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NCES 2003–403

Developments in School Finance: 2001–02

Fiscal Proceedings From the Annual State Data Conferences of July 2001 and July 2002

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June 2003

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National Center for Education Statistics

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Dedication

In memory of

Charles W. Foster III, 1918–2002
James E. Gibbs, 1910–2001
William P. McLure, 1910–2002

In March 2003, at the First General Session of the 28th Annual Conference of the American Education Finance Association, Eugene P. McLoone, Past President of the AEFA, requested a moment of silence in memory of Charles W. Foster III, James E. Gibbs, and William P. McLure. This year's *Developments in School Finance* is dedicated to these individuals in recognition and appreciation of their contributions to the field of education finance.

Charles W. Foster III was the second full-time employee of the Association of School Business Officials (ASBO) International and its first executive secretary, a position he held from 1955 until his retirement in 1978. During his tenure as executive secretary, ASBO International flourished, growing in membership from under 2,000 to more than 5,000. He was instrumental in bringing research to education business practices as well as improving professional education for school business officials. He received his doctorate of education in business management from Northwestern University in 1954.

James E. Gibbs was the first chief of the State Branch, Elementary and Secondary Division, U.S. Office of Education, after it was entrusted with improving data collection in state departments of education under Title X of the National Defense Education Act (NDEA). He continued in that position, with additional responsibilities under the Elementary and Secondary Education Act of 1965 (ESEA), until his retirement. He was the federal official most responsible for advancing state departments of education into the electronic data processing era. He also served as the fourth president of the American Education Finance Association (AEFA). He received his doctorate in 1954 from Peabody College of Vanderbilt University.

William P. McLure spent his life as an educator, analyst, and specialist in education finance and administration. He was AEFA's second president, in 1977. For many years he was professor of Educational Administration at the University of Illinois, Champaign-Urbana, and director of the Bureau of Education Research and Service. Studies he conducted improved understanding of the relationships among administrative, cost, and school performance factors. He received his doctorate from Columbia University in 1948.

Foreword

Jeffrey A. Owings

Associate Commissioner
NCES Elementary/Secondary and Libraries Studies Division

At the 2001 National Center for Education Statistics (NCES) Summer Data Conference, scholars in the field of education finance addressed the theme "Making Data Work." Discussions and presentations dealt with topics such as the effective display of finance data, assessing the financial condition of school districts, and the economic efficiency and funding adequacy of school districts. The theme for the 2002 Summer Data Conference was "Common Data, Common Goals" and the topics of education finance addressed included teacher pay, vouchers, measuring the cost of education, and the school district bond rating process.

Developments in School Finance: 2001–02 contains papers presented at the 2001 and 2002 annual NCES Summer Data Conferences. These Conferences attracted several state department of education policymakers, fiscal analysts, and fiscal data providers from each state, who were offered fiscal training sessions and updates on developments in the field of education finance. The presenters are experts in their respective fields, each of whom has a unique perspective or interesting quantitative or qualitative research regarding emerging issues in education finance. It is my understanding that the reaction of those who attended the Conferences was overwhelmingly positive. We hope that will be your reaction as well.

This volume is the seventh education finance publication produced from papers presented at the NCES Summer Data Conferences. The papers included present the views of the authors, and are intended to promote the exchange of ideas among researchers and policymakers. No official support by the U.S. Department of Education or NCES is intended or should be inferred. Nevertheless, NCES would be pleased if the papers provoke discussions, replications, replies, and refutations in future Summer Data Conferences.

Acknowledgments

The editor gratefully acknowledges the suggestions and comments of the reviewers at the National Center for Education Statistics (NCES): Jeffrey Owings, Associate Commissioner for the Elementary/Secondary and Libraries Studies Division, who provided overall direction, and Karen O'Conor, who provided early guidance on table format. At the Education Statistics Services Institute (ESSI), Leslie Scott provided technical review of the entire publication. Also at ESSI, Tom Nachazel proofread and coordinated production of the publication, with assistance from other members of the ESSI editorial team; Heather Block and Jennie Jbara performed the desktop publishing; and Elina Hartwell designed the cover.

Contents

Introduction

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

This introduction is divided into two sections. The first section provides a brief overview of each of the 10 papers included in this volume. The second section describes two new features of the search function of the National Center for Education Statistics (NCES) education finance (edfin) web site. These two sections are followed by the complete text of the 10 papers.

Section I—Overview of Papers

For the benefit of the reader, this section provides brief overviews of the 10 papers selected for this volume of fiscal proceedings. These papers were presented by education finance experts at the July 2001 and July 2002 NCES Summer Data Conferences. The presenters were invited to address "cutting edge" research in public school education finance. The following paragraphs present an overview of the papers in this volume, in the order in which they appear. For each paper, the title (in bold) and list of authors and their affiliations introduce the paper summary.

What We Know and What We Need to Know About Vouchers and Charter Schools. In this paper, Brian P. Gill, P. Michael Timpane, Karen E. Ross, and Dominic J. Brewer of RAND focus on competition in education, by such means as vouchers and charter schools, and explore the scant empirical evidence about these forms of competition. They raise empirical questions that they believe have not been addressed, examine whether the questions can be addressed in future work, and provide recommendations for policymakers planning to enact programs to promote competition.

The authors begin by examining empirical studies of the effects of competition on academic achievement, choice, access, integration, and civic socialization. Their empirical investigation demonstrates that many of the questions they believe should be addressed remain unanswered. For example, there appears to be a modest achievement benefit for African American children after 1 to 3 years in voucher schools, compared with continuation in local public schools; but the reason for the benefit and how long those effects last are unknown. Also, for other racial/ethnic groups, there is no consistent evidence. The little evidence that is available regarding the effects of a voucher program on the students who remain in public schools suggests that competition from vouchers may improve academic performance in public schools.

Gill et al. find that what we don't know about competition vastly exceeds what is known. There is little in-

formation comparing the achievement efficacy of different reforms, such as class size reduction, teacher professional development, high-stakes accountability, and the effects of programs to promote competition on those students who remain in public schools.

One aspect of competition that is likely to have a large impact on empirical outcomes is the program scale of such efforts. The authors remind us that nearly all of the existing evidence comes from tiny "escape valve" interventions in which competition evolves from efforts to assist high-risk children. It may be that only in comparison with underperforming public schools are vouchers and charter schools effective. The authors note that the economic costs of larger scale competition programs are unknown and warn that "scaling-up" often causes unexpected difficulties.

Gill et al. conclude by providing guidance to policymakers about the intelligent design of programs that promote competition, to maximize program benefits and mitigate harm.

Getting the Biggest Bang for the Educational Buck: An Empirical Analysis of Public School Corporations as Budget-Maximizing Bureaus. Anthony Rolle of Vanderbilt University presents, in this paper, an empirical analysis of whether public schools are budget-maximizing institutions. He undertook this examination because recent trends in education seem to be characterized by continued increases in organizational size and fiscal resources and by decreases in educational outcomes. The goal of the paper is to create a common understanding about the efficient uses of public education dollars.

In examining the literature, Rolle finds there is ample evidence that bureaucrats systematically request larger budgets regardless of the level of organizational output. While most of traditional economics deals with the behavior of profit-seeking firms, Rolle turns to a 1971 theory of supply for public bureaus developed by Niskanen, who concludes that bureaucrats attempt to maximize their agency's total budget during their tenure. Rolle selects Indiana, from 1981 through 1997, as an ideal setting to examine whether Niskanen's theory applies to public schools.

Efficiency in public schools, Rolle asserts, is concerned with how much education or knowledge is delivered to, and acquired by, students and at what cost. He uses a quadriform, or four quadrants, to assess school district efficiency outcomes. Inefficient school districts generate lower than expected outcomes with higher than expected expenditures. Effective school districts have higher than expected outcomes but also higher than expected expenditures. Efficient school districts have high outcomes and lower than expected expenditures. Rolle hypothesizes that if Niskanen is correct, variables measuring educational outcomes should not be statistically significant predictors of total expenditures per pupil.

Rolle concludes that Indiana public school districts cannot be designated as budget-maximizing agencies as defined by Niskanen's theory. However, they produce educational outcomes in a manner that is economically inefficient.

Occupational Choices and the Academic Proficiency of the Teacher Workforce. Authors Dan D. Goldhaber of the University of Washington and the Urban Institute and Albert Yung-Hsu Liu of the Urban Institute seek to identify the characteristics of teacher candidates in the "teacher pipeline" and examine the effects of compensation in different occupations on a teacher candidate's progress. They do this by examining whether respondents to the NCES Baccalaureate and Beyond Longitudinal Study (B&B) have taught, have trained as a teacher, are currently considering entering teaching, and have applied for at least one teaching job.

The rationale for this analysis is the authors' assertion that among schooling characteristics, teacher effectiveness has been shown to explain the largest share of the variation in student achievement. Although researchers have been unable to reach a consensus on which teacher characteristics correlate with student achievement, it is apparent that the teacher workforce tends to consist of college graduates with weaker academic skills. In addition, teachers with strong academic and specialized skills tend to migrate to schools with high socioeconomic and high-achieving students. Thus, it is important to identify other characteristics correlated with interest in teaching.

Exploring the B&B data, Goldhaber and Liu find that students who have considered teaching are more likely to have had a mother employed as a teacher and to

come from a low-income family. As might be expected, males are far less likely than females to consider teaching. Also, students who attend more selective colleges are less likely to actually apply for a teaching job.

The researchers find that the teacher labor market primarily rewards experience and advanced degrees. In contrast, the non-teacher labor market, while rewarding experience and advanced degrees, also rewards college selectivity and technical major. In the non-teacher labor market, wages are predicted to be higher for students with higher SAT scores; however, there is no similar premium for SAT scores (nor for college selectivity) in the teacher labor market. For most students, Goldhaber and Liu find, earnings are predicted to be higher outside of teaching than in the teaching profession and can be as much as $10,000 more for males with technical majors who graduate from more selective colleges. The authors conclude by cautioning that teachers may be particularly sensitive to non-pecuniary job characteristics when deciding to become teachers and choosing schools in which to work.

Variation in the Rewards for a Teacher's Performance: An Application of Quantile Regressions. In this paper, Sherrilyn M. Billger of Illinois State University explores the pay rewards for a private secondary school teacher's performance, using data from the NCES Schools and Staffing Survey (SASS) for 1990–91. She explores private school salaries because they exhibit substantial variation and a greater use of incentives than public school salaries.

Incentive pay, Billger asserts, is regaining popularity, even among teachers, and some 10 percent of public and private schools have such incentives. Using quantile regressions, Billger provides a fuller understanding of the relationship between salary and experience, suggesting that the returns to experience are greatest for the highest performing teachers.

The subject taught affects private secondary school teacher compensation, but compensation is not related to teaching the same subject as the teacher's college major. Incentive programs also affect salary; private secondary school teachers at schools with a merit pay program earn 6 percent higher salaries than do private secondary school teachers at schools without such a program.

National Evidence on Racial Disparities in School Finance Adequacy. Ross Rubenstein of Syracuse University explores, in this paper, the NCES Common Core of Data (CCD) to examine racial disparities in the adequacy of school financing across the United States. Rubenstein quantifies differences in adequacy across states, and across racial groups within states, and estimates the cost to bring all students' schools to selected levels of adequacy. A great deal of research has explored school finance equity within states, but much less research has examined adequacy. While equity analyses compare school districts to each other, adequacy measures education funding relative to an absolute standard.

Rubenstein asserts that an adequate funding level is one that provides all students the opportunity to achieve specified benchmarks and goals. Three methods of measuring adequacy have typically been used to determine adequate funding levels for different types of students. One method is a "professional expert" approach, in which experienced educators identify preferred instruction and estimate the price of the necessary components. A second method is the "exemplary district" approach, in which school districts with higher performance and lower spending are identified and set as the standard for each type of district. A third method uses an econometric approach, in which expenditures are related to various measures of student performance, and needs are used to construct a "cost index" that measures differences across districts in the resource levels required to produce a given level of student performance. Rubenstein uses the Odden-Picus Adequacy Index (OPAI) to quantify how far a given finance system is from achieving adequacy. Generally, achieving adequacy involves raising spending in all districts to the national median to provide adequate funding.

Rubenstein finds that most states have a higher proportion of students in schools below the adequacy benchmark than of districts below the benchmark. Most states with higher proportions of African American students in districts below the national benchmark also have lower proportions of minority students in school districts that have lower spending. In other words, minority children within states do not appear to be concentrated in lower spending districts.

He concludes that additional spending of $14–$16 billion would be needed to raise all districts in the country to the national median. The most consistent disparities across states are regional, with northeastern states generally having high levels of adequacy and southeastern states having low levels of adequacy. Interstate racial disparities in adequacy are generally greater than intrastate disparities. Urban and urban fringe districts are more likely to be below the median.

Competing Perspectives on the Cost of Education. Several presenters' papers addressed geographic cost variations and how differing approaches yielded considerably different estimates of the costs of education for school districts in Texas and New York. This paper, presented by Lori L. Taylor and Harrison Keller of the University of Texas at Austin, offers a brief discussion of current theory and practice regarding geographic cost adjustments, followed by discussion on the costs of public education in Texas, using different indexing strategies.

Taylor and Keller assert that there are two basic strategies for reflecting differences in school districts' geographic costs: cost-of-living (COL) and cost-of-education (COE). The basic premise of COL is that areas with relatively higher costs of living have to pay higher salaries to attract and retain school employees, which increases the cost of operating schools and school districts. COL estimates use either a "market basket" of goods and services (much like the Consumer Price Index) or a "comparable wage" strategy. The latter approach involves comparing the salaries of educators and non-educators. An advantage of both approaches is that these costs are beyond the control of school administrators. However, there are at least two limitations to these approaches, aside from the expense of data collection. Different communities may select different "market baskets," which would have different costs. For example, some school districts might select only teachers with advanced degrees and previous teaching experience. Another disadvantage is that high-cost communities may have amenities that make them desirable places to work. Finally, estimates typically are available only for large metropolitan areas, and many school districts with different costs may have the same estimate from a COL strategy.

COE estimates, Taylor and Keller maintain, use data on district expenditures to estimate either the costs of providing comparable levels of educational services (by estimating the cost to hire a typical teacher) or the costs of producing comparable educational outcomes. COE estimates can be applied to specific school districts, rather than a large metropolitan area, taking into account the cost variations within labor markets. COE estimates might also be obtained at a lower cost than COL estimates. COE estimates based on the cost of achieving educational outcomes can estimate both for variations in the prices paid for school employees and for deploying those employees to attain better student outcomes. Disadvantages of the COE approach include the possibility of missing a variable in the equation that increases costs for a school district. Perhaps most troubling, there is some evidence that certain school districts do not exhibit cost-minimizing behavior. If school officials can manipulate expenditures, or if the COE reflects inefficient school district operation, those districts that appear to have higher costs may simply reflect these local actions.

Taylor and Keller's examination of seven Texas geographic cost indexes finds little agreement across indexes regarding characteristics of high- and low-cost districts; it attributes these differences across indexes to differences in methodology. Within-market variations in labor markets are relatively small compared to between-market variations, favoring the COL approach. The authors conclude that the cost of educational inputs is a poor proxy for the cost of educational outcomes. It is precisely this last finding of Taylor and Keller that interests the authors of the following paper.

Financing an Adequate Education: A Case Study of New York. In this paper, William Duncombe and John Yinger of Syracuse University and Anna Lukemeyer of the University of Nevada, Las Vegas, seek to develop a school finance system that supports students and school districts trying to reach higher performance standards in New York State. They focus on the problem that schools with disadvantaged students must spend more than other schools to meet any given standard. The authors develop estimates of a district's cost for achieving an adequacy standard, and they propose funding such costs through a "foundation aid" formula.

As a standard of performance, Duncombe, Lukemeyer, and Yinger select a measure of performance set by the New York State Education Department. They find wide disparities in student achievement across districts in New York State, tied closely to school district size and urbanization. The five large city school districts have performance levels well below the current state average. Although only 5 percent of school districts do not reach a modest standard, they serve close to half the students in the state.

Using a COE index, the authors find that teacher costs differ between upstate and downstate districts, with downstate districts having above-average costs and upstate school districts having below-average costs. They suggest that wealthier school districts may be less efficient than poor school districts. The cost function they include uses the share of district enrollment of limited English proficient (LEP) students and the percentage of district children living below the poverty line. They calculate that each student in poverty requires a district to spend between $7,000 and $9,000 in additional resources to maintain the average performance level in New York.

Having determined the cost of adequacy, Duncombe, Lukemeyer, and Yinger devise a "cost-adjusted foundation aid" funding system with a minimum local tax rate requirement to achieve student outcome adequacy. The spending levels in the high-need New York urban school districts, the authors find, would have to rise to levels seldom achieved in large cities anywhere in the nation to bring students up to any reasonable standard. Such a substantial increase in state aid to high-need districts might increase inefficiency, they warn. However, they conclude that it is time to implement state aid systems that explicitly recognize that some districts must spend more than others to achieve any performance standard.

Bond Ratings and Bond Insurance: Market and Empirical Analysis for School Districts. Few studies have explored the decisionmaking process for school district officials when they are faced with the prospect of issuing bonds to fund extensive capital expenditures. In this paper, Mary H. Harris of Cabrini College empirically explores the difficult decision of school officials to have a bond issue rated by an independent rating agency. Few readers may be aware that the district must pay the independent agency a fee to cover the cost of conducting the credit rating. Once the bond is rated, the school district officials must then decide whether to purchase insurance as a credit enhancement to improve the rating. Harris examines 148 bond issues in 10 states from July 1993 through June 1994, where the proceeds were used for capital expenditures.

The rating agencies were originally developed to assist investors in comparing different bond issues with standard letter ratings. Moody's Investors Service (Moody's) focuses more on debt, and Standard & Poor's (S&P) focuses more on the economic base of the issuing entity. The fee these agencies charge is usually based on time and effort and averaged $7,000 per rating in 1993–94. The majority (58 percent) of rated bonds are rated by both Moody's and S&P. Larger bond issues typically receive ratings from two or three rating companies. Often, school districts choose to stay with a particular rating agency, as the cost of updating their information is lower than the cost of switching agencies.

If a school district receives a high bond rating on its issue, the results will be a lower bond financing cost and the ability to market the issue to a larger pool of investors. A high bond rating also reduces the price of the bond, thereby reducing the total financing cost. However, a school district may choose not to obtain a rating. For example, if the school district official anticipates that the issue will receive a poor rating and decides that not having any rating at all is just as attractive, the official may choose not to obtain a rating. If the issue is to be marketed locally, there is also little need for an agency rating. Another reason not to obtain an agency rating is if the amount of debt is small enough that the interest savings from the good rating are not large enough to offset the cost of obtaining a rating. Harris finds interesting regional differences and calls for more research in an often-neglected area.

GASB Update. The Governmental Accounting Standards Board (GASB) has adopted many accounting changes that will affect school districts, and Randal Finden of GASB addresses several in this brief article. He begins with a mention of the new financial reporting model for school districts and other public governmental entities (Statement No. 34), which includes a required "management's discussion and analysis" (MD&A) that describes a school district's financial events in layman's language. GASB State-

ment No. 39 requires the inclusion in a school district's financial statements of school district "affiliated organizations," such as parent-teacher organizations (PTOs), parent-teacher associations (PTAs), and foundations, provided their resources are "significant" to the school district.

Finden reports that GASB has also recently issued an exposure draft of a proposed Statement, to be effective after June 15, 2004, regarding the review of existing deposit and investment disclosure requirements. Investments must be reported at fair value, and as such things as interest rates change, investment values vary. The proposed Statement suggests methods a small government may use to reveal such investment risk, the simplest method being to list the investment, its maturity, and any call options. Credit risk outlines the debt obligations of a local government. Custodial credit risk involves deposits in financial institutions that might fail. GASB is seeking comment on this proposed Statement.

Finally, Finden discusses a current project of GASB, Other Post Employment Benefits (OPEB). OPEB refers to postemployment benefits other than retirement benefits, such as medical, dental, vision, and hearing benefits, and, when they are provided separately from a pension plan, life insurance and long-term care. GASB has begun to consider OPEB a part of compensation, deferred until after employment, and has tentatively decided to require recognition of OPEB costs over an employee's years of service, similar to current pension reporting requirements. GASB is still working on a method for small employers to calculate OPEB liability and expense without the use of an actuary. These and other changes in financial reporting will require our attention for years to come.

High Performance of Minority Students in DoDEA Schools: Lessons for America's Public Schools. The average academic achievement of all students and of African American and Hispanic students in Department of Defense (DoD) schools is among the highest in the nation according to the National Assessment of Educational Progress (NAEP). The Department of Defense enrolls approximately 112,000 students in schools in the United States and overseas, about the same number as the enrollment in the Charlotte-Mecklenburg, North Carolina, school district, with roughly 40 percent minority students. Claire E. Smrekar and Debra E. Owens of Vanderbilt University explore in their paper why DoD students outperform their peers, using a sample of 15 middle schools located in 10 school districts across the United States, Germany, and Japan. The paper is based on approximately 130 interviews conducted over a 4-month data collection period, focusing on financial support, resource allocation, personnel recruitment and selection, teacher quality, accountability, leadership styles, program diversity, and academic policy priorities.

Smrekar and Owens find that the DoD assesses the achievement of DoD students every year through standardized testing. Every school and district is provided with detailed assessment results, including performance by grade level, gender, and race. This intensive testing assists in school improvement. Schools that do not meet the DoD standard are targeted for intervention and enhanced resources. The cost per pupil in DoD schools is higher than the national average cost per pupil for U.S. public schools. Teacher salaries are competitive and schools are well staffed. Instruction, Smrekar and Owens find, is enhanced by state-of-the-art equipment and well-maintained facilities. The salary schedules in school districts of comparable size and demographics are reviewed regularly by the DoD to maintain a competitive salary schedule. All districts in the study reported extensive staff training linked to school goals.

Smrekar and Owens conclude with a variety of policy recommendations that flow from their findings. For example, they find that a larger proportion of middle and high schools in the DoD system have small enrollments compared to comparable public schools. They suggest that creating smaller "learning communities" may facilitate educational benefits for minority students in civilian schools.

Section II—New Features of the NCES Education Finance Web Site

Many readers are aware of the NCES education finance web site (*http://nces.ed.gov/edfin*) as a source of information, publications, and data on elementary and secondary education school finance and as a means of comparing school districts. In addition to the Standard search feature previously available for comparing school districts, two new search features have been added: 1) Geographic and 2) Create Your Own Group. Each of

the three search features is described below. The descriptions are followed by examples.

- *Standard* peer search uses the characteristics of a named school district, such as total students, student/teacher ratio, percentage of children in poverty, district type, and locale code, to select similar districts and compare their spending.
- *Geographic* peer search permits users to select school districts a specified distance from a particular zip code, listing all the school districts within, say, 10 miles of the zip code.
- *Create Your Own Group* permits you to choose only those school districts you wish to compare.

