# Impact of school district demographics and financial status on E-Rate funding: Analysis of Pennsylvania data for 1999 and 2004


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## Abstract

The E-Rate program was mandated by the 1996 Telecommunications Act to bridge the gap in telecommunications and internet access between rich and poor communities in the United States. Though the funding process has specific formulas to direct support at the most needy schools and school districts, the complex, multi-stage application process may prevent some school districts from availing of E-Rate funds due to lack of technical expertise and administrative support. The objective of the paper is to assess the cumulative impact of these two contradictory effects. We also examine changes in funding patterns over time, specifically the gap between poor/rural school districts has narrowed due to experience and better information. Data on all E-Rate projects where the recipient is a school district were collected for two years, 1999 and 2004, for the state of Pennsylvania. Results show that E-Rate funding was significantly positively correlated with the poverty rate and percentage of minority students—to this extent the program fulfilled the policy intent. However, rural school districts continue to be disadvantaged compared to their urban peers. Policy implications include further simplifying the E-Rate application process, and using some E-Rate funds to provide technical information on school networking to poor/rural school districts.

# Impact of school district demographics and financial status on E-Rate funding: Analysis of Pennsylvania data for 1999 and 2004

The E-Rate program, mandated by the 1996 Telecommunications Act to bridge the gap in telecommunications and internet access between rich and poor communities in the United States, has been instrumental in reducing the digital divide in America's schools, with nearly all schools in the nation now reporting that they are connected to the internet. However, internet access is not fully equalized yet especially in terms of classroom access and the quality of connections: for example, the National Center for Educational Statistics [NCES] (2005) reported that 97 percent of instructional classrooms in town schools have internet access, whereas only 90 percent of classrooms in city schools do; similarly, 98 percent of town schools have broadband connections while only 90 percent of rural schools do. Similar gaps exist in terms of number of computers per student and the variety of instructional software available in rich and poor schools.

It was in order to bridge persistent gaps like these that specific formulas were incorporated into the E-Rate funding mechanisms to direct support at the most needy schools and school districts. A total of $2.25 billion is available through the E-Rate program annually to fund telecommunications and internet access and connectivity in schools and libraries. Schools receive discounts for telecommunications access ranging from 20 percent to 90 percent of total eligible spending depending on the poverty level prevailing among the school's students—specifically, the percentage of students enrolled in the school lunch program. Data from the Universal Service Administration Company (USAC) show that poorer schools have indeed benefited significantly from the E-Rate program in every year since the program's inception.

However, observers have also pointed out school districts are not availing of E-Rate funds in proportion to the number of students enrolled, and to the extent of their eligibility under the poverty level guidelines built into the E-Rate program. For instance, Hudson (2004) found in her analysis of state level funding that E-Rate disbursements ranged from Alaska that received more than 278 percent of its population-based share, to New Hampshire that received only 14 percent. She found that poorer states occur at both ends of this spectrum. Observers have specifically pointed to the complex, multi-stage application process—time-consuming, labor intensive and often prone to pitfalls—as a factor that may prevent some school districts from availing of E-rate funds (Harris, 2001; Dickard, 2003; Bracey, 2004). Poor school districts that want to apply for E-Rate funds may simply lack the technical expertise, administrative support and time to put together effective proposals for funding. Thus, policy aim of supporting the neediest schools is at least partially neutralized by procedural and resource constraints.

The influence of these constraints in determining the success rate of applicants and the quantum of funding they receive is evident in the data. It is possible that some eligible entities could not apply for funding due to resource constraints, though obviously we have no data on these missed opportunities. But even among those applications that are filed, a significant percentage (approximately 20 percent) are not funded due to lack of documentation, unavailability of matching funds, or inclusion of ineligible services.[1] As we show in the analysis that follows, many applications are also not funded to the full

[1] Our compilation of data for Pennsylvania, for instance, showed that of Form 471 applications filed annually by all categories of applicants (schools, school districts, libraries and consortia) between 1999-2006, the percentage that were funded varied between 65.3 percent (in 2000) to 88.2 percent in 2005, with an average of 79.8 percent for the eight-year period. Data compiled by authors from Universal Service Administration Company Schools and Libraries Program Open Data Search tool at http://www.sl.universalservice.org/funding/opendatasearch/Search1.asp

extent of the requested commitment amount. This is in spite of the fact that the USAC does not usually commit more than the annual E-Rate funding cap of $2.25 billion. The only exceptions to this pattern since the program's inception were 2003 when the funding cap was exceeded significantly, and 2004 when there was a small overshoot. The average annual commitment in the 1999-2006 period was $2.2 billion, slightly below the program threshold.[2] Two inferences are possible from this data: first, the USAC has in most years turned down applicants rather than relax its screening criteria, and second, E-Rate funding is quite competitive. Both indicate that there is a need to study the factors that explain the ability of school districts to apply for and receive E-Rate funding.

In justifying the rationale for such an analysis, we need to contend with the point of view that further policy refinement is not required as much as the termination of the program itself. The main argument in favor of termination is that, by achieving near-universal internet penetration in schools and libraries, the E-Rate program has realized its mandate and should therefore be discontinued.[3] We contend otherwise. While the E-Rate program also funds initial connectivity expenses such as internal wiring, the major share of funding is in recent years claimed by recurring charges for internet access, telecommunications services and maintenance of internal connections; in 2006 for instance, one-time charges (for internal wiring) accounted for only 25 percent of total commitments, with the remaining being claimed by recurring expenditures for which

[2] The annual commitment amounts were as follows: 1999 ($2.15 bill.); 2000 ($2.08 bill.); 2001 ($2.2 bill.); 2002 ($2.18 bill.); 2003 ($2.7 bill.); 2004 ($2.3 bill.); 2005 ($2.04 bill.) and 2006 ($1.96 bill.). If 2003, the year in which the most significant over-commitment took place, is excluded the average annual allocation falls to $2.13 billion. See USAC Schools and Libraries program annual cumulative funding data available at http://www.sl.universalservice.org/funding/previous.asp.

[3] Other arguments more popular in the initial years of the program were that the E-Rate program is economically inefficient; legally untenable; or creates incentives for fraud and corruption, and should therefore be terminated (see Thierer, et al., 2002; Shuler, 1999). Attempts have been made in Congress to introduce legislation terminating the program, for instance HR 1252, the E-Rate Termination Act (2003).

there is a continuing need.[4] (see also Table 4 later in this paper). The availability of internet connectivity depends to an extent on the continuation of the E-Rate program, especially in poor communities where schools and public libraries are the only locations where the internet may be accessed. In a broader context as well, we observe that the United States is now lagging behind its major industrial competitors in broadband penetration (OECD, 2007). The E-Rate program is in many ways unique in the U.S. context, as a means of channelizing public support for broadband connectivity.

Given the above reasons, it is advisable that critical attention be focused on the implementation of the E-Rate program with the aim of improving its efficiency and ensuring that its benefits flow to the most deserving institutions and communities. Our objective in this article is to further this overall goal, by studying the factors affecting the ability of school districts of different demographic and financial profiles to apply for and receive E-Rate funding, and to identify changes, if any, in these relationships over time.

The paper is organized as follows. First, we provide an overview of the E-Rate program, with a special focus on the procedures for the disbursement of funds. Second, we present empirical studies on the patterns of distribution of E-Rate funds, and identify the key variables that have been used in the past as predictors of E-Rate funding. In this section, we also frame a set of hypotheses to be tested in this paper. In the third section, we introduce our data and methodology. We present the results in the next section, and finally discuss the policy implication of our findings.

