E-RATIONALIZATION: THE EFFICEINCY OF

A QUESTIONABLE, BILLION

DOLLAR BILL

By

CHUKA UCHENNA IKOKWU

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ABSTRACT

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Chuka Uchenna Ikokwu, B. Sc., Economics

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Faculty Mentor: Dr. Michael Ward

One part of the Telecommunications Act of 1996 in the US created a $2.25 billion per year fund from which schools and libraries could hope to recover much of the costs of providing Internet and telecommunications services. The nominal justification for this program, known as the E-Rate, was that these services are increasingly becoming crucial to children's education. Moreover, since numerous families in poor districts may not have internet access at home, the program tends to lessen disparities between children from different family types. From an economic perspective, the program would be deemed effective if its benefits outweigh its costs.

That is, are there sufficient educational outcomes due to the program relative to the costs?

In this thesis, I measured the effect that E-Rate participation for school districts in Texas had on certain education outcomes over time, with information provided by the Texas Education Agency. These outcomes included attendance rates, graduation rates, percent of students going on to college, and standardized test scores. The outcomes were matched with E-rate subsidy levels for various years and districts and a regression was run on the data to determine its isolated effect. The results revealed a number of improvements in outcome measures. However, implicit cost per outcomes tended to be quite high. Although the program is fairly effective, it seems quite expensive for such little change. For instance, a $100 million increase in E-Rate spending on these schools, would only increase the attendance rate by 3%. Despite, it could be more effective if more of this E-rate subsidy were veered particularly towards schools in poorer districts.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

E-RATIONALIZATION

Has the federal government wasted an annual $2.25 billion over the past couple of years? Is the heavy discount that provides free or discount computers and internet connections to schools and libraries from the government worth it or not? These are questions that I intend to answer via economics research methods and data analysis. The E-Rate Program currently allocates support for telecommunications services and Internet access to all eligible applicants regardless of need, and then makes internal connections support available to the neediest applicants first, as long as funds remain. However, there is a possibility that the expectations the government has of the program, and the expected benefits and advantages that could stem from it are not particularly significant. These expected benefits, and their actual results will be examined.

1.1 History of the E-Rate Program

Although the United States is a leader of the technological revolution, there are segments of American society, particularly the poor, minorities, and the geographically isolated, for which access to computers and the Internet is significantly lower. The E-Rate Program, created by Congress as part of the Telecommunications Act of 1996 (Public Law 104-104), is a federal program that seeks to bridge this "digital divide" by supporting broader public access to the new digital technology at public and private nonprofit educational institutions.

1.2 Implications of the E-Rate Program

The E-Rate Program was designed to help schools and libraries gain access to the Internet and other digital technology while allowing them to use their scarce resources to support other critical aspects of educational reform. As one principal reported, "This program has allowed us to have more and better communications equipment and greater, faster access to the Internet. It has freed funds for other activities that would not have been available." [Urban Institute].

Schools and libraries approved for the E-Rate Program receive discounts, thereby paying lower than market prices for telecommunication equipment and services. The discounts range from 20 to 90 percent and are based on the percentage of students eligible for participation in the National School Lunch Program and whether the school or library is located in a rural area (where the cost of remote access is likely to be higher). Communities with higher concentrations of poor children and those located in rural areas receive higher discounts. The total amount of these discounts is, however, subject to an overall $2.25 billion annual program cap.

The E-Rate Program supports the acquisition of digital technology infrastructure, including telephone services (basic, long-distance, and wireless); Internet and web site services; and the acquisition and installation of network equipment and services, including wiring in school and library buildings. Other components of an educational technology system—including computer hardware and software, staff training, and electrical upgrades—are not covered under the E-Rate Program.

