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Labor productivity growth in elementary and secondary school services: 1989–2012

New measures of labor productivity in elementary and secondary schools show that labor productivity declined from the mid-1990s through the first decade after 2000. However, it increased from 2010 forward because of labor input declines combined with modestly increasing enrollments and test scores.

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Education is a primary driver of economic growth and stability for nations and for individuals.[1] Investments in education affect the ability of a country to compete in international markets and to ensure increases in living standards for its residents. On an individual level, returns to investments in education are well documented. For example, high school dropouts earn less over their lifetimes than high school graduates. In addition, the penalty associated with lower educational attainment has become more pronounced over time: after the earnings are adjusted for inflation, economists project that expected lifetime earnings of high school dropouts today are less than the expected lifetime earnings of high school dropouts in 1970.[2]

In 2014, nearly 9 percent of all U.S. workers, almost 13 million individuals, were employed in the educational services sector.[3] In fact, the education sector now employs more workers than the entire manufacturing sector. Within the educational services sector, the elementary and secondary schools industry employed just over 8 million individuals, or 65 percent of employees in the broader education sector.[4] For the 2013–14 school year, expenditures for educational services in the United States are estimated at $1,194 billion, or 7.1 percent of the United States Gross Domestic Product (GDP). Of this total, $682 billion, or 4.1 percent of GDP, were expenditures for educational services at public and private elementary and

secondary schools and $512 billion, or 3.1 percent of GDP, were expenditures for education at postsecondary degree-granting institutions.[5]

Labor productivity is a statistical measure that relates an industry's output of services to the quantity of labor required to produce those services. Productivity data are essential for one to understand the education industry because they provide information on the efficiency of the production of services.

The U.S. Bureau of Labor Statistics (BLS) has developed measures of labor productivity and related series, including unit labor costs, for North American Industry Classification System (NAICS) 6111, elementary and secondary schools, the second largest component industry in the education sector by employment and receipts, after NAICS 6113, colleges, universities, and professional schools.[6] This is the first detailed industry in the education sector for which BLS has developed labor productivity series. The new measures reflect BLS commitment to expand its coverage of service industries, including those industries for which developing reliable series presents a significant challenge. This article introduces the new measures and examines productivity trends in this industry from 1989 to 2012.

The elementary and secondary schools industry includes both public and private schools providing educational and related services that constitute a basic preparatory education, typically from kindergarten through the 12th grade.[7] BLS measures for this industry include data for all schools, as well as separate data on public and private schools. During the 2012–13 school year, 98,454 public schools and 30,651 private elementary and secondary schools, serving over 55 million students, were operating in the United States.[8] Over 90 percent of these students attended public schools, while less than 10 percent attended private schools.[9] Although public school students overwhelmingly attended traditional public schools, the number of public school students attending charter schools increased from 0.7 percent in the 1999–2000 school year to 4.6 percent in 2012–13.[10] Charter schools are independent public schools operating under a contract or "charter," with a state agency or local school board. In exchange for greater flexibility and independence, the charter school agrees to be accountable for goals outlined in the charter, such as improving student performance. Failure to achieve these goals may cause the school's charter to be revoked.[11] Finally, 3.4 percent of school-age children were homeschooled during the 2012–13 school year.[12]

U.S. education system

Educational services in the United States have their roots in early colonial days. The first law establishing universal public education was the Massachusetts General School Law of 1647, which ordered, ". . . that where any town shall increase to the number of one hundred families or householders, they shall set up a grammar school . . . ."[13] From these rudimentary beginnings, the elementary and secondary education system in the United States has evolved and striven, guided by landmark legislation such as the 1965 Elementary and Secondary Education Act and the 1975 Education for All Handicapped Children Act, to educate children with varied economic circumstances, language skills, and mental and physical capabilities appropriately.[14]

The U.S. public school system historically has been the responsibility of local school districts and states. State education departments set general education requirements, whereas local school boards manage school district level decisions.[15] To receive federal funds for education, states must comply with various guidelines and standards that the federal government has established, through legislation.[16] Public school systems, which are required to provide free educational services to all, provide the majority of educational services to elementary and secondary school-age individuals with disabilities. In addition, public school systems serve the majority of economically

disadvantaged students.[17] States generally assign responsibility for providing adult education services, such as General Educational Development (GED) programs, literacy programs, and English as a Second Language (ESOL) programs, to local public school systems.

Educational standards for grades K–12 in public schools are established at the state level and are overseen by the individual state's education department. These standards typically include requirements for proficiency in basic subjects such as reading, writing, mathematics, and science; minimal achievement gaps by race, gender, ethnicity, and socioeconomic status; college readiness preparation, including availability and participation in college credit programs such as Advanced Placement (AP) and International Baccalaureate (IB) programs; and minimum academic credits for graduation. Requirements for a high school diploma vary by state and include achieving a minimum number of credits in English, mathematics, science, social studies, arts or vocational education, physical education and, in some states and school districts, a foreign language.[18]

Private schools must observe federal, state, and local laws, such as maintenance of state-required attendance, curriculum, and safety records and reports; compliance with local building, fire, and sanitation codes; and annual reports to the Internal Revenue Service.[19] Private schools may receive services under the federal Elementary and Secondary Education Act (ESEA), including participating in programs such as the National School Lunch Program, receiving funds from Individuals with Disabilities Education Act grants, and receiving funds from the Title I, Improving the Academic Achievement of the Disadvantaged, program for supplemental education.[20] Note, however, that private schools serve a small percentage of individuals with disabilities. Often, regional or national accrediting agencies, such as the Association of Independent Schools of New England, or the National Christian School Association, accredit private schools.