[4] In fact since 2000, the USAC has ceased to fund internal connections for applicants in all discount bands except those at the highest poverty levels (>80%). The percentage funding for internal connections was calculated from the USAC Schools and Libraries program annual cumulative funding data for 2006; available at http://www.sl.universalservice.org/funding/previous.asp.

**Overview of the E-Rate program**

The E-Rate program is one of a set of universal service initiatives mandated by the 1996 Telecommunications Act. Funding from the program is available for libraries, and for all public schools, as well as non-profit private schools and parochial schools with less than $50 million in endowments. These schools will receive discounts for telecommunications access ranging from 20 percent to 90 percent of total eligible spending. The percentage of discounts is indexed to the poverty level prevailing among the school's students—specifically, the percentage of students enrolled in the school lunch program in the schools that are participating in a E-Rate funded project.

Currently, a non-profit organization called the Universal Service Administration Company [USAC] implements that E-Rate program. Incorporated in 1997, the USAC has four divisions – High Cost, Low Income, Rural Health Care, and Schools and Libraries – active in each of the areas in which Congress had mandated universal service support (USAC, 2005). The Schools and Libraries Division (SLD) is responsible for the E-Rate program. The SLD is responsible, in addition to other duties, for generating projections of funding demand for the E-Rate program; determining discount levels; administering the review process and disbursing funds.

Schools entitled to receive support from the E-Rate program can use the funds for a variety of purposes related to telecommunications and internet access. But in order to prevent abuse or diversion of funds to non-eligible uses, an elaborate list of covered and non-covered expenditure categories have been evolved over time. In general, telecommunications services and internet access services are eligible for support from the E-Rate fund. In addition, internal wiring such as cabling and file servers for serving multiple users is also eligible (USAC, 2003). End user equipment, software (unless it is a file server or e-mail software) and content are not eligible for support. Further, the E-Rate program also requires that schools have to obtain telecommunications and internet access services from a telecommunications provider, that has previously obtained a service provider identification number (SPIN) from the USAC[5]. Any commercial vendor can install internal wiring and connections.

The source of funding for the E-Rate program, as well as for all other universal service initiatives administered by the USAC, is the federal Universal Service Fund (USF). The 1996 Telecommunications Act mandated that all telecommunications service providers must contribute in an equitable and non-discriminatory manner to a fund that will support universal service programs for low-income customers, high cost areas, schools and libraries, and rural health-care providers. The FCC determines contributions from each telecommunications provider based upon a calculation involving the total expected quarterly funding demand for the various USAC universal service programs, and the projected quarterly interstate and international end-user telecommunications revenues for all telecommunications providers (FCC, 2003). In 2006, the USAC received $7.19 billion dollars from contributors and distributed $6.6 billion through its various universal service programs (USAC, 2007). The E-Rate program alone is authorized to distribute a maximum of $2.25 billion per year to schools and libraries—in 2006, the latest available data show that the USAC committed $1.96 billion.[6]

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[5] Telecommunications providers interested in participating in any universal service program including the Schools and Libraries Program file Form 498 with the USAC to obtain the service provider identification number (SPIN). See http://www.usac.org/fund-administration/recipients/obtain-service-provider-id/.
[6] See USAC Schools and Libraries program annual funding commitment data at http://www.sl.universalservice.org/funding/previous.asp.

Funding under the E-Rate program is provided on an annual funding cycle that runs from July 1 through the following June 30. In order to claim E-Rate discounts, schools and libraries have to follow a multi-step process, beginning with the preparation of a technology plan. In it, the applicant identifies goals for the use of ICTs in the school or library, the staff training strategies, hardware and software requirements, overall budget (including expenditures not covered in the E-Rate program) and post-installation evaluation procedures (USAC, 2002). The applicant then prepares a formal request for service to the Schools and Libraries Division, which will be posted at the division's web site for service providers to view and respond. Applicants are expected to wait at least 28 days for potential service providers to respond, and to give all bids fair and equal consideration. At the end of this bid review process, the applicant chooses a provider and files a second form with the SLD during a specially designated time period (a 'filing window') for each annual funding cycle. If the funding request is approved, the SLD sends out letters to both the applicant and the chosen service provider. This stage is also used to determine the discount percentage that the applicant is entitled to receive, which could range from 20% to 90% of total program costs. On receipt of the letter, the applicant and the service provider may begin work on the program. Payments are then made as and when the approved products and services are delivered. Applicants can either make payment in full for all services received and receive reimbursement from the SLD up to the approved funding level, or receive discounts on their bills from service providers in which case the SLD will make payments directly to the service provider.

**Analyses of E-Rate Funding Patterns**

As discussed in the preceding section, the E-Rate program has put in place a complicated, multi-stage process for reviewing applications. Given the many allegations of fraud and misuse of funds that have periodically surfaced, it is perhaps necessary to thoroughly review each application. However, the complicated and resource-intensive nature of the application process also implies that at least some school districts may not have the expertise or personnel required to put together quality proposals. As one survey revealed, excessive paperwork and lack of proper training were the principal reasons that school districts mentioned for their failure to get E-Rate funding (Harris, 2001). It therefore becomes necessary to examine the patterns of funding disbursements taking into account school district demographics and financial profiles. We begin by reviewing the data on school internet access, and analyses available in the academic literature.

Data on internet and telecommunications access seem to indicate that the gaps in telecommunications and internet access have significantly narrowed in the years since the inception of the E-Rate program.[7] In 1997, when the E-Rate program was initiated, 78 percent of all American public schools were connected to the internet (NCES, 2005). By 2004, the last year for which data is currently available, internet access had increased to 100 percent of schools. In 1997, there were significant gaps in access between inner city schools (74 %), rural schools (79%) and "town" schools (84%). By 2004, this gap had

[7] Needless to say, correlation is not causation, and we do not argue that the E-Rate was the only, or even the principal, factor that narrowed the access gap. Other government programs such as the Technology Innovation Challenge Grants and the Technology Literacy Challenge Funds have supported school technology as well (Office of Educational Technology, 2000). However, the E-Rate program is by far the best funded of government programs supporting school technology: in the first three years of the E-Rate program, the E-Rate program accounted for 74.5% of all federal spending on school technology. Still, as others too have pointed out (Goolsbee & Guryan, 2006), the E-Rate legislation was passed amidst a broad-based Internet boom; schools might have adopted telecommunications and Internet access even in the absence of E-Rate subsidies, but the program may certainly have influences school districts at the margin to adopt the technology.

vanished with all schools reporting that they have internet access. In 1997, a large gap existed across poverty levels: 86 percent of schools with affluent students (with less than 35% of students eligible for the free or reduced-price lunch program) had internet access, whereas only 62 percent of schools with poor students (with more than 75% of students eligible for the free or reduce-price lunch program) did. By 2004, this gap had become negligible (100% and 99%).

This is not to say that the objectives of the E-Rate program have been fully achieved. While almost all schools now have internet access, there are still gaps in the percentage of instructional classrooms with internet access between rich and poor schools and in urban and rural areas. In 2003, only 90 percent of classrooms in schools with the highest concentration of poor students had access to computers with internet access, compared to 95 percent in schools with the lowest concentration of poor students (NCES, 2005). There are also differences in the number of students per internet-accessible computer: inner city schools have 5 students on average for each computer, while "town" schools have 4.1 students per computer and rural schools only 3.8 students per computer. All gaps have narrowed across the board between 1997 and 2003, but the digital divide still exists in American schools.