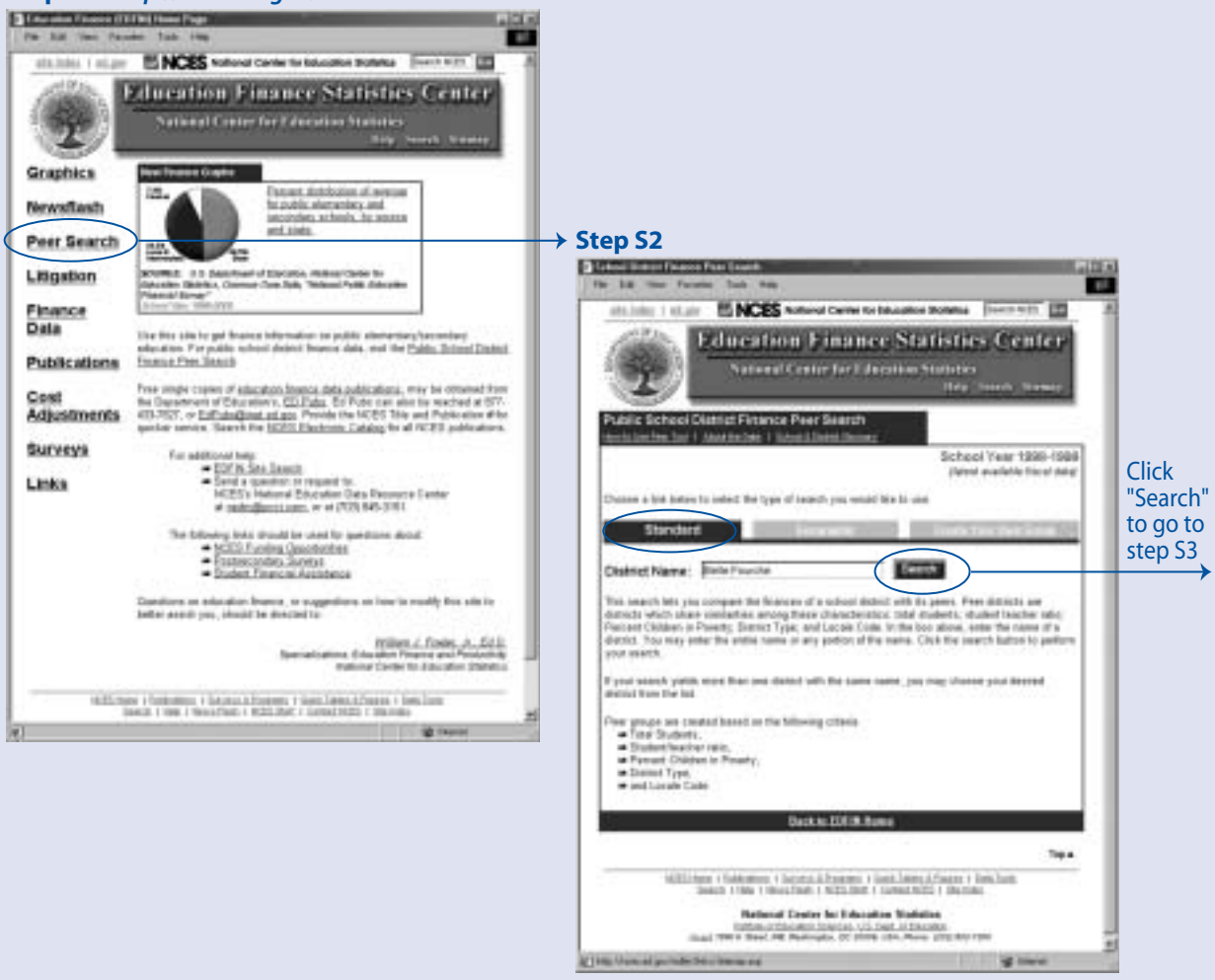
Standard peer search

For this example, assume that a school district official wants to compare the Belle Fourche school district to similar districts throughout the country.

Step S1 (figure 1)—
Go to the education finance web site. Click on "Peer Search."

Step S2 (figure 1)—
With "Standard" selected, specify school district (Belle Fourche). Click on "Search" to get a list of peer districts.

Figure 1. Starting a Standard peer search



Step S3 (figure 2)—
With peer districts listed, select one of the tabs at the top of the page (Revenues, Expenditures, Other Expenditures, Characteristics, Other Characteristics) for the information you want.

The step S3 graphic shows 3 of the 146 peer districts that were found, with "Revenues" selected. We see that the South Dakota school districts Belle Fourche, Hot Springs, and Vermillion have revenue per student of $6,741, $5,670, and $6,080, respectively.

Step S4 (figure 2)—
To get a web page of information about a school district, as shown in the step S4 graphic, click on the name of one of the districts listed in step S3.

Geographic peer search

For this example, assume a school district official wants to compare the Belle Fourche school district to districts that are located within 15 miles of Belle Fourche.

Step G1 (figure 2)—
To conduct a geographic peer search, return to the peer search home page. (One way to do this is to click on "New Search" at the bottom of a peer search web page, as shown in figure 2 below the step S3 graphic.)

Step G2 (figure 3)—
Select the "Geographic" tab. Enter the zip code of the district you want to compare (e.g., 57717 for Belle Fourche). Select the distance you want to search—15

Figure 2. Getting results of a Standard peer search and starting a new search

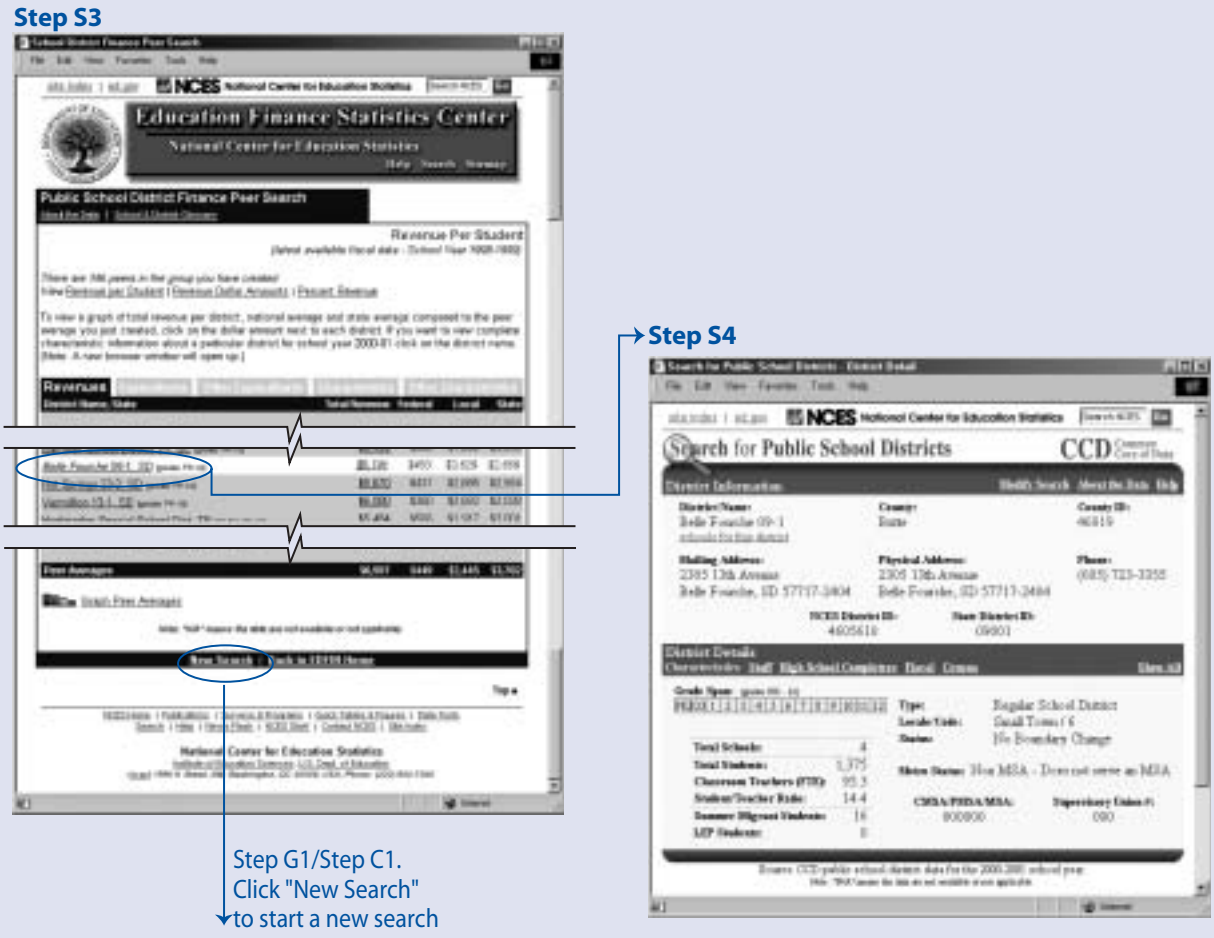
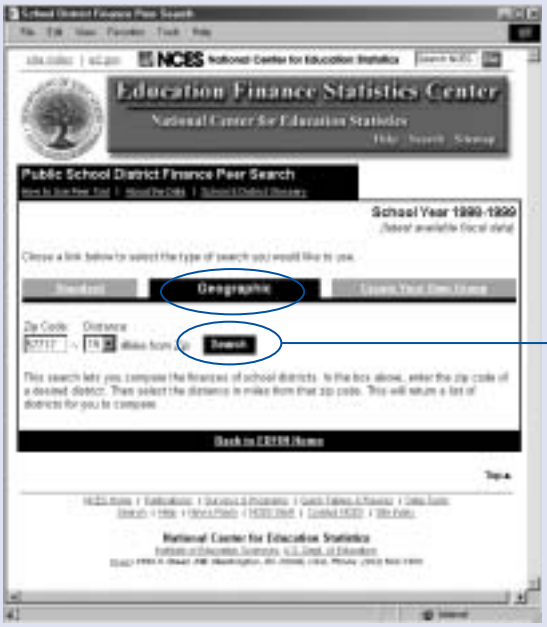


Figure 3. Conducting a Geographic peer search

Get to this step via
"New Search" (see step G1 in figure 2)

Step G2. *Click "Geographic" tab*



Step G3

Step G4

Step G5. *Click "Expenditures" tab*

miles—from the drop-down mileage selector. Click on "Search."

Step G3 (figure 3)—
The geographic search found Spearfish, South Dakota. Check Spearfish and click on "Select District" to get to step G4.

Step G4 (figure 3)—
Click on "View Peer Info" to get to the step G5 page, where you can select one of the following tabs: Revenues, Expenditures, Other Expenditures, Characteristics, or Other Characteristics.

Step G5 (figure 3)—
Click on "Expenditures" to get the information about Spearfish shown in the step G5 graphic.

Create Your Own Group peer search

For this step, assume a Belle Fourche school district official has identified two other districts with which to compare Belle Fourche.

Step C1 (figure 2)—
To compare Belle Fourche with other districts of your choice, return to the peer search home page. (One way to do this is to click on "New Search" at the bottom of a peer search web page, as shown in figure 2 below the step S3 graphic.)

Step C2 (figure 4)—
Click on "Create Your Own Group." Enter the name of each school district you want to compare, along with the state name from the drop-down list, clicking on "Search" after each selection. In this example, Belle Fourche, Hot Springs, and Vermillion (all in South Dakota) are selected.

Step C3 (figure 4)—
With three districts selected as a result of step C2, click on "View Peer Info."

Step C4 (figure 4)—
As a result of step C3, five tabs appear above the list of districts: Revenues, Expenditures, Other Expenditures, Characteristics, and Other Characteristics. Click on "Characteristics" to access the information shown in the step C4 graphic.

Conclusion

An "advanced" function is still under construction. It is anticipated that this upgraded function will provide a greater choice of school district criteria, such as confining searches to a single state, or to schools with a certain percentage of students in poverty.

NCES hopes you will try out the new "peer search" features and welcomes comments and suggestions to enhance this function, and that of the edfin web site. Comments may be e-mailed to *William.Fowler@ed.gov*.

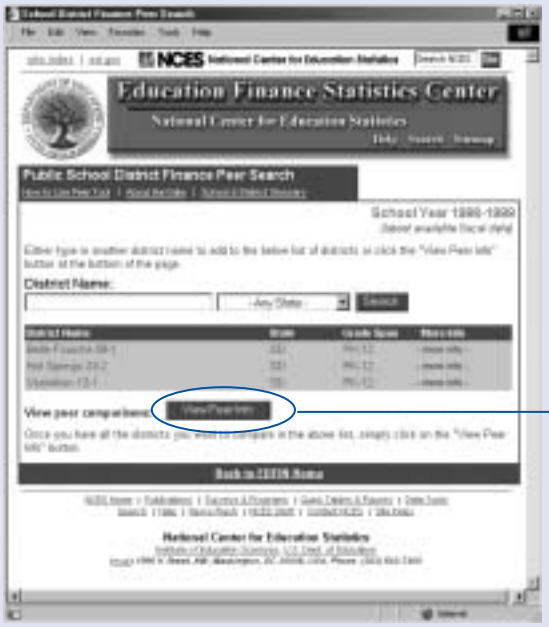
Figure 4. Conducting a Create Your Own Group peer search

Get to this step via
"New Search" (see step C1 in figure 2)

Step C2. *Click "Create Your Own Group" tab*

Enter each district name and click "Search" until you have created your desired group

Step C3



Step C4. *Click "Characteristics" tab*

What We Know and What We Need to Know About Vouchers and Charter Schools

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Introduction

In today's context of widespread dissatisfaction with our nation's public education system, a variety of reforms have been proposed to improve educational outcomes. One of the most controversial proposals is to provide parents with a financial grant, or "voucher," for use at any public or private school. Proponents argue that children using the voucher would be able to attend more effective and efficient schools; that the diversity of choices available would promote parental liberty and, if properly designed, benefit poor and minority youth; and that the competitive threat to public schools would induce them to improve. Thus, all would benefit from the use of vouchers. In what has become a fiercely contentious and highly political debate, opponents claim that vouchers would destroy public schools, exacerbate inequities in student outcomes, increase school segregation, breach the constitutional wall between church and state, and undermine the fabric of democracy by promoting narrow, particularistic forms of schooling.

Another proposal for education reform, less controversial among policymakers and the public, is to establish "charter" schools that are funded by public money and approved by a public agency but are schools of choice that operate outside the traditional system of public-school governance. A charter school is a self-governing institution, operating under a quasi-contract, or "charter," that has been issued by an agency of government such as a school district or a state education authority. A few voices have been raised in opposition to charter schools, expressing concerns about the possibility that they could lead to stratification in student placement and balkanization in curriculum. For the most part, however, charter schools have achieved considerable popularity across the political spectrum, with policy arguments centering on the terms and conditions of public oversight, such as collective bargaining provisions, applicability of assessment and accountability programs, and admissions policies. Charter school advocates argue that these schools will serve as laboratories for pedagogical innovation, provide havens for children who have been poorly served by traditional public schools, promote parental involvement and satisfaction, improve academic achievement, and save public education.

Conceptually and structurally, vouchers and charter schools challenge the "common school" model that has been the basis for the American system of public education for most of the nation's history. Opponents fear that privatizing the governance and operation of schools

will undermine their public purposes; supporters believe that autonomously operated voucher and charter schools can serve the public purposes of the educational system even though they are not owned and operated by government. ("Voucher schools" are schools that students with vouchers choose to attend.) Policymakers need empirical information on the effects of vouchers and charter schools to assess their merits and resolve this dispute.

This essay summarizes findings of a recent RAND book (Gill, Timpane, Ross, and Brewer 2001) that examines the empirical evidence on vouchers and charter schools. The aims of the book and this essay are fourfold. First, we identify and articulate the range of empirical questions that ought to be answered to fully assess the wisdom of policies that promote vouchers or charter schools, establishing a theoretical framework that accounts for the multiple purposes of public education. Second, we examine the existing empirical evidence on these questions, providing a broad assessment of what is currently known about the effects of vouchers and charter schools, in terms of academic achievement and otherwise. Third, we discuss the important empirical questions that are as yet unresolved and consider the prospects for answering them in the future. Fourth, we explore the details of the design of voucher and charter policies, concluding with recommendations for policymakers who are considering their enactment.

This essay summarizes findings of a recent RAND book that examines the empirical evidence on vouchers and charter schools.

The empirical evidence discussed in the book is derived from an exhaustive review of the existing literature on vouchers and charter schools, from studies of other forms of school choice in the United States and abroad, and from comparative studies of public and private schools.

Defining the Relevant Policy Questions

We seek to define the full range of policy questions about the empirical effects of school choice. An assessment of the wisdom of a voucher or charter law requires a full understanding of the varied goals that a system of schooling should promote. We divide the major policy questions into five broad categories, constructed to reflect the goals that are explicit or implicit in the arguments of both the supporters and opponents of educational choice, and more generally in the philosophical positions of those who have supported a public role in education over the last two centuries:

1. *Academic achievement*. Will vouchers/charter schools promote the academic skills, knowledge, and attainment of their students? How will they affect the achievement of those who remain in assigned public schools, as well as those who move to voucher/charter schools?

2. *Choice*. What is the parental demand for vouchers and charter schools? Will vouchers/charter schools induce a supply response that makes a variety of desirable school options available? What do voucher/charter parents think of their children's schools?

3. *Access*. Will voucher/charter programs be available to those who presently lack such options, notably low-income (frequently minority) residents of the inner city? Will they provide any options for students with special needs?

4. *Integration*. Will vouchers/charter schools increase or reduce the integration of students across and within schools and communities, by race/ethnicity and socioeconomic status?

5. *Civic socialization*. Will vouchers/charter schools contribute to the socialization of responsible, tolerant, democratically active citizens, or will they promote intolerance and balkanization?

What We Know From the Existing Empirical Evidence

Our evaluation of the existing evidence indicates that many of the important empirical questions about vouchers and charter schools have not yet been answered. Indeed, it would be fair to say that none of the important empirical questions have been answered

definitively. Even the strongest evidence is based on programs that have been operating for only a short period of time with a small number of participants; serious questions about generalizability remain. Nevertheless, the evidence is converging in some areas, as outlined below:

Academic Achievement

- Small-scale, experimental, privately funded programs that are targeted to low-income students suggest a possible (but as yet uncertain) modest achievement benefit (on the order of 0.1 to 0.3 standard deviations after 1 to 3 years) for African American children after 1 to 3 years in voucher schools, as compared with local public schools (Greene 2000; Howell and Peterson 2002; Howell et al. 2002; Mayer et al. 2002).
- For children of other racial/ethnic groups, attendance at voucher schools has not provided consistent evidence of either benefit or harm in terms of academic achievement (Howell and Peterson 2002; Howell et al. 2002; Mayer et al. 2002).
- Achievement results in charter schools are mixed, but they suggest that charter school performance improves after the first year of operation. None of the studies suggest that charter school achievement outcomes are dramatically better or worse than those of conventional public schools, on average (Bettinger 1999; Gronberg and Jansen 2001; Solmon, Paark, and Garcia 2001).
- Minimal evidence is available to assess the effect of vouchers and charter schools on the achievement of students who remain in conventional public schools. One of the few studies assessing the issue systematically (examining vouchers in Milwaukee and charter schools in Arizona and Michigan) suggests the possibility that competition from vouchers or charter schools may improve academic performance in conventional public schools (Hoxby 2002).

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Choice

- Parental satisfaction levels are high in virtually all voucher and charter programs studied, indicating that parents are happy with the school choices made available by the programs (see, e.g., Beales and Wahl 1995; Horn and Miron 1999; Howell and Peterson 2002; Mulholland 1999; Pioneer Institute 1998; Texas Education Agency 2000; Weinschrott and Kilgore 1998). In the experimental voucher programs that have been studied for 2 successive years, levels of parental satisfaction decline slightly in the second year but remain substantially higher than those of public school comparison groups (Howell and Peterson 2002; Myers et al. 2000).

Access

- Programs that have been explicitly designed with income qualifications have succeeded in placing low-income, low-achieving, and minority children in voucher schools (Howell and Peterson 2002; Metcalf et al. 1999; Myers et al. 2000; Wisconsin Legislative Audit Bureau 2000; Witte 2000).
- On the other hand, in most choice programs (whether voucher or charter), children with disabilities and children with poorly educated parents are somewhat underrepresented (see Beales and Wahl 1995; Howell and Peterson 2002; Metcalf et al. 1999; Myers et al. 2000; Peterson, Howell, and Greene 1999; Peterson, Myers, and Howell 1999; Wolf, Howell, and Peterson 2000; Young 2000).
- Education tax subsidy programs are disproportionately used by middle- and upper-income families (see Catterall 1983; Catterall and Levin 1982; Darling-Hammond, Kirby, and Schlegel 1985).

Integration

- In communities where public schools are highly stratified, targeted voucher programs may modestly increase racial integration by putting minority children into voucher schools that are less

uniformly minority, without reducing integration in the public schools (see, e.g., Fuller and Mitchell 1999; Fuller and Mitchell 2000; Howell and Peterson 2002).

- Limited evidence suggests that, across the nation, most charter schools have racial/ethnic distributions that probably fall within the range of distributions of local public schools. In some states, however, many charter schools serve populations that are racially homogeneous (North Carolina Department of Public Instruction 1998; RPP International 2000).
- Evidence from other school-choice contexts, both in the United States and abroad, suggests that large-scale, unregulated choice programs are likely to lead to some increase in stratification (Ladd and Fiske 2001; McEwan and Carnoy 1999; Willms 1996).

Civic Socialization

- Virtually nothing is yet known empirically about the civic socialization effects of voucher and charter schools.

What We Don't Know

The brevity of the above list of findings should send a note of caution to policymakers and to supporters and opponents of choice. For most of the key questions, direct evaluations of vouchers and charter schools have not yet provided clear answers, and the list of unknowns remains substantially longer than the list of knowns, as summarized below:

For most of the key questions, direct evaluations of vouchers and charter schools have not yet provided clear answers, and the list of unknowns remains substantially longer than the list of knowns.

Academic Achievement

Unknowns in the realm of academic achievement include, first, an explanation for the possible voucher advantage for African American children. In addition, the academic effectiveness of charter schools must be examined in a larger number of states over a longer period of time. Long-term effects on both achievement and attainment in both voucher and charter programs are as yet unexamined. Moreover, we have little information that would permit us to compare the effectiveness of vouchers and charter schools with other, more conventional reforms, such as class-size reduction, professional development, high-stakes accountability, and district-level interventions. Finally, the systemic effects—positive or negative—of both voucher and charter programs have yet to be clearly identified. Whether the introduction of vouchers/charter schools will help or harm the achievement of students who stay in conventional public schools remains largely uncertain, although a recent study suggests favorable effects (Hoxby 2002). This is perhaps the most important achievement issue, because most students are likely to be "non-choosers" and remain in conventional public schools.