Although private schools are generally required to provide a curriculum of study meeting the state minimum requirements, they often offer broader curriculums, lower pupil–teacher ratios, additional extracurricular activities, more qualified teachers, and even longer school years.[21] Graduation requirements of private high schools typically are more demanding than the requirements of public high schools.[22] From 1999 to 2000, private high schools required more coursework in social studies, mathematics, science, foreign language, and computer science than did public high schools.[23] For example, private schools required, on average, 3.1 years of mathematics and 1.5 years of foreign language, whereas public schools required 2.7 years and only 0.5 years, respectively.[24] Most private elementary and secondary schools are nonprofit; a very few are for profit, particularly schools run by Education Management Organizations, private organizations that manage charter schools.[25]

Today, public and private schools in the United States provide students with not only instructional services but also supplementary student support services, such as guidance counseling, healthcare services (including school nurses; school psychologists; vision, dental, audiology and speech screenings; and speech therapy services), food services, and transportation services (primarily offered by public schools). Additional support services for learning, emotionally, or physically disabled students are also provided, when appropriate.

Major challenges that the elementary and secondary schools industry has experienced include large increases in the number of non-English-speaking students, an increase in the number of students from impoverished circumstances, the integration of mentally and physically challenged students into general classrooms, and a cultural shift toward more working mothers, particularly mothers with preschool children. Demand for early

education programs has increased markedly because a growing number of women continue to work while raising young children.[26] Other additional challenges include the following:

- English language learners increased in all but 11 states and grew from 5.0 percent of students in 1993 to 9.2 percent in 2012.[27]
- Students living in poverty increased from 17 percent in 1990 to 21 percent in 2012.[28]
- Students participating in the free or reduced price lunch program increased from 32 percent in 1990 to 51 percent in 2012.[29]
- Students receiving special education services under the Individuals with Disabilities Education Act increased from 11 percent in 1990 to 13 percent in 2012.[30] The percentage of disabled students spending 80 percent or more of their time in a regular classroom environment increased from 33 percent in 1990 to 61 percent in 2012.[31]
- Enrollment of 3- and 4-year-olds in academic preschool programs increased from 32 percent in 1975 to 44 percent in 1990 and 55 percent in 2013.[32]
- Women in the labor force with children under age 6 increased from 39 percent in 1975 to 58 percent in 1990 and 65 percent in 2013.[33]

Education output

Constructing a labor productivity measure for elementary and secondary schools (NAICS 6111) first requires developing industry output and labor input measures. The output produced by establishments in NAICS 6111 includes educational and related services that develop the knowledge, skills, and competencies of students, culminating in completion of a basic preparatory education. However, educational services are difficult to measure directly.[34] In the United States, educational services are provided by a mixture of public and private organizations that include both nonprofit and for-profit entities. Measuring education output involves all the difficulties associated with measuring service outputs, further complicated by production in a nonmarket setting, such as production of educational services by public schools.[35] Services produced in a nonmarket setting are sometimes measured in terms of employee hours; that is, the service is defined as the employees' time. However, this definition of output is not appropriate for use in measuring productivity. If output growth is based on the related change in labor, then measured labor productivity is by definition constant and no information regarding industry efficiency can be determined.

Various countries use different methods of measuring education output. These output measures range from the very simple (such as a count of students enrolled) to more complex measures, which include a quality adjustment reflecting some aspect of educational outcome.[36] For primary and secondary education, several countries, including Australia, Finland, Germany, Greece, the Netherlands, and New Zealand, use a volume measure such as the number of pupils or number of teaching hours with no further adjustment.[37] Other countries, such as Hungary, Italy, Poland, and Spain, use the number of pupils as a volume measure and adjust for differences in class size.[38] The United Kingdom constructs an education output measure that uses the number of students as a volume

measure and the average point score per student in the 11th-year General Certificate of Secondary Education test as a quality adjuster.[39]

Although the number of students enrolled is a useful starting point for measuring elementary and secondary education output, it does not reflect changes in the educational attainment level of students. Educational attainment has been shown to vary over time, depending on teacher quality, class size, curriculum quality, and other factors. However, the extent to which the various characteristics of the educational environment and activities influence education output is not always clear. Fraumeni, Reinsdorf, Robinson, and Williams evaluated various combinations of characteristics, such as improved student–teacher ratios, changes in teaching staff composition, and high school dropout rates, and found that, although the direction in which a particular characteristic of the educational environment affects education output may be known, quantifying the impact on education output is difficult.[40]

A wealth of information is available on school performance. The federal government, through Title I of the federal ESEA and reauthorized by the federal Every Student Succeeds Act of 2015, requires states to create annual assessments of schools and school districts.[41] In addition, the Every Student Succeeds Act requires states to hold schools, districts, and states to yearly standards of achievement of students on standardized tests in reading and mathematics.[42] These standards are used to determine if schools, districts, and states are making adequate yearly progress (AYP) as a whole and for specific subgroups of students (including racial and ethnic groups, special education students, and English language learners). Schools, districts, and states failing to meet the AYP levels of achievement for 2 consecutive years in the same subject are considered to need improvement and must take specific steps to improve performance of their students.[43]

States also generally maintain testing programs and meet federal requirements for testing. Individual states perform testing in public and charter schools using standardized tests as required by their state department of education.[44] The charter agreement typically requires charter schools to participate in state and national testing programs.[45] Private schools may or may not be required by a state to participate in state-level academic testing.[46]

BLS education output measure

The BLS output measure for elementary and secondary schools introduced in this article adopts an approach that relies on student performance on standardized tests for capturing the effects of quality change. Separate attendance-adjusted series on numbers of students in public and private schools are used as proxies for the volume of output. To account for the effects of quality change, BLS analysts then applied adjustments based on national mathematics and reading test score data. Finally, BLS staff aggregated the public and private school quality-adjusted output measures using expenditure share weights to obtain a measure of overall output for the elementary and secondary schools industry.

BLS obtained public school enrollment data for students in prekindergarten to grade 12 (pre-K–12) from the National Center for Education Statistics (NCES), State Nonfiscal Survey of Public Elementary/Secondary Education.[47] Private school enrollment data for students in pre-K–12 are obtained from the NCES Private School Universe Survey.[48] Public and private school enrollments in kindergarten through 12th grade are adjusted for variations in daily attendance with the use of NCES data on the average daily attendance of public school students.[49]

Separate public and private school quality-adjustment series are developed on the basis of students' mathematics and reading test scores from the National Assessment of Educational Progress (NAEP) long-term trend (LTT) testing program for public and private schools.[50] These LTT test scores are available (in certain years only) in various subjects for students ages 9, 13, and 17. BLS interpolates the test score data between testing years in order to estimate test scores for nontesting years. As shown in this article, for each of the three categories of schools (all schools, public schools only, and private schools only), a ratio of the reading or mathematics test score to the perfect score was computed for each year and the mathematics and reading test scores were averaged together. When the attendance-adjusted student enrollment series for public and private schools were multiplied by the appropriate test score ratio series, quality-adjusted student output was obtained.