**(Table 1: E-Rate funding by discount bands)**

Data on E-Rate fund disbursements show interesting variations when taking into account school district demographics and financial status. For 2005, the USAC (2005) reported that fully 49% of funding went to applicants in the highest discount bands (with more than 50% of students eligible for the free or reduced rate lunch program) (see Table 1). A comparison of data from prior years (1998-2000) revealed a similar pattern. (GAO, 2001). Thus the data indicate that E-Rate program followed the legislative intent of supporting the neediest schools in its disbursements.

Several studies have analyzed E-Rate funding data using the state as the unit of analysis, using comparison of means (Hudson, 2004; Staihr & Sheaff, 2001) and multivariate regression techniques (Panagopoulos, 2005). Hudson (2004) analyzed patterns of E-Rate disbursements across states for the period 1998-2001, correlating income and rurality with E-Rate funding support per capita of population. She found a wide range of outcomes, from Alaska that received more than 278 percent of its population-based share, to New Hampshire that received only 14 percent. Though several of the states that received more than their share in population-based terms were very rural (Alaska, New Mexico), other rural states received less than their population-based share (Utah, South Dakota, Maine, Iowa). Surprisingly, Hudson found that New York and Illinois, "prosperous states with a mix of rural and urban areas" (pp. 313-314) were among the outperformers. She speculates that better local-level organization or professional assistance might have helped these states claim more than their share of E-Rate funding support.

Staihr and Sheaff (2001) also looked at state-by-state variations in E-Rate support, focusing on rural counties. Analyzing data from a subset of 15 states, they found that practically all rural counties received some E-Rate funding, though the per capita funding varied from as little as $0.02 for one rural county in Arkansas, to a high of $285.60 for a New Mexico rural county. But on average, there was less variation across states, than there was within the same state. Also, contrary to the intent of the 1996 Telecommunications Act that E-Rate funding should serve to equalize internet access between rural and urban areas, average per capita funding for rural counties in 6 of the 15 states analyzed was lower than the statewide average. Staihr and Sheaff speculate that three factors might account for these observed variations in E-Rate funding patterns: the age of the existing infrastructure, with states having older internal wiring and equipment having a greater incentive to apply for E-Rate funds; the local geography, that can affect the cost of providing service; and how aggressive school districts are in pursuing funding.

Panagopoulos (2005) conducted a multivariate regression analysis of E-Rate funding data by state, using population, percentage of population in the rural areas, the state's education level (using the proportion of the state's population with at least a bachelor's degree), computer penetration, and median income as the predictors. Using data for 2002, Ordinary Least Squares (OLS) estimation showed that only population was a significant predictor of E-Rate funding support, with more populous states receiving more funding. None of the other variables were significant.

In contrast to the above studies that have utilized statewide data, several others have used school districts or individual schools as the unit of analysis (Goolsbee & Guryan, 2006; Harris, 2001; Puma, Chaplin & Pape, 2000). Puma, Chaplin and Pape (2000) conducted a massive study of all E-Rate funding applications nationally, covering the first two years of the program. They found that poor and rural school districts increased their application rate, and their average funding per application between the two years. However, they found that the most impoverished school districts had lower participation rates, perhaps due to "limited knowledge of the E-Rate program, limited capacity to apply for E-Rate funds, limited funds for the co-payments, and/or limited technical expertise to use the purchased services" (p. 99).

Other studies have narrowed their focus to a single state, due to the sheer number of funded applications each year. For example, Goolsbee and Guryan (2006) analyzed panel data on school internet access in California for the period 1996-2000, using the school district subsidy rate as a predictor variable. The school district subsidy rate is calculated as the average E-Rate subsidy rate faced by applicant schools in the school district, which in turn is correlated with the poverty rate in the school district. They found that the annual change in the number of internet-accessible classrooms per teacher in each school was positively affected by the district subsidy rate: this effect was more pronounced in schools that applied for E-Rate funds, than in those that did not. The authors interpreted these results to say that the growth rate of internet access was higher in poorer schools during the 1996-2000 period (i.e. those most eligible to receive E-Rate support), with the highest growth rates recorded in schools that actually received E-Rate support. They estimate that the E-Rate program speeded the rate of internet adoption by 3.8 years—it would have taken that many years of additional growth at the prevailing trend to match the Internet access levels recorded in the last year. Disaggregating the data by the type of school, the authors found that internet growth rates in elementary schools was most responsive to the subsidy rate, and less responsive in middle schools, with growth rates in high schools practically unaffected. Growth rates in urban schools were more strongly correlated with district subsidy rates than in rural schools. Internet access grew more in schools with a higher percentage of minority students.

Harris (2001) conducted an analysis of E-Rate funding patterns using the school district as the unit of analysis, with data from Arkansas. Using a combination of survey data, U.S. Census Bureau poverty statistics, and E-Rate funding data from the USAC's Schools and Libraries Division, Harris investigated the relationship of E-Rate funding per pupil to the school district poverty level; percent students enrolled in the free and reduced lunch program; and school district size. Most interestingly, Harris specifically examined whether the ability of school districts to prepare high quality proposals influenced the amount of funding received. He argued that affluent school districts would be able to spend more on educational technology and employ better qualified technology personnel, with the result that their capacity to obtain and utilize E-Rate funds would be greater. "(S)chools that can afford to spend more money on telecommunications and on approved technology areas will receive more E-Rate money regardless of the poverty level corrections" (p. 8). Thus, data on the availability of at least one full-time technology person at the school district (coded as a dummy variable) and the technology person's level of education and knowledge of E-Rate funding processes were collected through the mailed survey and used as independent variables. Data were analyzed using two-way ANOVA and regression methods. Harris's results showed that E-Rate funding per pupil was negatively correlated with school district size, and positively with poverty level and the percentage of students eligible for the free or reduced rate lunch program. Mixed results were obtained when district size and status of technology person were considered. Medium and large school districts with at least one full-time technology person got more money than school districts with only part-time technology persons. However, small school districts with part-time technology persons got more funding than small school districts with full-time technology persons—perhaps because of an interaction with poverty levels, because poorer school districts (i.e., those with higher E-Rate discount rates) are also more likely to have only part-time technology persons.

The literature we have reviewed above identifies a number of variables that are likely to influence the disbursement of E-Rate funds across states, school districts and individual schools. However, a significant gap in the literature is that most studies have used data from the pre-2003 period, before the significant reforms that took place in April 2003 in response to the several reported cases of fraud and abuse in the program. The lack of more recent studies of the E-Rate program presents two problems for the literature. First, we have no assessment of E-Rate disbursement patterns after the 2003 reforms. Second, there is no study that compares data over time.[8] Considering that the literature identifies the lack of adequate managerial expertise, knowledge and experience as the main constraints that prevent school districts from applying for E-Rate funds, we have no way of judging whether the passage of time has allowed school districts to learn more about the application process, mitigating the negative impacts.

