveness analysis progresses to the point at which clear judgments can be made about which district, school, or unit is inefficient with respect to the production of desired learning outcomes. Such a finding on its face provides relatively little insight into the correct policy response. Punitive measures need to be considered carefully, but it makes little sense to reward units for an inefficient operation. We turn to these considerations for policymakers in the final section of the paper. Our goal is to understand how the results of research dealing with education costs and productivity can be translated into improved policies, particularly with respect to raising and distributing revenues for education.

A Micro-Level Model of Resource Allocation

It is useful to think of resources as instrumentalities that work in tandem with one another to generate desirable results. Resources come in many forms and exist within many contexts, but the trait they have in common is a potential to be configured in ways that give rise to something new, an outcome or result of some kind. Much of the policymaking significance of resources lies in their potential to shape and define desired ends as well as in the hope that steps can be taken to better realize their imbedded potential.

The notion of "potential" is important because it suggests variability in the degree to which outcomes are realized. The variability arises from at least two areas. On the one hand, resources in combination can vary dramatically in their potential ability to generate a given result. There have been many efforts to estimate the magnitude of these maximum or ideal productivity levels, often under the rubric of production function research (for overviews of this research as it has been applied to education, see Hanushek 1979, 1994, and Monk 1992). Some resource combinations simply have higher productivity potentials than do others.

On the other hand, circumstances intervene that can affect the selection of one resource combination versus another and can ultimately affect the ability of an organization to realize the full potential of its resource base. These circumstances take many forms and much contemporary debate involves trying to distinguish between circumstances that are externally imposed as opposed to those that arise out of complicit behavior on the part of actors at the local levels, be they administrators, teachers, other educators, students, parents, or others.

The circumstances giving rise to whatever discrepancies exist between ideal and actual resource allocation practices are of great interest to policymakers. In the following analysis, we explore these ideas by drawing a sharp distinction between ideal and actual practice. We are particularly interested in understanding the reasons for departures from ideal resource allocation practice and thinking through the implications for the design of education funding systems.

Ideal Resource Allocation Practice

We seek a heuristic that conveys key features of the stockpile of knowledge about the productivity of educational resources. More specifically, we are interested in capturing what is known about what works for students in what ways and under what conditions.

We proceed by approaching the phenomenon from the outcome side at a decentralized, micro level. Let us think in terms of individual students for whom outcome standards have been set such that there is the *ith* student with the *jth* outcome standard. Questions quickly arise about what creates these outcome standards. These are important questions, but they are not central to the task at hand. For now, we simply recognize that these standards are generated and articulated by some body that may or may not be external to the educational system (e.g., a state or local board of education, or a legislature). Presumably these standards are set on the basis of beliefs that their realization has salutary social and economic effects over the long run and/or because their realization fosters the fulfillment of whatever social obligation there might be with respect to guaranteeing fundamental human rights. We might also wish to recognize that standards need not be set by a single board or decision-making unit. Indeed, it is possible for central boards to set standards that can be raised by local units responding to higher demands for outcomes that may exist in particular communities. Locally set standards can also be exceeded by decisionmakers (e.g., site-based councils, building administrators, and teachers) located within individual schools and classrooms. There are important implications for how fiscal responsibilities attach to these nested standards, and we return to this point later in the analysis.

Regardless of who is setting the standards, we are conceiving of them at the level of the individual student, and this invites questions about the degree to which the standards vary across students. Again, this is an important matter, but one that need not detain us. Outcomes like a fundamental ability to read and write have a more universal appeal than, for example, more specialized or sophisticated outcomes like the ability to compare and contrast literature from different historical periods or the ability to repair automobiles. Moreover, once we introduce the idea that outcome standards may vary across students, questions arise about the basis and means by which students are best sorted across the standards.

[O]nce we introduce the idea that outcome standards may vary across students, questions arise about the basis and means by which students are best sorted across the standards.

The prevailing debate suggests that the magnitude of these sorting problems can be diminished by raising the base level of the standards so that expectations for pupil performance become more universal, particularly with respect to conventional forms of academic capabilities. Indeed, advocates of "systemic reform" see a universal raising of performance standards as a powerful means of diminishing the adverse effects of having schools sort students into alternative learning tracks. As we shall see, the resource implications of this approach are significant and need to be addressed by those advocating reforms along these lines.

However, even if high universal performance standards were established, there still remains a point beyond which differentiation can occur. There are, after all, returns to specialization. The educational system, even in the context of a serious and successful pursuit of systemic reform, is not relieved of having to deal with a differentiation of outcome standards. Decisions need to be made about what these differing outcome standards are and how students will be distributed across them.

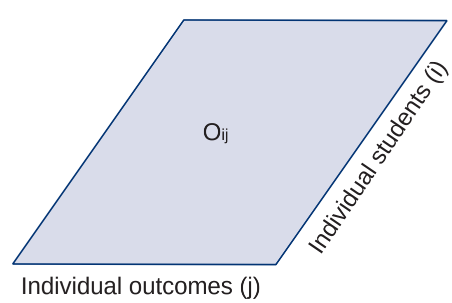
The result for our purposes is a student–outcome specific matrix in which each student is depicted in terms of the appropriate mix of performance capabilities. We can think in terms of a two-dimensional Matrix A shown in figure 1 in which the elements of this matrix (O_{ij}) indicate whether or not the *ith* student is expected to reach a performance target in the *jth* area or domain. Matrix A is a binary matrix in the sense that each element is either 0 or 1. In the case of a universal outcome standard, the *jth* column will consist exclusively (or almost exclusively) of ones. In the case of a specialized area of capability, zeros will be common and perhaps only a few of the rows (i.e., individual students) will have ones. Matrix A is an outcome–standard matrix. It is the starting point for this analysis of costs and constitutes the anchor for the entire system. Matrix A corresponds to one aspect of the demand society makes on the educational system to produce results. These demands need not be fixed over time nor exogenously determined, but for our purposes the idea is that they are in place.

Recall that we can differentiate between certain "base" standards that may be set centrally and "add-on" standards that are set locally. Thus, we can distinguish between Matrix A (Central) and Matrix A (Local) and recognize that the only difference will be the number of ones relative to the number of zeros. As we are conceiving it, Matrix A (Local) can have more ones than Matrix A (Central). It follows that there may be several different Matrix As, each corresponding to the standards set at a particular level of the system. Our goal is to link the establishment of a given Matrix A with the associated cost.

Notice that Matrix A does not provide insight into the level of learning expected. Instead, it simply provides an inventory of who is expected to develop capability in a particular area. The "degree of accomplishment" dimension is the second aspect of the demand society makes on the schools to produce results and has a direct bearing on costs. In order to handle this second aspect, we need to broaden the analysis as follows.