Although quality-adjusted output measures similar to the measure introduced in this article are used in other countries, such as the United Kingdom, research efforts to account for other dimensions of quality are ongoing. Research continues toward establishing empirical relationships between other educational characteristics of U.S. schools and the resulting education outputs. Industry providers themselves in all three types of schools (traditional public, charter, and private) track numerous metrics, in addition to the number of students enrolled, to measure their own output. These metrics include

- performance measures such as student–teacher ratios;
- parental involvement proxies;
- high school course difficulty rankings;
- lesson quality rankings;
- teacher experience and qualification;
- student composition;
- number of AP, IB, or dual credit courses completed;
- standardized testing of student achievement in selected subjects;
- percentage of pupils moving up each year;
- average daily attendance;
- high school dropout rates;
- graduation rates;
- percentage of graduating students enrolling in college; and
- percentage of transfer requests out of a specific school.

These are only some of the numerous measures often cited in assessing educational programs, and in the future, they may be used to develop more sophisticated methods of adjusting for quality change in the provision of educational services. Advances in the economics of education are discussed further in the Appendix.

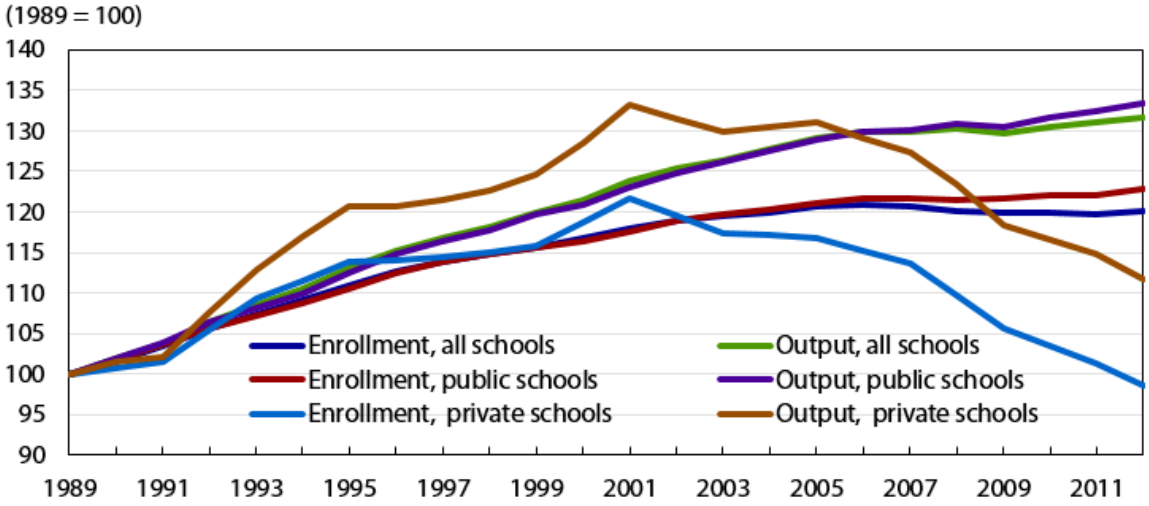
Labor input and expenditures

BLS traditionally measures the labor input component of productivity as the total number of hours worked in an industry. However, not many data of these types are available for primary and secondary education. Instead, BLS measures labor inputs for NAICS 6111, elementary and Secondary Schools, using data on the number of full-time equivalent (FTE) employees in detailed employment categories.[51] Public school labor input is measured with the use of NCES data on the number of FTE employees in 16 detailed employment categories.[52] These categories include not only teachers but also other school employees, such as librarians, guidance counselors, administrators, and student support staff. Private school labor input is drawn from the NCES Schools and Staffing Survey, Private School Questionnaire.[53] BLS combines counts of FTE employees in the detailed employment categories into broad employment categories. Then to develop labor input measures for public and private schools, BLS further combines the counts using expenditure share weights.[54] BLS constructs these weights for public school labor inputs using NCES National Public Education Financial Survey data on salaries and benefits.[55] Total labor input for the industry is measured as an aggregate of the public and private school labor inputs, aggregated with the use of the public and private school expenditure share weights.

Trends in elementary and secondary schools

Output. Output in all elementary and secondary schools increased at a 1.2-percent average annual rate from 1989 to 2012, with the greatest rate of growth occurring in the 1990s, as shown in figure 1. Output grew 1.8 percent per year between 1990 and 2000, slowed to 0.5 percent per year between 2000 and 2007, and then slowed even further to a 0.1-percent average annual rate from 2007 to 2012. Because public schools constituted just over 90 percent of all elementary and secondary schools, output trends in public schools were similar to those for all elementary and secondary schools. For private elementary and secondary schools, output increased at only a 0.5-percent average annual rate from 1989 to 2012, with the highest period of growth from 1990 to 2000.