In this paper, we follow the example of Goolsbee and Guryan (2006) and Harris (2001) in focusing on funding support for school districts. Since individual schools and libraries too are eligible to receive support from the E-Rate program, our decision to focus only on school districts may require defense. First, schools, school districts and libraries are quite different in their administrative structure, financial needs and managerial capabilities—comparing applications from the three within the same study

[8] Goolsbee and Guryan (2006) is the notable exception, but their main objective is to study the growth rate in internet penetration in schools over time and how the E-Rate program affected it. It is not explicitly to compare disbursement patterns cross-sectionally. Also, their data only covered the early years of the E-Rate program, 1996-2000.

may perhaps be less meaningful that focusing on one type of entity. Second, school districts claim the vast majority of funding, typically around 80 percent, made available though the E-Rate program.[9] Third, from a practical viewpoint, data for a school level comparison were not available for some of the variables we wanted to include in the model. The most comprehensive public-access database we could locate—the Common Core of Data from the National Council of Educational Statistics (NCES)—provides only school district level data for financial variables (eg. local, state and federal revenues) and indicators of poverty status (percentage of the population below poverty level and median family income). Nevertheless it is possible that, since the school district aggregates data across several schools, some of the variability relating to poverty level may be masked in our findings. This study is therefore not a substitute for an analysis of school level data.

Again following Goolsbee and Guryan (2006) and Harris (2001), we decided to focus on data from a single state. These previous studies justified their choice because the total number of applications nationally is too large to analyze tractably, especially when we need to collate data from multiple databases as we do in this study. In our case, we chose to focus on the state of Pennsylvania because this state quite closely approximates the nation in terms of urban-rural population distribution, median household income and poverty level, though this state has a higher percentage of white population and greater population density than the nation as a whole (See Table 2). Even if our findings from

[9] The percentage of total amounts committed in the E-Rate program that were claimed by school districts in the last eight years is as follows: 1999 (74.4%); 2000 (81.8%); 2001 (80.1%); 2002 (79.6%); 2003 (80.1%); 2004 (79.6%); 2005 (80.2%); and 2006 (77.6%). The remaining funding goes to individual schools, libraries, library consortia or other consortia. See USAC Schools and Libraries program annual funding commitment data at http://www.sl.universalservice.org/funding/previous.asp.

Pennsylvania may not be generalizible to the whole country, this state presents a better standard of comparison than most other states.

**(Table 2: Comparison of PA and US)**

Based on the literature reviewed above, we can frame two contrasting influences on the amount of E-Rate funds that school districts receive. First, from the E-Rate policy guidelines, we may expect that the higher the proportion of traditionally disadvantaged groups a school district has, the greater will be the E-Rate program support: specifically, a higher proportion of students eligible for the free/reduced lunch program the school districts has; the higher will be the E-Rate program support. However, the ability of a school district to apply for and receive E-Rate funding is related to the availability of financial, managerial and technical resources. Resource-poor school districts may be unable to apply for E-Rate funding as often as resource-rich school districts, other factors remaining the same. This may be because they do not have the technical and/or managerial expertise to negotiate the application process, or because they do not have the educational infrastructure and training necessary to absorb educational technology. Therefore, school districts with higher total revenue and more staff would tend to attract higher levels of E-Rate funding. Also, the location of the school district may have an impact on resources. Urban and suburban school districts, with greater access to information and interpersonal networks may be better places to obtain assistance on the application process. Therefore, other factors remaining the same, we may expect rural school districts to obtain less funding, compared to their city counterparts. To test these effects, we framed the following hypotheses each addressing a set of influences: socio-economic status, location and resource availability.

*H1A*: Other factors remaining the same, school districts with lower socio-economic status, such as a higher poverty rate, higher percentage of minority students, or a higher percentage of students eligible for the free/reduced price lunch program, will receive more E-Rate funding.

*H1B*: Other factors remaining the same, school districts with greater resource availability, such as higher total revenue per student or higher staff-to-student ratio, will receive more E-Rate funding.

*H1C*: Other factors remaining the same, rural school districts will receive less E-Rate funding than other school districts

In addition to the contrasting influences discussed above, we are also interested in how the pattern of funding has changed over time. It is likely that the resource gap confronting poor/rural school districts has narrowed over time due to experience, as well as the numerous online resources and best practice guides that have come up over time to help school districts claim E-Rate funds. Previous studies have documented that school districts have become better at negotiating the E-Rate filing process over time, with a greater percentage of school districts applying in each funding cycle: for example, Chaplin (2001) reported that schools run by the Bureau of Indian Affairs (BIA) increased their application rate from 35 percent in 1999 to over 95 percent in 2000, and received more than three times the national average E-Rate funding per student. With the disadvantage from resource constraints and location being mitigated over time, we may expect that E-Rate funding patterns will be going to conform more closely to the policy intent.

*H2A*: Over time, resource availability, such as higher total revenue per student or higher staff-to-student ratio, will become a weaker predictor of E-Rate funding, other factors remaining the same.

*H2B*: Over time, school district location will become a weaker predictor of E-Rate funding, other factors remaining the same.

These hypotheses are tested with E-Rate funding over two funding cycles.

**Data**

Data on E-Rate funding amounts, school district demographics etc. were collected for all school districts in Pennsylvania from several databases: the USAC Schools and Libraries database[10], the National Center for Education Statistics (NCES) database[11], and the US Census 2000[12]. The USAC Schools and Libraries allows searches for various information regarding applications, funding commitments and disbursements online. The NCES provides a program called the Common Core of Data (CCD), which annually collects fiscal and non-fiscal data about all public schools and districts in the U.S. The information about school districts such as the number of students eligible for free and reduced lunch, a district's total revenue, and a district's residential status were obtained through the CCD *Build a Table* tool. This application enables users to create customized tables of CCD public school data from five CCD surveys and a Census Special Tabulation. Some socio-demographic information on each district was also collected from the U.S. Census 2000.

In this study, we chose 1999 and 2004 as the two years for comparison for hypotheses H2A and H2B. The year 1999 was the first full year in which the USAC

[10] http://www.sl.universalservice.org/funding/opendatasearch/Search1.asp
[11] http://nces.ed.gov/ccd/bat/
[12] http://nces.ed.gov/surveys/sdds/about.asp

administered the E-Rate program.[13] The second year for comparison, 2004 was also a significant transition year since in April 2003 the FCC had announced a number of program reforms after media reports of fraud and abuse—including three-year suspensions for companies or individuals convicted of fraud, a ban on funds for duplicative services and greater program oversight (Shiver, 2003).[14] These two transition points separated by 5 years are also sufficiently apart to allow us to study changes in the patterns of funding.

An initial query to the USAC database yielded a total of 2523 applications in 1999 and 3160 applications in 2004 for the state of Pennsylvania. After deletions for missing data, our database included 2170 funded applications for 1999 (86.0% of all applications) and 2728 (86.3%) for 2004. Since the unit of analysis is a district, we aggregated the applications data for each district and obtained a total of 423 districts in 1999 and 514 districts in 2004. Table 3 provides summary data on E-Rate funded applications, and their allocation to internet access, telecommunications and internal connections.

**(Table 3: E-Rate funds committed)**

The USAC data was paired with school district demographic and fiscal data from the NCES Common Core of Data (CCD) database and socio-demographic information from the U.S. Census. Variable are defined as they are in the original databases (see

[13] Prior to 1999, the E-Rate program was administered by a separate entity called the Schools and Libraries Corporation (SLC). Pursuant to a Government Accounting Organization (GAO) investigation that found that the FCC had not acted in conformity with regulations for government corporations in setting up the SLC, Congress passed legislation in April 1998 (HR 3579) ordering the FCC to bring all universal service programs under the same organization. Accordingly, the SLC was merged into the USAC effective January 1, 1999 (see Jayakar, 2004).

[14] Since the E-Rate funding cycle runs July to June, the changes that were announced in April 2003 took effect the next funding year, and would be reflected in funding patterns reported for 2004.