For each O_{ij}, we wish to conceive of every known response, treatment, or what we shall call an "educational service" that can be drawn on to facilitate the kind of learning associated with the *jth* area of learning. These educational services can be conceptualized in terms of discrete configurations of purchased, hired, and donated inputs that are combined with a student's time. We need to differentiate between the *quantity* of a given service and the *quality* of the service in question. Differences in quality correspond to differences in the service being provided (i.e., one discrete configuration of resources compared with another), whereas changes in quantity correspond to doing more or less of the same sort of treatment. For example, a school might decide to offer students more classtime during a typical week to help them enhance performance on a new and more demanding learn-

Figure 1.—Matrix A: Inventory of outcome standards specific to individual students and areas of performance



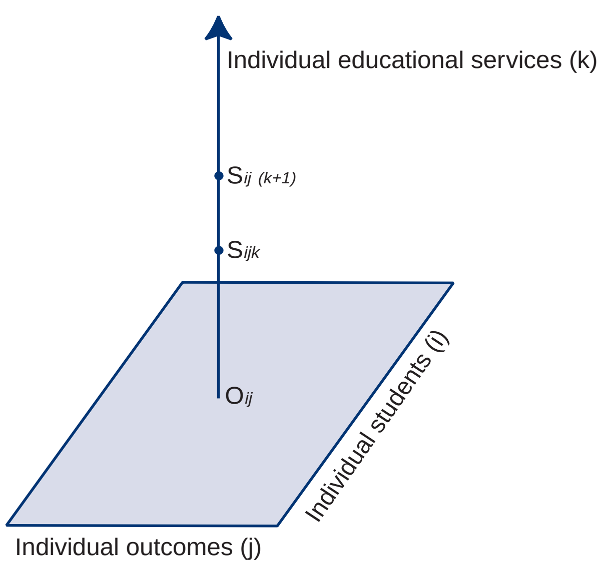
NOTE: O_{ij} = 1 if performance is desired for the *ith* student in the *jth* area; otherwise O_{ij} = 0.
SOURCE: Authors' sketch.

ing standard that has been put into place. As long as the treatment falls under the heading "more of the same" resources that were previously being supplied, we are dealing with differences in quantity of a given service. In contrast, if the district made a substantive change in the configuration of resources, perhaps by adding a teaching assistant or reducing class size, then the service in question has changed its character and we are faced with the challenge of figuring out how many units of each of the two conceptually different services must be provided to meet the outcome standard.

For the sake of simplicity, we assume that educational outcomes are produced using fixed proportions of discrete inputs and are subject to constant returns to scale. This means that a doubling of every input (i.e., a doubling of the quantity of the educational service being provided), is associated with a doubling of the learning gain for the student in question. Let the letter *S* represent each of these possible educational services (i.e., configurations of inputs), and let us define each S_{ijk} so that it is specific to the *ith* student and the *jth* learning standard with the letter *k* serving as an index that orders the various alternative educational services that might be employed. We can think in terms of S_{ijk} in which the various Ss are arrayed along a vertical axis that grows out of the two-dimensional plane on which Matrix A is placed. Thus, for each combination of *i* and *j*, there exists a vertical column of *S*s shown in figure 2 that represents the alternative ways of meeting the *jth* learning standard for the *ith* student.

We introduce the degree of learning dimension into the framework by conceiving of each S_{ijk} as the level of resources required using the *kth* configuration of inputs for the *ith* student to reach the stipulated level of learning associated with the *jth* standard. For now, let us assume that these degree of learning standards are fixed so that either a student is expected to reach the standard (i.e., the corresponding cell entry in Matrix A is a 1) or not (i.e., the corresponding cell entry in Matrix A

Figure 2.—Matrix A with a depiction of the cost of alternative means of achieving the *ith* outcome for the *jth* student



NOTE: S_{ijk} = total cost of having the *ith* student achieve in the *jth* area of performance at the stipulated level of accomplishment using the *kth* service.

SOURCE: Authors' sketch.

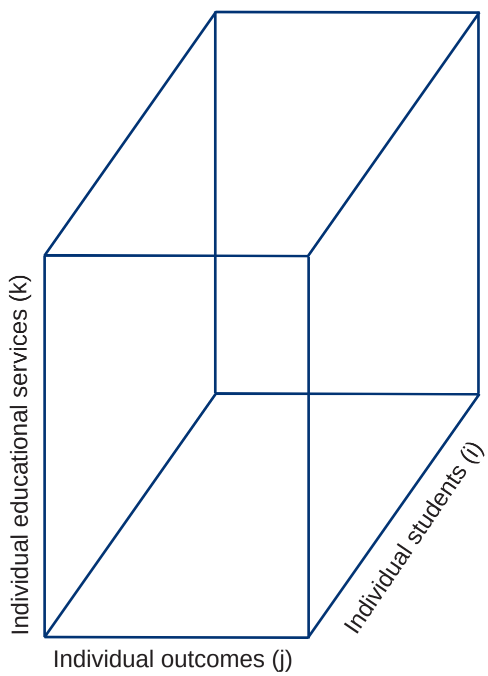
is a 0).[1] Each S_{ijk} can be thought of as the total cost associated with realizing the *jth* learning standard for the *ith* student using the *kth* service or configuration of inputs.

There are two reasons why S_{ijk} can differ from $S_{ij(k+1)}$. First, the intrinsic productivities of the inputs being combined can vary. Some inputs are more productive than others. Second, the unit costs of the various inputs can vary. Some inputs are more readily available than others, and the relative degree of scarcity in the face of the prevailing demand will establish price.

Consider the case of two alternative ways of achieving a given learning outcome, one that involves the time of a well-prepared teacher and one that involves the time of a poorly prepared teacher. Assuming teacher preparation is positively related to both the teacher's productivity with the student in question (we return to this topic in the Teacher Quality Research section) and the cost of the resource (i.e., the teacher's salary), we cannot deduce a priori how the two S_{ijk}s will compare with one another. This will depend on the relative strength of the two effects that are pulling in opposite directions.

We use the term "cost" deliberately because we are interested in the resources *required* to reach the identified outcome using the stipulated configuration. We recognize that some of the configurations will be more attractive (i.e., less costly than others) and that some "resources" are less than optimal (e.g., time from an unmotivated or poorly prepared teacher). Our intent is to have an exhaustive compilation of all the possible ways that the identified learning outcomes can be produced. Suffice it to say that the three-dimensional matrix we have envisioned and labeled Matrix A* in figure 3 will be very large.

Figure 3.—Matrix A*: Depiction of the cost of all possible ways to accomplish the established learning outcome goals



SOURCE: Authors' sketch.

[1] Alternatively, we could introduce the idea that in addition to the 0 versus 1 question that is dealt with by Matrix A, the expected degree of learning might vary among the students who are expected to learn in a given area. In other words, among the 1s in a given column of Matrix A, there may be variation in the degree to which each of the students is expected to perform.

There remain potentially important interdependencies across learners that need to be considered. Learning in school settings is not a private affair. The resources required for one student to learn can be affected by the characteristics of fellow learners. However, if we conceive of fellow learners as resources that may or may not be available to the student in question, the various possibilities can be provided for in the vertical columns of Matrix A*.