Figure 1. Enrollment and quality-adjusted output for all schools, public schools, and private schools, 1989–2012

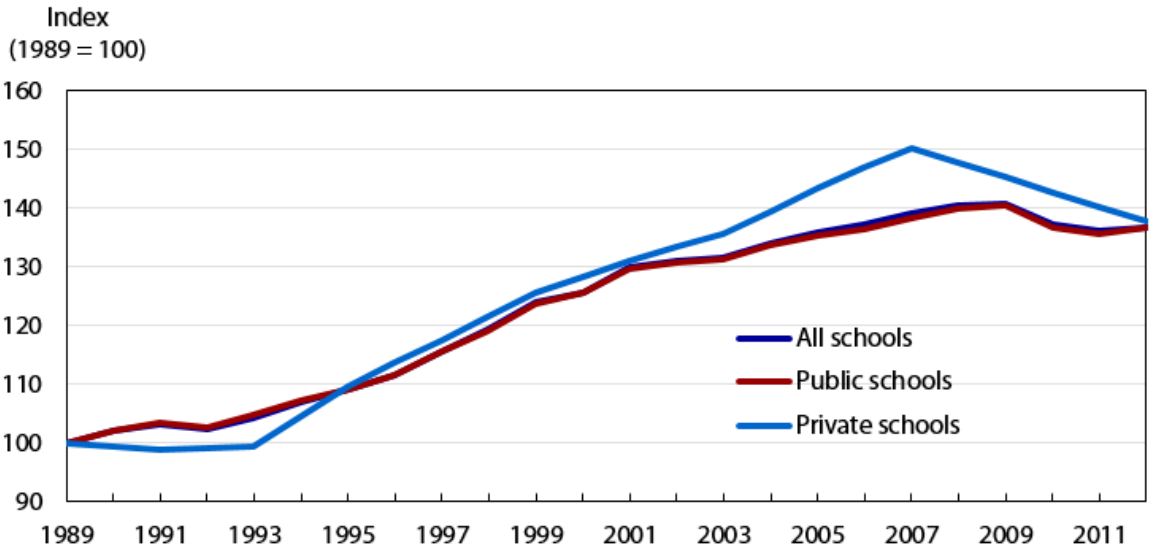


Sources: U.S. Department of Education, National Center for Education Statistics, State Nonfiscal Survey of Public Elementary/Secondary Education and Private School Universe Survey; U.S. Bureau of Labor Statistics.

One factor that strongly affects the output measure is school enrollment, which changed along with the population of school-age children.[56] Public school enrollment grew 1.2 percent per year from 1990 to 2007 but only increased 0.2 percent per year from 2007 through 2012.[57] Private school enrollment increased steadily from 1990 to 2000 at an average annual rate of 1.8 percent, then declined 0.5 percent per year from 2000 to 2007, and fell 2.8 percent per year from 2007 to 2012.[58] Increased tuition and fees, a decline in the economic well-being of families, and increased competition from public schools, particularly charter schools, have been cited as possible explanations for the decline in private school enrollment.[59] Public charter schools have served an increasing number of students, with enrollment rising from 0.3 million students in 1999 to 2.3 million students in 2012.[60]

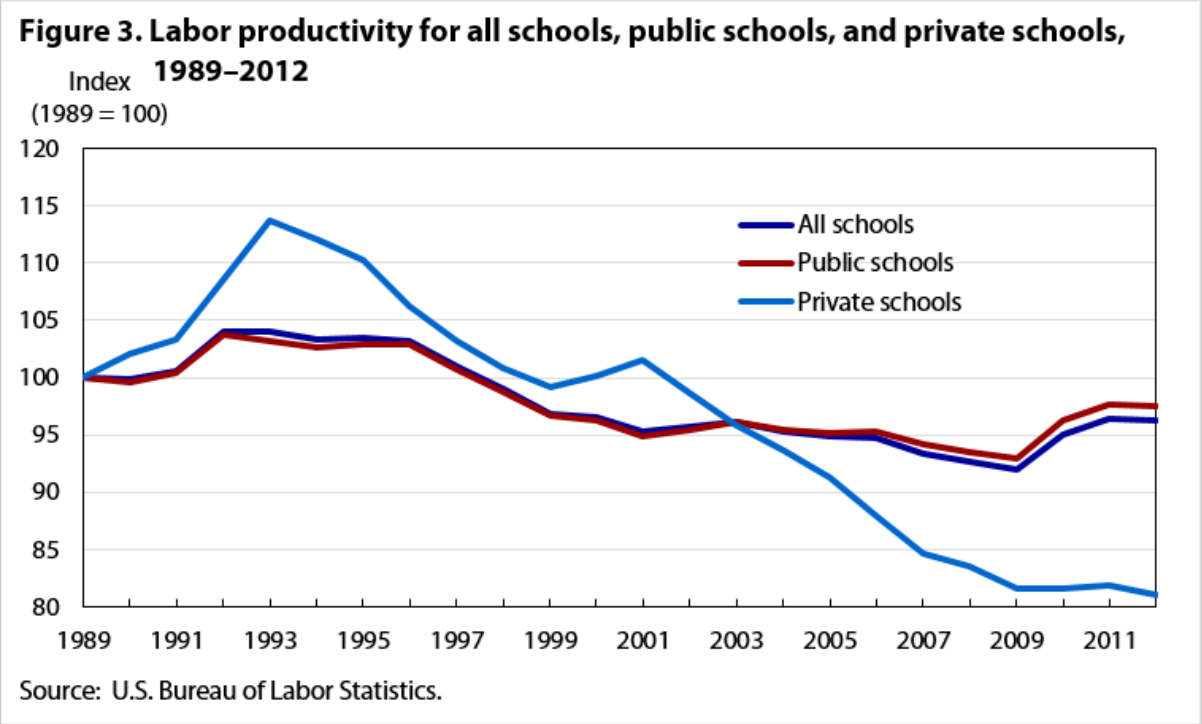
The output measures also reflect variation in the NAEP LTT mathematics and reading student test scores of public and private schools, which were used as output quality adjusters. Private school student test scores ranged from 8.6 to 22.0 points higher than public school student test scores during the 1989–2012 period (on a 500-point scale) and were, on average, 14.89 points higher than public school student scores, with the largest differences found in reading scores.[61] Both public and private school student test scores have increased gradually since the long-term trend assessments of private schools began in 1978.[62] For public schools, incorporating the quality adjustment increased output growth by 0.25 percentage points from 1989 to 2012, while private school output increased by 0.44 percentage points because of the test-score-based quality adjustment.

Figure 2. Labor input for all schools, public schools, and private schools, 1989–2012



Sources: U.S. Bureau of Labor Statistics; U.S. Department of Education, National Center for Education Statistics, State Nonfiscal Survey of Public Elementary/Secondary Education and Schools and Staffing Survey, Private School Questionnaire.