Table 4 for the definitions) except in the case of the *SUBURBAN* and *RURAL* dummy variables. The NCES designates each school district with a locale code based on its geographical location and population attributes such as density. These designations are in turn based on U.S. Bureau of the Census categories: large city, mid-size city, urban fringe, fringe of large city, fringe of mid-size city, large town, small town and rural.[15] Based on the category definitions, school districts falling within the urban fringe, urban fringe of a large city and urban fringe of a mid-size city were classified as *SUBURBAN*. School districts designated as rural were obviously labeled *RURAL*, and the rest were classified as *URBAN*.

For each application, the USAC database provided the *committed amount* defined as "total amount committed by USAC," indicating the funding authorized by the USAC for that application for that year, that can be disbursed to a service provider as the sanctioned project is implemented. Since our unit of observation is the school district and each district has multiple applications, we aggregated the committed amounts into total committed amount per district. To convert the data into a form appropriate for linear regression analysis, the dependent variable was transformed into the natural log form.[16]

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[15] The category definitions are as follows. *Large city*: a principal city of a Metropolitan CBSA, with the city having a population greater than or equal to 250,000; *mid-size city*: A principal city of a Metropolitan CBSA, with the city having a population less than 250,000; *urban fringe*: A closely settled area, contiguous to and outside a principal city; with a minimum population of 2,500 inhabitants; with a population density of at least 1,000 per square mile; with a Census Urbanized Area Code; *urban fringe of a large city*: any incorporated place, Census designated place, or non-place territory within a Metropolitan CBSA of a large city and defined as urban by the Census Bureau; *urban fringe of a mid-size city*: any incorporated place, census designated place, or non-place territory within a CBSA of a Mid-size City and defined as urban by the Census Bureau; *large town*: an incorporated place or Census designated place with a population greater than or equal to 25,000 and located outside a Metropolitan CBSA or inside a Micropolitan CBSA; *small town:* an incorporated place or Census Designated Place (CDP) with population less than 25,000 and greater than or equal to 2,500 and located outside a CBSA or CSA; *rural*: any incorporated place, Census designated place, or non-place territory not within a Metropolitan CBSA or within a Micropolitan CBSA and defined as rural by the Census Bureau.

[16] Linear regression assumes that scatter of points around the best-fit line has the same standard deviation all along the curve. The assumption is violated if the points with high or low X values tend to be further

Table 4 presents the definitions of the dependent variables and independent variables used in the analysis.

**(Table 4: Variable definitions)**

Summary statistics on these variables are provided in Table 5, for both years 1999 and 2004. The data clearly shows that the number of applicants has increased since 1999. Nevertheless, school districts received less total funding in 2004 than in 1999. A greater standard deviation in 1999 compared to that of 2004 indicates that the E-Rate funding distribution was more variable in 1999 than that in 2004. The percent free/reduced lunch eligible students, percent of total population at/below poverty level, total number of schools and total students decreased in 2004, whereas the percent of minority student, total revenue per student, and total staff increased.

**(Table 5: Summary statistics)**

### Statistical Analysis

The main objective of this paper is to examine the impact of two contrasting influences on E-Rate funding, namely the policy intent built into the program to favor disadvantaged school districts, and the inability of some resource-poor and/or rural schools to avail of E-Rate funds due to the lack of managerial or technical expertise. Three hypotheses were framed to test for the impact of these factors, by using the total E-

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from the best-fit line (Weisberg, 2005). The exploratory statistics for the data showed that the response variable does not have normality and homoskedasticity which are critical assumptions required for the OLS linear regression analysis. Non-normality and non-equal variance seem to be caused by several outliers such as Philadelphia and Pittsburgh districts. Thus, it was decided to transform the dependent variable to the natural log form which makes the outliers less influential and ensures both normality and non-equal variance.

Rate funding for all applications submitted by school districts as the dependent variables. The independent variables are divided into three groups: those relating to location (the *SUBURBAN* and *RURAL* dummies); socio-economic conditions (the percentage of students eligible for the free/reduced rate lunch program in the school district, *FREELUNCH*; the percentage of minority students, *MINORITY*; the percentage of the population at or below the poverty level, *POVERTY*), and the school district's financial and administrative resources (total school district revenues per student, *REVSTU*; and the staff-to-student ratio in the school district, *STAFFRATIO*) (see Table 4 for definitions). We present five alternative specifications of the models for 1999 and 2004 in Tables 6 and 7 respectively.

**(Table 6: Regression results for 1999)**

We begin with full models that include all the independent variables. However, high correlations between some independent variables and a multicollinearity test[17] signified that some variables would need to be deleted from the final model to prevent multicollinearity (these tests are not reported here due to limitations of space). So the subsequent models were developed by deleting variables through stepwise backward elimination. Interestingly, the fully specified models for each year saw different independent variables achieving significance: in 1999, the percent of free/reduced lunch

[17] Multicollinearity was inferred from the collinearity diagnostics table in SPSS. A condition index greater than 15 indicates a possible problem, while an index greater than 30 suggests a serious problem with collinearity. Alternative collinearity statistics such as tolerance and VIF (Variance Inflation Factor) indices are also available—a low tolerance value of a variable indicates that it is contributing little useful information for the model, whereas large VIF values are indicators of multicollinearity (see Neter, et al., 1996 for a fuller discussion of collinearity diagnostics).

eligible students, rural location, the number of schools, total students, total staff and per capita income produced rather robust significant parameter estimates. Although the number of schools and total staff were significant in both the full model and reduced models, the results are questionable because of the high correlations between variables.

In the final model for 1999, the linear combination of three predictor variables (*FREELUNCH*, *MINORITY* and *REVSTU*) was significantly related to the E-Rate funding committed by the USAC [$F(3, 223) = 32.104$, $p < 0.00$)]. The *FREELUNCH* variable has a positive coefficient, showing support for the policy intent. The *MINORITY* variable too indicates that lower socio-economic status was a significant factor in E-Rate disbursements. However, the revenue per student (*REVSTU*) variable too has a positive relationship with the E-Rate funding indicating that richer schools draw more E-Rate funding, once other factors are controlled for. Location, whether rural or suburban had no significant impact on E-Rate funding.

**(Table 7: Regression results for 2004)**

In contrast, the final regression model for the year 2004 show significant coefficients for the percentage of minority students, location (rural and suburban), and total revenue per student (see Model 4 in Table 7). The linear combination of the four predictor variables (*MINORITY*, *RURAL*, *SUBURBAN* and *REVSTU*) was significantly related to E-ate funding committed by the USAC [$F(4, 450) = 41.305$, $p < 0.00$]. Both rural and suburban location show negative coefficients indicating that if a school district is located in a non-urban area, it is likely to have less E-Rate funding compared to urban districts.

The comparison of results in the two years reveals several interesting similarities and differences. First, two of the variables, the percentage of minority students (*MINORITY*) and revenue per student (*REVSTU*) showed consistent and significant results across both years. The positive coefficient on the *MINORITY* variable supports the policy intent of directing funding at the school districts with the lower socio-economic status. But the resource constraint hypothesis was also supported: the positive coefficient of *REVSTU* in both years shows that, other factors remaining the same school districts that have higher resource availability tended to attract more E-Rate funding. The other similarity was that neither the school district's poverty rate nor the staff-to-student ratio was significant predictors of funding in either year—perhaps because other variables included in the model were better proxies for socio-economic status and resource availability. But results on the other variables were more inconsistent between the years. Location was not a significant predictor in 1999, but became a significant *negative* predictor in 2004. The percentage of students eligible for free/reduced price lunch was a significant determinant in 1999, and in the expected positive direction. But after five years, the percent of free/reduced lunch student was not significant any more. This is indeed a surprising finding, given that the eligible discount rate is determined based directly on this metric—we discuss this further below.