We have now conceived of the costs associated with achieving each of the identified learning standards for each of the identified students using all imaginable educational treatments or services. In this sense, the formulation is context or circumstance free. For the moment the only constraints we have introduced stem from the set of outcome standards that anchors the system and the characteristics of the learners in question. Out of this universal set of possibilities we wish to identify the ideal resource allocation practices in which "ideal" is conceived as being synonymous with "least cost," to reach the prespecified outcome standard and in which "cost" is measured in terms of the various S_{ijk}s that comprise the various columns of Matrix A*.

We can accomplish this result by traveling up and down each vertical column of Matrix A* searching for the configuration of inputs with the best (i.e., smallest) S_{ijk}. This will be the most desirable or idealized combination of resources for meeting a specific learning standard for a specific student. In other words, this is the least costly option possible given the attributes of the learner, the prevailing state of knowledge about the production of learning, and the absence of geographical as well as organizational context. For each combination of the *ith* student and the *jth* learning standard, one element of the vertical column vector will be identified. If these identified "idealized best practice" elements are projected onto a two-dimensional plane, there will emerge a new two-dimensional matrix in which each entry conveys information about the nature of the best practice and the cost associated with realizing the defined outcome standards.

This matrix, called Matrix IBP (for Idealized Best Practice) with each cell entry labeled IBP_{ij}, reflects the available knowledge about what works best to reach the learning standards for each of the identified students. The smaller the cell entry values of Matrix IBP, the better is the knowledge base, the more favorable are the prevailing terms of trade for the resources in question, or both. Over time, we might expect the magnitudes of the IBP_{ij}s to diminish (as more is learned about how learning takes place) for a given set of learning standards for a given set of learners. However, this is not necessarily true, because the unit prices for the inputs built into the services represented by the elements of Matrix IBP could rise in real terms. Efforts to reduce the magnitude of the IBP_{ij}s can come from the results of research designed to improve the effectiveness of inputs; they may also arise from more grassroots types of gains in which teachers, in effect, discover the nature of the production functions they face and find ways to pool their knowledge so that students can benefit from the results.

We can move from Matrix IBP to a calculation of total cost for reaching the targets for the identified students by summing all of the entries found in Matrix IBP. Recall that the individual cells of Matrix IBP provide the minimum cost figure for each student with respect to the type and degree of learning expected in each identified area. Some of the cell entries in Matrix IBP will be 0, and these correspond to instances in which the student in question is not expected to achieve a learning outcome in a particular domain. Thus, there is a single figure that represents the total cost of realizing the stipulated performance standards in which the intrinsic productivity of inputs is fully realized: *TC(IBP)*.

Learning in school settings is not a private affair. The resources required for one student to learn can be affected by the characteristics of fellow learners.

Let us revisit the question of how and by whom the outcome targets were set. We did not deal with this above other than to note that there could be a role for relatively centralized bodies like state boards of education *and* there could be a role for local bodies like school district boards of education or perhaps school site councils. The key point is the *TC(IBP)* is very sensitive to the mix and level of the outcome standards. If we think of the state board as setting minimum standards on which a local board can build, it follows that *TC(IBP)* for the state board will be less than or equal to *TC(IBP)* for the local board. It would also seem to follow that the state will have more of an interest in covering the cost of reaching the standards being set by the state board, and this suggests a division of fiscal responsibility that is reminiscent of conventional foundation types of school finance formula.

This formulation provides a useful starting point in the effort to conceptualize and calculate the costs of reaching a finite set of learning standards for a given student population. However, Matrix IBP and the price tag, *TC(IBP)*, is not directly observable given the fact that it is completely divorced from actual local circumstance. The next step in the analysis is to begin introducing elements of local circumstance into the formulation, and, as we shall see, there can be dramatic implications for resources. As we introduce local circumstance to the formulation, we begin to enter the real world of schooling practice in which circumstances can force departures from "ideal" practices. Our attention turns next to what we will call "actual" resource allocation practice.

Actual Resource Allocation Practice

In contrast to the "ideal" distribution and utilization of resources that is described by Matrix IBP, there is existing practice with respect to the distribution and use of resources across students and outcomes. Existing practice can be represented by returning to the three-dimensional Matrix A*. However, instead of traveling up and down the vertical columns searching for best practice, this time the search is for the nature of the actual educational service that is being provided to each student on an outcome-specific basis. Recall that each cell entry in Matrix A*, S_{ijk} (for every *k* not equal to 0) represents a measure of the total cost associated with each possible service that would be incurred if the service in question were used to achieve the *ith* student's *jth* outcome. Previously, we searched for the best (i.e., lowest) value of S_{ijk}; here we are searching for the *kth* service that most closely corresponds to the service actually being delivered to the student in question. We have already constructed a two-dimensional Matrix IBP in which the elements (IBP_{ij}) corresponded to the total cost associated with meeting the *ith* student's *jth* need under the best of conditions. Here we can construct a parallel two-dimensional matrix, call it *AP* (for Actual Practice), in which each element (AP_{ij}) represents the total cost of meeting the identified needs using the educational services that are currently in use. We can sum all of the elements of the AP Matrix and thereby obtain the total cost of reaching the stipulated learning outcomes for the identified group of students using prevailing practice: *TC(AP)*. *TC(AP)* captures what it would cost to reach the standards with no changes being made in how we operate schooling systems. It embodies a "more of the same" approach to reform.

Notice that *TC(AP)* will reflect all existing circumstances that bear on both the productivity and unit costs of resources. The prevailing use of organizational structures will be reflected (i.e., the existing numbers, size, and composition of districts, schools, classes, and groups). Whatever degree of disaffection, lack of motivation, or outright hostility that is present will also be reflected in *TC(AP)*. The idea is to ask how much of the service in use will be required to overcome whatever lack of motivation there might be on the part of a student, a teacher, or both. Similarly, the place-sensitive nature input prices will be reflected. In other words, input prices may be higher in some regions than in others (see, for example, Chambers and Fowler 1995), which bears on the choice of the relevant S_{ijk} in each of the vertical columns of Matrix A*.

By definition, each IBP_{ij} will be less than or equal to each AP_{ij} and *TC(IBP)* will be less than or equal to *TC(AP)*. Indeed, some of the AP_{ij}s may be very large. If a service is not well suited for meeting a particular need, the cost of realizing the outcome target using the ill-suited service could become quite large. The discrepancies between the AP_{ij}s and the IBP_{ij}s are important for policymakers. Specifically, these discrepancies measure the degree to which the system is misaligned in the sense that less than ideal uses are being made of resources in relation to the outcome standards that have been set. The larger the discrepancies, the larger is the misalignment within the system.

Such "misalignments" can occur for good and not so good reasons, and this realization introduces an important distinction into the analysis of productivity and cost. For example, a discrepancy can occur between an AP_{ij} and an IBP_{ij} because of structural realities that limit the ability of administrators and teachers to realize ideal practice through no fault of their own. For example, an administrator might be operating within a school that is either too large or too small to operate efficiently. The administrator may be choosing the best S_{ijk} available given the constraint of existing school size, but this best S_{ijk} could be considerably larger than the idealized S_{ijk} in Matrix IBP. Although school size is a decision variable, it would seem inappropriate to hold a building level administrator accountable for a suboptimal school size. We offer this as an example of what we will call realistic (as opposed to idealized) best practice in which the idea is to introduce a level of tolerance for a certain set of suboptimal resource allocation practices.

