World Wide Wonder?

Measuring the (non-)impact of Internet subsidies to public schools

Like the television revolution, which brought electronic boxes into schools in the 1960s and was supposed to turn classroom teaching on its head, computers were rolled into schools in the 1990s and connected to the worldwide web with the expectation that education would never be the same. TVs never really caught on as chalkboard replacements. Although they are still around, they seem to be used primarily as “educational film” filler by substitute teachers. The wired computer invasion has been very different. We never saw classrooms filled with rows of children sitting in front of televisions. And there was no national Marshall Plan to close the “television gap.” The Internet, in fact, was something of an answer to the “vast wasteland” of TV; and it came with such promise for education that a new national anxiety, the “digital divide,” was born and with it a rush of educators and philanthropists wanting to make sure that the poor would not be shut out of the worldwide promised land.

The best evidence of the concern over the digital divide was the speed with which the federal government interceded to help close it. A program offering generous subsidies to schools and libraries for the purchase of Internet technology was made part of the massive overhaul of the Telecommunications Act in 1996. (In Internet time, this was almost prehistory: Amazon and eBay didn’t open their online doors until 1995, and Google was still two years from birth.) The subsidies were apportioned on a sliding scale, with poorer schools receiving more. Known as the E-Rate (education rate) program, the schools and libraries subsidy was funded by a tax on long-distance telephone service. It quickly became the most ambitious federal school technology program in history.

“Because of the E-Rate,” gushed Vice President Al Gore in May of 1997, “our children will not be stranded in the high-rent districts of cyberspace. We now can go from a world where most teachers don’t even have phones to a world where all teachers can help their students talk to the world. Our nation has taken a great step forward in closing the gap between the information haves and the information have-nots.”

The first E-Rate subsidies were distributed in 1998, in time to reach schools for the 1998–99 academic year. As applications increased, funding grew from $1.7 billion in
1998–99 to $2.1 billion in 2000–01, very near the maximum allowed by statute, which was (and remains) $2.25 billion per year. The program’s size was staggering, especially considering that total public-school spending on computers in 1999 (including hardware, software, training, networking) was only $3.3 billion.

Many of the supporters of the E-Rate program, including former Secretary of Education Richard Riley, expected the program to do more than simply wire schools. To be successful, Riley said, E-Rate “must show that it really makes a difference in the classroom, and that means helping students learn the basics and other core subjects.”

Billions of dollars in subsidies later, we can make some tentative conclusions about the effectiveness of the E-Rate program: whether it has, as Al Gore predicted, closed the gap between the “information haves and information have-nots,” and whether it fulfilled its promise, as Richard Riley demanded, to make “a difference in the classroom.” The conclusions are a mixed bag.

**California Here We Come**

To find out what happened to the E-Rate program, we turned our attention to California. With fully 13 percent of the public-school enrollment in the United States, California provides a large enough sample to allow for informative conclusions about the program. Better yet, it is also the only state that kept comprehensive records of school computer and Internet access before the enactment of the E-Rate initiative. We thus have a very valuable point of comparison to gauge E-Rate’s impact on Internet access and student test performance. We analyzed data beginning with the 1996–97 school year, before E-Rate, and ending with the 2000–01 year, when the program’s onset and initial growth make it easiest to measure its impact.

Before the implementation of E-Rate, the digital divide cut sharply through California’s public-school system. Our data indicate that schools with the most affluent student bodies, where less than 1 percent of students were eligible for free or reduced-price lunch, already had Internet access in roughly one-half of their classrooms during 1996–97. In contrast, schools with 75 percent or more of their students eligible for the lunch program had a mere 8 percent of classrooms wired (see Figure 1).

The good news about the E-Rate program is that it clearly helped to narrow the digital divide among schools (see Figure 2). Offered Internet technology for lower prices, public schools responded by purchasing more. Because the E-Rate subsidies were more generous for schools likely to lag behind in technology adoption, gaps in access to Internet technology narrowed.