The final objective of this paper is to examine the changes over time, if any, in the influence of the independent variables on E-Rate funding. Specifically, we test the expectation from prior literature that resource constraints and location will become less important as predictors of E-Rate funding over time, as school districts gain better experience and information on the application process. To test this, we constructed a combined database of 1999 and 2004 observations and estimated models with interaction terms between all the independent variables and a year dummy (1999=0; 2004=1). The expectation was that, if indeed there were no significant differences in the influence of the independent variables between the two years, the coefficients on the interaction terms would be insignificant. We also tested the joint hypothesis that all the interaction terms are simultaneously zero, indicating that there is no significant difference in variable effects between the two years.[18] The results are reported on Table 8. Model 1 is the full specification including all the independent variables and their interactions with the year dummy. Model 2 is the best fit model obtained with stepwise backward elimination—in the presence of multicollinearity between some of the independent variables, Model 2 provides better estimates of the variable coefficients (see footnote 17 above).

**(Table 8: Regression results for combined data)**

As can be seen from Model 2 in Table 8, three of the variables had significant impacts on E-Rate funding patterns that were consistent between the two years: rural location, the percentage of minority students, and revenue per student. Rural location was a significant disadvantage across both the years—contrary to the expectation from prior literature, the data did not reveal any mitigation of this effect over time. The percentage of minority students was associated with higher levels of E-Rate funding in the combined

[18] The test uses the incremental F value when the model is run with and without the subset of variables to be tested (here all the year interaction terms). The F statistic has degrees of freedom of [p, N-k], where p is the total number of variables included in the model, N is the number of observations and k, the number of restrictions imposed on the model (here, the number of year interaction terms set to zero).

results, indicating that school districts with lower socio-economic status continued to attract more E-Rate funding as intended by policy. But the coefficient of revenue per student was positive in the combined data (as it was in the separate year analyses in Tables 6 and 7): when other factors are held constant, school districts with greater financial resources continued to benefit more from the E-Rate program.

The coefficients on the interaction terms in Model 2 show differences between the two years. While suburban location had no impact on E-Rate funding in 1999, it was a negative predictor in 2004 as indicated by the sign of the coefficient on the *YEAR* x *SUBURBAN* interaction term. This too is contrary to the expectation from the literature that location will become less influential with the passage of time. In 1999, the percentage of students eligible for the free/reduced rate lunch program was a significant and positive predictor of E-Rate disbursements; in 2004, there was practically no impact of this variable once the interaction term was also taken into account. This is interesting, given that the free/reduced rate lunch program percentage is the criterion used to determine the discount rates for the E-Rate program. The F-tests for the joint hypothesis indicate rejection of the null hypothesis that all the coefficients for the interaction terms are simultaneously zero—in other words, there are significant differences in variable effects between the two years.

**Discussion and conclusions**

This article was motivated by the concern that, despite the policy preferences for resource-poor/rural school districts built into the E-Rate program, there were certain procedural impediments that may prevent some school districts from making use of the program. These include the complicated, time-consuming and technically challenging E-Rate application process, and the lack of managerial and technological resources for some school districts. The objective of the paper was to assess the cumulative impact of these contradictory forces on the total quantum of E-Rate funding awarded to school districts. Since we were also interested in changes in the effects of predictive variables over time, we compiled two years of data, for 1999 and 2004, for the state of Pennsylvania.

To test for these effects, we framed hypotheses about three groups of independent variables: those pertaining to socio-economic status, resource availability and location. Based on the literature review, school districts with lower socio-economic status, such as a higher poverty rate, higher percentage of minority students, or a higher percentage of students eligible for the free/reduced price lunch program, were expected to receive more E-Rate funding in accordance with the policy intent. But factors remaining the same, school districts with greater resource availability, such as higher total revenue per student or higher staff-to-student ratio, were also expected to receive more E-Rate funding. Finally, we also tested for the effects of location: rural school districts were expected to be less well-funded than other school districts.

Regression analyses were carried out for both years separately, as well as for the combined dataset and provided generally consistent results, with a few exceptions as discussed below. Among independent variables indicating socio-economic status, the percentage of minority student was a significant positive predictor of E-Rate funding in all three sets of regressions, while the poverty rate did not achieve significance in any of the models perhaps because its effect was better captured by the other variables.

However, the surprising result in this group was the effect of the free/reduced price lunch program variable. The percentage of students eligible for this program is the criterion used by the USAC to determine the discount bands for applications: therefore it was expected to be a strong predictor of E-Rate funding. Moreover, this effect was expected to be stronger in 2004 because some of the resource availability and location constraints preventing poor/rural school districts from applying for E-Rate funds were expected to be mitigated through better information sharing and the evolution of best practice standards. It is therefore surprising that in 2004, there was practically no impact of this variable once the interaction term was also taken into account. This may be partially explained by an apparently widespread practice when schools put together E-Rate applications—as Goolsbee & Guryan (2006) point out, schools have become adept at convincing high-poverty schools in their districts to collaborate on E-Rate proposals. Since the discounts are calculated based on the data for all participating schools, higher subsidies are made available when high-poverty schools are included on proposals. Evidently, schools have become better over time at this form of ‘proposal sharing’ which explains why eligibility for the free/reduced lunch program, that significantly predicted E-Rate funding in 1999, no longer does so in 2004. Since this study used the district-wide measure of eligibility for the free/reduced lunch program (and not for the specific schools participating in an E-Rate application), it may not have fully captured this sort of selection behavior. Nevertheless, this finding highlights the fact that at least part of the E-Rate funding intended for high-poverty schools is actually flowing to richer schools with the technical and administrative skills to put together competitive proposals—in some ways, a win-win situation, but in other ways a diversion of much needed-resources away from the poorest schools. This finding suggests that the USAC should tighten its screening procedures to ensure that the most egregious effects of this form "proposal gaming" are controlled. At the minimum, USAC may need to specify clearer allocation formulas in multi-school projects, to ensure that all participating schools receive their fair share of E-Rate funding.

To test for the impact of resource availability, two independent variables were used: the school district's total revenue per student and the staff-student ratio. Revenue per student was strongly positively correlated with E-Rate funding in all the models, indicating that other factors being the same, schools with greater financial resources manage to obtain more E-Rate funding. This lends credence to the resource constraint hypothesis that states that poorer school districts may face constraints in applying for E-Rate funding in spite of the policy preferences built into the program. This view is also supported by the results on the location variables. Rural location was not a significant predictor of funding in 1999, but it was significantly negative in the 2004 data, as well as in the combined results. Suburban location too turned into a negative predictor in 2004. Urban school districts seem to be outperforming their suburban and rural counterparts in securing E-Rate funds, and at an increasing rate with the passage of time. This too is counter to the expectation from the literature that with the passage of time, factors other than the policy variable (free/reduced price lunch eligibility) should become less important as predictors of funding. The USAC may wish to implement additional safeguards to ensure that rural school districts are not left behind in the race for funding. One initiative may be to use a part of the E-Rate funding corpus to provide technical information on school networking to poor and or rural school districts. Legislative authorization as part of the current rewrite of the 1996 Telecommunications Act to permit this may also be advisable.