Labor input. Labor input grew 1.3 percent annually from 1989 to 2012 in elementary and secondary schools, as shown in figure 2. Average annual growth rates for labor input dropped in each successive subperiod examined, a pattern also seen for output. Labor input grew 2.1 percent per year from 1990 to 2000, increased more slowly at 1.5 percent per year in 2000–07, and then declined at a 0.5-percent rate from 2007 to 2012. Labor input at private schools increased 2.3 percent per year from 2000 to 2007, much faster than that for public schools. From 2007 through 2012, labor input declined more rapidly in private schools (1.7 percent per year) than in public schools (0.4 percent per year).



Labor productivity. Labor productivity in elementary and secondary schools, calculated as output per FTE of labor input, rose from 1990 to 1995 and then declined steadily until 2009. Although productivity rose from 2010 forward, it did not regain the level that it had reached in 1989. The average change in labor productivity for all elementary and secondary schools over the period, as a whole, was a slight decline of 0.2 percent per year. Figure 3 displays labor productivity trends for the industry and for public and private schools, from 1989 to 2012. Because public schools educate over 90 percent of the students, the industry and the public school trends are nearly identical. Public school labor productivity peaked in 1992 and 1995 and then declined steadily until 2009, reflecting declining growth in output and a somewhat slower decline in labor input growth. The decline in the public school output growth rate primarily reflects the slowing growth rate of the school-age population. From 1990 to 2012, the school-age population grew at an average annual rate of 0.79 percent, with a growth rate of 2.02 percent from 1990 to 2000 and 0.26 percent from 2000 to 2012.[63] As shown in table 1, beginning in 2009, public school output growth continued to slow while labor input fell off significantly, with a –0.91-percent growth rate of labor input for 2009 to 2012, resulting in an upturn in public school labor productivity. Labor productivity in private schools declined sharply after 1993 and even more severely after 2001 than in public schools. This decline appears to be the result of a more cautious reduction in labor inputs by private schools than by public schools. In addition, private schools did not experience the same uptick in productivity after 2010 as their public counterparts. Private school output growth remained positive from 1993 to 2001, while labor input growth increased markedly. From 2001 to 2012, private school output growth retreated to negative values and while labor input growth fell dramatically, labor productivity growth for private schools remained negative. Figure 4 displays output, labor input, and labor productivity annual growth rates for the industry overall, public schools only, and private schools only, from 1990 to 2012.

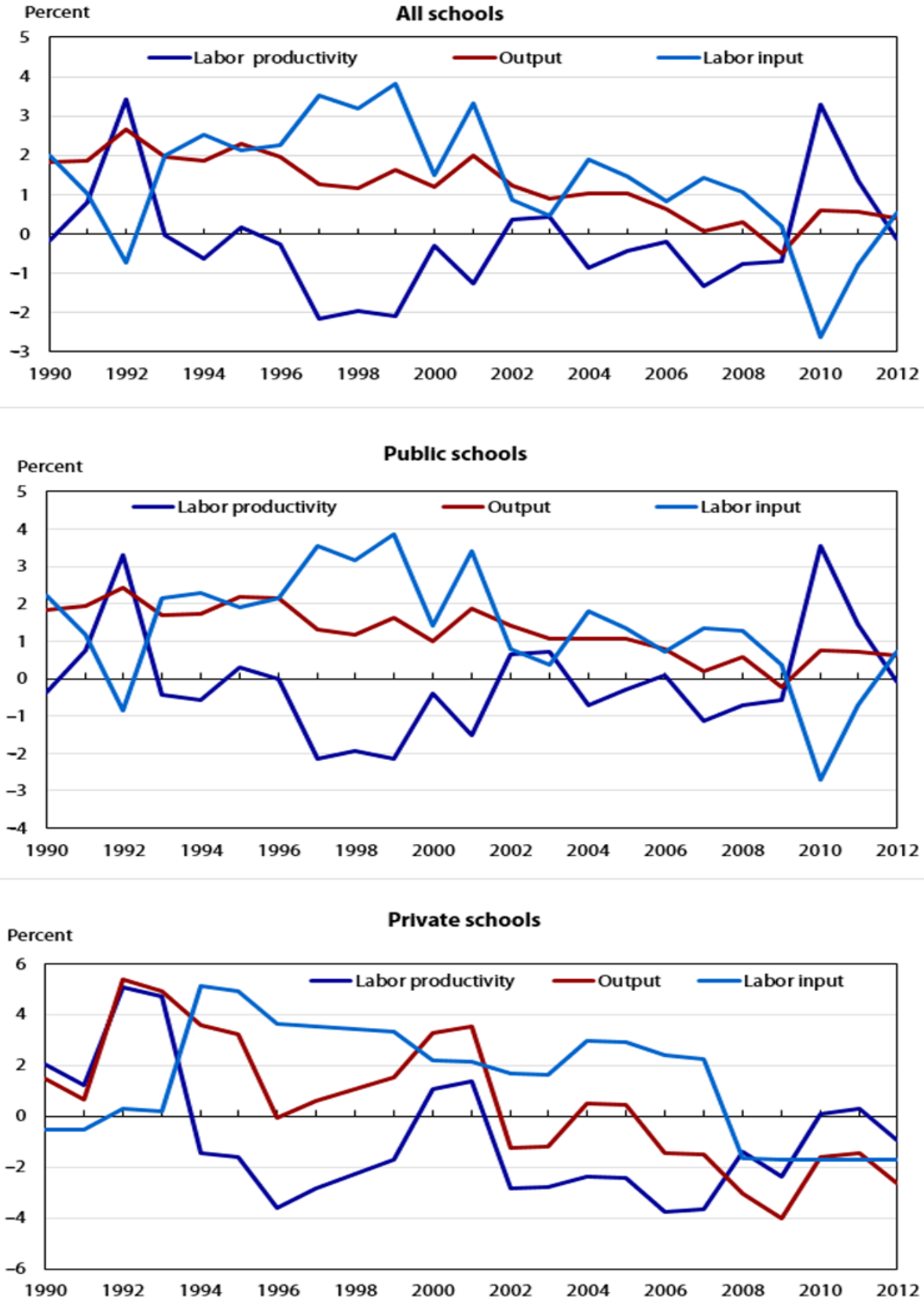
Table 1. Average annual percentage-growth rates of labor productivity, output, and labor input for all schools, public schools, and private schools, 1989–2012