Choice

The most important unknown related to parental liberty concerns the quality and quantity of the supply of schools made available by voucher and charter programs. The number of high-quality alternatives that different varieties of voucher and charter programs will produce is for the moment highly speculative.

Access

Critical unanswered questions about access to voucher and charter schools relate to the variability that would result from different kinds of programs. The characteristics of voucher students in existing programs differ from those of charter students, and the characteristics of charter students vary across states. Other programs might differ further still in terms of the access they provide to different groups of students. In particular, many varieties of vouchers may be used disproportionately by middle- and upper-income families.

Integration

The effects of voucher and charter programs on the sorting of students across schools have not been well explored thus far. Although studies have produced extensive amounts of demographic data on the students participating in voucher and charter programs, very few studies have provided school-level information on both voucher/charter schools and local public schools,

linked to information on individual students—which is essential to understand dynamic integration effects. Even a direct comparison of school-level integration in voucher/charter schools and conventional public schools does not tell us how the introduction of a voucher/charter policy changes levels of integration across schools. A full understanding of integration effects requires a clear assessment of all possible counterfactuals. Where would students of different racial/ethnic groups be in the absence of vouchers/charter schools? Different answers to this question imply very different effects for vouchers and charter schools. Would the students attend local public schools, would they pay tuition at racially homogeneous private schools, would their families move to the suburbs to enable them to attend racially homogeneous public schools, or would they be schooled at home? Unfortunately, no studies of vouchers or charter schools have provided the kind of dynamic analysis that would produce clear answers.

Civic Socialization

Despite the fact that civic socialization is commonly recognized as a critical public purpose of the educational system, next to nothing is known about the relative effectiveness of voucher, charter, and conventional public schools in socializing students to become responsible citizens. The best available evidence is far short of that which is available to assess each of the other outcome dimensions. The slim evidence that is available provides little support for the view that existing private schools do any worse than public schools, on average, at socializing citizens (Campbell 2001).

Implications for Policy

The Significance of Scale

Specific variations in the details of voucher/charter policies are likely to make a big difference to many of the empirical outcomes. Program scale is one variable that is likely to be especially important.

Nearly all of the existing empirical evidence on the effects of vouchers and charter schools comes from relatively small-scale programs. Many of the existing voucher programs are "escape valves" that are targeted to a small number of at-risk children. For these programs, most of the existing evidence is neutral or somewhat favorable: they provide valued new choices to low-income families and may provide achievement benefits to African American children. Although we know little about empirical effects in other dimensions—including integration, civic socialization, and cost—it seems unlikely that escape-valve programs would result in major harms on any of these dimensions. In brief, in some contexts—such as high-poverty cities with substantial African American populations, or communities that have underperforming public schools—targeted voucher programs may produce discrete benefits. Such programs will not be the silver bullet that will rescue urban education, but they are unlikely to produce the negative consequences that voucher opponents fear.

Specific variations in the details of voucher/charter policies are likely to make a big difference to many of the empirical outcomes. Program scale is one variable that is likely to be especially important.

Evidence on existing charter laws is harder to summarize because variation across states is dramatic, in terms of both the provisions of the laws and the observed empirical effects. Existing charter schools frequently satisfy a parental demand, and they are producing academic results that are mixed but show signs of promise. Other effects are ambiguous or unknown.

The implications of the findings for larger scale choice programs, however, are unclear. Generalizing from evidence on small voucher/charter programs to infer the outcomes of large-scale choice programs is not easy, for several reasons. First, the voucher experiments that provide some of the best evidence on achievement effects are "black boxes"—they do not allow a look "inside" to explain the mechanisms that produce the (apparent) achievement advantage for low-income African American children who use vouchers. The range of possible explanations for the observed achievement difference is wide, and different explanations have profoundly different implications for whether the effect would be reproduced in a larger scale program. If, for example, African American voucher students have benefited only because the voucher program put them in classrooms with high-achieving peers, then the effect might disappear in a larger scale program in which large num-

bers of low-achieving students end up in voucher classrooms together. Similarly, if the experimental advantage is attributable to a context of underperforming public schools, then a universally available alternative might show no advantage when compared to a broader range of higher performing public schools. Other mechanisms that could explain the experimental findings may be more easily duplicated on a larger scale. Until we understand the source of the experimental findings, however, we cannot know whether they will apply to larger scale programs.

Similar issues arise with respect to the studies of achievement in charter schools. The existing charter studies show mixed results, with some agreement that academic performance is lowest in the first year of a charter school's existence. Programs that seek to open large numbers of new charter schools should not expect high achievement in the short term.

Empirical effects on the dimensions of access and integration will almost certainly differ for large-scale programs. Most existing voucher programs serve low-income or other at-risk children because they are explicitly designed to do so, with eligibility tied to income or to the performance of the local public school. Universally available voucher programs, by contrast, may disproportionately benefit highly educated and upper-income families who have the means to take advantage of them, particularly if the programs are funded at low levels and permit supplemental tuition payments. Similarly, large-scale choice programs (whether vouchers or charters) are more likely to undermine school-level integration than are "escape-valve" vouchers that put low-income children in existing private schools.

The economic costs of large-scale voucher/charter programs are also highly unpredictable. They depend not only on the details of policy design, but also on the "takeup rate": the number of students who switch schools to participate in the program. Costs will go up if students switch into higher cost schools, but costs could actually decline if students switch from higher cost to lower cost schools. Escape-valve programs provide little guidance about the takeup rate of universally available programs.

Even if small-scale programs are theoretically generalizable, programs in the process of scaling up often encounter unexpected difficulties. Scale-up often results in a distortion of the original conditions by which the program was effective. Newly established voucher/charter schools may or may not be as effective as preexisting private schools. High-quality, nonprofit providers (including religious institutions) may lack the capacity and incentive to expand, and the supply may be filled largely by for-profit school operators—whose effectiveness is as yet unknown.

On the other hand, vouchers and charter schools may in some respects be easier to scale up because they can be uniquely sensitive to local needs and desires. They are chosen and implemented at the school level, rather than imposed from above, which makes them fully compatible with all school-level programmatic reforms. In consequence, they may bypass at least a few of the implementation and scale-up problems that have undermined a wide variety of educational reforms over the last 30 years. Whether they will succeed in doing so—and in producing the achievement, access, liberty, integration, and socialization outcomes desired from our schools—remains to be seen.

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A Note on Universal-Choice Systems

The most ambitious voucher/charter programs would replace the existing system of educational governance and finance with an entirely new system in which all schools are autonomous and every family must choose a school. Direct evidence on these highly ambitious proposals is very limited, because they have never been fully implemented in the United States.

Universal-choice systems would, of course, encounter many of the implementation challenges described above. In addition, however, because such proposals would directly change the entire educational system, they have the potential to create larger effects—both

positive and negative—than other varieties of programs. Systemic effects would not merely be the indirect result of competition or creaming, but would follow directly from the changes to all public schools. These proposals, therefore, could create either the greatest benefits or the greatest harms. Care in the details of design might permit the construction of a universal-choice program which could avoid negative consequences and perhaps produce substantial benefits; but predicting such benefits depends, for now, on theory rather than existing evidence.

Considerations in Policy Design

Despite the large number of uncertainties that remain about the empirical effects of vouchers and charter schools, it is possible to provide some guidance about the intelligent design of the details of voucher/charter programs. Policymakers who are considering voucher or charter laws can maximize program benefits and mitigate harms through thoughtful policy design. Here we consider a series of questions that address the relationship between policy details and empirical effects in each of the five key outcome dimensions. Because tradeoffs among desired outcomes may sometimes be necessary, the ideal design depends to some extent on how policymakers value and rank the various outcomes promoted by the educational system. Nevertheless, the relationship among outcomes is sometimes complementary rather than competitive; a few of the same policy prescriptions can serve multiple purposes. The prescriptions below should be considered tentative rather than definitive; they are promising policy options based on plausible extrapolation from the available evidence:

These prescriptions should be considered tentative rather than definitive; they are promising policy options based on plausible extrapolation from the available evidence.

How might policymakers maximize the likelihood that voucher/charter schools will be academically effective?

- Include existing private and parochial schools.
- Enforce requirements for testing and information dissemination.
- Don't skimp on resources.

How might policymakers maximize the likelihood that systemic effects on non-choosers are positive rather than negative?

- Establish communication among schools.
- Impose consequences on schools that do not perform at acceptable levels.
- Give the public schools the autonomy to act competitively.
- Require open admissions.
- Require all students to choose.

How can policymakers ensure that a substantial number of autonomous schools are available?

- Permit existing private and parochial schools to participate.
- Provide generous funding.
- Avoid overregulation.
- Do not make the local school district the exclusive chartering authority.

How can policymakers ensure that autonomous schools serve low-income and special-needs children?

- Actively disseminate information about schools.
- Target specific children.
- Forbid tuition add-ons.
- Provide generous funding.
- Use an equitable funding method.
- Provide supplemental funding for students with special needs.
- Require open admissions.

How can policymakers promote integration in programs of autonomous schooling?

- Require open admissions.
- Target communities with racially homogenous public schools.
- Include existing private and parochial schools.

- Reward integration financially.

How can policymakers ensure that voucher/charter schools are effectively socializing their students to become responsible citizens of our democracy?

- Disseminate information about mission, values, curriculum, and outcomes.

Conclusion

Our review of the evidence leaves us without a crisp, bottom-line judgment of the wisdom of voucher and charter programs. Prudent observers would note that, at the current scale of such efforts, many important questions cannot be answered at all, notably those concerning total demand, supply response, school characteristics and performance at scale, or final impact on public schools in the new equilibrium. Moreover, in important respects—notably civic socialization—the effects of current or proposed autonomous schools are virtually unknown. And design is crucial: autonomous school policy can be targeted or not, regulated or not, generously funded or not, inclusive of existing providers or not. Each of these policy levers has important implications for student outcomes. A program of vigorous research and experimentation is called for, but not one confined to choice programs: better information is needed on the performance of conventional public schools and alternative reform models as well. In the meantime, political decisions will undoubtedly be made, for and against vouchers and charter programs. They will be informed by good evidence, one hopes, but not fully justified by it for many years to come.

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Getting the Biggest Bang for the Educational Buck: An Empirical Analysis of Public School Corporations as Budget-Maximizing Bureaus

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About the Author

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Introduction

Profit-seeking organizations—deriving substantial proportions of their revenues from consumer purchases—generate dollars in a different manner than public bureaus, which derive a large portion of their revenues from taxing authorities. Consequently, the economic incentives faced by public bureaus differ from those facing private firms in ways that do not generate expected cost-effective behaviors (Barnett 1994). Still, despite the differences in organizational and economic incentives between managers of public sector organizations and private sector firms, educational researchers (e.g., Hanushek 1986; Kirst 1983; Mann and Inman 1984; Rossmiller 1987; Walberg and Fowler 1987; Walberg and Walberg 1994) are committed to improving the results of schooling through the use of

traditional economic analyses. Yet this type of research has shown that examining educational bureaus using the cost-minimizing assumptions of traditional economic theory provides mixed results at best.

The inconsistent analytical results generated by the examination of educational finance issues when using traditional economic assumptions—a relationship where financial inputs are assumed to be minimized while desired outputs are maximized—leaves a number of important questions about the nature, productivity, and efficiency of public school districts unanswered (Hentschke 1988):

- What type of incentives and constraints influence the expenditure behavior of public school districts?
- What organizational objectives are pursued by public school districts? Among these, which are maximized or optimized?
- To what extent, and under what circumstances, are individual or bureaucratic desires reflected in the organizational outcomes generated by public school districts?

The goal of this research paper is to create a common understanding about the efficient uses of public education dollars.

In light of commonly used economic analyses, these questions become particularly important given that trends in education seem to be exemplified by continued increases in organizational size, fiscal resources, and decreases in educational outcomes (Bennett 1992; Hanushek 1995; Sowell 1993).

Within the traditional economic framework, public school districts generally are labeled as economically inefficient organizations. These assertions are supported primarily by the absence of strong production function relationships. Little is known, though, about the efficiency of educational organizations when examined outside of the traditional cost-minimization framework. Consequently, the purpose of this research is to contribute to our knowledge about the efficiency of public schools by examining empirically the theory of budget-maximizing bureaucratic behavior (Niskanen 1968, 1971, 1973, 1975, 1991, 1994). Specifically, this research will examine Indiana public school corporations (i.e., school districts) to determine if they act as budget-maximizing bureaucracies; and if so, examine whether these school corporations produce educational outcomes in a manner that is economically inefficient.

Ultimately, the goal of this research paper is to create a common understanding about the efficient uses of public education dollars. Using a budget-maximizing economic theory to analyze educational bureaus provides a different, but important, perspective when examining

1. The cost-minimization assumption applied commonly to economic models of education;
2. The nature of the input-output relationship assumed to apply to educational bureaus;
3. The concepts of efficiency as they apply to educational bureaus;
4. The time-lagged effects of prior years' educational outcomes on current year budgets; and
5. The pervasive use of simple linear production functions to predict educational outcomes.

With this increased level of understanding, policymakers and the public can begin to address the more complex issue of improving the use of public resources to produce higher levels of organizational outcomes.

Background

Prior to Friedman's (1962) assertion that "educational free markets" would be more efficient at allocating educational resources than a system of public sector bureaucracies, Mises (1944) provided some of the earliest critical insights to economic theory as it related to public organizations:

> [Public] bureaus specialize in the supply of those services whose value cannot be exchanged for money at a per-unit rate . . . Consequently, bureaus cannot be managed by profit goals and the traditional economic incentives (pp. 47–49).

According to Niskanen (1971), Tullock (1965) developed the theory for a "maximizing bureaucrat" that examined personal relations and advancement procedures within public bureaus; but he did not use the general applicability of his theory to investigate budget and output behavior. Similarly, Downs (1967) focused primarily on behavior within public bureaus. He developed a comprehensive theory of internal management processes but also stopped short of investigating the consequences of maximizing behavior as it relates to budget and output performance.

Although the ideas of Mises, Tullock, and Downs form the basis for a theory that addresses budget-maximizing bureaucratic behavior, Niskanen (1968) was the first to specifically address the questions answered by traditional economic theory:

- Given differing levels of demand and supply, how much output is produced at what cost?
- How do output levels and costs vary under these changing economic conditions?
- Is the output produced efficiently or inefficiently?

The theory of budget-maximizing bureaucratic behavior states that bureaucrats attempt to maximize the agency's total budget during their tenure.

Specifically, the theory of budget-maximizing bureaucratic behavior states that subject to a budget constraint greater than or equal to the costs of supplying the output expected by a public bureau's sponsors, bureaucrats attempt to maximize the agency's total budget during their tenure (for a more complete explanation, see *Appendix*). In other words, lacking the lure of performance-based salaries and benefits as rewards for increasing organizational efficiency, public sector managers—acting as self-interested individuals seeking to maximize their own welfare—attempt to maximize their nonpecuniary benefits (e.g., prestige, scope of activities, or perquisites) through the pursuit of larger agency budgets. As a result of this budget-maximizing behavior, Niskanen hypothesizes that public bureaus generate

- budgets that are larger than optimal;
- output that may be too low when compared to expenditure levels; and
- output that is produced inefficiently.

Niskanen advances two arguments in support of his assertion that public managers act as budget-maximizing bureaucrats: *rationality* and *survival*. He claims that by personality or preparation, public administrators strive to serve their perception of the public interest. However, they cannot acquire all the information on individual preferences and production opportunities necessary to determine the public interest. In addition, he claims public administrators do not have the authority to order an action contrary to the different perceptions of the public interest held by other bureaucrats or higher level government officials. Rationally, therefore, bureaucrats must pursue preferences through the acquisition of larger and larger budgets in order to maximize their personal utility (Niskanen 1973, p. 23).

Niskanen's survival argument also suggests bureaucrats seek to maximize budgets. Two groups of people significantly influence an administrator's tenure in public office: the employees of the agency and the sponsors of the agency (e.g., taxpayers, municipal government officials, and state legislators). He claims individuals employed by public organizations not only desire budget-maximization for reasons similar to those of the bureau administrators but also can influence the agencies to seek increased budgets. Employees of public bureaus can be cooperative, responsive, and work effectively; or, they can deny information to the public sector manager in order to undermine directives. Niskanen believes the behavior of this group depends greatly on their perceived rewards for employment with the bureau. Consequently, the bureaucrat who seeks operating efficiencies without budget increases will have difficulty "buying the cooperation" of employees (Niskanen 1973, p. 24).

Niskanen asserts that at each stage of the budgetary review process, sponsors—due to a lack of time, information, and staff necessary to monitor programs—depend on public managers to propose new programs while advocating for the maintenance of existing programs. He believes this dependency is due to the fact that the total activities and budget of most bureaus are beyond the comprehensive understanding of

people who are not involved directly with the organization. Consequently, sponsors focus most of their attention advocating for budget changes and reveal their spending priorities by approving of—or disapproving of—different portions of budgets. When the preferences of sponsors are realized, bureau executives are nominated, confirmed, and supported by them repeatedly; on the other hand, bureau executives are forced to resign when sponsor preferences are not realized. Therefore, bureaucrats must attempt to realize sponsor preferences through the acquisition of larger and larger budgets or face resignation (Boyd and Hartman 1988).

There is ample evidence that bureaucrats systematically request larger budgets regardless of the level of organizational output generated. This idea has been relatively unchallenged since the claim was made (Wildavsky 1964). Wildavsky claimed bureaucrats request moderate annual budget increases in order to maximize long-term budget goals. Bush and Denzau (1977)—supported later by Lynn (1991)—found evidence that a majority of bureaucrats want and ask for increased budgets. Similarly, Blais and Dion (1991) found that bureaucrats tend to vote for political parties that favor state intervention. Young (1991) found that there is little relationship between growth of bureaus and bureaucrats' salaries. Aucoin (1991) found that budget controls are put into place by sponsors and legislators because there exists a belief that bureaus always will attempt to increase their budgets. Kiewiet (1991) found that school superintendents hold tax rates as high as possible without having to obtain voter approval. Finally, Campbell and Naulls (1991) found that bureaucrats seek larger budgets because of their values—regardless of self-interest in salary. It is this type of research literature—historical and contemporary work supporting the idea that bureaucrats believe it is in their best interest to obtain increased budgets—that affirms the necessity for exploring economic models and theories employing budget-maximizing frameworks as opposed to the cost-minimization assumptions of traditional economic analyses.

There is ample evidence that bureaucrats systematically request larger budgets regardless of the level of organizational output generated.

Research Methodology

Examining Niskanen's theory of budget-maximizing bureaus within the state of Indiana should be extremely enlightening because of the state's history of preferring low state tax rates combined with prudence in budget allocations. Prior to 1973, the state used a foundation program approach to allocate monies to its 294 school corporations. Under this approach, the state provided one-third of total education funding, with local property taxes providing the remaining two-thirds. The state formula was calculated as the difference between a common revenue level and the yield of a common property tax. In order for school corporations to generate extra revenue, high property tax levies were needed to obtain the desired revenue (Lehnen and Johnson 1989).

In 1973, the state legislature took action to control property taxes by freezing property tax levies. This action resulted in a decreased reliance on support provided locally and an increased reliance on state funds. The property tax reform program also had an unanticipated effect: It increased inequities in revenues that had been developing prior to 1973, because the property tax legislation froze an inequitable funding system in place (Lehnen and Johnson 1989). Between 1979 and 1986, the Indiana General Assembly used a combination of flat grants, percentage increases, and combinations of the two methods to increase revenues for school corporations. Despite these revenue generating measures, disparities continued at the local levels even though state aid became the dominant source of school support, providing approximately two-thirds of education funding (Bauer 1992). In 1986, recognizing that there were large disparities in the per-pupil revenues of school corporations, the state legislature provided "bottom-up" support through per-pupil allocations to ensure that low-spending corporations could increase their revenues.

Tired of waiting for the General Assembly to take meaningful action on school finance issues, the Lake Central School District filed suit in 1987 alleging the following:

1. The state of Indiana failed to provide "for a general, and uniform system of Common Schools" as outlined in the state constitution (Ind. Const. art. 8, § 1); and
2. The state of Indiana violated the Equal Protection clause outlined in the state constitution (Ind. Const. art. 1, § 23) by granting property-rich school corporations the privilege or option of generating more revenue than property-poor.

Later, forming a group called Schools Allied for Funding Equity (SAFE), the Lake Central plaintiffs also charged that state property tax limitations take fiscal control away from local school districts while aggravating funding disparities across districts.

In 1991, the House Select Committee on Primary and Secondary Education began meeting to "create legislation addressing both improvements in finance equity and general education reform" (Bauer 1992). The key component of the proposed legislation—to be enacted in the 1994 academic year—was the creation of a new funding formula that achieves the joint goals of reducing disparities in spending and tax effort. In 1993, SAFE agreed to have their lawsuit "dismissed without prejudice" with promises from then Governor Evan Bayh and the General Assembly that the year's legislative session would seek a more equitable education funding formula (Rolle 1994).

It is within this sociopolitical context—Indiana's economically conservative one—that Niskanen's theory will be examined.

Indiana's 1993 "Reward for Effort" funding system—which was to be phased in over a period of at least 6 years—seeks to provide revenue to school corporations in a more equitable manner. This approach is designed to provide low-revenue school corporations with access to higher assessed valuations per student. Despite the formula's emphasis on increasing revenues for low-spending schools, a number of revenue and tax rate limitations constrain the ability of the new school funding formula to achieve high levels of interdistrict equity quickly (Theobald and Rolle 1995). It is within this sociopolitical context—Indiana's economically conservative one—that Niskanen's theory will be examined.

Data Description

The data obtained and examined originally in this research span 10–20 academic years, 1981 through 1997, depending upon the variable examined. The variables are defined, calculated, and reported in the *Accounting and Uniform Compliance Guidelines Manual for Indiana Public School Corporations* (Indiana State Board of Accounts 1998), published jointly by the Indiana State Board of Accounts and the Indiana Department of Education's Center for Administration & Fiscal Measurement. Additionally, the study uses expenditure, output, and demographic variables specified by the state of Indiana's Performance-Based Accreditation System legislation (Ind. Code § 20-1-1.2 [1998]) and the Indiana Department of Education's Center for Assessment, Research, and Information Technology. Due to the embryonic state of Indiana's still-developing comprehensive reporting system, the number and type of school corporation variables examined are not as expansive as desired in the theoretical construction of this research. For example, college attendance rates and Scholastic Aptitude Test (SAT) scores were not available in order to provide more objective measures of school outcomes.

A few clarifications are necessary regarding some of the variables examined. The measurement of the variable representing teacher experience included *all* certified employees prior to 1986—not only classroom teachers. In lieu of actual statistics on remediation, summer school enrollment as a percent of the annual district enrollment is used as a proxy measure for the percent of students remediated. Dollars of Indiana School Incentive Awards (ISIA) received at the district level is used as a proxy for overall quality of a school corporation. More specifically, in 1989, the ISIA program began granting monetary compensation to schools showing improvement over their prior 3-year average in academic performance and attendance. Each school competes only against its own performance averages. Cash awards—based on an annual appropriation from the state assembly—go to individual schools that improve in at least two of four areas: Indiana State-

wide Test for Educational Progress (ISTEP) total battery scores, ISTEP language scores, ISTEP mathematics scores, and average daily attendance.