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**Table 1: E-Rate Funding by Discount Bands ($ millions), 2005**

| Discount Band | Telecom Services | Internet Access | Internal Connections | Total | % of Total |
|---|---|---|---|---|---|
| 20-29% | 1.6 | 0.4 | 0.0 | 2.0 | 0.17% |
| 30-39% | 5.0 | 1.0 | 0.0 | 6.0 | 0.52% |
| 40-49% | 76.9 | 20.8 | 0.0 | 97.6 | 8.51% |
| 50-59% | 76.0 | 21.5 | 0.0 | 97.5 | 8.50% |
| 60-69% | 118.7 | 30.3 | 0.0 | 149.0 | 12.99% |
| 70-79% | 183.1 | 50.1 | 0.0 | 233.2 | 20.33% |
| 80-89% | 205.9 | 47.5 | 0.0 | 253.4 | 22.10% |
| 90% | 46.1 | 16.6 | 245.4 | 308.2 | 26.87% |
| Total | 713.2 | 188.1 | 245.4 | 1146.8 | 100.00% |

Source: USAC (2005); Notes: Discount bands are determined based upon the percentage of students eligible for the free or reduced rate lunch program; In 2005, only applicants in the 90% discount band were eligible to receive funding support for internal connections.

**Table 2: Comparison of PA and US in demography, income and school district size**

| | PA Total | US Total |
|---|---|---|
| The number of school districts[1] | 501 (2004-2005) | 14,205 (2004-2005) |
| Total population | 12,281,054 (4% of total) | 281,421,906 |
| White alone | 10,484,203 (85%) | 211,460,626 (75%) |
| Black or African American | 1,224,612 (12%) | 34,658,190 (12%) |
| American Indian and Alaska Native | 18,348 (0%) | 2,475,956 (1%) |
| Asian | 219,813 (2%) | 10,242,998 (4%) |
| Native Hawaiian and Other Pacific Islander | 3,417 (0%) | 398,835 (0%) |
| Some other race | 188,437 (2%) | 15,359,073 (5%) |
| Two or more races | 142,224 (1%) | 6,826,228 (2%) |
| Urban | 9,464,101 (77%) | 222,360,539 (79%) |
| Rural | 2,816,953 (23%) | 59,061,367 (21%) |
| Persons under 18 years old, percent, 2005 | 22.7% | 24.8% |
| Average household size (2006) | 2.47 | 2.61 |
| Average family size | 3.07 | 3.2 |
| Median household income, 2004 | $43,714 | $44,334 |
| Per capita money income, 1999 | $20,880 | $21,587 |
| Persons below poverty, percent, 2004 | 11.2% | 12.7% |
| Land area, 2000 (square miles) | 44,816.61 | 3,537,438.44 |
| Persons per square mile, 2000 | 274 | 79.6 |

Note. [1] Regular school districts, including components of supervisory unions. Regular school districts include both independent districts and those that are a dependent segment of a local government. Components of supervisory unions operate schools, but share superintendent services with other districts.

Source. U.S. Department of Education, the US Census Bureau's State & County QuickFacts, and 2006 American Community Survey. Available at http://quickfacts.census.gov/qfd/states/42000.html

**Table 3. E-Rate Funds Committed ($ millions) (1999 and 2004)**

| | Funds committed (U.S. $ mill) | Funds committed (PA, total) | Funds committed (PA, analyzed data) | Internet access | Telecommunications | Internal connections |
|---|---|---|---|---|---|---|
| **1999** | $2,154.01 | $81.56 | $71.75 | $2.43 | $16.64 | $52.67 |
| | | (4% of U.S.) | (88% of PA, total) | (3% of PA, analyzed data) | (23% of PA, analyzed data) | (73% of PA, analyzed data) |
| **2004** | $2,301.69 | $77.84 | $65.49 | $68.47 | $27.82 | $65.24 |
| | | (3% of U.S.) | (84% of PA, total) | (10% of PA, analyzed data) | (42% of PA, analyzed data) | (47% of PA, analyzed data) |

**Table 4: Dependent and Independent Variables**

| Variable Name | Definition |
|---|---|
| ***Dependent Variables*** | |
| *LNCOMAMT* | Natural logarithm of aggregated committed amount in a school district |
| ***Independent Variables*** | |
| *SUBURBAN* | A dummy variable for the residential status of a district (If a district falls in the urban fringe, urban fringe of a large city and urban fringe of a mid-size city as classified by the census bureau, then 1, otherwise 0) |
| *RURAL* | A dummy variable for the residential status of a district (If a district falls in a rural area as classified by the census bureau then 1, otherwise 0) |
| *FREELUNCH* | Percent of students who are eligible for free and reduced lunch in a district |
| *MINORITY* | Percent of minority students in a district |
| *POVERTY* | District percent of total population at/below poverty level |
| *REVSTU* | Natural logarithm of district total revenue per student (District total revenue from local, state and federal sources divided by the total number of students in the district) |
| *STAFFRATIO* | Ratio of total staff to total number of students in the school district |

## Table 5: Summary Statistics by School District

| Variables | Year | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|---|
| No. of Applications from Each School District (*APPLICATIONS*) | 1999 | 423 | 1 | 134 | 5.96 | 9.77 |
| | 2004 | 514 | 1 | 56 | 6.15 | 5.20 |
| Committed Amount (*LNCOMAMT* ) | 1999 | 404 | 661 | 42469293 | 177587 | 2116818 |
| | 2004 | 514 | 0 | 30875386 | 127409 | 1376400 |
| Percent Free/Reduced Lunch Eligible Students (%) (*FREELUNCH*) | 1999 | 392 | 1 | 81 | 25.95 | 15.89 |
| | 2004 | 466 | 0 | 99.05 | 25.08 | 16.8 |
| Percent Minority Students (%) (*MINORITY*) | 1999 | 236 | 0.64 | 92.49 | 9.93 | 15.19 |
| | 2004 | 466 | 0.11 | 100 | 10.8 | 17.92 |
| District Total Revenue per Student ($) (*REVSTU*) | 1999 | 397 | 6406 | 29477 | 8677 | 1626 |
| | 2004 | 465 | 7323 | 19251 | 9939 | 2200 |
| Percent Population at/below Poverty Level (%) (*POVERTY*) | 1999 | 393 | 1.74 | 26.43 | 9.57 | 4.99 |
| | 2004 | 455 | 1.74 | 34.71 | 9.41 | 5.15 |
| Total Number of Schools (No.) (*SCHOOLS*) | 1999 | 399 | 1 | 259 | 6.41 | 13.95 |
| | 2004 | 477 | 1 | 263 | 6.01 | 12.97 |
| Total Students (UG, PK-12) (#) (*TOTSTUDENTS*) | 1999 | 397 | 44 | 205199 | 3758.3 | 10603.4 |
| | 2004 | 474 | 218 | 189779 | 3465.37 | 9074.53 |
| Per Capita Income (Census 2000) ($) (*PCINCOME*) | 1999 | 393 | 12174 | 54181 | 19762.62 | 5854.81 |
| | 2004 | 473 | 12067 | 54181 | 19280.35 | 6985.9 |
| Total Staff (#) (*TOTSTAFF)* | 1999 | 405 | 13 | 24360 | 423.34 | 1250.648 |
| | 2004 | 476 | 35.5 | 22553.6 | 425.04 | 1084.61 |
| Median Family Income (Census 2000) ($) (*MEDFAMINC)* | 1999 | 393 | 29556 | 112644 | 48508 | 13753 |
| | 2004 | 473 | 25898 | 112644 | 47257 | 16669 |
| Log(ComAmount) (n. log) (*LNCOMAMT*) | 1999 | 404 | 6.49 | 17.56 | 10.32 | 1.28 |
| | 2004 | 509 | 4.56 | 17.25 | 10.42 | 1.11 |
| Average Committed Amount per Application | 1999 | 404 | 83 | 987658 | 15718 | 54703 |
| | 2004 | 514 | 0 | 571766 | 11427 | 29815 |

Note: Total staff has fractional values because part-time employees are counted as fractions of Full Time Equivalent (FTE) teachers.