1.3 The Benefits of Computers in the Classroom

According to an article written by Michael J Coley, an education policy analyst at Princeton in New Jersey, a review of the research on the effectiveness of educational technology at the Educational Testing Service (ETS) shows that rudimentary uses of computers to teach concepts like addition and subtraction can be effective and efficient. However, it also shows that more pedagogically complex uses of the computer, for example, using the Internet in small groups to conduct collaborative research, often show inconclusive results. It appears that the more complex and sophisticated the instructional design, the more difficult the evaluation. But sometimes these complex situations offer promising and inviting vignettes on the future of teaching and learning. Let us look at some of the clear benefits of computers in the classrooms.

Studies show computer-based instruction can individualize instruction and give instant feedback to students, even explaining the correct answer. The computer is infinitely patient and nonjudgmental, thus motivating students to continue.

Coley, in September of 1997, also found that in a presentation to a recent RAND conference, researcher James Kulik, around 1990, summarized more than a decade's worth of work spent analyzing the effectiveness of computers used for instruction. A research approach called meta-analysis allowed him to aggregate the findings of more than 500 individual studies of computer-based instruction. The studies, conducted independently by research teams using different methods at eight research centers, focused on different uses of the computer with different populations. The conclusions drawn by Kulik indicate that students usually learn more in less time when they receive computer-based instruction. He also concluded that students like their classes more and develop more positive attitudes toward computers when their classes include computer-based instruction. Kulik also implied that computers do not, however, have positive effects in every area in which they were studied. In 34 studies that examined students' attitudes toward subject matter, for instance, the average effect of computer-based instruction was near zero.

For the most part, the computer programs reviewed in Kulik's analysis were developed before 1990 and tended to emphasize drill and practice. More recently, the Software Publishers Association released a report prepared by an independent consulting firm that analyzed 176 studies conducted from 1990 to 1995 on the effectiveness of technology in schools. The report showed students in technology-rich environments experienced positive effects on achievement in all major subject areas, preschool through higher education, for both regular and special-needs students. Most students--although not necessarily low-achieving students, who tended to require more structure--were better able to pace themselves when technology was used. Student attitudes toward learning and the students' own self-concepts improved consistently when computers were used for instruction. "The use of technology as a learning tool can make a measurable difference in student achievement, attitudes, and interactions with teachers and other students," the report concluded.

A lot of studies have demonstrated that technology is particularly valuable in improving student writing. The ease with which students can edit their written work on word processors makes them more willing to do so, which in turn improves the quality of their writing. Studies have shown that students are also better at critiquing and editing written work that is exchanged over a computer network with students they know. And student writing that is shared with other students over a network tends to be of higher quality than writing produced for in-class use only (Coley, 1997).

Other benefits are documented as well. As schools have added computers, they have reported improvements in their attendance and dropout rates. They have also reported students are more challenged, more engaged, and more independent. Unfortunately, there is always the problem of 'Moral Hazard', which involves situations where students expected to use these school computers for academic purposes, use them instead for their own personal interests and for leisure activities, such as surfing the web and playing solitaire or pinball. However, if students that do not engage in the moral hazard problem, the benefits above do apply to their use of computers for the classroom purposes. These benefits support the emergence of the E-Rate Program but whether the program is working effectively is not determined by these benefits alone.

1.4 Factors Affecting the E-Rate Effect

According to a formative evaluation of the E-Rate Program done by the Integrated Studies of Educational technology by Michael E. Puma, Duncan Chaplin, Kristin Olson, and Amy Pandjiris of the Urban Institute, the E-Rate Program has helped equalize access to the types of digital technology eligible for program discounts. Although classroom-level Internet access is still more common in wealthy schools, there have been increases in classroom access in the poorest schools since 1998, after a period of relative stagnation. However, the problem for the above situation, in which the minor positive effects are so expensive, lies in the fact that although public districts and schools, especially those in poor and rural communities, have been the primary beneficiaries of E-Rate Program support, significant gaps exist in their ability to make effective use of the acquired technology for classroom instruction.