Time span	All schools			Public schools			Private schools		
	Labor productivity	Output	Labor input	Labor productivity	Output	Labor input	Labor productivity	Output	Labor input
1989–2012	–0.17	1.20	1.37	–0.11	1.26	1.37	–0.91	0.49	1.41
1989–93	.99	2.06	1.06	.80	1.98	1.17	3.25	3.09	–.15
1993–2001	–1.08	1.66	2.77	–1.05	1.63	2.71	–1.40	2.07	3.53
2001–12	.08	.56	.47	.25	.73	.47	–2.02	–1.58	.46
1989–95	.58	2.07	1.48	.49	1.97	1.48	1.63	3.20	1.54
1995–2009	–.84	.98	1.83	–.73	1.07	1.82	–2.13	–.14	2.03
2009–12	1.49	.51	–.97	1.62	.70	–.91	–.20	–1.90	–1.71

Source: U.S. Bureau of Labor Statistics.

Unit labor costs and compensation. The concept of “unit labor costs” compares labor compensation with output and is a useful gauge of how much output is received over time relative to labor costs, or the “cost competitiveness” of labor input in the production of output. One may also calculate unit labor costs by dividing hourly compensation (labor cost per hour) by labor productivity (output per hour). Therefore, an increase in labor productivity growth offsets the growth of hourly compensation in calculating unit labor costs. A greater rate of labor productivity growth relative to growth in hourly compensation will result in lower unit labor costs.

Figure 4. Annual growth rates of labor productivity, output, and labor input for all schools, public schools, and private schools, 1990–2012



Source: U.S. Bureau of Labor Statistics.

BLS calculated unit labor costs for public elementary and secondary schools using data on public school salaries and benefits from the NPEFS. Unit labor costs increased at an average annual rate of 3.4 percent from 1989 to 2012.[64] Public school unit labor costs varied over this period, increasing at a rate of 3.6 percent from 1990 to 2000, 4.3 percent from 2000 to 2007, and declining to 1.2 percent from 2007 to 2012. Regarding data from the National Association of Independent Schools, private school unit labor costs increased at a rate of 5.4 percent for the 1998–2012 period.[65] From 1990 to 2000, private school unit labor costs rose at a rate of 4.2 percent, increasing to 7.7 percent from 2000 to 2007 and falling to 5.0 percent for 2007–12. For the industry overall, unit labor costs rose at an average annual rate of 3.6 percent from 1989 through 2012, with a variation of 3.7 percent from 1990 to 2000, and at a rate of 4.6 percent from 2000 to 2007 and declined to 1.5 percent from 2007 to 2012.[66]

Labor compensation, the sum of salaries and benefits paid to employees, increased at a rate of 4.8 percent for the elementary and secondary schools industry from 1989 to 2012. Labor compensation increased steadily in the industry overall, growing at a rate of 5.5 percent from 1990 to 2000 and 5.6 percent from 2000 to 2007 before declining to 1.7 percent for 2007–12. This 4.8-percent annual growth in labor compensation from 1989 to 2012 for the elementary and secondary schools industry is similar to the 4.4-percent annual growth in labor compensation found in the nonfarm business sector as a whole, one of the broadest aggregates for which productivity measures are published. However, when combined with flat or declining labor productivity in the industry, this increase in hourly compensation resulted in relatively rapid increases in unit labor costs.

Public school labor compensation increased at a rate of 4.7 percent during this period (1989–2012), whereas private school labor compensation increased at a rate of 5.9 percent. Public school labor compensation grew at a steady 5.4-percent growth rate from 1990 to 2007 before declining to 1.6 percent growth for 2007–12. Labor compensation of private schools grew at a rate of 6.7 percent from 1990 to 2000 and 7.6 percent from 2000 to 2007 before declining to 2.3 percent from 2007 to 2012. Looking at the components of labor compensation, we find that benefits grew at a faster rate than salaries in the elementary and secondary schools industry. The gap between growth in benefits and growth in salaries was particularly wide between 2000 and 2007, with benefits rising 4.1 percent faster than the rate salaries rose.

Conclusion

The elementary and secondary schools industry must be responsive to changes in the population requiring educational services. Increased enrollments of students with specific needs, such as English-language learners, disabled students, and impoverished students, challenge the industry. The industry is also subject to variation in economic conditions, with public schools facing tighter budget constraints during periods of economic downturn and private schools facing families with more limited budgets. Variations in factors influencing student educational outcomes, such as teacher quality, student–teacher ratios, and curriculum quality, also play a role in determining the output of educational services. In the future, we hope to provide additional information on changes in these underlying factors and their quantitative impact on educational services. This new measure is a first step toward understanding the relationship between production of educational services and the labor inputs used in this production.

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Appendix: advances in education economics

Over the last few years, economists have progressed tremendously in understanding some of the central issues in education. Many research studies have used large datasets to understand school performance and to unravel connections between school performance and students' economic success later in life. This appendix summarizes much of the recent economic research and guides interested readers toward other research topics in which they may be interested.

We begin with three studies conducted shortly after 2000 that influenced the economics of education considerably. In the first study, Hanushek and Kimko come to two central conclusions.[67] First, countries that have students who score high on international tests in science and mathematics also have higher rates of economic growth. Second, immigrants to the United States who come from countries with higher scores also earn more in the United States. These results suggest that these countries produce high-quality human capital and are thus able to grow more quickly. Such evidence is also consistent with an emphasis on science and technology education.

In a second study, Hanushek shows that, in most contexts, more resources devoted to education do not lead to better results.[68] A few exceptions to this general rule exist, mostly among young children and disadvantaged groups. For example, Hanushek remarks that if disadvantaged students were fortunate enough to have strong teachers, at the 85th percentile, for 5 consecutive years, such a boost in itself would be sufficient to eliminate the entire gap between mainstream and disadvantaged students.[69] What stands out most strongly from this study is how additional resources generally do not lead to improved results. Findings such as these have led scholars to conclude that, since added resources do not work, educators will have to fundamentally change the structure of schools and their incentives to produce better outcomes.