Although it seems reasonable to introduce this tolerance, placing bounds on what constitutes acceptable and unacceptable departures from idealized best practice is very problematic. Consider the case of an unmotivated student. If we treat the time of such a student as a given, we will find ourselves choosing an S_{ijk} with a relatively high cost because higher levels of the service in question will be needed to offset the low productivity of the student time input. In contrast, if the student could be motivated, the configuration of inputs would change for the better and we can reasonably presume that fewer outside resources will be needed for the student to reach the standard. Shall we hold the teacher responsible for the student's lack of interest? Is the teacher complicit in the use of a suboptimal resource allocation practice? Who should bear the cost of financing these suboptimal practices? A final example concerns the setting of unit prices for key inputs. Although we recognize that input prices may vary geographically, it is possible that actors within the system contribute to the differentials that are observed. For example, some districts may bargain more effectively with their employees than others, and some of the resulting price differentials may reflect what amounts to complicit behavior on the part of certain officials.

We are not able to resolve these questions in this analysis, but it is important to introduce the idea of acceptable departures from idealized best practices into our cost formulation. We shall treat it primarily as a placeholder at this point, but it is a very important placeholder and one whose reality has not been factored sufficiently into debates over how to finance education.

Thus, we can define a new matrix, called RBP (Realistic Best Practice), whose elements correspond to the various best possible S_{ijk}s taking account of externally imposed local circumstance over which officials have no direct influence. There is room for considerable disagreement about what counts as an externally imposed local circumstance, and decisions about whether to treat a local circumstance as externally imposed or not has a direct impact on the degree to which Matrix RBP will be different from Matrix IBP. The magnitudes of the various elements of Matrix RBP will lie between the magnitudes of the *BP* and *AP* matrices. Similarly, if we sum the elements of Matrix RBP and define that amount as *TC(RBP)*, we will find that *TC(IBP)* is less than or equal to *TC(RBP)*, which will be less than or equal to *TC(AP)*.

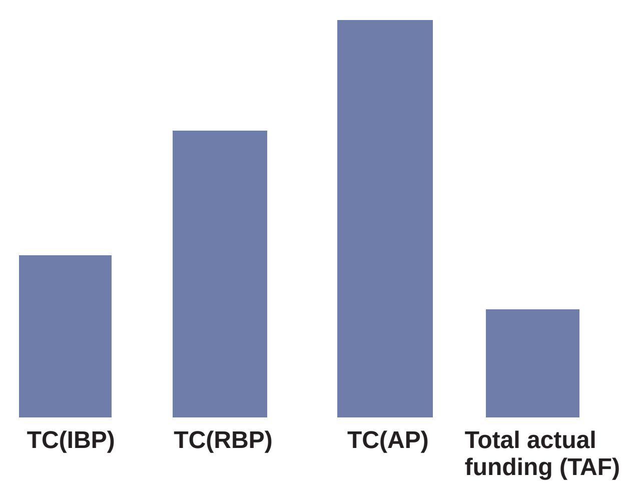
We now introduce a final element of real world circumstance—namely, the adequacy of the resource base that is provided to operate the system. The question becomes one of comparing the magnitude of the resources being allocated into the system (Total Actual Funding—TAF) with the various cost figures that we have conceptualized. Keep in mind that merely spending resources implies relatively little about the level and distribution of learning outcomes being realized. Thus, TAF may be larger or smaller than *TC(IBP)* but is presumably less than *TC(AP)*.

Figure 4 suggests that movement from actual to best practice involves a significant improvement in the utilization of resources. Figure 4 also suggests that resources currently allocated into the system are not adequate for realizing the performance standards for the identified students, even if idealized best practices were in use. The educational system depicted by figure 4 is clearly underfunded, but it is equally clear that a careless pursuit of the outcome targets in the absence of parallel efforts to promote improvement in practice could lead to a serious erosion of the system's efficiency and a waste of resources, a rather ironic result given the goals of the reform. Finally, figure 4 illustrates the important point that policymakers who seek to achieve a stipulated mix and level of student outcomes need to concern themselves with the alignment of the system as well as the adequacy of the resource base.

The Costs of Adequacy

If we presume that the setting of performance standards implies a judgment about what constitutes an adequate program, the model provides insight into what needs to be clarified before costs can be attached to adequacy. In particular, the model shows that agreement needs to be reached about:

Figure 4.—Hypothetical depiction of costs versus expenditures for realizing performance standards



SOURCE: Authors' sketch.

1) The number and nature of the columns in Matrix A;

2) The overall incidence of "universal" standards (i.e., the incidence of columns of ones with no zeros) in Matrix A;

3) The tolerance for the presence of some zeros in the "universal" standards columns in Matrix A and clarity about what is an acceptable level of "some" (e.g., 1 percent, 5 percent, 10 percent, or other);

4) The relative incidence of ones versus zeros in Matrix A (i.e., interest–willingness in going beyond the setting of "universal" standards); and

5) The willingness to accept differential levels of accomplishment based on student attributes (i.e., the degree to which "accomplishment" in a given area is differentiated among students who are expected to perform in that area).

We turn next to the progress that has been made in estimating the costs of achieving high performance standards. We begin by examining explicit attempts to generate cost estimates and then turn to what has been learned about the productivity and cost of a key educational input: the quality of teachers and teaching.

Existing Attempts to Estimate the Cost of Educational Outcomes

Researchers are dealing more explicitly with the links between costs and outcomes in a school finance context. Several approaches have emerged, and in this analysis we review each in turn. The approaches vary in terms of their degree of emphasis on economics, and we have ordered the discussion such that we move from approaches with the least to approaches with the most economic content. In particular, we examine the educator judgment model, the unit cost of inputs model, the cost of prevailing best practices model, and the cost function model, with and without adjustments for efficiency.

Educator Judgments

The goal of this approach is to assess the cost of providing an "adequate" education for students based on a consensus among educators over adequacy's relevant components and realistic best practices. These agreed-upon components and practices are then assessed in terms of their cost and totaled into an estimate of the full cost. The approach takes into account the inefficiencies associated with funding the expansion of actual practice to meet outcome standards (recall how large *TC(AP)* was presumed to be relative to *TC(RBP)*), but the search for the relevant benchmark tied to realistic best practices is based on judgments from panels of disinterested educators about what is appropriate under a given set of circumstances. One could argue that this is the default approach states have relied on for years as they have designed school finance formula, but in recent years there have been more explicit attempts to look at these judgments from a cost–resource perspective. The resource cost model that was developed by Jay Chambers and Thomas Parrish for Illinois and Alaska (Chambers and Parrish 1994) is a sophisticated and quite ambitious version of this approach. More recently, Guthrie et al. (1997) developed a version of this approach for Wyoming.