**Table 6: OLS Estimation of Natural Logarithm of Total Committed Amounts for School Districts, 1999**

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| Constant | -4.881 | -4.234 | -4.090 | -3.687 | -4.874 |
| | [-0.767] | [-0.772] | [-0.755] | [-0.683] | [-0.908] |
| *SUBURBAN* | -0.045 | -0.039 | | | |
| | [-0.210] | [-0.186] | | | |
| *RURAL* | -0.288 | -0.283 | -0.257 | -0.267 | |
| | [-1.311] | [-1.300] | [-1.546] | [-1.607] | |
| *MINORITY* | 0.028 | 0.028 | 0.028 | 0.028 | 0.030 |
| | ***[4.305 | ***[4.346] | ***[4.353] | ***[4.345] | ***[4.739] |
| *POVERTY* | 0.026 | 0.024 | 0.025 | | |
| | [0.925] | [0.905] | [0.961] | | |
| *FREELUNCH* | 0.016 | 0.016 | 0.016 | 0.023 | 0.023 |
| | *[1.665] | *[1.703] | *[1.726] | ***[3.890] | ***[4.485] |
| *REVSTU* | 1.639 | 1.551 | 1.531 | 1.494 | 1.614 |
| | **[2.195] | **[2.563] | **[2.577] | **[2.520] | ***[2.736] |
| *STAFFRATIO* | -1.327 | | | | |
| | [0.201] | | | | |
| F[p, 223] | 14.238 | 16.677 | 20.095 | 24.897 | 32.104 |
| Prob >F | ***.000 | ***.000 | ***.000 | ***.000 | ***.000 |
| $R^2$ | 0.316 | 0.316 | 0.315 | 0.313 | 0.304 |
| Adj. $R^2$ | 0.294 | 0.297 | 0.300 | 0.300 | 0.295 |
| N | 223 | 223 | 223 | 223 | 223 |

T-statistics in square brackets; *** = p<0.01; ** = p<0.05; * = p<0.10
Note: [1] The degrees of freedom for the F statistic are [p, 223], where the p refers to the number of independent variables in each model: 7, 6, 5, 4 and 3 for Models 1 to 5 respectively.

**Table 7: OLS Estimation of Natural Logarithm of Total Committed Amounts for School Districts, 2004**

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| Constant | 3.405 | 3.417 | 3.219 | 3.990 |
| | [1.101] | [1.106] | [1.062] | [1.481] |
| *SUBURBAN* | -0.525 | -0.531 | -0.519 | -0.510 |
| | ***[4.072] | ***[-4.199] | ***[4.267] | ***[4.234] |
| *RURAL* | -0.621 | -0.625 | -0.625 | -0.627 |
| | ***[4.714] | ***[-4.785] | ***[-4.794] | ***[-4.813] |
| *MINORITY* | 0.026 | 0.026 | 0.025 | 0.025 |
| | ***[7.631] | ***[7.694] | ***[8.683] | ***[8.724] |
| *POVERTY* | 0.003 | | | |
| | [0.234 | | | |
| *FREELUNCH* | -0.002 | -0.001 | | |
| | [-0.403] | [-0.338] | | |
| *REVSTU* | 0.812 | 0.812 | 0.831 | 0.726 |
| | **[2.279] | **[2.281] | **[2.370] | **[2.456] |
| *STAFFRATIO* | -1.544 | -1.501 | -1.564 | |
| | [-0.547] | [-0.534] | [-0.558] | |
| F[p, 450] | 23.538 | 27.510 | 33.055 | 41.305 |
| Prob >F | ***.000 | ***.000 | ***.000 | ***.000 |
| $R^2$ | 0.271 | 0.271 | 0.271 | 0.270 |
| Adj. $R^2$ | 0.260 | 0.261 | 0.263 | 0.264 |
| N | 450 | 450 | 450 | 450 |

[T-statistics in square brackets; *** = p<0.01; ** = p<0.05; * = p<0.10]
Note: [1] The degrees of freedom for the F statistic are [p, 450], where the p refers to the number of independent variables in each model: 7, 6, 5, and 4 for Models 1 to 4 respectively.

**Table 8: OLS Estimates for Natural Logarithm of Total Committed Amount for Each School District with Interaction Terms, Combined 1999/2004 Database**

| | Model 1 | Model 2 |
|---|---|---|
| | [full] | [best fit 1999] |
| Constant | -5.720 | 2.088 |
| | [-1.045] | [-1.043] |
| *SUBURBAN* | -0.051 | |
| | [-0.277] | |
| *RURAL* | -0.294 | -0.468 |
| | [-1.543] | ***[4.673] |
| *MINORITY* | 0.027 | 0.027 |
| | ***[4.941] | ***[8.834] |
| *POVERTY* | 0.027 | |
| | [1.126] | |
| *FREELUNCH* | 0.016 | 0.022 |
| | *[1.921] | ***[4.883] |
| *REVSTU* | 1.751 | 0.866 |
| | ***[2.737] | ***[3.166] |
| *STAFFRATIO* | -2.919 | |
| | [-0.538] | |
| *YEAR*CONSTANT* | 8.649 | 0.537 |
| | [1.347] | ***[3.266] |
| *YEAR*SUBURBAN* | -0.478 | -0.023 |
| | **[-2.059] | ***[-4.528] |
| *YEAR*RURAL* | -0.325 | |
| | [-1.361] | |
| *YEAR*MINORITY* | -0.002 | |
| | [-0.254] | |
| *YEAR*POVERTY* | -0.023 | |
| | [-0.819] | |
| *YEAR*FREELUNCH* | -0.018 | -0.023 |
| | *[-1.846] | ***[-4.528] |
| *YEAR*REVSTU* | -0.875 | |
| | [-1.171] | |
| *YEAR*STAFFRATIO* | 0.440 | |
| | [0.071] | |
| model F[p, 674] | 18.217 | 38.066 |
| Prob >F | ***0.000 | ***0.000 |
| joint test F [p, 674-k] | 3.473 | 11.635 |
| Prob >F | ***0.001 | ***0.000 |
| $R^2$ | 0.293 | 0.285 |
| Adj. $R^2$ | 0.277 | 0.278 |
| N | 674 | 674 |

[T-statistics in square brackets; *** = p<0.01; ** = p<0.05; * = p<0.10]
Note: [1] The degrees of freedom for the F statistic are [p, 674], where the p refers to the number of independent variables in each model: 14, 6, and 8 for Models 1 to 3 respectively. [2] For the joint hypothesis tests, the degrees of freedom for the F statistic are [p, 674-k], where p is 14, 6, and 8 for Models 1 to 3 respectively, and k is the number of restrictions imposed in each model: 7, 3 and 4 respectively in Models 1 to 3.