One reason for the gap stated above is that students in poorer E-Rate Program districts and schools are, according to district and school administrators and teachers, more likely (controlling for other factors) to face a variety of conditions that may limit their use of technology for instruction, including inadequate teacher skills, limitations of existing school buildings (i.e., security, space, and electrical systems), and the speed and reliability of existing Internet connections. Similarly, students in rural E-Rate Program districts and schools are more likely (controlling for other factors) to have the use of technology for instruction limited by students' lack of general technology skills and by the limited availability of technical support staff.

Secondly, students in urban E-Rate Program settings are, controlling for other factors, more likely to face constraints related to the adequacy of teacher and student technology skills, the availability of technical support staff, building electrical systems, and the speed and reliability of their Internet connections.

Thirdly, district and school size are associated with greater organizational and technical complexity, as well as increased scale and scope of technology systems. Therefore, students in larger E-Rate Program districts and schools are more likely to face a number of barriers to the expanded use of educational technology, including low availability of adequately trained teachers and of training opportunities for them; low availability of instructional computers; teacher access to an e-mail account at school; low speed and reliability of the Internet connections; limited access to technical support; and adequacy of building space and electrical systems.

Fourthly, controlling for other factors, students in larger E-Rate Program schools are less likely to have teachers who use educational technology and who use computers for "complex" purposes in their classrooms. Finally, students in elementary E-Rate Program schools are less likely than students in middle and secondary E-Rate Program schools to have their use of the Internet and other digital technology constrained by the availability of technical support or the technology skills of their teacher.

1.5 The Role of Technology

In an age where technology is one of the driving forces of advancement in a nation, there is no doubt as to its vast importance in every sector of the economy, including the educational sector. Information technology, particularly access to the new cutting edge telecommunications, has quickly expanded into the nation's schools, matching its rapid penetration into the workplace and mainstream society. Proponents of the expanded use of computers in school foresee important transformations tied to the use of newer cutting edge developments—multi-media computers, broad bandwidth communication "pipes," and widely distributed connectivity to the Internet exposing teachers and students to an exciting world of distance learning, "streamed broadcast" of audio and video, and a host of other digital advances. For many schools, however, especially those in high-poverty and geographically isolated communities, a lack of access to this new technology is a serious problem (as are a lack of adequately trained technical and instructional staff and other more mundane problems such as inadequate electrical power and space).

During the past 20 years, the role of the computer in American schools has expanded as its capacity as a learning tool has changed, and it has increasingly become an integral part of daily classroom life. In particular, the Internet has exposed students to topics that they could previously only find in textbooks or at the library, has enabled teachers to enrich their classroom instruction, has provided increased opportunities for teacher professional development (e.g., through distance learning and emails), and increased the efficiency of routine administrative tasks e.g., recording grades (Urban

Institute, 2000). These uses imply the increasing importance of information technology and telecommunication in education goes on.

The continual growth of information technology, the effectiveness of telecommunications and the helpfulness of Internet in classrooms all make for a huge influence on the life of the E-Rate Program. This is so because if not for the above, there would not be that much of a need to close the digital divide[1] or to support the heavy need for telecommunications in the classroom. The issue lies in the fact the growing role of technology in the nation is not enough to confirm the success of the E-rate Program.

1.6 Why do Schools & Libraries Want the E-Rate Program?

Asking why schools and libraries need the E-Rate Program is almost like asking why college students apply for financial aid. One can almost consider it a rhetorical question. One must bear in mind that one of the E-Rate Program's chief functions is to help poor schools connect to the Internet. From an economic point of view, a good question to tackle would be whether the benefits of the program outweigh its costs.

Of all the money provided for members of the E-Rate Program, public districts, including public schools and public libraries, account for approximately 79.2% (Urban

[1] The digital divide is a term that springs from the fact that households with incomes over $75,000 are 20 times more likely to have access to the Internet than those at lower income levels, and nine times more likely to have a computer at home. Even at the lower income levels, urban households are twice as likely to have Internet access as rural households. Also, Whites are more likely to have access to the Internet from home than are African Americans and Hispanics from any location (e.g., work, school). Even controlling for income, African Americans are less likely than whites to use the Internet (Urban Institute, 2000).