The bad news, though, is that the additional investments in technology generated by E-Rate had no immediate impact on measured student outcomes.

**The Right Spending Spurs**

Outcomes aside, the E-Rate program seems to be a model for how to induce school “reform” through a scaled incentive system. It did not provide preselected technology to schools or cover 100 percent of the price when schools made their own purchases. Instead, E-Rate subsidized schools’ purchases of approved technology. Requiring schools to foot part of the bill, it was believed, would encourage them to make only those purchases that they saw as having some value to them.

During the period covered in our study, the subsidy rate under E-Rate ranged from 20 to 90 percent, depending on the share of students who qualify for the national school-lunch program and whether the school is classified as rural. For example, an urban or suburban school with between 35 percent
and 49 percent of its students eligible for the national school-lunch program would receive a 60 percent subsidy; an investment of $1,000 in approved technologies would cost the school only $400. The same $1,000 investment for an urban school with more than 75 percent of its students eligible for school lunches would cost just $100. The subsidies for rural schools were slightly higher to reflect their higher costs of getting connected.

Schools were able to draw on E-Rate funding to support purchases of any commercially available services and equipment that had the primary purpose of delivering telecommunications and Internet access to classrooms or other places of instruction. This included basic telephone service, Internet access, a high-speed T1 line, telecommunications wiring, routers, and switches. Schools could not, however, receive subsidies for things like software or computers that were not connected to the Internet.

Schools could apply for the program individually or as part of a district-wide application. The subsidy rate for districts was based on the average share of students eligible for school lunches across all schools included in the application. The rules required that local administrators “strive to ensure that each school receives full benefit of discount to which entitled.”

Between the 1998 and 2000 school years, California received almost $937 million in E-Rate subsidies, or more than 20 percent of the entire national subsidy to public schools in that period. California E-Rate funding increased sharply in 2000–01, rising from $254 million to $475 million, due entirely to the $230 million in E-Rate funding that the Los Angeles Unified School District received that year.

A Gold Rush of Megabytes
Internet access in California public schools increased considerably after E-Rate was introduced. A database maintained by the state's department of education since 1996–97 contains information about the number of classrooms in each school that were connected to the Internet. During the 1997–98 school year, the year before the first E-Rate funding was awarded, only 55 percent of California’s 8,186 public schools had any Internet connections in classrooms. Using the number of teachers in each school as a rough proxy for the total number of classrooms lets us estimate the percentage of classrooms with connections: a quarter of classrooms in California had Internet access.

As the E-Rate funds grew, Internet access became more widespread. By 2000–01, 85 percent of California schools had at least one classroom with Internet access, while two-thirds of all classrooms in California had such access.

The simultaneous increase of Internet access and the advent of E-Rate funding do not, of course, prove that it was E-Rate that improved access, as there was already a clear upward trend in the fraction of public schools with Internet access before the E-Rate program began. According to data from surveys conducted by the U.S. Department of Education, the share of public-school classrooms nationwide with access to the Internet increased fivefold from 1994 to 1996 (from 3 percent in 1994 to 15 percent in 1996), followed by continued growth through 1999 (51 percent in 1998 and 63 percent in 1999). Similarly, our data from California indicate that Internet access in California classrooms increased by 53 percent between the 1996–97 and 1997–98 school years (from 17 percent to 26 percent of classrooms). The spread in Internet access before E-Rate suggests that, even in the absence of the federal subsidy, many schools would have chosen to make Internet investments.
Closing the Digital Divide
Did the federal government spend billions of dollars to encourage Internet investment that would have happened anyway? Another common concern about E-Rate is that rich schools might receive the lion’s share of the subsidy money, despite having a lower subsidy rate, because they have more funds available for computer and Internet investment.