In the final study, Rivkin, Hanushek, and Kain studied the value added of learning of students in Texas schools.[70] "Value added" is a measure of a student's learning in a given year, and it is measured by the increase from the previous year's test scores. The value-added measure reflects the "gain" in a student's test scores compared with previous years' scores and controls for family, neighborhood, and school influences on a student. This value-added approach makes adjusting for individual student differences in learning capability possible. Teacher evaluation by year-to-year gains in student achievement then become a useful additional measure of teacher effectiveness.

Teacher effects are generally found to be consistent over time: Teachers with high value-added scores within a given year tend to have similar scores in other years; teachers with low value-added scores tend to have similar scores in other years. This result has been the basis for a renewed emphasis on measuring and rewarding good teachers.

After the Rivkin et al. study and other similar work showed that teacher value added could be estimated, further work analyzing education in terms of teacher value-added data then exploded. New teachers were found to have below-average teacher scores in their earlier years, particularly in their first year.[71] Many teachers with especially low scores in their early years soon left the profession. Having shown that low income and minority students are taught more frequently by beginner teachers and experience higher teacher turnover rates, Rivkin et al. and others argued for implementing policy incentives such as higher pay to retain more experienced, qualified teachers for

disadvantaged students.[72] Teacher scores were uncorrelated with many factors often used in teacher pay, such as the presence of a graduate degree.[73]

A recent study has also illustrated the very strong returns associated with early childhood education. James Heckman demonstrated that attempts to improve learning are much more effective in children's early years, when the brain is more malleable.[74] Heckman explained many of the basic ideas in clear, nontechnical language. Heckman's work often distinguishes between cognitive (learning) skills and noncognitive skills, such as perseverance and reliability, which have proven to influence children's future economic success extensively.

In the last few years, economists have published several articles showing the important and enduring affect teachers have over a student's lifetime. For example, Chetty et al. showed that unusually effective kindergarten teachers could create $8,500 to $10,700 greater lifetime earnings per student, in present value, or $170,000 to $214,000 greater earnings for a class of 20 students.[75] Interestingly, the effects of class quality on test scores faded over time, but the effect on eventual adult income remained operating through noncognitive effects. Similarly, Chetty, Friedman, and Rockoff found that, as long as they controlled for previous test scores, value-added measures are an unbiased measure of teachers' effect on student achievement.[76] In further work, Chetty, Friedman, and Rockoff showed that [measures of teacher value added] are not just measures of effectiveness in teaching for the test but are useful predictors of future adult income.[77] Finally, Chetty and Hendren showed that students benefit from moving from poor to higher income areas as long as they move before age 13.[78]

The evidence just summarized illustrates the importance of teacher value-added effects. Nevertheless, value-added methods have become a controversial topic, especially because, depending on the construction of the particular measure and the accuracy of student testing, they may mischaracterize the contribution of individual teachers. The American Statistical Association has cautioned about the use of value-added methods in evaluating individual teachers.[79] Rothstein tested three different value-added measures and found that the measures fail to uphold some underlying assumptions, including that fifth-grade teacher assignments should not be correlated with fourth-grade student gains.[80] Rothstein finds that students who do exceptionally well in fourth grade trend downward in gains in fifth grade as their achievements fall back toward the mean gain, and students who do poorly in fourth grade trend upward in gains in fifth grade as they advance toward the mean. According to Rothstein, the value-added measures he tested credited teachers for the students assigned, rather than accurately capturing the value added by the individual teacher.[81] Despite such concerns, measures of the value added by teachers are important. The Gates Foundation (Measures of Effective Teaching [MET] Project) found that constructing a composite measure of teacher effectiveness that combines information from test score growth, classroom observations, and student-perception surveys of the classroom environment results in a fair and reliable measure.[82] In addition, using classroom observations of teacher performance and student-perception surveys to evaluate teachers generates valuable measures in their own right.[83] In a pioneering effort, the Gates Foundation is underwriting a project that will videotape teachers with high value added, analyze the characteristics that high value-added teachers have in common, and explore how the secrets of their effectiveness can be taught to other teachers.[84]

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NOTES

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[2] Ibid. See figure 1, pp. 1–2.

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[15] School boards develop policies and regulations to control the operation of the schools in a school district, including system organization, school site location, school finance, equipment purchase, staffing, attendance, curriculum, extracurricular activities, and other functions, and may also be authorized to levy taxes, initiate eminent domain proceedings, acquire land, and assume bonded indebtedness. See Joseph Beckham and Barbara Klaymeier Wills, *Education encyclopedia*, "Duties, responsibilities, decision-making and legal basis for local school board powers," http://education.stateuniversity.com/pages/2391/School-Boards.html.

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[17] These students often require additional support through the public school system, such as breakfast and lunch programs, safe after-school programs, and tutoring, to compensate for their reduced access to in-home and in-community resources.

[18] The National Council of State Supervisors for Languages (NCSSFL) provides documentation on foreign language high school graduation requirements by state at http://ncssfl.org/.

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[44] Commonly used standardized tests include the Iowa Tests of Basic Skills for K–8 and the Iowa Tests of Educational Development, used for grades 9–12, published by Riverside Publishing/Houghton Mifflin; the Stanford Achievement Test, Ninth Edition, published by Harcourt Educational Measurement; and the Michigan Educational Assessment Program (MEAP), devised to assess educational achievements of students in the Michigan school systems.

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[48] The National Center for Education Statistics (NCES) Private School Universe Survey of the U.S. Department of Education produces data similar to that of the NCES Common Core of Data for the public schools. Private schools are included in the survey when they teach at least one of grades 1–12, ungraded students between 5 and 18 years old, kindergarten (traditional year of school primarily for 5-year-olds before first grade), transitional kindergarten (extra year of school for kindergarten-age children who are judged not ready for kindergarten), or transitional first grade (extra year of school for children who have attended kindergarten but have been judged not ready for first grade). Early childhood programs and daycare centers that teach kindergarten, transitional kindergarten, or transitional first grade are also included in the survey. For more information, see http://nces.ed.gov/surveys/pss/index.asp.