The approach relies heavily on the judgments of educators to ascertain the components of realistic best practices based on years of professional experience in different settings. There is no formal link with outcomes other than the available wisdom based on practice from those participating in the process. Although efforts are made to make the panels "disinterested," questions remain about the accuracy of such judgments as well as about potential conflicts of interest because there is likely to be an understandable underlying agenda to justify additional resources which support unmet educational needs of students. We also note that these efforts have not been informed by clear statements from the states or other standard setting bodies about the features of Matrices A and A*. None of the key elements of what constitutes adequate outcomes (see the list of items 1–5, previously) are specified. In this light, the necessary implicit judgments, estimates, and guesses of the various S_{ijk}s are all the more difficult to deduce.

There have also been some recent attempts to "cost-out" innovative programs that purport to reflect realistic best practice that are sensitive to both the underlying circumstances educators face as well as the kinds of outcome standards that are being established. These models include "Success for All," accelerated schools, and the School Development Program, among others. Cost assessments of these models to date include King (1994) and Barnett (1996). Chaikind and his colleagues (Chaikind, Danielson, and Brauen 1993) reported the use of similar approaches to estimate the cost of special education. We include these efforts under the educator judgment heading because the models are adopted because of professional judgments about their appropriateness in a given setting and because they include judgments about how to best adapt the requirements of each model to local circumstance. The resulting cost estimates therefore reflect an attempt to achieve benchmark efficiency standards that lie between the two extremes that we have identified *(TC(IBP)* and *TC(AP)*).

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Unit Cost of Inputs

Efforts have also been made to focus on differences in the unit cost of key inputs into the educational system. A number of different approaches have been employed, some relying on a market basket strategy (e.g., McMahon 1996) in which the focus is on how much a given basket of inputs costs in one place compared with another, and others in which the emphasis is on underlying models of supply and demand with allowances for compensating differentials such as the fact that teacher salaries tend to be lower in places with favorable working conditions, all else being equal. These latter models are called hedonic wage models and have been studied extensively by Jay Chambers (1997, 1998). These hedonic models are particularly interesting for our purposes because they include explicit distinctions between influences on the unit prices of inputs that are within and outside of the control of local school officials. Recall that this is the essence of the distinction we emphasized between the realistic and idealized best practice standards.

It is worth noting that the unit cost approach to date has not made an explicit connection to the outcome standards reflected in Matrices A and A*. The question is more along the lines of asking how much more it costs to hire the same input in one place compared with another. Clearly, this is a relevant question. It bears directly on one of the key sources of cost difference between the various services that might be employed to produce a given gain in a given area of learning (i.e., S_{ijk} versus $S_{ij(k+1)}$). But, it should be clear how far short this approach falls of specifying all of the possible sources of cost difference and contingency that need to be dealt with in a comprehensive calculation of what it will cost in a particular place to reach a prespecified set of outcomes. As we shall see in the discussion about cost functions, it is possible to build unit cost indices into more comprehensive measures of the costs to produce educational outcomes.

Costs of Observed Best Practices

Under this rubric can be found explicit attempts to link outcome standards to comprehensive conceptions of cost. In other words, costs are not restricted to differences only in the unit prices of individual types of inputs, and the formulation deals directly with learning outcome phenomena. The outcome standards are specified in terms of performance on examinations, and the question becomes one of identifying places that seem to be producing these outcomes with admirable levels of efficiency.

The strategy is intuitively straightforward. Districts are identified that have reached a prespecified minimally acceptable level of performance, and efforts are made to control for gross differences in the contextual reality of the identified districts. For example, districts with extraordinarily high or low levels of wealth and expenditure might be excluded on the grounds that they are highly atypical. The next step involves carefully reviewing practices that exist within the identified districts with an emphasis on identifying efficient results. For example, it might be found that some districts in the group are able to reach the outcome standard with a given set of class sizes and characteristics of instructional personnel. The costs of these various approaches can be estimated and interest can be focused on those successful places with the lowest level of cost. These districts and their practices can become benchmark standards. The associated cost estimates can then be used as the basis of a school finance system that is designed to cover the costs of adequate programs in which adequacy is rooted in outcome standards. A number of states have explored one version or another of this approach in recent years including Ohio (Augenblick 1997), Illinois (Governor's Commission, 1996), Mississippi (Augenblick, Myers, and Anderson 1997), and New York (Monk, Nusser, and Roellke 1998).

The implicit reasoning within this approach is that if some places can produce the desired test score results at a given (low) level of cost, it follows that it is possible for others to do so as well and that we can scale up the system by providing only those resources that would be necessary if the observed best practices were employed. In other words, the resources commensurate with *TC(AP)* should *not* be provided, and policymakers can rest easy knowing that they are not facilitating the kind of internal inefficiency that is suggested by the high cost shown for *TC(AP)* in figure 4.

Of course, the key piece in this reasoning is whether the prevailing best practices in settings in which they are observed are realistically available to places in which they are not currently in place. The approach includes efforts to adjust for differences in extenuating local circumstances, but the adjustments to date are not very sophisticated.

Our conclusion is that the cost of the observed best practice approach represents an important step in defining the middle ground efficiency benchmark that needs to be established in any serious attempt to estimate the costs of outcome performance standards, but that it is based on a crude set of adjustments. The approach moves the field in the correct direction, but the distance traveled is modest. Although there is progress to report, it needs to be recognized that this progress can have adverse effects at individual sites. For example, a given site may be seriously disadvantaged in its efforts to secure funding if it is expected to achieve an observed best practice that is not realistic for understandable reasons. Of course, this begs the question of what the "understandable reasons" are, but this is the crux of the problem facing analysts who work in this area.

Other problems lie in the approach's heavy reliance on existing test scores as the basis of the outcome standards. The available test score indicators are far removed from the kinds of outcome standards implicit in Matrices A and A*. The approach enjoys the virtue of an explicit emphasis on outcomes, but is limited by the narrowness and crudeness of the available indicators.

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Cost Functions

In defining cost functions, economists have been the most active with ambitious models that attempt to take into account differences in unit prices of inputs as well as differences in how the inputs are being combined, all with effort to provide sophisticated controls for district structural characteristics in order to avoid the criticism we just made of the observed best practice approach.

The cost function approach makes use of econometric estimating techniques including explicit attempts to model simultaneous and other endogenous effects as well as nonparametric techniques such as data envelopment methods. These models represent some of the most promising work to date in the effort to establish the costs of outcomes and warrant a careful assessment. The models are potentially of great interest to policymakers because they establish conceptual links between outcomes and resources, and also because they have the potential to give concrete dollar estimates of the costs of achieving adequacy.

The cost function approach makes use of econometric estimating techniques including explicit attempts to model simultaneous and other endogenous effects as well as nonparametric techniques such as data envelopment methods.

Let us begin with a general overview of the approach. The idea is to estimate a cost function. A cost function, when properly estimated, reveals the minimal cost necessary for achieving a given result. Presuming we can specify adequacy in terms of Matrices A and A*, and in theory we should be able to ascertain the idealized minimal cost of doing so—namely, *TC(IBP),* thanks to the construction of a cost function.