A special comment needs to be made regarding the exclusion of student achievement test scores as a primary outcome variable in this analysis. Despite the emphasis placed on standardized achievement test scores as a key outcome variable in education finance research, Berlin and Sum (1988)—re-emphasized in Levin and Kelly (1994)—used multivariate analyses to show that completing high school (typically measured by graduation rates) is more important economically than a student gaining an additional grade equivalent on a standardized test. This research evidence—combined with concerns that standardized exams are biased against both low-income and minority students—was the major factor that led to the exclusion of test scores as a primary outcome variable. Additionally, standardized achievement data—California Achievement Test (CAT), California Test for Basic Skills (CTBS), and ISTEP scores—were not reported by the Indiana Department of Education in a manageable (or malleable) form. Nevertheless, a form of standardized achievement still is being measured in this analysis because standardized achievement scores are included as part of Indiana's incentive grant calculation.

Completing high school (typically measured by graduation rates) is more important economically than a student gaining an additional grade equivalent on a standardized test.

Operationalization of Data

The data reviewed above form the bases for the operationalization of the variables examined in this research. After careful consideration, some variables remained unchanged; others were combined, modified, or excluded from the analysis based on the integrity of the data. Ultimately, the operational variables were assigned to one of three data categories: expenditure, outcome, or demographic. Expenditure variables represent the budget amounts that sponsors are willing to spend on education in a particular school corporation. The number of expenditure variables were reduced to include only total expenditures. Outcome variables represent the student results that sponsors are monitoring to determine how well educational services are being delivered by a school corporation. The number of outcome variables were reduced to include (1) average daily attendance rates; (2) percent of 12th-graders graduating; (3) percent of students remediated; and (4) school corporation quality. The average daily attendance rate was calculated by dividing the average daily attendance by the number of students enrolled.

The graduation rate was calculated by dividing the number of high school graduates by the number of students enrolled in the 12th grade. The percentage of students remediated was calculated by dividing summer school enrollment by the number of students enrolled during the regular academic year. School corporation quality was measured by dividing the total amount of ISIA grants allocated to a school corporation by the number of students enrolled in the district.

Demographic variables represent socioeconomic conditions that affect budget expenditures, delivery of educational services, and student outcomes. Along with variables representing city type and student enrollment, the number of demographic variables were reduced to include (1) average years of teacher experience; (2) average age of teachers; (3) number of single parent households per student; (4) student/teacher ratio; (5) median family income; (6) percent of population without high school diplomas; and (7) percent of Asian, Black, Hispanic, Native American, and White students enrolled.

Only regular school corporations are included in the analysis—special education, vocational, and cooperative school districts were excluded due to lack of data. The percentages of Asian, Black, Hispanic, and Native American students were calculated by dividing the number of each type of student by the total number of students enrolled. The percentage of White students was calculated by subtracting the total percentage of minority students from 100 and will be used in lieu of individual race categories. Unfortunately, the percentages of single parent households in a school corporation were unavailable. In the absence of this data, the number of single parent households per student is used as a substitute.

The basic budget-output model—consisting of an expenditure variable regressed onto linear and quadratic organizational outcome variables—is determined by Niskanen's original theory. The use of demographic variables is not; therefore, before a final operationalization of these variables was made, correlational analyses were used to reduce the amount of collinearity between them. Teacher age and teacher experience were correlated highly ($r \approx 0.9$); consequently, teacher age was removed from further analysis. Also, a high correlation ($r \approx -0.7$) existed between median family income and percent of individuals without a high school diploma. Finally, there was a moderate interaction $\{r : r \in [0.3, 0.6]\}$ across years between amount of teacher experience and number of single parent households per student.

Before factor analyses were conducted, the demographic variables were separated into two categories: community and school characteristics. Only the variables measuring community characteristics were subjected to principal component factor analyses with varimax rotation to develop standardized scales that measure specific combinations of demographic influences. For the 1981–85 school years, one community risk factor—family status—emerged from the analyses as a combination of median family income, percent of individuals without a high school diploma, and number of single parent households per student. For the years 1986 and beyond, when statistics on student race began to be recorded by the Indiana Department of Education, two community risk factors emerged from the analyses: (1) *family status,* consisting of inversed median family income and percent of individuals without a high school diploma; and (2) *family type,* consisting of the percentage of minority students in a school corporation and number of single parent households per student.

A major component of this research is determining whether or not Niskanen's original budget-output function represents the economic behavior of Indiana public school corporations accurately.

Therefore, four demographic variables are used in the analysis: student/teacher ratio, teacher experience, family status, and family type.

Model Specification

A major component of this research is determining whether or not Niskanen's original budget-output function represents the economic behavior of Indiana public school corporations accurately. In his presentation, Niskanen uses a simple mathematical function to represent the maximum budget that sponsors are willing to grant a bureau for an expected level of output. The function has the following properties: (1) the first derivative is a positive monotonic function over the relevant range (i.e., over some range of expected output, the sponsor is willing to grant a higher budget for a larger expected output); and (2) the second derivative is a negative monotonic function over the relevant range (i.e., over some range, the sponsor is willing to grant a higher budget for a smaller expected output).

Several types of mathematical functions share these two properties, but Niskanen uses a quadratic production function to represent the budget-output equation.

In lieu of examining every type of mathematical function that satisfies—or does not satisfy—Niskanen's mathematical assumptions, it seems appropriate to apply Weierstrass's Theorem of Polynomial Approximation (Johnson 1984). Weierstrass proved mathematically that over a closed interval any continuous function may be approximated over the whole interval by a polynomial of suitable degree. Therefore, only polynomial functions will be examined in this research. Regardless of the type (or types) of budget-output function (or functions) found to describe the economic behavior of Indiana public school corporations, they also will need to be examined while taking into account the influences of various demographic characteristics that affect education. The addition of these variables is necessary to control for different levels of student preparation. Without such controls, comparisons between districts would be unfair—similar to comparing the quality of car production between the Ford and Mercedes-Benz corporations. Therefore, the basic functional form of the four types of quadratic budget-output functions mentioned previously becomes slightly more complex and will be represented mathematically as:

$$B_t(x) = Q_{t-1}(x) \text{ ¤ } D_{t-1}(x)$$

where $B_t(x)$ and $Q_{t-1}(x)$ represent the basic functional components of a budget-output function, and $D_{t-1}(x)$ represents demographic characteristics that influence both the endogenous and exogenous variables in the budget-output function.

Measuring Efficiency

An examination of average total costs and marginal costs is warranted in the private sector because most production functions are known—this phenomenon does not exist in the public sector. Efficiency in public schools, by contrast, is concerned with how much education or knowledge is delivered to—and acquired by—students, and at what cost. Similar to the private sector, being "more efficient" means one of two things when discussing education finance and economic issues:

1. increasing output levels while using the same amounts of input, or
2. maintaining output levels while using lesser amounts of input.

Additionally, public school spending is conducted such that no student's educational situation is made worse in order to improve the situation of another student. Therefore, a different measure of production efficiency is warranted. In this research, economic efficiency is measured using the modified quadriform method (Anderson 1996; Genge 1991; Genge 1992; Hickrod et al. 1989; Hickrod et al. 1990). A quadriform is an abstract tool devised to allow a hypothesized relationship to be viewed both graphically and quantitatively (figure 1).

Unlike average-marginal cost analyses, the modified quadriform examines expenditure and output variations relative to other school corporations within the state. This method seems more appropriate to apply to public schools given that a production function for education has not yet been determined. The following four terms define the economic relationships shown by the quadriform:

- *Inefficient* school corporations are those that generate lower than expected outcomes with higher than expected expenditures (quadrant 1).

Figure 1. Basic quadriform diagram

SOURCE: Adaptation from Anderson, D.M. (1996). *Stretching the Tax Dollar: Increasing Efficiency in Urban and Rural Schools.*

- *Effective* school corporations are those that generate higher than expected outcomes using higher than expected expenditures (quadrant 2);
- *Ineffective* school corporations are those that generate lower than expected outcomes using lower than expected expenditures (quadrant 3); and
- *Efficient* school corporations are those that generate higher than expected outcomes using lower than expected expenditures (quadrant 4).

In this research, expenditures are measured along the vertical axis; output is measured across the horizontal axis.

Quantitatively, the modified quadriform is constructed as a two-stage model that (1) captures the input-output relationship as two separate regressions; and (2) uses discriminant analysis to identify the "alterable" characteristics that distinguish efficient school corporations from inefficient school corporations. (This research is concerned primarily in determining the efficiency levels of public school corporations; therefore, only the first stage of modified quadriform method will be utilized.)

If Niskanen is correct, variables measuring educational outcomes should not be statistically significant predictors of total expenditures per pupil.

Mathematically, the two regression equations are of the form

$$Z_i = \alpha + \sum B_{t-i} W_{t-i} + u_{t-i}$$

where Z_i represents the expected values—expenditure or outcome—for each school corporation and W_{t-i} represents the unalterable values for each school corporation. Consequently, the Z_i's forming the expenditure and outcome regressions create the axes of the quadriform.

The regression residuals determine which of the four quadriform categories a school corporation is assigned. More specifically, the outcome regression residual values are associated with values on the *x*-axis of a Cartesian plane. At the same time, the expenditure regression residual values are associated with values on the *y*-axis of the same Cartesian plane. Each corresponding (*x,y*) pairing of residuals represents where in the quadriform (i.e., in which of the four quadrants) a specific school corporation will be designated. Theoretically, approximately 25 percent of all school corporations should fall into each quadrant.

Unfortunately, the modified quadriform discussed shows only annual efficiency categorizations among Indiana school corporations—it does not account for school corporations remaining in or changing categories over time. In order to determine the longitudinal nature of efficiency among Indiana public school corporations, an additional layer of analysis was appended to the original modified quadriform analysis. After the initial modified quadriform analysis was completed, each school corporation was given an annual value of 1 for the category within which it fell (e.g., a school corporation may be "ineffective" in 1986 and "efficient" in 1987) and annual values of 0 for the remaining three categories. Subsequently, an arithmetic mean—which will have a value between 0 and 1 for any of the quadriform categories—was taken across all years examined. As a result, a school corporation was defined as a *perennially* efficient, effective, ineffective, or inefficient producer of educational outcomes if its school corporation average was greater than 0.50 in any category. School corporations with averages less than or equal to 0.50 were excluded from further analyses. Finally, these perennially categorized school corporations were reanalyzed within a new set of quadriforms.

Data Analysis

Consistent with Niskanen's theory, the state of Indiana's K–12 public school corporations are public bureaus that promise a bundle of activities—and expected outputs based on these activities—in exchange for a tax-supplied budget. In order to test empirically whether or not the total expenditures per pupil of public school corporations can be represented by a quadratic budget-output function that is concave-down, a series of regression equations were modeled to conform to Niskanen's original hypothesis. If Niskanen is correct, variables measuring educational outcomes should not be statistically significant predictors of total expenditures per pupil. Further, variations in total per-pupil

expenditures should not be explained by variations in outcome variables (i.e., the adjusted r-squared statistics of the regression models should be close to 0).

Analysis of Original Budget-Output Regressions

For 15 of the 17 years covering 1981–97, less than 10 percent of the variation in total expenditures per student can be explained by variations in average daily attendance (table 1). In 1984 and 1990, though, independent variables in the hypothesized function explained 15.9 and 33.9 percent, respectively, of the variation in total expenditures per student. The standardized coefficient for the linear term (a_{std}) of average daily attendance was positive for 6 of the 17 years while being a statistically significant predictor of total expenditures per student for 4 years. The standardized coefficient for the quadratic term (b_{std}) of average daily attendance was negative for 5 of the 17 years while being a statistically significant predictor for 4 years. Over the time

Table 1. Original form budget-output regressions for total expenditures per student and average daily attendance: 1981–97

Year	Coefficients for Q_{t-1}			Coefficients for $(Q_{t-1})^2$			Power
B_t	a	a_{std}	p-value	b	b_{std}	p-value	$AdjR^2$
1981	5,714.7	1.062	.001	–1802.8	–0.999	.002	0.031
1982	2,829.0	0.301	.468	–212.5	–0.049	.906	0.057
1983	–438.1	–0.045	.912	1,027.3	0.218	.587	0.024
1984	–314.1	–0.042	.882	1,279.8	0.447	.114	0.159
1985	–166.8	–0.029	.919	450.6	0.241	.398	0.039
1986	–3468.4	–0.255	.551	2,950.4	0.445	.298	0.032
1987	–463.3	–0.034	.938	1,635.2	0.245	.572	0.038
1988	–2989.3	–0.243	.538	2,995.4	0.514	.193	0.070
1989	–8284.5	–0.727	.003	5,738.0	0.950	.000	0.082
1990	–32881.6	–1.848	.000	20,655.9	2.286	.000	0.339
1991	10,501.1	0.667	.085	–4146.6	0.552	.154	0.015
1992	15,944.5	0.807	.188	–6582.9	–0.62	.312	0.033
1993	–2196	–0.098	.883	3,339.4	0.274	.679	0.025
1994	–6796.6	–0.246	.662	5,947.8	0.722	.471	0.020
1995	8,642.9	0.744	.013	–2707.1	–0.722	.015	0.015
1996	5,048.1	0.200	.733	–146.6	–0.011	.985	0.029
1997	–6949.6	–0.243	.728	6,517.8	0.424	.545	0.027

where

B_t = current year's total expenditures per student on public education
Q_{t-1} = previous year's average daily attendance
a = regression coefficient for Q_{t-1}
a_{std} = standardized regression coefficient for Q_{t-1}
$(Q_{t-1})^2$ = previous year's average daily attendance squared
b = regression coefficient for $(Q_{t-1})^2$
b_{std} = standardized regression coefficient for $(Q_{t-1})^2$
t = time in academic school years
$AdjR^2$ = amount of variation in B_t explained by variations in Q_{t-1} and $(Q_{t-1})^2$

SOURCE: Calculated from Indiana Department of Education data, 1981–97.

period examined, average daily attendance is a weak predictor of total expenditures per student, but the strongest predictive models represent functions that are concave-up.

For 16 of the 17 years covering 1981–97, less than 2 percent of the variation in total expenditures per student can be explained by variations in graduation rates (table 2). In 1994, though, independent variables in the original budget-output function explained 15.4 percent of the variation in total expenditures per student. The standardized coefficient for the linear term of the graduation rate was positive for 7 of the 17 years, while this term was a statistically significant predictor for 2 years. The standardized coefficient for the quadratic term of the graduation rate was negative for 8 of the 17 years, while this term was a statistically significant predictor for 2 years. Therefore, over the time period examined, graduation rates are a weak predictor of total expenditures per pupil, but the strongest predictive model represents a function that is concave-up.

Table 2. Original form budget-output regressions for total expenditures per student and graduation rate: 1981–97

Year	Coefficients for Q_{t-1}			Coefficients for $(Q_{t-1})^2$			Power
B_t	a	a_{std}	p-value	b	b_{std}	p-value	$AdjR^2$
1981	−1055.6	−0.292	.140	875.4	0.407	.040	0.017
1982	630.6	0.192	.359	−409.3	−0.219	.297	−0.003
1983	698.4	0.197	.338	−302.3	−0.146	.478	−0.002
1984	419.7	0.112	.594	−57.9	−0.028	.895	0.000
1985	951.6	0.291	.168	−380.1	−0.231	.274	0.002
1986	260.5	0.071	.741	−5.4	−0.003	.988	−0.002
1987	1,604.3	0.445	.048	−738.5	−0.424	.059	0.007
1988	569.7	0.152	.501	−324.7	−0.173	.443	−0.005
1989	−127.3	−0.02	.917	195.2	0.039	.838	−0.007
1990	−942.6	−0.13	.303	663.4	0.212	.093	0.006
1991	−1188.2	−0.171	.354	744.5	0.141	.443	−0.004
1992	−70.1	−0.01	.956	−60	−0.011	.953	−0.007
1993	−695.9	−0.091	.582	444.2	0.084	.611	−0.006
1994	−2817.8	−0.344	.005	2,620.4	0.678	.000	0.154
1995	−1446.5	−0.169	.298	1,056.2	0.182	.264	−0.003
1996	−1318.2	−0.149	.414	1,125.4	0.172	.346	−0.004
1997	−392.4	−0.038	.825	32.9	0.004	.980	−0.006

where

B_t = current year's total expenditures per student on public education
Q_{t-1} = previous year's average daily attendance
a = regression coefficient for Q_{t-1}
a_{std} = standardized regression coefficient for Q_{t-1}
$(Q_{t-1})^2$ = previous year's average daily attendance squared
b = regression coefficient for $(Q_{t-1})^2$
b_{std} = standardized regression coefficient for $(Q_{t-1})^2$
t = time in academic school years
$AdjR^2$ = amount of variation in B_t explained by variations in Q_{t-1} and $(Q_{t-1})^2$

SOURCE: Calculated from Indiana Department of Education data, 1981–97.

For 9 of the 10 years covering 1988–97, less than 5 percent of the variation in total expenditures per student can be explained by variations in remediation rates (table 3). In 1990, independent variables in the original budget-output function explained 6.3 percent of the variation in total expenditures per student. The standardized coefficient for the linear term of the remediation rate was positive for 6 of the 10 years, while this term was a statistically significant predictor for only 1 year. The standardized coefficient for the quadratic term of the remediation rate was negative for 4 of the 10 years, while this term was a statistically significant predictor for only 1 year. Therefore, over the time period examined, remediation rates are a weak predictor of total expenditures per pupil, but the strongest predictive model represents a budget-output function that is concave-up.

For 6 of the 8 years covering 1990–97, less than 1 percent of the variation in total expenditures per student can be explained by variations in school quality (table 4). In 1990 and 1994, though, independent variables in the original budget-output function explained 38.6 and 15.2 percent, respectively, of the

Table 3. Original form budget-output regressions for total expenditures per student and remediation rate: 1981–97

Year	Coefficients for Q_{t-1}			Coefficients for $(Q_{t-1})^2$			Power
B_t	a	a_{std}	p-value	b	b_{std}	p-value	$AdjR^2$
1981	—	—	—	—	—	—	—
1982	—	—	—	—	—	—	—
1983	—	—	—	—	—	—	—
1984	—	—	—	—	—	—	—
1985	—	—	—	—	—	—	—
1986	—	—	—	—	—	—	—
1987	—	—	—	—	—	—	—
1988	12,645.6	0.115	.483	516,370.9	0.131	.423	0.050
1989	35,046.8	0.305	.068	–487658.2	–0.126	.452	0.033
1990	–2872.3	–0.229	.176	16,619.2	0.467	.006	0.063
1991	–828	–0.084	.601	8,062.0	0.284	.079	0.036
1992	117.7	0.012	.941	1,964.7	0.071	.669	–0.001
1993	–48.5	–0.008	.974	2,993.1	0.124	.412	0.007
1994	2,248.7	0.181	.234	–1556.4	–0.047	.754	0.012
1995	209.3	0.187	.184	–4249.1	–0.155	.273	–0.001
1996	2,668.5	0.303	.003	–2421.2	–0.211	.04	0.024
1997	–543.7	–0.047	.756	8,035.3	0.258	.088	0.040

where

B_t = current year's total expenditures per student on public education
Q_{t-1} = previous year's average daily attendance
a = regression coefficient for Q_{t-1}
a_{std} = standardized regression coefficient for Q_{t-1}
$(Q_{t-1})^2$ = previous year's average daily attendance squared
b = regression coefficient for $(Q_{t-1})^2$
b_{std} = standardized regression coefficient for $(Q_{t-1})^2$
t = time in academic school years
$AdjR^2$ = amount of variation in B_t explained by variations in Q_{t-1} and $(Q_{t-1})^2$

— Not available.

SOURCE: Calculated from Indiana Department of Education data, 1981–97.

variation in total expenditures per student. The standardized coefficient for the linear term of school quality was positive for 2 of the 8 years, while this term was a statistically significant predictor for 2 years. The standardized coefficient for the quadratic term of school quality was negative for 1 of the 8 years, while this term was a statistically significant predictor for 2 years. Therefore, over the time period examined, school quality is a weak predictor of total expenditures per pupil, but the strongest predictive models represent budget-output functions that are concave-up.

Budget-Output Regressions With Demographic Variables

Niskanen's original budget-output function also needs to be examined while taking into account the influences of various demographic characteristics that affect education. The addition of variables representing these characteristics is necessary to control for different types of community and family characteristics that affect education. Without such controls, comparisons between districts with different types of external in-

Table 4. Original form budget-output regressions for total expenditures per student and school quality: 1981–97

Year	Coefficients for Q_{t-1}			Coefficients for $(Q_{t-1})^2$			Power
B_t	a	a_{std}	p-value	b	b_{std}	p-value	$AdjR^2$
1981	—	—	—	—	—	—	—
1982	—	—	—	—	—	—	—
1983	—	—	—	—	—	—	—
1984	—	—	—	—	—	—	—
1985	—	—	—	—	—	—	—
1986	—	—	—	—	—	—	—
1987	—	—	—	—	—	—	—
1988	—	—	—	—	—	—	—
1989	—	—	—	—	—	—	—
1990	–10984	–0.237	.031	102,647.2	0.832	.000	0.386
1991	–2428.5	–0.067	.649	5,379.8	0.057	.698	–0.006
1992	–5479	–0.091	.525	37,599.8	0.093	.516	–0.005
1993	–13510.3	–0.198	.209	86,359.2	0.171	.278	–0.001
1994	–50091.3	–0.604	.000	438,397.0	0.849	.000	0.152
1995	–12313.2	–0.176	.243	52,470.1	0.072	.632	0.006
1996	1.3	0.008	.964	–0.2	–0.025	.888	–0.007
1997	5.0	0.024	.891	0.3	0.040	.820	–0.003

where

B_t = current year's total expenditures per student on public education
Q_{t-1} = previous year's average daily attendance
a = regression coefficient for Q_{t-1}
a_{std} = standardized regression coefficient for Q_{t-1}
$(Q_{t-1})^2$ = previous year's average daily attendance squared
b = regression coefficient for $(Q_{t-1})^2$
b_{std} = standardized regression coefficient for $(Q_{t-1})^2$
t = time in academic school years
$AdjR^2$ = amount of variation in B_t explained by variations in Q_{t-1} and $(Q_{t-1})^2$

— Not available.