[49] Average daily attendance data are obtained from the U.S. Department of Education, National Center for Education Statistics, National Public Education Financial Survey, http://nces.ed.gov/ccd/stfis.asp. Because average daily attendance data are not available for private schools, the public school data on average daily attendance are used for adjusting both public and private school enrollment for variations in daily attendance. The attendance of prekindergarten student enrollment is not adjusted because attendance is not compulsory for this group of students.

[50] The National Assessment of Educational Progress (NAEP) is the largest nationally representative and continuing assessment of elementary and secondary school students in the United States. Assessments are conducted periodically in mathematics, reading, science, writing, the arts, civics, economics, geography, and U.S. history. The NAEP (also known as "The Nation's Report Card"; see endnote 11) is a congressionally mandated assessment in various subject areas administered by the National Center for Education Statistics, a branch of the U.S. Department of Education. Results are summarized only at the national, state, and trial urban district

(Trial Urban District Assessment [TUDA]) levels. The NAEP created the TUDA in 2002, beginning with six urban districts participating in reading and writing assessments, to support the improvement of student achievement in the nation's large urban districts. In 2009, 18 districts participated in mathematics, reading, and science. In 2011, 2013, and 2015, 21 districts participated. NAEP assessments are administered uniformly with use of the same sets of test booklets across the nation and, as a result, serve as a common metric for all states and selected urban districts. The assessment stays essentially the same from year to year, with only carefully documented changes. This process permits NAEP to provide a clear picture of student academic progress over time. Long-term trend assessment in mathematics and reading is conducted differently from the NAEP's main assessments, and the two types of assessments are not comparable. For additional information, see http://nces.ed.gov/nationsreportcard/about/.

[51] These categories include elementary and secondary school teachers, instructional aides, guidance counselors, librarians and library support staff, school administrators (principals, assistant principals, head masters, assistant heads), school administrative support staff, psychologists, speech therapists, audiologists, school nurses, attendance officers, cafeteria staff, bus drivers, custodial and building maintenance staff, and security staff. Public school systems also employ local education agency administrators such as school district superintendents, assistant superintendents and deputy superintendents, administrative assistants, business managers, administrative support staff, and instructional coordinators. Although private schools do not require local education agency staff, they may employ business officers, admissions officers, development officers, and directors of studies.

[52] These data are obtained from the National Center for Education Statistics, State Nonfiscal Survey of Public Elementary/Secondary Education. The 16 public school detailed employment categories include prekindergarten teachers, kindergarten teachers, elementary school teachers (excluding prekindergarten and kindergarten teachers), secondary school teachers, ungraded teachers, instructional aides, instructional coordinators, guidance counselors, librarians, library support staff, local education agency administrators, local education agency administrative support staff, school administrators, school administrative support staff, student support services staff, and all other support staff.

[53] Private school detailed employment categories include principals, assistant principals, other managers, instruction coordinators, teachers (grades K–12), teacher aides, other aides, guidance counselors, librarians and media specialists, librarians and media center aides, nurses, student support staff (includes student support services professional staff, such as school psychologists, social workers, and speech therapists), secretaries and clerical staff, food service personnel, custodial and maintenance staff, and other employees (includes health and other noninstructional aides and other employees not identified by function). These data are available every 4 to 6 years. Data points between available years are interpolated with use of average annual growth rates. Because the Schools and Staffing Survey, Private School Questionnaire, gathers data on number of teachers for grades K–12 only, we estimate the number of private school prekindergarten teachers for each year by dividing annual private school prekindergarten student enrollment by the private school student–teacher ratio for that year.

[54] We defined the six broad employment categories to closely match the six public school expenditure categories available in the National Center for Education Statistics (NCES), National Public Education Financial Survey. Expenditure share weights for each of the six broad employee categories are calculated with the use of NCES National Public Education Financial Survey data on salaries and benefits (http://nces.ed.gov/ccd/stfis.asp). The use of expenditure share weights in constructing nonmarket output and input index measures is discussed by W. Erwin Diewert in "The measurement of nonmarket outputs and inputs using cost weights," Discussion Paper no. 08-03 (Vancouver, BC, Canada: University of British Columbia, April 2008); and in chapter 16, System of National Accounts 1993, Eurostat, IMF, OECD, UN, and the World Bank (New York: United Nations, 1993).

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[62] Differences between long-term trend reading and mathematics test scores administered by Catholic schools and public schools are presented in *The nation's report card: trends in academic progress, 2012*, NCES 2013-456 (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2012), pp. 42–43, http://nces.ed.gov/nationsreportcard/subject/publications/main2012/pdf/2013456.pdf.

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[65] The National Association of Independent Schools (NAIS) generously provided mean and median salary data by employee category for private schools. Total annual private school salary expenditures were estimated with use of data on the number of private school employees by employee category from the U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, Private School Questionnaire, and NAIS salary data by type of employee. Because private school benefits data were unavailable, private school benefits were estimated with the use of private school salary data and the ratio of public school benefits to salaries. This estimation approach constrains estimated private school benefits to the public school benefits growth rate, and as a result, the private school benefit data are not published separately. The U.S. Bureau of Labor Statistics, Occupational Employment Statistics program (OES), began publishing wage data by occupation for private schools in this industry in 2009. The OES data may eventually be used to replace the NAIS data, which are not from a representative sample of private schools.

[66] Labor compensation is defined to include salaries and benefits. Labor compensation for public schools is measured with use of data on salary and benefit expenditures from the National Center for Education Statistics (NCES), National Public Education Financial Survey. While extensive and detailed expenditure data are available for public schools, little expenditure data are available for private schools. Using NCES data on number of employees and historical salary data from the National Association of Independent Schools (NAIS), we construct estimates of salary expenditures for each of 10 detailed private school employee categories. Benefits expenditures for private schools are not available from the NAIS. To estimate private school benefits, we computed the ratio of public school benefits expenditures to public school salaries expenditures and applied this ratio to total salaries expenditures obtained from the NAIS. We obtained aggregate elementary and secondary industry compensation by summing total public and private labor compensation.

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