Of course, there are many difficulties which fall into different categories: (1) we are not very advanced in specifying the properties of Matrices A and A* (i.e., our outcome-oriented adequacy standards); (2) we suspect that there is a substantial amount of prevailing inefficiency in the field such that a survey of randomly selected sites could be misleading in terms of identifying best practices; (3) there is considerable endogeneity inherent in the system (i.e., features that have bearing on costs are related to other embedded characteristics and it can be difficult to disentangle the several different ways that influences on cost are connected); and (4) judgments need to be made about what is accepted as realistic versus idealized best practice.

Analysts have responded in various ways to these challenges, and we review their work in the order of the level of ambition and technical sophistication involved. An important step in the direction of estimating education cost functions was taken by Imazeki and Reschovsky (1998). They used multivariate methods to estimate a cost of education function for Wisconsin and took account of endogeneity by using instrumental variable estimating techniques. Imazeki and Reschovsky also included a teacher input cost index so that their model dealt with important unit cost differences as well as with costs associated with differences in how inputs can be combined to produce outcomes.

Imazeki and Reschovsky acknowledge the problem associated with uneven amounts of inefficiency across the observations in their data. This unevenness is problematic because it means that high levels of observed spending due to inefficient operation may be misinterpreted as unavoidable high costs of producing the outcomes in question. Concerns about the uneven levels of efficiency among observed schooling units has prompted some analysts to build "efficiency" adjustments in their cost function approach. William Duncombe and his colleagues have worked on this problem and have made use of data envelopment techniques to construct measures of individual school district's efficiency levels using New York state data (e.g., Duncombe, Ruggiero, and Yinger 1996). The logic is that the addition of a control for differences in efficiency across the sites in the sample establishes the long-sought realistic best practice benchmark that will ultimately permit the state to make aid adjustments that are sensitive only to bonafide differences in costs (higher expenditures due to circumstances over which there is no local discretion).

A central question is whether techniques like data envelopment are adequate to the task of generating a trustworthy efficiency adjustment–control. There are good reasons to exercise caution. First, the technique is similar in principle to what underlies the observed best practice method in which districts achieving similar results are compared and those doing so with the least amount of cost are singled out as examples of what, in theory, is possible for the others to achieve. A problem arises if what is possible for some is realistically not possible for others. The data envelopment method attempts to keep the analysis realistic by employing a linear optimization routine that compares districts facing similar exogenously determined environmental factors (e.g., size, wealth, composition of the student population, etc.). Although these environmental features are relevant and permit more sophisticated controls than those shown earlier for the cost of the observed best practice model, there is no doubt that they fall short of controlling completely for the circumstantial influences on what counts as realistic best practice (*TC(RBP)*).

As an example of how the statistical controls can fall short of the mark, consider the case of two school districts with very similar characteristics with the exception of their size. Suppose that the smaller of the two districts finds itself spending at higher levels to provide a comparable outcome for its students. Suppose also that the reason for these higher costs is a rancorous history of past attempts to reorganize the district into a larger unit. Finally, suppose that there is ample "blame" for this state of affairs, which is widely shared across and within the affected communities. It is hard to conceive of a statistical indicator which is going to capture the rancorous history that could have bearing on a decision to treat the higher spending in the smaller setting as a legitimate higher cost rather than as an instance of inefficiency that should not be offset by the state. We can reach different conclusions about what counts as "realistic" best practice in the smaller school setting, and an efficiency indicator that is based on the data envelopment methods that are currently available is not likely to resolve this question.

Second, the technique depends heavily on the specification of outcomes. Recall the emphasis we placed on the components of Matrices A and A* as the core of an outcome-oriented standard. The existing data envelopment methods are based on standardized test score outcomes and are insensitive to the kinds of important outcome specification questions that are included in these two matrices. This is important because there is a potential for the envelopment comparisons to be made across districts pursuing very different agendas in terms of outcomes. The higher spending that is observed in one place may reflect an efficient pursuit of higher standards (the results of which are not captured by the existing assessments), but the envelopment method could interpret the higher spending as evidence of a serious inefficiency. A clear specification of outcome targets and consensus about what the state-imposed adequacy standards are going to be is essential for the development of an accurate and dependable efficiency index.

A central question is whether techniques like data envelopment are adequate to the task of generating a trustworthy efficiency adjustment–control.

Third, there are conceptually distinct degrees of efficiency, and data envelopment methods actually employ a relatively weak efficiency test. Ruggiero (1996) called attention to the difference between Farrell and Koopmans standards of efficiency. Passing the Farrell standard means that there is no way to reduce inputs equi-proportionally and maintain the same level of outcome. In other words, a school district will be Farrell efficient if it is impossible to reduce all inputs by some common percentage amount and maintain the same level of outcome. In contrast, within an inefficient district in a Farrell sense, it would be possible to reduce all inputs by, for example, 3 percent and have no adverse effect on outcomes. Koopmans efficiency requires that all slack be removed from the system such that it is impossible to reduce any input without adversely affecting the level of outcome. Thus, Koopmans efficiency is a more stringent standard in the sense that a district could achieve Farrell efficiency and still be able to make efficiency improvements by reducing the supply of one input relative to the others while holding the outcome constant.

The distinction between Farrell and Koopmans standards of efficiency is significant because data envelopment techniques make implicit use of the Farrell standard. In other words, while the data envelopment approach provides a control for differences in efficiency across the units in the sample, the efficiency of these units may still vary in the Koopmans sense, and it is possible for this variation to be substantial. The problem is that we are still left with a situation in which high expenditure levels in one place relative to another may be due to differences in Koopmans efficiency or differences in real costs. It is worth noting that this problem remains even if the other problems are resolved. Ruggiero (1996) has addressed this problem using a second stage (parametric) canonical regression technique that builds upon the data envelopment method to come closer to the identification of Koopmans efficient school districts.

The distinction between Farrell and Koopmans standards of efficiency is significant because data envelopment techniques make implicit use of the Farrell standard.

These reasons for skepticism create a dilemma for policy analysts as well as for policymakers. We might agree that a cost function complete with a Koopmans efficiency index developed according to Ruggiero's specifications is conceptually preferable to a less sophisticated, observed best practice approach or a cost function with no adjustment for efficiency, but this conceptual progress comes with some potentially significant costs. It is more than a matter of making incremental progress toward a fixed goal, because there is real potential for efficient practices to be misinterpreted as inefficient practices. Districts that are working with realistic best practices could find themselves penalized wrongly because of remaining limitations in the techniques being developed. However, conceptual progress should not be discounted, and it is clear that further efforts need to be made to extend this work.

It is particularly important to make progress in terms of the specification of the outcomes (i.e., clarifying the properties of Matrices A and A*). We also see promise in approaches that blend elements of the educator judgment and the cost function approach. It could be possible, and quite desirable, to rely on sophisticated cost functions to generate first approximations of estimated costs with a given set of circumstances to reach the stipulated outcome standards but to then build in an explicit appeals or "clarification" process which would permit informed judgments about particular local circumstances that may make the first approximation results unattainable. We speculate that an iterative process that draws on professional judgments in the context of cost estimates emerging from sophisticated cost function offers the best hope of making progress toward identifying the true costs of adequacy. For an alternative view that places greater relevance on the professional judgement approach, see Guthrie and Rothstein (1999).