SOURCE: Calculated from Indiana Department of Education data, 1981–97.

fluences would be unfair. For each of the 17 years covering 1981–97, more than 20 percent of the variation in total expenditures per student can be explained by variations in average daily attendance and demographic characteristics (table 5). In 1984, 1985, and 1990, independent variables in the modified budget-output function explained 42.5, 38.7, and 46.7 percent, respectively, of the variation in total expenditures per student. The standardized coefficient for the linear term of average daily attendance was positive for 4 of the 17 years, while this term was a statistically significant predictor for 5 years. The standardized coefficient for the quadratic term of average daily attendance was negative for 4 of the 17 years, while this term was a statistically significant predictor for 8 years. Among the demographic variables examined, family status, family type, and student/teacher ratio were statistically significant predictors of total expenditures every year examined while teacher experience was a statistically significant predictor for 7 years. Therefore, when controlling for variations in demographic characteristics over the time period examined, average daily attendance is a moderately strong predictor of total expenditures per pupil, but the strongest predictive models represent functions that are concave-up.

For each of the 17 years covering 1981–97, more than 18 percent of the variation in total expenditures per

Table 5. Original form budget-output regressions for total expenditures per student with average daily attendance and demographic variables: 1981–97

Year	Standardized coefficients for Q_{t-1}, $(Q_{t-1})^2$, and demographic variables						Power
B_t	a_{std}	b_{std}	Family status	Family type	Student/teacher ratio	Teacher experience	$AdjR^2$
1981	*0.694	*–0.755	*–0.139	—	*–0.400	*0.178	0.205
1982	–0.166	0.310	*–0.236	—	*–0.453	*0.254	0.335
1983	–0.611	*0.680	*–0.241	—	*–0.498	*0.222	0.335
1984	–0.455	*0.785	*–0.264	—	*–0.401	*0.248	0.425
1985	*–0.528	*0.666	*–0.269	—	*–0.465	*0.318	0.387
1986	–0.667	*0.781	*–0.238	—	*–0.347	*0.152	0.218
1987	–0.138	0.256	*–0.221	*–0.235	*–0.357	0.040	0.278
1988	–0.325	0.523	*–0.297	*–0.265	*–0.290	0.030	0.316
1989	*–0.570	*0.736	*–0.251	*–0.293	*–0.271	–0.071	0.283
1990	*–1.797	*2.179	*–0.175	*–0.245	*–0.229	*–0.107	0.467
1991	0.473	–0.451	*–0.229	*–0.292	*–0.371	–0.002	0.281
1992	0.373	–0.303	*–0.176	*–0.282	*–0.396	0.036	0.299
1993	–0.419	0.512	*–0.201	*–0.290	*–0.369	–0.04	0.287
1994	–0.507	0.598	*–0.247	*–0.325	*–0.270	–0.078	0.252
1995	*0.653	*–0.666	*–0.194	*–0.354	*–0.170	–0.089	0.205
1996	–0.076	0.200	*–0.246	*–0.361	*–0.270	–0.09	0.296
1997	–0.094	0.171	*–0.263	*–0.413	*–0.296	–0.1	0.352

where

B_t = current year's total expenditures per student on public education
Q_{t-1} = previous year's average daily attendance
$(Q_{t-1})^2$ = previous year's average daily attendance squared
a_{std} = standardized regression coefficient for Q_{t-1}
b_{std} = standardized regression coefficient for $(Q_{t-1})^2$
Family status = measures influence of income and education level
Family type = measures influence of single parent household and race
Student/teacher ratio = proportion of students to teachers
Teacher experience = years of teaching
t = time in academic school years
$AdjR^2$ = amount of variation in B_t explained by variations in Q_{t-1} and $(Q_{t-1})^2$

* Denotes statistical significance at the .05 level or better.

— Not available.

SOURCE: Calculated from Indiana Department of Education data, 1981–97.

student can be explained by variations in graduation rates and demographic characteristics (table 6). In 1981 and 1994, independent variables in the modified budget-output function explained 20.9 and 37.6 percent, respectively, of the variation in total expenditures per student. The standardized coefficient for the linear term of the graduation rate was positive for 8 of the 17 years, while this term was a statistically significant predictor for 2 years. The standardized coefficient for the quadratic term of the graduation rate was negative for 9 of the 17 years, while this term was a statistically significant predictor for 2 years. Among the demographic variables examined, family status, family type, and student/teacher ratio were statistically significant predictors of total expenditures every year examined, while teacher experience was a statistically significant predictor for 8 years. Therefore, when controlling for variations in demographic characteristics over the time period examined, the graduation rate is a weak predictor of total expenditures per pupil, but the strongest predictive models represent budget-output functions that are concave-up.

For each of the 10 years covering 1988–97, more than 18 percent of the variation in total expenditures per student can be explained by variations in remediation rates and demographic characteristics (table 7). In 1990, independent variables in the modified bud-

Table 6. Budget-output function regressions for total expenditures per student with graduation rates and demographic variables: 1981–97

Year	Standardized coefficients for Q_{t-1}, $(Q_{t-1})^2$, and demographic variables						Power
B_t	a_{std}	b_{std}	Family status	Family type	Student/teacher ratio	Teacher experience	$AdjR^2$
1981	*–0.388	*0.475	*–0.135	—	*–0.389	*0.207	0.209
1982	0.082	–0.139	*–0.227	—	*–0.489	*0.254	0.318
1983	0.165	–0.192	*–0.228	—	*–0.507	*0.224	0.325
1984	0.112	–0.134	*–0.237	—	*–0.455	*0.260	0.306
1985	0.206	–0.27	*–0.269	—	*–0.488	*0.302	0.362
1986	0.018	–0.011	*–0.226	—	*–0.360	*0.159	0.196
1987	0.335	–0.356	*–0.203	*–0.236	*–0.387	0.047	0.273
1988	0.009	–0.053	*–0.270	*–0.295	*–0.333	0.029	0.277
1989	–0.069	0.094	*–0.237	*–0.336	*–0.306	–0.099	0.235
1990	–0.039	0.053	*–0.141	*–0.331	*–0.279	*–0.152	0.186
1991	–0.219	0.229	*–0.236	*–0.290	*–0.381	0.006	0.281
1992	0.005	–0.035	*–0.173	*–0.282	*–0.419	0.040	0.295
1993	–0.019	–0.003	*–0.192	*–0.293	*–0.389	–0.038	0.278
1994	*–0.356	*0.648	*–0.235	*–0.308	*–0.273	–0.068	0.376
1995	–0.131	0.119	*–0.195	*–0.347	*–0.191	–0.067	0.190
1996	–0.08	0.083	*–0.251	*–0.361	*–0.297	–0.069	0.282
1997	–0.046	0.013	*–0.264	*–0.417	*–0.313	*–0.111	0.347

where

B_t	= current year's total expenditures per student on public education
Q_{t-1}	= previous year's average daily attendance
$(Q_{t-1})^2$	= previous year's average daily attendance squared
a_{std}	= standardized regression coefficient for Q_{t-1}
b_{std}	= standardized regression coefficient for $(Q_{t-1})^2$
Family status	= measures influence of income and education level
Family type	= measures influence of single parent household and race
Student/teacher ratio	= proportion of students to teachers
Teacher experience	= years of teaching
t	= time in academic school years
$AdjR^2$	= amount of variation in B_t explained by variations in Q_{t-1} and $(Q_{t-1})^2$

* Denotes statistical significance at the .05 level or better.

— Not available.

SOURCE: Calculated from Indiana Department of Education data, 1981–97.

get-output function explained 23.2 percent of the variation in total expenditures per student. The standardized coefficient for the linear term of the remediation rate was positive for 5 of the 10 years, while never being a statistically significant predictor. The standardized coefficient for the quadratic term of the remediation rate was negative for 3 of the 10 years, while this term was a statistically significant predictor for only 1 year. Among the demographic variables examined, family status, family type, and student/teacher ratio were statistically significant predictors of total expenditures every year examined, while teacher experience was a statistically significant predictor for 2 years. Therefore, when controlling for variations in demographic characteristics over the time period examined, the remediation rate is a weak predictor of total expenditures per pupil, but the strongest predictive model represents a budget-output function that is concave-up.

For each of the 8 years covering 1990–97, more than 19 percent of the variation in total expenditures per student can be explained by variations in school quality and demographic characteristics (table 8). In 1990 and 1994, independent variables in the modified budget-output function explained 52.7 and 37.3 percent, respectively, of the variation in total expenditures per student. The standardized coeffi-

Table 7. Budget-output function regressions for total expenditures per student with remediation rates and demographic variables: 1981–97

Year	Standardized coefficients for Q_{t-1}, $(Q_{t-1})^2$, and demographic variables						Power
B_t	a_{std}	b_{std}	Family status	Family type	Student/teacher ratio	Teacher experience	$AdjR^2$
1981	—	—	—	—	—	—	—
1982	—	—	—	—	—	—	—
1983	—	—	—	—	—	—	—
1984	—	—	—	—	—	—	—
1985	—	—	—	—	—	—	—
1986	—	—	—	—	—	—	—
1987	—	—	—	—	—	—	—
1988	–0.107	0.228	*–0.270	*–0.280	*–0.325	0.006	0.290
1989	0.201	–0.116	*–0.225	*–0.303	*–0.313	–0.101	0.241
1990	–0.216	*0.407	*–0.132	*–0.308	*–0.275	*–0.167	0.232
1991	–0.127	0.236	*–0.224	*–0.270	*–0.375	0.003	0.291
1992	0.033	0.058	*–0.163	*–0.274	*–0.428	0.044	0.301
1993	–0.042	0.181	*–0.178	*–0.290	*–0.403	–0.034	0.296
1994	0.070	0.049	*–0.219	*–0.319	*–0.306	–0.07	0.254
1995	0.085	–0.077	*–0.188	*–0.342	*–0.200	–0.071	0.189
1996	0.153	–0.112	*–0.231	*–0.344	*–0.307	–0.062	0.288
1997	–0.033	0.163	*–0.239	*–0.405	*–0.313	*–0.099	0.363

where

B_t	= current year's total expenditures per student on public education
Q_{t-1}	= previous year's average daily attendance
$(Q_{t-1})^2$	= previous year's average daily attendance squared
a_{std}	= standardized regression coefficient for Q_{t-1}
b_{std}	= standardized regression coefficient for $(Q_{t-1})^2$
Family status	= measures influence of income and education level
Family type	= measures influence of single parent household and race
Student/teacher ratio	= proportion of students to teachers
Teacher experience	= years of teaching
t	= time in academic school years
$AdjR^2$	= amount of variation in B_t explained by variations in Q_{t-1} and $(Q_{t-1})^2$

* Denotes statistical significance at the .05 level or better.

— Not available.

SOURCE: Calculated from Indiana Department of Education data, 1981–97.

cient for the linear term of school quality was positive for 1 of the 8 years, while this term was a statistically significant predictor for 2 years. The standardized coefficient for the quadratic term of school quality was negative for 2 of the 8 years, while being a statistically significant predictor for 2 years. Among the demographic variables examined, family status, family type, and student/teacher ratio were statistically significant predictors of total expenditures every year examined, while teacher experience was a statistically significant predictor for 2 years. Therefore, when controlling for variations in demographic characteristics over the time period examined, school quality is a weak predictor of total expenditures per pupil, but the strongest predictive models represent budget-output functions that are concave-up.

Niskanen and Modified Quadriform Analyses

Figure 2 shows total expenditures per student within quadriforms of perennially categorized school corporations for average daily attendance, graduation rates, remediation rates, and school quality. Just under 13 percent of school corporations in Indiana are inefficient producers of average daily attendance compared to 27 percent that are efficient producers. Twelve percent of Indiana school corporations are inefficient producers of graduation rates com-

Table 8. Budget-output function regressions for total expenditures per student with school quality and demographic variables: 1981–97

Year	Standardized coefficients for Q_{t-1}, $(Q_{t-1})^2$, and demographic variables						Power
B_t	a_{std}	b_{std}	Family status	Family type	Student/teacher ratio	Teacher experience	$AdjR^2$
1981	—	—	—	—	—	—	—
1982	—	—	—	—	—	—	—
1983	—	—	—	—	—	—	—
1984	—	—	—	—	—	—	—
1985	—	—	—	—	—	—	—
1986	—	—	—	—	—	—	—
1987	—	—	—	—	—	—	—
1988	—	—	—	—	—	—	—
1989	—	—	—	—	—	—	—
1990	*–0.245	*0.798	*–0.142	*–0.247	*–0.268	*–0.097	0.527
1991	–0.039	–0.021	*–0.230	*–0.290	*–0.387	0.004	0.279
1992	–0.001	–0.026	*–0.177	*–0.280	*–0.421	0.039	0.295
1993	–0.08	0.033	*–0.204	*–0.280	*–0.382	–0.035	0.280
1994	*–0.531	*0.762	*–0.218	*–0.331	*–0.254	–0.077	0.373
1995	–0.075	0.014	*–0.185	*–0.343	*–0.193	–0.074	0.192
1996	–0.02	0.000	*–0.245	*–0.362	*–0.301	–0.072	0.282
1997	0.058	0.019	*–0.276	*–0.410	*–0.313	*–0.120	0.352

where

B_t	= current year's total expenditures per student on public education
Q_{t-1}	= previous year's average daily attendance
$(Q_{t-1})^2$	= previous year's average daily attendance squared
a_{std}	= standardized regression coefficient for Q_{t-1}
b_{std}	= standardized regression coefficient for $(Q_{t-1})^2$
Family status	= measures influence of income and education level
Family type	= measures influence of single parent household and race
Student/teacher ratio	= proportion of students to teachers
Teacher experience	= years of teaching
t	= time in academic school years
$AdjR^2$	= amount of variation in B_t explained by variations in Q_{t-1} and $(Q_{t-1})^2$

* Denotes statistical significance at the .05 level or better.

— Not available.

SOURCE: Calculated from Indiana Department of Education data, 1981–97.

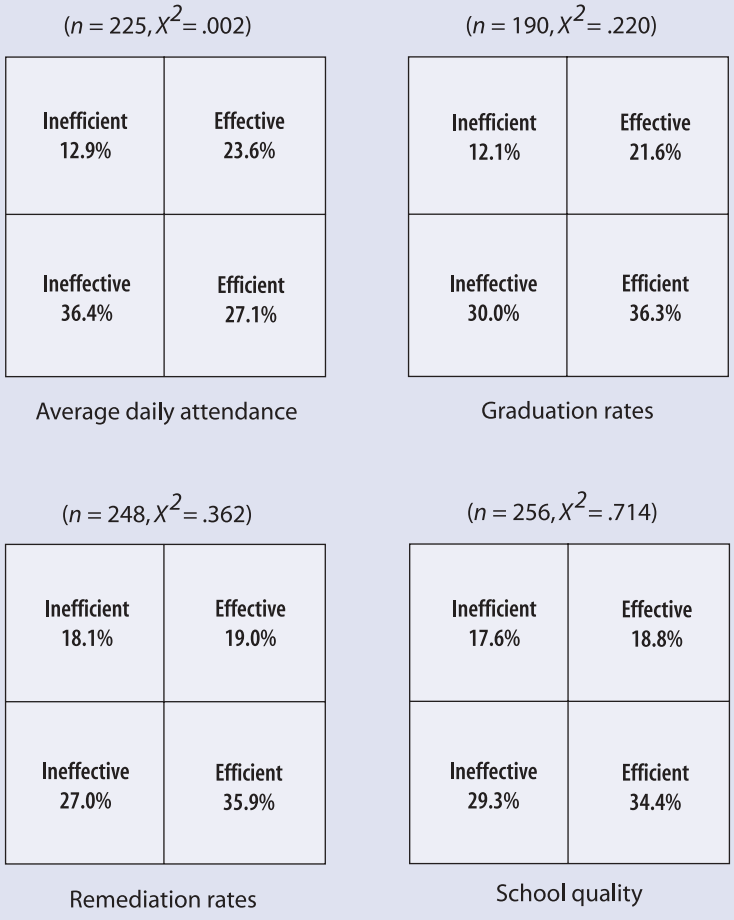
pared to 36 percent that are efficient producers. Eighteen percent of Indiana school corporations are inefficient producers of low remediation rates compared to 36 percent that are efficient producers. Over 17 percent of Indiana school corporations are inefficient producers of school quality compared to 34 percent that are efficient producers.

Statistically significant differences in expected values versus actual values within the "cell" categories were found only in the quadriform measuring average daily attendance. Therefore, in contrast to Niskanen's analytical conclusion that the entire system of Indiana school corporations is an inefficient producer of educational outcomes, modified quadriform analyses of perennially categorized corporations show that approximately 15 percent of the state's school corporations produce educational outcomes in a manner that is economically inefficient. Additionally, more than 30 percent of Indiana public school corporations were found to be economically efficient producers of educational outcomes. Finally, it is necessary to note one unexpected observation: *On average, more Indiana school corporations produce educational outcomes in a manner that is economically ineffective than at levels that are economically inefficient.*

Conclusion

In contrast to Niskanen's hypothetical assertions, expenditure-outcome relationships for Indiana public school corporations were found to be represented best by budget-output relationships that are *concave-up*. Further, analytical evidence in this research suggests that some statistically significant relationships *do exist* between the current year's total expenditures per stu-

Figure 2. Modified quadriform analysis for total expenditures per student across years 1981–97



SOURCE: Calculated from Indiana Department of Education data, 1981–97.

dent and previous year's organizational outcomes. Average and marginal total expenditures per student for the production of education were not found to be equal. On the other hand, modified quadriform analyses showed that the Indiana public school system has twice as many economically efficient school corporations as inefficient ones. Therefore, Indiana public school corporations cannot be designated as budget-maximizing agencies in the context defined by Niskanen's theory.

Budget-Output Functions

Niskanen's theory of budget-maximizing bureaus hypothesizes that expenditure data for Indiana public school corporations should be represented best by quadratic budget-output functions that are concave-down. Additionally, he claims no statistically significant relationships should exist between the current year's total expenditure per student and previous year's organizational outcomes. As a result of these two occurrences, the system of Indiana public schools will be inefficient producers of educational outcomes. After examining Niskanen's original hypothesis empirically, evidence suggests that expenditure data for Indiana public school corporations are represented best by budget-output functions that are concave-up. Moreover, statistically significant relationships do exist between current year total expenditures per pupil and previous year educational outcomes—notably when considering average daily attendance.

Indiana public school corporations cannot be designated as budget-maximizing agencies in the context defined by Niskanen's theory.

After controlling for various demographic characteristics, stronger evidence exists that expenditure data for Indiana public school corporations are represented best by budget-output functions that are concave-up. Moreover, some statistically significant—and stronger—relationships do exist between current year total expenditures per pupil and previous year educational outcomes when controlling for demographic characteristics—especially when considering average daily attendance. It is important to note that every year demographic variables were included in the predictive models that family status, family type, and student/teacher ratio had negative—but statistically significant—relationships with total expenditures per student. In other words, school corporations with large percentages of low-income families, individuals without high school diplomas living in the community, minority students, single-parent households, and high student-teacher ratios tended to receive less money per student—on average—than school corporations without these characteristics. Still, despite the constant statistical significance of the demographic variables, educational outcome measures maintained stronger relative predictive strength among all variables in the budget-output models.

Economic Efficiency

The final portion of Niskanen's theory charges that average and marginal total expenditures per student for the production of educational outcomes will not be equal; therefore, Indiana public school corporations will produce educational outcomes inefficiently. After examining this hypothesis empirically, the average total expenditures per student for Indiana public school corporations were found to be unequal to their marginal costs. This lack of equality existed across all years examined regardless of which of the four outcome variables—average daily attendance, graduation rates, remediation rates, and school quality—were employed in the analysis. Further, over the years examined, remediation rates and school quality had mean differences that were statistically significant more than 50 percent of the time. Therefore, according to Niskanen's criteria, Indiana public school corporations produce educational outcomes in a manner that is economically inefficient.

Unlike the average-marginal cost analyses, the modified quadriform examines expenditure and output variations among individual corporations. When examining total expenditures per student across all educational outcome categories (i.e., total expenditures per student within quadriforms of perennially categorized school corporations for average daily attendance, graduation rates, remediation rates, and school quality), modified quadriform analyses of perennially categorized corporations show that approximately 15 per-

cent of the state's school corporations produce educational outcomes in a manner that is economically inefficient. On the other hand, more than 30 percent of Indiana public school corporations were found to be economically efficient producers of educational outcomes. It is important to note one unexpected observation: On average, more Indiana school corporations produce educational outcomes in a manner that is economically ineffective (30.7 percent) than at levels that are economically inefficient.

Implications for Indiana Public School Corporations

Even though the conclusions based in this research are well-grounded, there still is a need to replicate the statistical and mathematical modeling presented using more comprehensive data. This reanalysis should be conducted both for total expenditures per pupil as well as other expenditure categories (e.g., instructional expenditures per student). The analyses should focus specifically on two aspects of the theory of budget maximization: (1) Determining stronger predictive relationships between expenditures as outputs and educational outcomes as inputs; and (2) Determining accurate mathematical models of sponsor preferences. With further research into these two types of models, a determination of whether bureaus spend in accordance to sponsor preferences will be easier to discern.

Given the recent changes in the state education funding formula that were designed to improve the availability of revenue for low-wealth school corporations, it is surprising that the effects of demographic variables remain so prevalent.

Similar to discovering stronger predictive relationships between expenditures and educational outcomes, research conducted to improve the use of quadriform analyses also is warranted. Though the method is sound analytically, the use of regression analyses to determine the axes of the quadriform may lead to "questionable" placement of school corporations. It is important to remember that the axes of the quadriform are being developed while attempting to control for demographic characteristics that exist in school corporations. It may be better to develop only the expenditure axes based on demographic characteristics while basing the educational outcome axes on *desired* outcomes as opposed to actual averaged outcomes. This small change will show which school corporations are efficient at producing educational outcomes relative to others in Indiana. Moreover, this change also will show which school corporations are efficient at achieving the educational goals desired by parents, teachers, and policymakers in the state.

With demographic characteristics being statistically significant—and having a consistently negative influence on expenditures—in most of the analyses conducted in this research, a more thorough examination of their influences on education expenditures in the state of Indiana is warranted. Given the recent changes in the state education funding formula that were designed to improve the availability of revenue for low-wealth school corporations, it is surprising that the effects of demographic variables remain so prevalent. It will be important to discover what types of school districts—suburban or rural corporations versus large or small corporations—are affected by these demographic characteristics and what causes the consistently negative relationship with expenditures per student.

Finally, the most surprising conclusion from the analysis in the research is the large percentage of schools classified as ineffective in producing educational outcomes. On average, this grouping of districts was second only to efficient school corporations. Initially, a descriptive analysis of this group of school corporations would provide insight to what factors lead to their perennially low expenditure levels, educational outputs, and potential underservicing of their student populations. Further, if these schools are underfunded due primarily to changes in the state's school funding formula, a re-examination of the formula is necessary as questions about the type of equity goals desired in Indiana resurface.