Our data, however, confirm that E-Rate funding in California through 2001 went disproportionately to schools with higher poverty rates. During the first three years of the E-Rate program, school districts with 50 percent or more of their students eligible for free or reduced-price lunch, and subsidy rates of 80 and 90 percent, received almost 90 percent of all public-school funding (see Figure 1). There was some distortion in the very wealthiest sections of the state: the 10 percent of districts with less than 1 percent of their students eligible for the federal-lunch program received, on average, seven times as much funding per pupil as districts with between 1 and 20 percent of students eligible ($127 and $17, respectively). The poorest districts, however, received substantially more funding per pupil than even the richest schools. Schools with 75 percent or more of their students eligible for the lunch program received the most funding per pupil: $341.

The additional spending by poorer districts during E-Rate’s first three years dramatically narrowed the digital divide. During the 1996–97 school year, districts with the highest poverty rates had the lowest percentage of their classrooms online. Over the next year (and still before the E-Rate program) this gap grew even wider. Once the E-Rate program began in 1998, however, the poorest schools, which had the largest subsidy rates, accelerated their adoption of Internet technology, and the gap between rich and poor schools began to close (see Figure 2).

Subsidized Investment
These patterns suggest that E-Rate worked as intended to encourage new Internet investments within the poorest districts, but they do not rule out the possibility that some other difference between poor and rich schools was responsible for the convergence. We therefore also examined how each school’s rate of growth in the percentage of rooms connected changed annually from 1996–97, two years before any subsidies were awarded, through 2000–01.

If, all other things being equal, schools with larger potential subsidy rates increased their Internet capacities by more than schools with lower potential subsidy rates, we would have strong evidence that the subsidies were the incentive to increase investment.

When making these comparisons, we also controlled for any effects of differences in the fraction of students in a school eligible for the federal school-lunch program. As mentioned above, schools with more school lunch–eligible students were actually spending less on Internet technology before E-Rate’s implementation. Nonetheless, including this poverty measure enabled us to differentiate the more rapid growth we would expect among higher-poverty schools as they play catch-up and the slowing of investment among higher-income schools as they near full Internet access for their school.

We found that the bigger the subsidy, the more a school increased its growth rate of Internet access over what it would have invested without the subsidy. On average, a 10 percent increase in the E-Rate subsidy led to a 1.36 percent increase in the number of classrooms with Internet access per year. If a school with average Internet growth before E-Rate had received no subsidy between 1996–97 and 2000–01, our results indicate that only about 40 percent of classrooms would have had Internet access by the 2000–01 school year. In fact, access at this same school with the subsidy was 66 percent of classrooms online, or 68 percent higher than expected.

All schools did not respond to the incentive in the same way. Rural schools proved to be much less responsive to the subsidy program than urban schools, perhaps because they faced higher prices for Internet services or were unable to get the T1 broadband at all, which would have meant that their total cost for new investment would have been greater despite their having higher subsidy rates. Primary and middle schools (all those with no students in grades 10–12) saw an especially large increase in investment in Internet technology in response to the incentive; the response among high schools was smaller. Finally, schools that are heavily black and Hispanic were more responsive to the subsidy than schools with mostly white and Asian student bodies. Perhaps schools with larger minority populations were more budget constrained and therefore more responsive to the subsidy rate.

Student Achievement
E-Rate spurred schools to invest more in the Internet, and by that measure it was a great success. But did improved Internet access boost student achievement, as many of its strongest proponents had hoped? To answer this question, we gathered data on each school’s performance on the Stanford Achievement Test (not to be confused with the SAT or Scholastic Aptitude Test given to
The Internet itself, though, seems unlikely to be a silver bullet for solving the problems of America’s public schools.

Austan Goolsbee is professor of economics and Jonathan Guryan associate professor of economics, the Graduate School of Business, University of Chicago. They are research associate and faculty research fellow, respectively, at the National Bureau of Economic Research (NBER). This article is adapted from a study that will appear in The Review of Economics and Statistics.