Teacher Quality Research

Although many types of inputs contribute to the production of desired educational outcomes, in this section we narrow our attention to address what is known about the impact of teacher quality. In other words, we shift our focus to studies that trade comprehensiveness for a more focused examination of a specific category of inputs. We have selected studies estimating relationships between teacher quality and educational outcomes for several reasons. First, teacher resources represent a large proportion of the total resources committed to education, and consequently can have a disproportionate effect on the productivity of the enterprise.

Because teachers are a key component of almost all of the S_{ijk}s in Matrix A, it makes sense to take stock of what is known about the productivity of this cross-cutting input. Second, several elements of this category of inputs, for instance, preservice teacher preparation programs and certification requirements, are particularly interesting from a policymaking perspective.

The studies included in our review vary in terms of how heavily they rely on formal economic models of production. Some use sophisticated econometric techniques to test hypothesized models of production. Others consider the costs and effects of various alternatives to teacher preparation. Still others test for relationships using simple bivariate correlational analyses. We include a variety of studies along this "methodological continuum" and also present findings from reviews that others exploring this literature have conducted. We contend that although all of this work does not fit squarely into the categories of production or cost function research, it is nonetheless important to consider given the lessons it provides regarding such a key input to the production process.

The category of inputs associated with teacher quality is broad. For instance, teachers' pay scales are generally based on factors which include years of experience and degree level. In addition, characteristics such as course work taken to prepare for the profession, prestige of the institution at which one's degree was earned, and literacy or knowledge measured through the use of tests have been identified as attributes likely to contribute to successful teaching. In this section, we examine the impact of three specific indicators of teacher quality: (1) a teacher's preparation *program*, including degree level, links to state certification, and the presence of extended or other alternative teacher education programs; (2) the specific *course work* taken by teachers in preparation for the profession, with attention given to both the amount (e.g., number of courses, number of credits) and the type (e.g., pedagogical, content-specific) of courses taken; and (3) teachers' *test scores* indicating some aspect of teacher knowledge, proficiency, and level of literacy. All of the studies reviewed focus on preservice preparation rather than in-service professional development. The impact of these indicators of teacher quality has been measured in terms of a variety of educational outcomes including student achievement (general–composite as well as in specific subjects), principals' evaluations of teachers, teachers' perceptions of themselves and the quality and impact of their preparation, and teacher attitudes. We were able to draw several broad conclusions about the relationship between these teacher quality variables and educational outcomes from the numerous studies and research reviews that we examined.

Teacher Preparation/Certification Programs

One indicator of the quality of teachers concerns the "package" of their educational preparation, without attention to the individual components of that package (e.g., specific courses) or to the skills and knowledge acquired. This input has been studied in terms of the level of academic degree possessed by the teacher, the number of years of schooling, and whether or not the teacher has earned state certification to teach through traditional versus alternative routes. Much attention in the literature on teacher quality and preparation deals with the question of whether the quality of the candidates who are enrolled in, and graduate from, teacher education programs is lower than that of students in other degree programs, thus limiting the quality of the supply of teachers.

In general, the studies we reviewed pertaining to the impact of teacher education programs on teacher effectiveness offer several insights. First, "traditional" teacher education programs seem to make a difference with regard to a variety of measures of teacher quality and performance. Olsen (1985) found that

"[T]raditional" teacher education programs seem to make a difference with regard to a variety of measures of teacher quality and performance.

graduates of education programs tend to be equal to or better than noneducation graduates in terms of their high school rank, math and English placement scores, and cumulative grade point averages in a variety of college subject areas. Hawk, Coble, and Swanson (1985) used a matched comparison design to demonstrate that student math achievement scores are higher for students whose teachers were certified in mathematics. Goldhaber and Brewer (1996) also report positive effects of subject-specific training programs on student math and science achievement. Darling-Hammond's (1990) review of the literature on the relationship between teacher education and teacher effectiveness found that fully prepared and certified teachers are generally more highly rated and more successful with students than teachers without full preparation.

[F]ully prepared and certified teachers are generally more highly rated and more successful with students than teachers without full preparation.

In addition, several studies explore the impact of alternative teacher education programs such as requiring graduate education for teachers. Research shows that the relationship between graduate study and teaching effectiveness is modest (Domas and Tiedeman 1950; Goldhaber and Brewer 1996; Turner et al. 1986). Furthermore, several studies address the productivity of alternative routes to teacher certification through cost analyses concluding that alternatives such as extended year programs (Hawley 1987) and master's degrees (Knapp et al. 1991) may not be cost effective.

Teacher Course Work

Measures of the level and type of course work taken by teachers represent proxies for what teachers know and can do in the sense that course work indicates the degree of exposure individuals have had to particular areas of study (e.g., subject-specific content versus teaching methods). During the mid-1980s, the debate over the importance of subject matter versus education course work in teacher preparation programs took on new life (Ferguson and Womack 1993). This theme surfaces in a number of the studies we examined which consider course work as the indicator of teacher quality.

The studies we reviewed vary in terms of the measures, data, and methods used. Nonetheless, they are rather consistent in their findings. Most notably, they suggest that teacher course work in both content areas and pedagogy contributes to positive educational outcomes, but the relative impact of their effects varies. Subject matter preparation in the subject area taught is shown to be important in several studies (Perkes 1968; Hawk, Coble, and Swanson 1985), but investments appear to have diminishing returns after a certain point (Darling-Hammond 1990; Monk 1994). In contrast, course work in education methods is shown to have consistent positive effects that often outweigh those of content coursework (Ferguson and Womack 1993; Monk 1994). Further supporting this finding are a number of meta-analyses that emphasize the importance of pedagogical verses content course work in the preparation of teachers (Evertson, Hawley, and Zlotnik 1985; Ashton and Crocker 1987; Darling-Hammond 1990).

Several of the more sophisticated multivariate studies reviewed demonstrate some of the complexities associated with the education production function. More specifically, the production process appears to depend on a number of factors including student characteristics, teacher attributes, and subject area (see, for examples, Druva and Anderson 1983; and Monk 1994). In addition, Monk and King (1994) looked at multiple levels of schooling to conclude that it is the cumulative effect of the set of teachers a student has had over time, rather than the subject matter preparation of the entire faculty, that affects student mathematics and science achievement.

Teacher Test Scores

Test scores are arguably the best measure of what a teacher knows and can do because they go beyond exposure to programs and specific courses to assess the knowledge and skills that individuals have actually acquired. However, test scores are also arguably the least policy manipulable relative to the other indicators of teacher quality discussed in this paper. Although policymakers can require that certain tests be taken and passed by teacher candidates, it is far more difficult to influence the degree to which individuals excel on these tests, particularly broad proficiency assessments like literacy tests. The debate over the role and relevance of teacher test scores received a great deal of attention in the late 1970s through the 1980s. One explanation for this may be that the legality of using the National Teacher Examination (NTE) for certification purposes was upheld by the United States Supreme Court in N.E.A. versus South Carolina in 1978 (Stedman 1984).