Implications for Budget Maximization Theory

Niskanen claimed that sponsor preferences should be represented best by budget-output equations that are concave-down, quadratic functions. Niskanen's first and second derivative criteria assume that sponsors are willing to pay for services up to a certain expenditure level. Evidence from Indiana public school corporations shows that statistically significant relationships between expenditures and outputs are represented best by quadratic functions that are concave-up. Concave-up functions represent economic behaviors to the converse of Niskanen's derivative assumptions: A reluctance to pay for services until a given impetus is received (small budgetary increases over time). This empirical evidence is consistent with the conservative nature of the Indiana legislature's fiscal policy. Therefore, a change to Niskanen's theory may be first to examine the fiscal history of a particular sponsor's expenditure preferences before determining the concavity of their budget-output functions.

Further, if the concavity assumptions of Niskanen's theory are dependent on particular sponsor preferences at specific times, it is doubtful that bureaus attempt to pursue the spending preferences of their sponsors. Given the nature of state politics, individuals managing bureaus and sponsors—in conflict over differences with respect to values, preferences, beliefs, perceptions of reality, and access to information—struggle for power and the capacity to distribute scarce resources. As a result of this conflict, the ability to bargain, negotiate, and compromise becomes the most important asset utilized by actors in the system. The resulting web of compromises generates a confusing multiplicity of objectives—many in opposition to one another—that emerge as organizational and political goals. Therefore, it seems more likely that bureaus attempt to spend money on programs that will achieve organizational goals while also spending money on programs that appease sponsors. In short, bureaus may not pursue sponsor preferences specifically due to their complex nature and a desire to balance technical and allocative efficiency objectives.

Given the difficulty of defining sponsor preferences, it will be equally difficult to define these complex expenditure-outcome relationships mathematically. For Indiana school corporations, strongly predictive budget-output relationships were found generally around specific years: 1984, 1990, and 1994. Not coincidentally, these also are years when the Indiana legislature made changes in the state's education finance formula. At these particular times, it seems appropriate that strong mathematical relationships should exist between expenditures and educational outcomes. At other times, when various and multiple sponsor preferences are being pursued, it becomes more difficult to find specific mathematical relationships. As such, it seems inappropriate for a bureau's level of efficiency to be measured as a pursuit of what could be the unattainable: an accurate and logical mathematical representation of a state's legislative process. The difficulty in developing this mathematical relationship may be a primary reason that a primary educational production function (or production functions) is yet to be found.

Finally, the attempted coupling of a bureau's expenditure patterns to sponsor preferences also raises questions about the appropriateness of using traditional average-marginal costs analyses as the primary determinant of efficiency within an organization. Average–marginal expenditure analyses usually are reserved for production activities that are well defined. Government spending for public services—such as education—is not one of these activities. Therefore, the use of a method like the modified quadriform analyses seems more appropriate. Here, acknowledging that a primary production function does not exist, efficiency is based on those organizations that are efficient producers of outcomes relative to those that are not. At this point, instead of pursuing a specific economic or mathematical relationship—that very likely will not be found—a series of "best practices" can be developed by examining what the efficient bureaus are doing and what the inefficient bureaus are not.

Appendix: Theory of Budget-Maximizing Bureaucratic Behavior

Most of traditional economics deals with the behavior of profit-seeking firms, owners of production factors, and consumers. Since most economic activity is organized through profit-seeking firms by the voluntary exchange of production factors for capital, and of capital for consumer goods, this methodology is appropriate for market exchanges. Economists also have developed an elaborate structure of widely accepted propositions about what public goods and services ought to be supplied. However, even the theory of public goods rests on the assumption that public agencies—even though financed by government—will behave similarly to those in a competitive industry. Public choice theory—the field of economics that encompasses budget-maximization theory—offers an alternative framework to traditional economic analyses (Buchanan and Tollison 1984; Downs 1998; Peacock 1992). Using this alternative framework challenges not only cost minimization assumptions, but also allows for a discussion on the structure of educational bureaucracies as well as ideas of efficiency and accountability in education.

In *Bureaucracy and Representative Government* (1971), Niskanen developed a theory of supply for public bureaus that is

> based on a model of purposive behavior by the manager of a single bureau. . . . not to explain the actions of individuals but to generate hypotheses concerning aggregate consequences of the interaction among individuals (p. 5).

This construction is similar to the theory of supply that is based on the model of the profit-seeking firm. In this instance, though, the bureaucrat is the central figure—the "chooser" or the "maximizer"—and is assumed to

- face a set of possible actions;
- have personal preferences among the outcomes of these actions; and
- choose the action within the possible set that is preferred.

The larger political and organizational environment also is believed to influence the behavior of the bureaucrat by constraining sets of possible actions; changing relationships between actions and outcomes; and influencing preferences (Niskanen 1971, p. 7).

The central motivational assumption for a business manager is that when profits of the firm are maximized, personal utility can be maximized in a variety of pecuniary and nonpecuniary ways (Niskanen 1971, pp. 36–37). Similarly, Niskanen believes bureaucrats also need to be recognized as individuals who maximize personal utility and not as those devoted solely to promoting the general welfare or the interests of the state. Consequently, several variables may enter a bureaucrat's personal utility function: salary, perquisites of the office, public reputation, power, patronage, output of the bureau, ease of making changes, and ease of managing the bureau. Moreover, he claims that during a bureaucrat's tenure in office, all of these variables—except the last two—are a positive monotonic function of the bureau's total budget. Niskanen believes it is not necessary that a bureaucrat's utility be strongly dependent on each variable increasing in conjunction with the budget, but only that increases are associated positively with the level of the budget. Consequently, budget maximization becomes an adequate proxy even for those bureaucrats with relatively low pecuniary motivations and relatively high motivations for attending to the public interest (Niskanen 1971, pp. 38–39).

Ultimately, Niskanen gives the most complete definition of the central motivational assumption for budget-maximization theory:

> Subject to the constraint that the budget must be greater than or equal to the minimum total costs of supplying the output expected by the bureau's sponsor, bureaucrats maximize their total budget of their bureau during their tenure.

He adds the "budget constraint" maxim because any bureau, during any budget period, may supply more or less than the expected level of output. However, over time, every bureau will be constrained to supply the output expected by the sponsor. A bureau that consistently promises more than it can deliver is penalized by the discounting of future promises and the receipt of lower budgets. Conversely, a bureau that

performs better than expected is likely to be rewarded by higher future budgets (Niskanen 1971, p. 42).

Budget-Output Function

From the vantage point of the bureau, Niskanen asserts that the preferences of the sponsor can be summarized mathematically by a *budget-output function* (Niskanen 1971, p. 25). Any point represented by this function represents the maximum total budget a sponsor is willing to grant to the bureau for a specific expected level of output. The function has the following properties:

- Over some range of expected output, the sponsor is willing to grant a higher budget for a higher expected output. (The first derivative is a positive monotonic function over the relevant range.)
- Over some range, the sponsor is willing to grant a higher budget per unit of output for a smaller than expected output than for a larger than expected output. (The second derivative is a negative monotonic function over the relevant range.)

Several types of equations share these two properties, but Niskanen uses a quadratic function of the following form to represent the concave-down budget-output function:

$$B_t = aQ_{t-1} - bQ_{t-1}^2 \text{ subject to } Q_{t-1} : Q_{t-1} \in [0, a/2b]$$

where,

$B_t \equiv$ maximum total budget sponsor is willing to grant to bureau during a specific time period;

$Q_{t-1} \equiv$ expected level of output by bureau during a specific time period;

$t \equiv$ time in academic years; and,

$a, b \equiv$ the coefficients for Q_{t-1} and Q_{t-1}^2, respectively.

He claims a total budget-output function is a necessary building block for a theory of supply by bureaus because the exchange of promised activities and expected output for a budget is conducted "entirely in total" rather than in "unit" terms. The budget-output function, therefore, should be considered to be the product of two relationships: (1) the relationship between budget and level of service; and (2) the relationship between level of service and output (Niskanen 1971, pp. 25–26).

Furthermore, Niskanen states that a bureaucrat usually can estimate the sponsor's budget-output function fairly accurately from previous budget reviews, from recent changes in the composition of the collective organization, and by the levels of influence different constituencies exert on the sponsor. In addition, he believes a bureaucrat also possesses greater knowledge about the cost and production factors for the services provided than members of the sponsor organization do. In contrast, budgets offered by the bureau reveal little about the minimum budget amount that would be sufficient to supply a given output. Therefore, Niskanen claims, a bureaucrat needs relatively little information—most of which can be estimated by the revealed preferences of the sponsor—to exploit the position as a monopoly supplier of a given service. The members of the collective organization, on the other hand, need a great deal of information—little of which can be estimated from revealed behavior—to exploit their position as a monopsony buyer of services. Therefore, the theory Niskanen developed originally assumed that the sponsor is passive and knows the largest budget it is prepared to grant for an expected level of services. These characteristics are assumed because there is no incentive or opportunity for the sponsor to obtain information on the minimum budget necessary to supply this service (Niskanen 1971, pp. 29–30).

Finally, Niskanen's completed theory of budget-maximizing bureaucratic behavior states that subject to a budget constraint greater than or equal to the costs of supplying the output expected by a bureau's sponsors, bureaucrats attempt to maximize an agency's total budget during their tenure. As a result of this budget-maximizing behavior, Niskanen concludes that bureaus generate output that is produced inefficiently. Therefore, if the general theory of budget-maximizing bureaucratic behavior holds, expenditures for a public bureau should be represented by a quadratic budget-output function that is concave-down, with no statistically significant relationships between the current year's total budget and its previous year's organizational outcomes, and with average costs of production that are not equal to marginal costs of production (Niskanen 1971, pp. 49–50).

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Occupational Choices and the Academic Proficiency of the Teacher Workforce

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Introduction

Recent research continues to support assertions by policymakers and professional educators that teacher quality is of paramount importance in promoting higher levels of student achievement. Among schooling characteristics, teacher effectiveness has been shown to explain the largest share of the variation in student achievement (Rivkin, Hanushek, and Kain 1998; Goldhaber, Brewer, and Anderson 1999). Differences in teacher quality have been found to explain more than one grade level equivalent of performance on standardized tests by their students (Hanushek 1992). Moreover, the impact of having particular teachers appears to explain students' achievement growth for several years (Sanders and Rivers 1996; Wright, Horn, and Sanders 1997).

There is broad agreement on the critical importance of teachers. However, there are also longstanding concerns about the quality of the current K–12 teacher workforce.[1] Dating back to the early and mid-1980s, commissions such as the National Commission on Excellence in Education (1983), the Carnegie Forum on Education and the Economy (1986), and more recently, the National Commission on Teaching and America's Future (1996) have all stressed the importance of teachers and the need to upgrade the skills of the teacher workforce. Today, teachers are better qualified, by some measures, than other college graduates. We find that teachers are more likely to hold advanced degrees and tend to have higher undergraduate grade point averages. But teachers also tend to be less academically proficient as measured by college entrance exam scores, the number of remedial courses

[1] Unless otherwise noted, we limit our discussion of teachers to those employed by public sector local education agencies.

they take in college, and the selectivity of the undergraduate colleges from which they graduate (Henke, Geis, and Giambattista 1996).

Some have suggested large across-the-board salary increases as a means of addressing concerns about the academic proficiency of the teacher workforce (as well as perceived teacher shortages). Others, however, point out that across-the-board increases may not be a particularly effective means of drawing more skilled personnel into teaching (Ballou and Podgursky 1995, 1997). In this paper, we investigate the hypothesis that observed differences in demonstrated academic proficiency may be due to the dissimilarity between teaching and other occupations in the *structure* of compensation. That is, we explore how compensation structures influence the career path decisions of prospective teachers.

We use data from the Baccalaureate and Beyond Longitudinal Study (B&B) to estimate the probability of progress through the teacher pipeline of a cohort of academic year (AY) 1992–93 college graduates. We find that, among other factors, college selectivity and college entrance exam scores predict progress through the teacher pipeline. We then estimate the returns to various attributes in the teacher and non-teacher labor markets and find that, while the public sector teacher labor market primarily rewards experience and advanced degree, the non-teacher labor market rewards these two attributes as well as college selectivity and technical major. These differential returns imply opportunity costs to enter the teaching profession that vary systematically based on an individual's college and undergraduate major.

This paper is arranged as follows: first, we provide background literature examining the relationship between teacher quality and opportunity costs. Second, we describe the data used in our analyses. Third, we present results from models describing the probability of progress through several stages of the teacher pipeline as well as salaries in chosen occupations. Fourth, we simulate opportunity costs of entering the teaching profession for men and women with different academic backgrounds. Finally, we offer some concluding thoughts on policy implications and our research agenda.

Background

Teacher Quality and Effectiveness

Using holistic measures of effectiveness that include observable and unobservable attributes, educational research has shown the overall impact of teacher quality to be the most important predictor of student achievement among school-related variables. Rivkin, Hanushek, and Kain (1998) estimate that, at a minimum, teacher quality accounts for 7.5 percent of the total variation in student achievement, a much larger share than any other educational input such as class size. This estimate is similar to that of an analysis by Goldhaber, Brewer, and Anderson (1999), who found that just over 8 percent of the variation in student achievement is due to differences between teachers.

Researchers and professional educators have been unable to reach a consensus on a concise set of teacher characteristics that correlate with student achievement.

These findings strongly suggest that raising the quality of the teacher workforce may be an effective lever for policymakers to raise student achievement levels. However, researchers and professional educators have been unable to reach a consensus on a concise set of teacher characteristics that correlate with student achievement. Goldhaber, Brewer, and Anderson (1999), for instance, estimated that only 3 percent of the contribution teachers make toward explaining student achievement is correlated with teacher experience, degree level, and other teacher characteristics included in their statistical model (e.g., race and gender). The remaining 97 percent is associated with teacher qualities or behaviors that could not be isolated and identified, such as understanding how children learn, being able to convey academic content, and connecting with the community. These traits and actions are certainly components of teacher quality but are difficult to include in statistical analyses.

Among studies that focus on observable inputs, relatively few studies that relate teacher characteristics to student outcomes include variables designed to measure the academic skills of teachers. Research that does include these attributes, however, tends to show correlations with teacher effectiveness. For example, studies all the way back to and including Coleman and Campbell (1966) have found teacher performance on a variety of standardized tests to be a good predictor of student achievement.[2]

While not all studies show a positive relationship between measures of teacher academic skills and student outcomes,[3] a meta-analysis by Greenwald, Hedges, and Laine (1996) suggests that teacher academic skills are correlated with student outcomes more often than characteristics such as graduate education and experience levels. Of the 24 studies of teacher ability reviewed, 50 percent reveal a positive and statistically significant effect, 4 percent a negative and statistically significant effect, and 46 percent no statistically significant effect.[4] This contrasts with studies of teacher experience and teacher education in which 72 percent of 46 studies and 68 percent of 68 studies, respectively, fail to show statistically significant effects.

A meta-analysis suggests that teacher academic skills are correlated with student outcomes more often than characteristics such as graduate education and experience levels.

Unfortunately, the teacher workforce tends to consist of college graduates of lesser academic proficiency: teachers are more likely to be drawn from the lower end of the distribution of standardized test scores and are more likely to have taken remedial coursework in college relative to their college graduate counterparts (Henke, Gies, and Giambattista 1996). Moreover, several studies suggest that this trend has become more pronounced in recent decades (Ballou 1996; Murnane and Singer 1991; Turner 1998; Vance and Schlechty 1982).

Compensation Structures

The differences between the structures of compensation in the teacher and non-teacher labor market may in part explain why individuals with stronger demonstrated academic skills tend to choose professions other than teaching. Although diverse, research on the structure of compensation in the non-teacher labor market suggests there are rewards for productivity on the job. Bretz and Milkovich (1989), for instance, estimate that 93 to 99 percent of private sector firms use some type of pay-for-performance plan for salaried individuals. Often, it takes an indirect form where individuals are rewarded for characteristics correlated with productivity. Studies have shown that the private sector labor market provides financial rewards for individuals who graduate from more selective colleges (Brewer, Eide, and Ehrenberg 1999) and who have higher standardized test scores (Murnane and Willet 1995).

In contrast, the explicit compensation structure used in over 95 percent of public local education agencies (LEAs) is known as the single salary schedule. This compensation structure differs significantly from that of most other occupations because it typically rewards only two characteristics within a given LEA: teacher experience and degree level (Odden and Kelley 1997). It is important to note that despite its rigidity, the teacher labor market may still reward individual characteristics such as college selectivity and undergraduate major. For example, there may be informal sorting of teachers

[2] Ferguson (1998), for instance, found measures of teachers' literacy skills, as measured by the Texas Examination of Current Administrators and Teachers, were associated with student achievement gains on mathematics tests, and Ferguson (1996) found a relationship between teachers' American College Testing Program (ACT) scores and students' fourth-grade reading test scores. Ehrenberg and Brewer (1994) found that college selectivity predicted students' test performance, and Strauss and Sawyer (1986) found a relationship between teachers' performance on licensure exams and students' test scores.

[3] For example, see Summers and Wolfe (1977) and Pugach and Raths (1983).

[4] Greenwald, Hedges, and Laine (1996) classify all teacher background characteristics as teacher ability except for teacher education and teacher experience. Examples include verbal and quantitative test scores.

on the salary schedule *within* an LEA that leads to differential rewards for characteristics *other than degree and experience levels*.[5] Additionally, we may observe sorting of teachers *between* LEAs if, for example, teachers from more selective colleges tend to teach at higher paying schools. Empirical evidence suggests that teachers with strong academic skills tend to migrate to LEAs and schools with high socioeconomic and high-achieving students (Lankford and Wyckoff 2000).

Such structural differences between the teaching profession and all other occupations suggest opportunity costs that vary markedly depending on individual background characteristics. For instance, if the non-teacher labor market rewards college selectivity more than the teacher labor market, we may predict that individuals who attend more selective colleges make greater financial sacrifices to enter the teaching profession relative to those who attend less selective colleges. Similarly, if the premium for majors such as math, science, or engineering is greater in the non-teacher labor market relative to the teacher labor market, we may predict similar differences in the opportunity cost of entering the teaching profession.

Structural differences between the teaching profession and all other occupations suggest opportunity costs that vary markedly depending on individual background characteristics.

The Teacher Pipeline

The purpose of this paper is to better understand career decisions related to the teaching profession made by recent college graduates. The teacher pipeline is a useful theoretical construct that provides a framework for a discussion of the supply of K–12 teachers. Our theoretical pipeline is presented in figure 1. Each node in the pipeline is based on a question from B&B (discussed below). The first node is based on the question, "*Have you ever trained or worked as a teacher at the preschool, grade school, or high school level, or are you currently considering teaching at these levels?"* Related questions pertain to completion of a student teaching class or a teacher certification program, or both, but fall outside the scope of this paper. Individuals who answer yes to the first node are then asked, *"Beginning around your graduation, how many applications for teaching positions have you submitted?"*

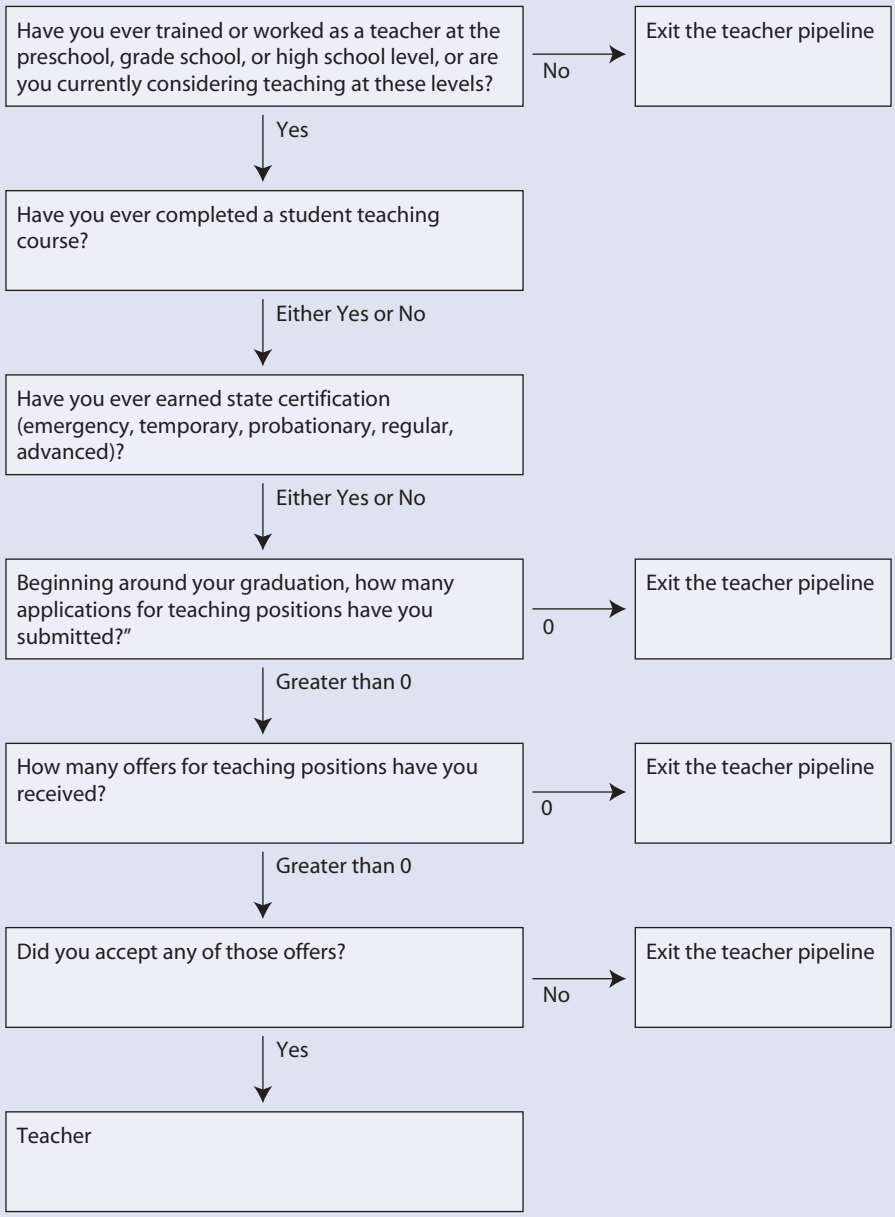
The subsequent nodes in the teacher pipeline are based on the questions *"How many offers for teaching positions have you received?"* and *"Did you accept any of those offers?"* These stages are fundamentally different from the previous two in that they reflect demand side forces in the teacher labor market. LEAs play the primary role in providing job offers, and accepting an offer is conditional on receiving at least one job offer.

If there are differentials between the teacher labor force and other recent college graduates on measures of academic skills, how are they reflected, if at all, in the various stages of the pipeline leading up to employment? Research on pathways to the classroom that compares teacher candidates to other college graduates suggests that attrition is spread throughout the pipeline. High school seniors who intend to major in education score lower on college entrance exams than their college-bound peers (Gitomer, Latham, and Ziomek 1999). Henke, Chen, and Gies (2000) and Henke, Gies, and Giambattista (1996) found that the college entrance examination scores for those who prepared to teach, were teaching, or were considering teaching were lower than those of their undergraduate counterparts.

Empirical research on decisions made by teachers is consistent with these trends as well. For instance, in a study on the attrition rate out of the teaching profession, Henke, Chen, and Gies (2000) found that graduates in the top quartile of college entrance examination scores are twice as likely as those in the bottom quartile to leave the profession in less than 4 years (32 percent vs.

[5] For example, it may be the case that teachers with attributes that are more in demand (e.g., math and science teachers) tend to be credited with more years of experience than those with backgrounds in other subjects. Such an example shows how districts might reward attributes other than degree and experience levels while ostensibly staying within the framework of the single salary schedule.

Figure 1. The teacher pipeline



SOURCE: Created by the authors based on questions from the U.S. Department of Education, National Center for Education Statistics (NCES), Baccalaureate and Beyond Longitudinal Study (B&B).

16 percent). Existing research on the teacher pipeline is succinctly summarized by Murnane and Singer (1991), who write that "college graduates with high test scores are less likely to take jobs, employed teachers with high test scores are less likely to stay, and former teachers with high test scores are less likely to return."

Data and Methodological Approach

This paper analyzes data derived from the Baccalaureate and Beyond Longitudinal Study (B&B), a nationally representative survey of more than 10,000 individuals who completed an undergraduate degree in AY 1992–93. Participants were initially selected from the 1992–93 National Postsecondary Student Aid Study (NPSAS:93) and were interviewed for B&B in 1994 (B&B:93/94) and again in 1997 (B&B:93/97). Students provided comprehensive information on themselves, including demographic characteristics, family background experiences, undergraduate and graduate level educational achievement, and labor market experiences through 1997. B&B devotes special attention to career decisions related to the teaching profession.

This paper analyzes data from the Baccalaureate and Beyond Longitudinal Study (B&B), a nationally representative survey of more than 10,000 individuals who completed college in 1992–93.

In the pipeline analysis portion of our paper, we confine our attention to the 10,080 individuals who responded to the first follow-up (B&B:93/94). For each node of the teacher pipeline construct that we analyze, we use a logistic probability model to estimate the probability of progress, where the dependent variable is a discrete choice variable that takes on binary values. The first node estimates affirmative answers to "*Have you ever trained or worked as a teacher at the preschool, grade school, or high school level, or are you currently considering teaching at these levels?"* We refer to this node as "*Have you ever considered teaching as a profession?*" The second node we estimate is conditional on progress through the previous node and is derived from the question, *"Beginning around your graduation, how many applications for teaching positions have you submitted?"* For simplicity, we truncate all numbers of applications greater than zero to 1, transforming the node to the question *"Beginning around your graduation, have you submitted at least one teaching application?"*

Omitting nonrespondents gives us a sample size of 9,845 observations, of which 3,235 have taught, trained, or are considering teaching as a profession. Of these 3,235 individuals, 1,702 submitted at least one teaching application; 1,533 submitted zero applications.

We group our explanatory variables into three vectors: demographic characteristics (gender and race/ethnicity), family background variables (parents' income, and parent occupation), and demonstrated academic proficiency (college selectivity index, undergraduate major, undergraduate grade point average, and college entrance exam score). Math, science, and engineering majors are aggregated into a composite technical major dummy variable. College selectivity data comes from *Barron's Profiles of American Colleges* and the College Board. We define the college selectivity as the average Scholastic Aptitude Test (SAT) score of the incoming class of AY 1989–90. College entrance exam scores are re-centered scores on the SAT or equivalent ACT scores. Details on variable construction are provided in appendix A.

Columns (1) and (2) in table 1 present the average characteristics of respondents who have not and have considered teaching, respectively. (Unless otherwise noted, differences are significant at the $p = .05$ level.) In the sample, men comprise 50 percent of the respondents who have not considered teaching, in contrast to 31 percent of the respondents who have considered teaching as a profession. And, while the proportions of White students in the two groups are statistically equal, we see differences between the groups for minority students. Native Americans and African Americans make up greater shares of those considering teaching relative to those who do not. Conversely, Asian and Pacific Islander Americans make up a lesser share of those considering teaching relative to those who do not.

Among family background characteristics, students who have considered teaching report having a mother employed as a teacher more frequently and tend to come from families with lower family incomes. The mean college entrance exam score and college selectiv-

Table 1. Descriptive statistics of the teacher pipeline

Characteristic	Have not considered teaching (1)	Considered teaching[1] (2)	Considered, have not applied (3)	Considered, applied[2] (4)
Male (in percent)	49.59	31.07	38.94	23.97
Native American (in percent)	0.53	0.87	0.78	0.94
Asian and Pacific Islander American (in percent)	5.42	2.01	3.00	1.12
African American (in percent)	5.17	7.23	8.94	5.70
Non-White Hispanic (in percent)	4.95	5.53	4.96	6.05
White (in percent)	83.24	83.77	81.47	85.84
Mother is a teacher[3] (in percent)	7.56	10.64	8.47	12.52
Father is a teacher[3] (in percent)	2.79	2.92	3.16	2.73
Family income (in dollars)	47,473	42,651	44,797	40,715
College selectivity index[4]	1,009	987	996	980
Technical major (in percent)	22.31	11.90	15.59	8.58
Undergraduate grade point average	3.06	3.12	3.04	3.18
College entrance exam score	1,015	977	995	961
Total respondents	6,610	3,235	1,533	1,702

[1]Considered teaching is defined as yes to *"Have you ever considered teaching as a profession?"*

[2]Applied is defined as yes to *"Beginning around your graduation, have you applied to at least one teaching job?"*

[3]Parent occupation comes from the parent survey of the 1992–94 National Postsecondary Student Aid Study (NPSAS:93), which was given only to a sample of the NPSAS:93 respondents.

[4]Average Scholastic Aptitude Test (SAT) score of the incoming class of AY 1989–90.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1993/94 Baccalaureate and Beyond Longitudinal Study (B&B:93/94).

ity index for those who consider teaching are 38 and 22 points less, respectively, than the mean score and selectivity index of their counterparts. These results are consistent with previous research, discussed above, showing a negative relationship between some measures of academic skills and the propensity to enter and remain in the teaching profession. Respondents who have considered teaching also report majoring in technical fields at lower rates than those who have not considered teaching.

Sample characteristics for those who applied to zero teaching jobs and those who applied to at least one teaching job, conditional on having considered teaching as a profession, are presented in columns (3) and (4), respectively. The differences between these two groups are similar to the previous node in the teacher pipeline. Males comprise 39 percent of those who do not apply, 15 percentage points more than the percent of men among applicants. White students make up a higher share of nonapplicants; Asian and Pacific Islander Americans and African Americans make up lesser shares of applicants than of nonapplicants; and Native Americans and non-White Hispanic Americans make up greater shares of applicants than of nonapplicants.

The differences in family background characteristics are consistent with those of the previous node. The mean college entrance exam score and college selectivity index of those who apply are 34 and 16 points less, respectively, than the mean score and index of those who choose not to apply. And, among those who considered teaching, those with technical majors make up a lesser share of applicants than of nonapplicants.

An important point to note in the construction of the pipeline is that college choice may not be independent of the decision to become a teacher. It may be the case that individuals who intend to teach select a different set of colleges than their peers (Reback in press). If less selective colleges are more likely to offer teacher-training programs, then college selectivity is endogenous to our model. A similar line of reasoning is appropriate for undergraduate major because an education major is often a requirement for successful completion of a teacher training and certification program. Furthermore, if there is a correlation between

undergraduate grade point average and major, grade point average may also be endogenous to our pipeline model. Thus, we estimate two variants of our pipeline model. The first includes the college-specific variables college selectivity, technical major, and undergraduate grade point average that we treat as exogenous. In the second variant, we substitute college entrance exam scores for all college-specific variables.

Our wage regression model analyzes a different subset of B&B data. To obtain sufficient variation in our sample, we stack observations from B&B:93/94 and B&B:93/97 and estimate the returns to various characteristics separately for teachers and non-teachers.[6] Because individuals potentially appear in our sample multiple times, we estimate our wage regressions using a random effects model.

We limit our analysis to individuals who provide information on their occupation and salary for their job in April of the survey year (B&B:93/97 asks for most recent job if the respondent is not employed in April). We further restrict our sample to individuals who worked full time, defined as working at least 30 hours per week. Because the single salary schedule is less prevalent among private sector teachers, we exclude teachers who are employed by private schools or whose sector of occupation cannot be determined. As a result, our final sample size is 13,636 observations, of which 1,421 are public sector teachers and 12,215 are non-teachers.

Our wage regression model analyzes a different subset of B&B by estimating the rates of return to various characteristics separately for teachers and non-teachers.

The dependent variable for our wage model is the natural log of annual salary. In each survey, respondents report dollar figures and the unit of time in which they report their salary, which can be any of per hour, per day, per week, per month, or per year. For purposes of comparison, we convert all wages to annual salary, using the conversion suggested by the documentation in the B&B, and adjust to 1997 dollars.[7]

The explanatory variables in the wage model are vectors of demographic characteristics (gender, race/ethnicity, marital status, and number of dependents), demonstrated academic proficiency (college selectivity index, undergraduate major, undergraduate grade point average, college entrance exam score, and advanced degree status), and labor market characteristics (years of full-time work experience and state of residence). Advanced degree is a dummy variable that indicates any of master's degree, first professional (e.g., JD), or doctoral degree.

It is important to note that by estimating the rates of return in the teacher and non-teacher labor market separately, we do not consider the role of wages in the selection of occupation. This potentially biases our findings if choice of occupation is correlated with both included explanatory variables and wages.

Table 2 presents the basic descriptive statistics of teachers in column (1) and of non-teachers in column (2). A number of differences between the two groups resonate with previous research and our findings from the teacher pipeline. The higher percentage of females among teachers is consistent with the historical gender composition of this profession (Bacolod 2001). In addition, relative to all other occupations, the teacher labor force is made up of higher shares of Whites and non-White Hispanic Americans and a lower share of Asian and Pacific Islander Americans. There are some striking differences between teachers and non-teachers in terms of their academic attributes and skills. Perhaps not surprisingly, teachers report majoring in technical fields less often than non-teachers. The mean college entrance exam score of teachers is 54 points less than that of non-teachers; for the college selectivity index, this difference is 41 points. However, teachers have higher rates of advanced degree attainment and a higher mean grade point average than non-teachers.

[6] Such an approach is warranted by Chow tests that indicate structural differences between these subsamples.

[7] Because teachers typically have 2 months of leave from work during their students' summer vacation, we also estimate our models using an annualized salary that assumes a 180-day year, a 36-week year, and a 10-month year. This is in contrast to the 260-day year, 30-week year, 12-month year for non-teachers. We experiment with these conversions, but these do not affect our wage regression results in significant ways.

Table 2. Descriptive statistics for the wage regression model

Characteristic	Public sector teachers (1)	Non-teachers (2)
Male (in percent)	22.17	47.09
Native American (in percent)	0.77	0.61
Asian and Pacific Islander American (in percent)	0.77	3.91
African American (in percent)	5.14	5.83
Non-White Hispanic (in percent)	6.26	4.70
White (in percent)	86.70	84.36
Married (in percent)	55.26	35.22
Dependents (including self)	2.15	1.72
College selectivity index	962	1,003
Technical major (in percent)	7.53	19.21
Undergraduate grade point average	3.24	3.03
College entrance exam score	950	1004
Advanced degree (in percent)	8.44	5.93
Years of experience	2.55	2.37
Salary (in dollars)	24,378	30,474
Total respondents	1,421	12,215

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1993/94 Baccalaureate and Beyond Longitudinal Study (B&B:93/94).

Results

Progress Through the Teacher Pipeline

The first logistic probability model we estimate analyzes the decision to consider teaching as a profession. Table 3 presents the marginal probabilities for this model. (Marginal probabilities are calculated for a person with the mean characteristics.) Column (1) presents results that include college-specific characteristics (college selectivity index, undergraduate major, and undergraduate grade point average). Perhaps not surprisingly, males are predicted to be less likely (by about 14 percentage points) than females to consider teaching; in fact, based on the overall sample mean, they are almost 60 percent less likely than females to answer in the affirmative. African Americans are significantly more likely to consider teaching while Asian and Pacific Islander Americans are significantly less likely to consider it.

Family background characteristics also appear to influence the decision to consider teaching. Individuals whose parents have higher incomes are significantly less likely to consider teaching as a profession; for every additional $10,000 in income of an individual's parents, the probability that one considers teaching falls by 0.4 percentage points. Individuals who report a mother employed as a teacher are also 9 percentage points more likely to consider teaching.

Majoring in a technical field is associated with an 11 percentage point decline in the probability of answering yes. Also, having a 3.5 undergraduate grade point average rather than a 2.5 is predicted to increase the probability that individuals choose teaching by 3 percentage points. One explanation for the divergent findings between grade point average and college selectivity is that there may be grade inflation in education programs.

As we discussed above, it may be inappropriate to include measures of college selectivity, undergraduate major, and undergraduate grade point average in this stage of the pipeline analyses because individuals may choose their college and college courses based on their desire to teach. In column (2) of table 3, we present the marginal probabilities from a model that substitutes college entrance exam scores for these three measures of demonstrated academic proficiency. The coefficients of all nonacademic variables in the model change little in this specification of the model, and the results with regard to demonstrated academic skills also remain quite similar. An increase of 100 points in one's college entrance exam score is predicted to de-

Table 3. Marginal probabilities for the pipeline node I[1]

Characteristic	(1)		(2)	
Constant	0.0294	(0.0555)	0.0489**	(0.0297)
Male	-0.1415*	(0.0102)	-0.1622*	(0.0099)
Native American	0.0679	(0.0563)	0.075	(0.0565)
Asian and Pacific Islander American	-0.1833*	(0.0301)	-0.209*	(0.03)
African American	0.0568*	(0.0201)	0.0305	(0.0199)
Non-White Hispanic	0.0213	(0.0216)	0.0013	(0.0214)
Parents' income (each additional $10,000)	-0.0038*	(0.0011)	-0.0037*	(0.0011)
Mother is a teacher	0.0922*	(0.0260)	0.0939*	(0.026)
Father is a teacher	0.0087	(0.0454)	0.0012	(0.0454)
College selectivity index[2]	-0.0202*	(0.0046)		†
Technical major	-0.1129*	(0.0139)		†
Undergraduate grade point average	0.0336*	(0.0100)		†
College entrance exam score[2]		†	-0.0133*	(0.0028)
Total respondents	9,845		9,845	
-2 log likelihood	-5,965		-6,010	

*Indicates p value < .05.

**Indicates p value < .10.

†Not applicable.

[1]Affirmative to *"Have you ever considered teaching as a profession?"*

[2]Each 100-point increase.

NOTE: Standard errors are in parentheses.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1993/94 Baccalaureate and Beyond Longitudinal Study (B&B:93/94).

crease the probability of considering teaching by roughly 1 percentage point.

The second node in the teacher pipeline that we estimate models responses conditional on having considered teaching as a career. Column (1) of table 4 presents the marginal probabilities for the model that includes college-specific variables. The results for this decision node are strikingly similar to those for considering teaching as a profession. Again, gender is a significant predictor of application among those who considered teaching as a profession; males are almost 14 percentage points less likely to apply for a teaching job than females.

Family background variables continue to predict progress through the teacher pipeline as well. An increase of $10,000 in parent income is associated with a 0.6 percent loss of the probability of progress, and having a mother who is a teacher increases the probability of progress by 13 percentage points.

The marginal probability for college selectivity is 2 percentage points for every 100 point change in college selectivity. For example, an individual who has considered teaching and graduates from Dartmouth College (college selectivity = 1130) is about 3 percentage points less likely to apply for at least one teaching job than someone at the University of Kentucky (college selectivity = 990), all else equal. Technical majors are 11 percentage points less likely to apply for at least one teaching job. These results should be treated with caution, however, because of the potential correlation between unobservable career desires and our included explanatory variables.

In column (2), we report the results when we substitute college entrance exam scores for college selectivity, technical major, and undergraduate grade point average. Again, the estimated coefficients change little and support the general finding that at this second node, individuals who attend more selective colleges (or have higher college entrance exam scores) are less likely to actually apply for a teaching job.

Table 4. Marginal probabilities for the pipeline node II[1]

Characteristic	(1)		(2)	
Constant	-0.0402	(0.1054)	0.3196*	(0.056)
Male	-0.1386*	(0.0202)	-0.1709*	(0.0197)
Native American	0.0343	(0.0973)	0.0364	(0.0974)
Asian and Pacific Islander American	-0.2122*	(0.0707)	-0.2325*	(0.0703)
African American	-0.1091*	(0.0366)	-0.1553*	(0.0358)
Non-White Hispanic	0.0497	(0.0408)	0.0238	(0.0401)
Parents' income (each additional $10,000)	-0.0055*	(0.0022)	-0.0064*	(0.0022)
Mother is a teacher	0.1332*	(0.0489)	0.1301*	(0.0487)
Father is a teacher	-0.0657	(0.0871)	-0.0376	(0.0863)
College selectivity index[2]	-0.0214*	(0.0087)		†
Technical major	-0.1125*	(0.0292)		†
Undergraduate grade point average	0.1194*	(0.0198)		†
College entrance exam score[2]		†	-0.0199*	(0.0055)
Total respondents	3,235		3,235	
-2 log likelihood	-2,140		-2,163	

*Indicates p value < .05.

†Not applicable.

[1]Affirmative to *"Beginning around graduation, have you applied to at least one teaching job?"*

[2]Each 100-point increase.

NOTE: Standard errors are in parentheses.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1993/94 Baccalaureate and Beyond Longitudinal Study (B&B:93/94).

Wage Structures in the Teacher and Non-Teacher Labor Markets

Table 5 presents the random effects coefficient estimates of wages in the teacher and non-teacher labor markets. It is generally accepted practice to estimate the wages of males and females separately, given that there are differential returns by gender to various individual characteristics (Deolaliker 1993; Lundberg and Rose 2002; Schultz 1993). Since there are relatively few male teachers, the coefficient estimates for the male teacher model tend to be insignificant. For this reason, we do not report these results by gender; however, the magnitudes of the coefficient estimates were generally consistent with the estimates from the pooled sample of men and women.

Column (1) of table 5 presents the coefficient estimates for all teachers. We see a number of results that are consistent with the determination of salaries based on the single salary schedule. There are significant and positive rates of return to experience and attainment of an advanced degree. Each additional year of experience is associated with a 5.7 percent higher salary, and the completion of an advanced degree is correlated with a 9.5 percent higher salary, all else equal. In contrast, there are no differences in salaries, all else equal, based on a teacher's race/ethnicity (Native Americans are the exception), marital status, or number of dependents.[8] Nor are there statistically significant differences based on college selectivity, major, or undergraduate grade point average, measures that proxy for demonstrated academic proficiency and training.

These findings are certainly consistent with the use of the single salary schedule as a compensation structure. It is useful to recall that even with the use of the single salary schedule it was possible to observe returns to demonstrated academic proficiency, subject matter training, or other attributes in the teacher labor

[8] Men are found to receive a small wage premium in the teacher labor market, but the magnitude of this effect is far less than that in the non-teacher labor market.

Table 5. Random effects model results

Characteristic	Public sector teachers (1)		Non-Teachers (2)		Public sector teachers (3)		Non-Teachers (4)	
Constant	9.8999*	(0.1083)	9.4727*	(0.0735)	10.0405*	(0.0606)	9.6663*	(0.0424)
Male	0.0501*	(0.0189)	0.1630*	(0.0123)	0.0469*	(0.0184)	0.1681*	(0.012)
Native American	-0.1735*	(0.0864)	0.1021	(0.077)	-0.1786*	(0.0862)	0.0720	(0.0776)
Asian and Pacific Islander American	-0.0220	(0.1002)	0.0558**	(0.0311)	-0.0069	(0.0998)	0.0708*	(0.0312)
African American	0.0593**	(0.035)	-0.0113	(0.0262)	0.0546	(0.0347)	-0.0201	(0.0262)
Non-White Hispanic	-0.0113	(0.0340)	-0.0285	(0.0296)	-0.0058	(0.0339)	-0.0399	(0.0298)
Married	0.0057	(0.0200)	0.0123	(0.0147)	0.0033	(0.0201)	0.0219	(0.0147)
Dependents (including self)	-0.0030	(0.0084)	0.0486*	(0.0069)	0.0014	(0.0087)	0.0435*	(0.0070)
College selectivity index[1]	0.0077	(0.0087)	0.0122*	(0.0058)		†		†
Technical major	0.0389	(0.0293)	0.1306*	(0.0154)		†		†
Grade point average	0.0356**	(0.0189)	0.0883*	(0.0124)		†		†
College entrance exam score[1]		†		†	0.0054	(0.0049)	0.0208*	(0.0035)
Advanced degree	0.0953*	(0.0271)	0.0666*	(0.0216)	0.0968*	(0.0269)	0.0827*	(0.0216)
Years of experience	0.0570*	(0.0050)	0.0943*	(0.0031)	0.0562*	(0.0050)	0.0934*	(0.0031)
Total respondents	1,421		12,215		1,421		12,215	
-2 res log likelihood	458.9		20,301.8		450.7		20,375.7	

*Indicates p value < .05.

**Indicates p value < .10.

†Not applicable.

[1]Each 100-point increase.

NOTE: Standard errors are in parentheses.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1993/94 Baccalaureate and Beyond Longitudinal Study (B&B:93/94).

market as a result of sorting within or between districts. As we describe below, however, the fact that we do not observe returns to academic skills or subject matter training implies that the teacher labor market differs markedly from the non-teacher labor market.

Column (2) shows the random effects model estimates of the returns for the non-teacher labor market. Unlike the teacher labor market, we find strong evidence of returns to gender, family composition, measures of demonstrated academic skills and training, and labor market experience. (Unless otherwise noted, all of the differences between the teacher and non-teacher labor markets discussed below are statistically significant at the 95 percent confidence level). Males are predicted to earn a pay premium of about 16 percent compared to a premium in the teacher labor market of only 5 percent. There is also a premium for individuals with children; we observe a 5 percent higher wage for every additional dependent. These findings for the non-teacher labor market are broadly consistent with previous findings in the literature.

There are important differences between the two labor markets in the returns to demonstrated academic proficiency and specialization. While there is little evidence in the teacher labor market of returns to college selectivity, in the non-teacher labor market, individuals who attend more selective colleges are predicted to earn more. An individual from a college with a 100 point higher selectivity index than the average is predicted to make 1.2 percent more in salary. We also observe that the return to undergraduate grade point average is higher in the non-teacher labor market than in the teacher labor market. A 1-point increase in grade point average is associated with an 8.8 percent increase in salary, whereas in the teacher labor market the same increase is associated with only a 3.6 percent increase in salary (the difference between these two estimates is significant at the 90 percent confidence level). Finally, the non-teacher labor market appears to significantly reward individuals who major in technical subjects; we estimate a 13 percent pay premium for those who have either a math, science, or engineering major.