Given the role of the NTE as a potential gatekeeper for teachers, the predictive validity of this instrument has been the object of study. Although Ayers and Qualls (1979) found that NTE scores are significantly related to grade point averages and scores on the ACT, correlations between NTE scores and principal and pupil ratings were found to be quite low. Likewise, Quirk, Witten, and Weinberg (1973) demonstrate that NTE scores are not highly correlated with supervisor ratings during the student-teaching period or during the first year of teaching. Pugach and Raths (1983) make several recommendations about the use of the NTE that argue against using this test as an end-of-program criterion for teacher candidates.

Other studies suggest that some test scores seem to predict high levels of teacher performance and desired educational outcomes. More specifically, tests that assess the impact of literacy levels or verbal abilities of teachers tend to show positive effects (Coleman et al. 1966; Ehrenberg and Brewer 1995; Ferguson 1991). In contrast, studies of the impact of the NTE (as noted above) and other state-mandated tests of basic skills, teaching abilities, or both (Guyton and Farokhi 1987) do not appear to be strong predictors of teacher performance. Finally, these studies also reinforce the complexity of the education production process in that the impact of what teachers know and can do as indicated by test scores depends on factors like student attributes (Ehrenberg and Brewer 1995; Strauss and Sawyer 1986).

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Lessons to Learn About Indicators of Teacher Quality

The central goal of this review was to organize the existing research concerning the productivity of teacher inputs to demonstrate how education productivity research can inform policy decisions. We chose to focus on teacher quality given the large proportion of educational resources attributable to this type of input and the relevance that findings in this area have for policy. Indeed, numerous policymakers have called for various reforms related to the preparation of teachers (Bush 1987). For instance, in its call for improved teacher preparation, the National Commission on Excellence in Education (1983), in their report *A Nation at Risk*, stated "teacher preparation programs are too heavily weighted with courses in educational methods at the expense of course in subjects to be taught." The Carnegie Foundation for the Advancement of Teaching recommended that teacher education programs require a 3.0 grade point average for admission, and that teachers complete courses in an academic core in four years and then spend a fifth year learning about education (Boyer 1983). Likewise, the Holmes Group (1986) advised that all major universities with substantial enrollments of preservice teachers should adopt the four-year liberal arts baccalaureate as a prerequisite for acceptance into their teacher education programs. Most recently, the National Commission on Teaching and America's Future has focused on accreditation, recommending that these issues be left to professional organizations. Clearly, the studies reviewed in this section have implications for these types of policy decisions, and improving the overall productivity of the educational enterprise.

In general, the wide range of studies reviewed here suggest several broad conclusions regarding teacher quality. First, teacher education programs seem to make a difference, but alternative routes to certification such as extended programs or the requirement of a master's degree for certification can be questioned on cost-effectiveness grounds. Second, although teacher course work in both subject matter and pedagogy have been shown to contribute to positive educational outcomes, investments in the area of subject-matter preparation may have diminishing returns after some point. Third, some teacher test scores, particularly those that measure broad qualities like literacy or verbal ability, appear to be associated with high levels of teacher performance. Finally, and perhaps most important, several of the more methodologically sophisticated studies demonstrate the complex nature of the education production process. Factors associated with students, teachers, and courses have been shown to affect the impact of teacher quality variables on educational outcomes. Also, other issues such as the alignment between teacher preparation and teacher assignment have begun to emerge in the literature as important issues that have an impact on the productivity of teacher resources (Hawk et al. 1985, Monk and Rice 1998).

The distinction between actual practice and best practice, particularly realistic best practice, is important to maintain as efforts are made to make efficient progress toward attaining new outcome standards.

Implications for Policymakers and Researchers

Education policymakers face contentious choices in a climate of limited resources. They are responsible for making wise decisions about how to get the most productive use of these resources. The resource allocation model we presented in this paper provides a starting point for framing and even guiding the decisions that must be made. The distinction between actual practice and best practice, particularly realistic best practice, is important to maintain as efforts are made to make efficient progress toward attaining new outcome standards. The greater the discrepancy in the cost associated with realistic best practice and actual practice, the more productive the system can become. These considerations are important for policymakers at many different levels of the decision-making structure.

It is heartening to see the progress that has been made toward mapping the path to greater levels of productivity in the education arena. Efforts to estimate the magnitude and nature of the links between education outcomes with their costs are becoming more sophisticated as well as more informative and useful. Furthermore, knowledge about the productivity of key cross-cutting inputs such as teacher quality is becoming more conclusive, providing insights that can lead policymakers toward improved practice.

What are the next best steps to take in the quest to realize more productive use of resources in schools and school systems across the country? We see three promising steps that need to be taken in the near term.

First, further work needs to be done to establish the conceptual link between outcomes and costs. The matrices we introduced provide useful insights, but we recognize that more needs to be done, particularly with respect to efficiencies that can be realized by providing services to multiple students at once as well as by providing services that meet multiple goals simultaneously. The model is built on the premise that different students benefit more or less from different kinds of services with respect to particular educational outcomes, and this has implications for the cost of the service alternatives. However, it is reasonable to expect that what works best for one student may also work well for others in ways that make it possible to realize additional efficiencies. Similarly, the model specifies services with respect to individual educational goals, but clearly some types of services are intended and can be expected to promote multiple outcomes simultaneously. These issues of aggregation are important to consider as we operationalize this model because schools and school systems are bound to serve groups of students and routinely seek to meet multiple goals simultaneously.

Second, policymakers need to be clearer about the content of their high performance standards, particularly with respect to the number and types of standards and, even more important, with respect to the degree to which those standards are expected to be universal. Departures from universality may involve applying the standard to only a subset of the student population, or allowing the standard to be met at different levels for different students. The specification of outcome standards is a key step in the further development of the resource allocation model and the linking of costs to outcomes. Policymakers need to do more than generate and salute vacuous rhetoric. Hard decisions need to be made about the degree to which we aspire to universal versus differential outcomes across students. The resource allocation model makes it clear that answers to questions about the costs of adequacy presuppose clear pictures of what the outcome standards entail.

Finally, we were impressed with the potential for iterative cost calculation methods to generate the most useful estimates of cost. We think the key is to draw upon educator judgments that are informed by the results of sophisticated cost and production function estimations. We were similarly impressed by the progress being made toward estimating the productivity of teacher resources, although we share in the frustration of many regarding the existing limits on the availability of direct indicators of teacher quality. There are important implications for the collection of the next generation of data for cost-productivity research. It is essential to more directly measure the capabilities of teachers. Crude proxy measures for teacher quality, such as degree level, years of experience, and even numbers of courses taken are inadequate substitutes for direct measures of teacher content knowledge and teaching capabilities. It is also essential for the next generation of data for cost-productivity research to include sophisticated measures of pupil outcome gains. Value-added test score measures may be the best that can be expected in the near term, but we dare to hope that progress can be made toward the developing assessment instruments that are well aligned with the outcome standards embodied in Matrices A and A*.

Hard decisions need to be made about the degree to which we aspire to universal versus differential outcomes across students. The resource allocation model makes it clear that answers to questions about the costs of adequacy presuppose clear pictures of what the outcome standards entail.

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