It is worth noting that the return to experience in the non-teacher labor market, where there is estimated to be a 9.4 percent pay premium for an additional year of experience, is significantly larger than the 5.7 percent return to an additional year of experience in the teacher labor market. This difference is potentially important if long-term earnings potential influences occupational choice. Given that we are estimating wages for a sample of recent college graduates (they graduated in AY 1992–93), most have relatively little labor market experience. Furthermore, we do not know how many years of *teaching* experience teachers are credited as having. Thus, our estimates of the returns to experience should be treated with caution.

As we discussed in the teacher pipeline section, the choice of college—and by extension, undergraduate major and grade point average—may be endogenous to the selection of occupation. We address this problem in the same manner as in our approach in the teacher pipeline section and substitute college entrance exam score for college-specific variables in this paper.[9] In columns (3) and (4) we present the results from our random effects model that substitutes college entrance exam score for college selectivity, undergraduate major, and undergraduate grade point average. Our overall findings with regard to academic skills change little with this model specification. In the non-teacher labor market, wages are predicted to be higher for individuals with higher SAT scores (by about 2 percent for every 100 SAT points); however, there is no corresponding premium for SAT scores in the teacher labor market.

In the non-teacher labor market, wages are predicted to be higher for individuals with higher SAT scores; however, there is no corresponding premium for SAT scores in the teacher labor market.

In our final model specification (which is not included in the table), we estimate models that include both college-specific variables and college entrance exam scores. Consistent with our prior findings, neither individual SAT score or college selectivity are rewarded in the teacher labor market. In contrast, we observe marginally significant (at the 10 percent level) rates of return for these two characteristics in the non-teacher labor market.

The differences in compensation structure between the teacher and non-teacher labor markets imply that the financial opportunity costs associated with teaching vary systematically based on individual background characteristics. The implications of these differences are discussed below.

Opportunity Cost Simulations

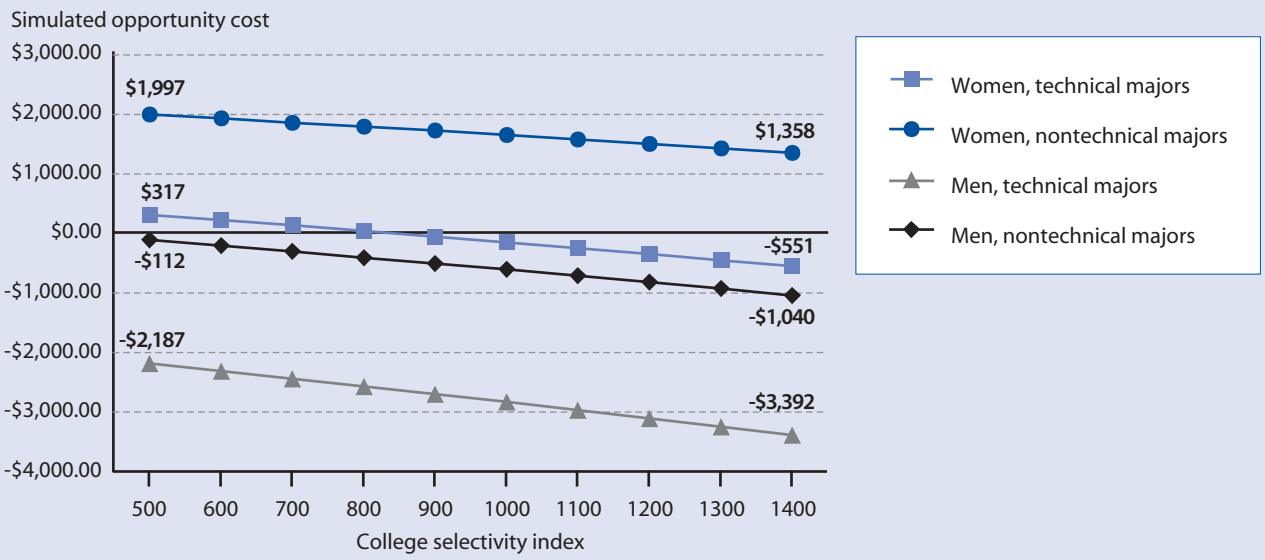
In this section, we discuss our simulations of the financial opportunity costs associated with teaching as opposed to entering the non-teacher labor market. We simulate the costs for men and women with different academic backgrounds (training, degree level, and college selectivity) as well as for individuals with different experience levels. In general, we calculate opportunity costs as the average of the difference of the predicted salary as a teacher less the predicted salary as a non-teacher. A more detailed discussion of the simulation is provided in appendix B.

Based on the actual characteristics in our sample, we estimate what men and women would have earned had they chosen the alternate occupation (e.g., teacher entered the non-teacher labor market and vice versa). The average predicted wage for female teachers is $23,692, about $600 less than the predicted wage for female college graduates outside of teaching. The average predicted wage for male teachers is $24,975, which is about $5,000 less than the predicted wage for males outside of teaching.

Figures 2 through 4 show the results of various simulations. The horizontal axis illustrates the opportunity cost depending on the selectivity of the college attended.

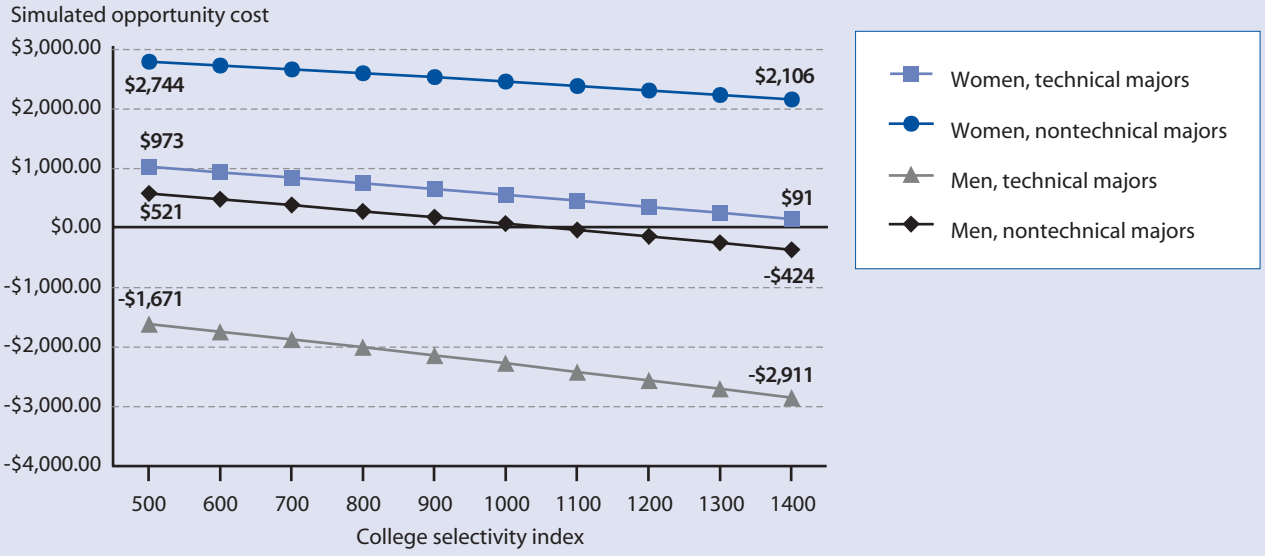
[9] One might argue that scores on college entrance exams are themselves endogenous; for instance, individuals who wish to enter a particular occupation may study more than those wishing to enter a different occupation. This argument, however, seems less plausible than the argument for the endogeneity of college selectivity and major.

Figure 2. Simulated opportunity costs of entering the teaching profession: No work experience, no advanced degree



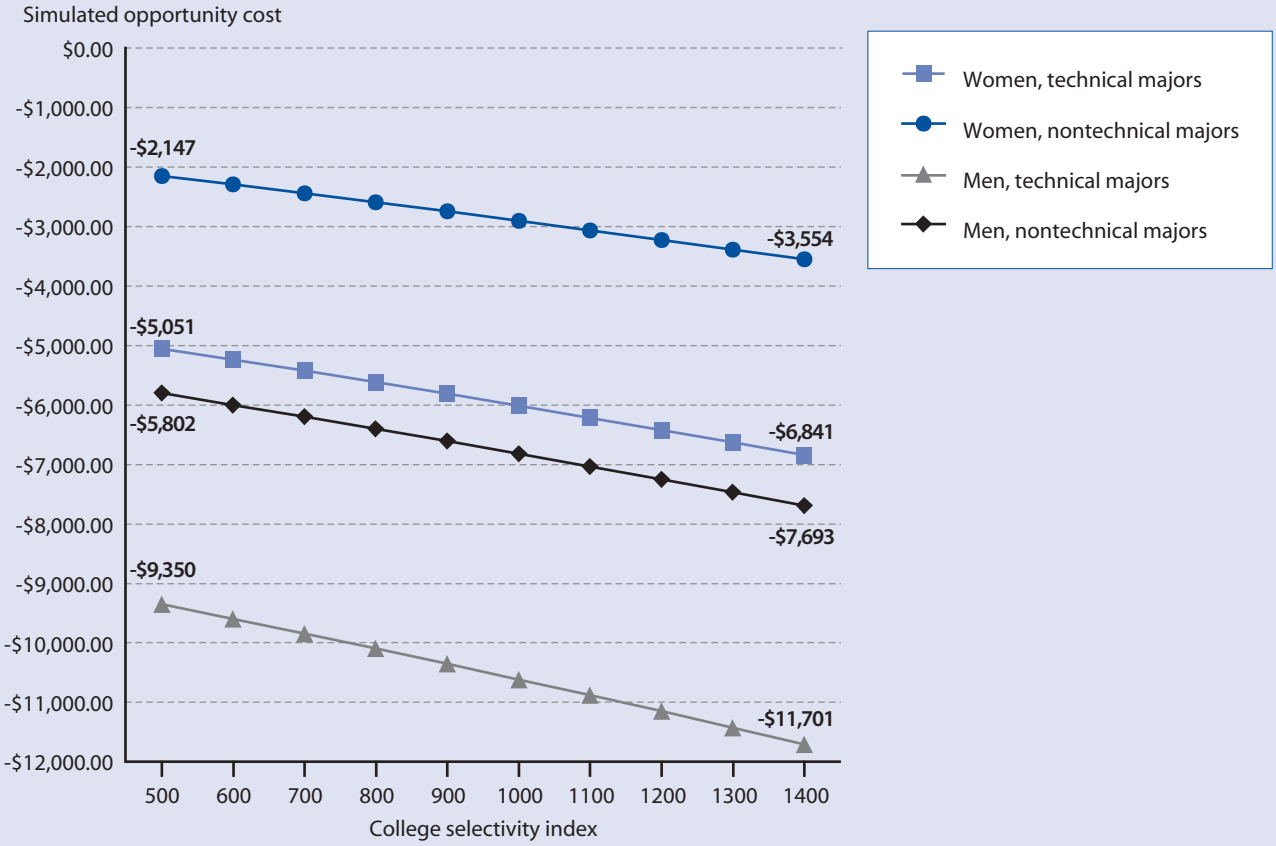
SOURCE: Authors' simulations based on the U.S. Department of Education, National Center for Education Statistics, Baccalaureate and Beyond Longitudinal Study (B&B).

Figure 3. Simulated opportunity costs of entering the teaching profession: No experience, with advanced degree



SOURCE: Authors' simulations based on the U.S. Department of Education, National Center for Education Statistics, Baccalaureate and Beyond Longitudinal Study (B&B).

Figure 4. Simulated opportunity costs of entering the teaching profession: Five years' experience, no advanced degree



SOURCE: Authors' simulations based on the U.S. Department of Education, National Center for Education Statistics, Baccalaureate and Beyond Longitudinal Study (B&B).

The plotted line represents the predicted salary for an individual who enters the teaching profession less the predicted salary if that individual were instead to enter the non-teacher labor market. Negative numbers imply that one is predicted to have a higher salary as a non-teacher whereas positive numbers imply that one is predicted to make more as a teacher.

Figure 2 presents the simulated opportunity cost for the average individual with zero years of work experience and no advanced degrees. The negative slope of each line reflects the lower estimated return to college selectivity in the teacher labor market relative to the non-teacher labor market. The top line, representing the opportunity costs for women who have a nontechnical major, lies above zero regardless of the selectivity of the college attended (though it is closer to zero for more selective colleges), implying that it is more financially lucrative for them to become teachers (the exact opportunity cost, of course, is contingent on the calculation of annual salaries). This is not necessarily the case for women who completed a technical major in college. Although those who attend less selective institutions earn slightly more as teachers than they otherwise are predicted to earn, women with technical majors who attend a college with an average SAT score of about 800 or greater are predicted to earn more outside of the teaching profession. In contrast to women, men are predicted to earn more outside of teaching regardless of their choice of college or major.

However, the opportunity costs rise for men who attend more selective institutions and have technical majors.

Because the teacher labor market provides explicit returns to both experience and level of education, we present simulations in which we vary these dimensions. These results reflect the patterns discussed above: men face larger opportunity costs than women, those with technical majors face larger opportunity costs than nontechnical majors, and opportunity costs rise for individuals who attend more selective institutions.

Figure 3 shows the simulated opportunity costs for individuals who hold an advanced degree but have no work experience. Women who major in nontechnical subjects are still predicted to earn more as teachers regardless of college selectivity, significantly more than is the case for women who do not hold an advanced degree. For example, a woman who attends a college with an average SAT of 1000 and holds a master's degree is predicted to earn $2,400 more as a teacher, while a similar woman who does not hold a master's degree is predicted to earn only $1,700 more as a teacher. The opportunity costs for women with technical majors, with and without an advanced degree, are $503 and –$146, respectively. The opportunity costs for men without technical majors, with and without an advanced degree, are $17 and –$607, respectively. These figures imply that an advanced degree makes it more financially worthwhile to be a teacher for women with or without technical majors and for men with nontechnical majors. The opportunity costs for men with technical majors still imply that they are predicted to be financially better off as non-teachers.

For most individuals, earnings are predicted to be higher outside of teaching than in the teaching profession.

In our final simulation, we simulate the opportunity costs for individuals with 5 years of labor market experience and no advanced degree. Figure 4 illustrates the importance of the differential returns to experience between labor markets. With 5 years of experience and no advanced degree, women with nontechnical majors (college selectivity = 1000) must now *sacrifice* $2,900 to teach, in contrast to the same individuals with no experience who *receive* $1,657 to teach. The effects of 5 years of experience for all groups, regardless of college selectivity, major, or gender, show that for most individuals, earnings are predicted to be higher outside of teaching than in the teaching profession. At the extreme, the estimated opportunity cost to enter the teaching profession for males with technical majors who graduate from more selective colleges can reach $10,000!

Conclusions

The results presented in this study suggest that measures of demonstrated academic proficiency predict the likelihood of potential teachers advancing through the teacher pipeline. Individuals with stronger demonstrated academic proficiency (e.g., higher college entrance exam scores or college selectivity) are less likely to consider teaching and less likely to apply for a job as a teacher. This may be explained, in part, by the compensation structure in teaching, since our salary structure results reveal important differences between the teacher and nonteacher labor markets in terms of the rewards associated with academic skills and training. These differences, which are consistent with the use of the single salary schedule, suggest that individuals with stronger academic backgrounds or technical training face greater opportunity costs to being teachers, all else equal.

Unless individuals systematically differ in terms of the value they place on nonpecuniary job characteristics, we would expect those with higher SAT scores, technical majors, or graduates from more selective colleges to be less likely to teach. This is exactly what we find in our analyses of various points on the teacher pipeline: those with higher college entrance exam scores, those who go to more selective colleges, and those who graduate with a technical major are less likely to have taught, trained as a teacher, or considered teaching as a profession.

Though the results of the study are suggestive of a causal connection between compensation structure and the decisions made by individuals in the teacher

pipeline, we are cautious about drawing strong conclusions since the current study is limited in several respects. In particular, in the analyses of teacher compensation structure, we focus exclusively on salaries, omitting nonpecuniary rewards as well as bonuses and rewards for nonclassroom work in the school. Individuals certainly consider other characteristics of jobs that are part of a compensation package (e.g., health and retirement benefits) as well as other nonpecuniary job characteristics (e.g., pressure at work and collegiality). There is in fact evidence that teachers are particularly sensitive to nonpecuniary job characteristics when making decisions about the schools and districts in which they teach (Loeb 2001). Furthermore, the underlying assumption of career choice models is that individuals choose careers and jobs that maximize utility, so a limitation of the current study is that we do not explicitly treat the selection of occupation as endogenous, despite the fact that individuals self-select into occupations.[10] Future work on the impact of the compensation structure in teaching on the decisions made by individuals to enter or remain in the profession should explore these issues more fully.

Appendix A: Variable Construction

This appendix details how we constructed the variables used in our analysis. Questions regarding the survey should be directed to the National Center for Education Statistics (NCES) in the U.S. Department of Education. Unless otherwise noted, constructed variables with missing data are coded to 0 and flagged.

Demographic Characteristics

We identify the gender of the respondent using B2RSEX from the B&B:93/97 and supplement it with the gender variables RSEX, GENDER, SEX, and M_STGEN from B&B:93/94 and NPSAS:93.

We use B2ETHNIC to create a set of separate dummy variables for race for the categories Native American, Asian and Pacific Islander American, Black, Non-White Hispanic, Other, and White.

Demonstrated Academic Skills and Educational Attainment

Respondents' college selectivity is defined as the average SAT score of the incoming class of AY 1989–1990 at the undergraduate institution from which they graduated. Data are imputed from *Barron's Profiles of American Colleges*. If only ACT scores are available, we convert these scores to SAT using the conversion table found at the web site *http://www.collegeboard.com/sat/cbsenior/yr2001/pdf/ten.pdf*. Missing values are supplemented with data supplied by the College Board.

We use B2BAMAJR to construct a set of separate dummy variables for undergraduate major for the categories business and management, education, engineering, health professions, public affairs/social services, biological sciences, mathematics and other sciences, social science, history, humanities, psychology, and other. We then construct a composite technical major by combining engineering, biological sciences, and mathematics and other sciences majors. All other majors are defined as nontechnical majors.

For undergraduate grade point average, we use NORMGPA from the transcript survey if it is available. Otherwise, we use data from CUMULGPA in B&B:93/94, which asked respondents about their cumulative grade point average.

Advanced degree is calculated from questions on higher educational achievement. We acknowledge an advanced degree if the respondent has earned a master's, first professional, dual degree in which one degree was master's or first professional, or doctoral degree before or on the month of relevant employment in each of the surveys (see Salary and Employment). For B&B:93/94 respondents, we use PB01DGDT-PB03DGDT for the date one received the degree, and PB01PROG-PB03PROG for the program type. In the event that it is a dual degree, program types can be found in P01PRG01 and P01PRG02. Construction for B&B:93/97 recipients are analogous to B2P01PRG-B2P05PRG as program

[10] For instance, it is possible that individuals who know they are not likely to excel or earn a high salary in teaching are likely instead to choose other professions (and vice versa). To the degree that variables omitted from our wage equations and important to the determination of salaries are correlated with both measures of academic skills and the choice of occupation, our coefficient estimates will be biased.

types and B2P01DGD-B2P05DGD as the dates respondents received the degree.

Family Status

Marriage status in April 1994 is derived from B2MAR494, and marriage status in April 1997 is derived from B2MAR497. Single, divorced, separated, widowed, and living in a marriage-like relationship are considered not married.

Total number of dependents (including the respondent) is derived from TOTNUMDP and B2TOTDEP for B&B:93/94 and B&B:93/97 respondents, respectively.

Labor Market Experience

We calculate labor market experience using EMPL9207-EMPL9212 for B&B:93/94 respondents and B2EM9207-B2EM9212 for B&B:93/97 respondents. We consider a month employed if the month is after the graduation date and before or equal to the relevant month of employment (see Salary and Employment).

Parent Background Variables

Parents' income is derived from CINCOME in the NPSAS:93 survey, which is defined as total family income from the 1991 calendar year. If the student is not a dependent, then CINCOME contains the student's income.

Parents of a subset of the NPSAS:93 respondents were interviewed about the financing of their child's undergraduate education. MOMOC and DADOC contain the occupation of the mother and father, respectively. We code a flag if parent occupation is "school teacher."

Pipeline Variables

The first pipeline node, "*Have you ever trained or worked as a teacher at the preschool, grade school, or high school level, or are you currently considering teaching at these levels?*" is derived from TEACH in B&B:93/94. For those who replied yes to TEACH, responses to "*Beginning around your graduation, how many applications for teaching positions have you submitted?"* are found in APPLICAT. We recode this continuous variable to a dichotomous one, where values greater than 0 are coded to 1 and responses of 0 are coded to 0.

Salary and Employment

For B&B:93/94, respondents provided earnings data on their primary job in April 1994. Data are reported as real dollar figures in APRANSAL, which we convert to 1997 dollars. For B&B:93/97, respondents provided data for their job in April 1997, or the last month of their most recent job. Earnings are reported in B2AJBSAL with a corresponding wage rate (per hour, per day, per week, per month, per year) in B2AJRATE. We use the strategy employed by NCES in converting all figures to annual wages. If wages were reported per hour, we calculate the weekly wage with the hours worked per week, B2AJBHRS. We assume a 260-day work year, a 52-week year, and a 12-month year. Wages are converted to 1997 dollars.

For each salary figure, respondents were asked about their occupation. Because the occupation codes for the two follow-ups differ, MPR Associates reconstructed the variables to match the coding scheme of B&B:93/97. These two new variables, AJOBOCCR and B2AJOBR, are available from MPR Associates.

State of Employment

B2STATE and B1STATE provide information for respondents to B&B:93/94 and B&B:93/97, respectively. Individuals in Puerto Rico, the Virgin Islands, or other countries were coded as other, and those with missing information were coded as missing. We construct a set of separate dummy variables for each state.

Teacher Sector

For respondents to B&B:93/94 we use TCHSCHL, which provides the NCES code for the school taught at most recently. We assume that the questions for April 1994 salaries correspond to this school. Schools without NCES codes but for which there are sufficient data on name, city, and state of school are imputed with codes from the Common Core of Data (CCD) and the Private School Universe Survey (PSS).

Teachers in B&B:93/97 are assigned sectors using BSCL01-B2SCL05. We identify the relevant school

in which the respondent was teaching in April 1997 or most recent job. We also impute codes for schools for those for whom we can.

Appendix B: Simulations

This appendix describes our approach in estimating opportunity costs of entering the teaching profession. For each profession, we estimate the predicted natural log of salary using each individual's characteristics in the wage regression model. We then convert these estimates to salary in dollars and take the average. To estimate the opportunity cost, we take the mean of the difference between salary as a teacher and salary as a non-teacher. When we estimate the opportunity cost for, say, women without technical majors, we estimate the mean opportunity cost for all individuals in our sample and use each person's individual characteristics, except that we force each person to be a woman and to have a technical major. For figures 2 through 4, we estimate the opportunity cost at different levels of the index of college selectivity.

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