Institute) of it. It is no question that public schools, who do not charge their members fees for primary gain, are in need of heavy financial assistance 100% of the time. Although the budget for the American government is currently in a deficit, millions of schools and libraries still have to depend on that deficit to progress; this is precisely one of the many reasons why the government has to go as far as collecting a fee from all American phone users to distribute $2.25 billion a year to poor schools and libraries [cyber-playground.com].

Among many other reasons why schools want the E-Rate Program are common factors like location, size of the school district, and the digital divide. These three factors frequently work side by side with each other in strengthening Schools' want for the E-Rate Program. When schools are located in poor/rural areas, the population of the school district tends to be large mainly due to the fact that public schools are all the low income parents can afford; this results in a shortage of funds to update the facilities and close the digital divide, as the population of students is growing faster than the amount of funds being received. So basically it would be difficult for these highly populated rurally-located schools to acquire funds for technological improvement without the help of discount programs like the E-Rate Program. In addition, according to the Urban Institute's analysis of the E-Rate Program, larger districts, schools, and libraries are more likely to apply for E-Rate Program discounts, most likely because of the reasons stated above.

The question of whether the E-Rate Program is effective is a unique issue on its own, irrespective of whether schools and libraries want it or not. The E-Rate Program might be very useful and highly wanted, but that certainly does not mean that it is an effective program, so let us move on to bigger and brighter questions about the E-Rate Program.

1.7 What are the benefits of becoming more Internet-friendly?

Coupled with the ever growing role of technology in this age, the benefits of becoming more Internet-oriented and more up to date on telecommunications are overwhelming. It has been estimated that there are more than a total of seven billion electronic devices in households all over the world, and our lives seem to be becoming more automated as years go by. Numerous job applications ask how many words-per-minute one can type, irrespective of the position being applied for. Some of these applications have to be been done only via the internet e.g. blockbuster careers, as well as accommodation and shopping. All of the above will require at least an average level of computer literacy, or at least some type of familiarity with telecommunications. It can be assumed that a lot of the residents of this technology driven community are increasingly finding themselves in a situation where average computer literacy is almost mandatory, and so the benefits of becoming more internet-oriented would seem rather balancing and up-to-speed inducing.

When schools and libraries take advantage of the E-Rate Program, the students are sure to become more Internet-oriented and this could only do more good than harm for the recipients of the program. One can not imagine how many students and E-Rate Program recipients would be more effective in computer generated research and web searches. It ought to improve the level of computer literacy of students at school districts and libraries as well as bring them more up to speed with the rampant technological advancement of the society, thus helping to further close the digital divide, and making the recipients much more efficient at many everyday processes that require an average level of computer literacy.

CHAPTER II

METHODOLOGY

We shall now address the core point of this whole issue of whether the government is making a good economic decision or not. This is where econometrics comes into play, i.e. research methods involving statistical analysis of data.

2.1 Method of Research

The method I have chosen to determine the effectiveness of this program is the classic regression analysis. In statistics, linear regression analysis is a method of estimating the conditional expected value of one variable, y, given the values of some other variable or variables, x. The variable of interest, y, is conventionally called the "dependent variable". The other variables, x, are called the "independent variables". The term independent variable suggests that its value can be chosen at will, and the dependent variable is an effect, i.e., causally dependent on the independent variable, as in a stimulus-response model. Although many linear regression models are formulated as models of cause and effect, the direction of causation may just as well go the other way, or indeed there need not be any causal relation at all. Regression, in general, is the problem of estimating a conditional expected value (LaborLawTalk.com).

Simply put, the analysis involves the estimation of the relationship between the independent variable, which in this case is the level of E-Rate Program funding, and the dependent variable, measures of academic and educational outcomes. What my research will show is whether the E-Rate Program has a negative or positive effect on these academic outcomes, and the degree of the effect. The formula for the regression equation looks something like this:

$$Outcome_{it} = \beta_0 + \beta e - rate_{it} + \text{E}DummyI + \varepsilon_{it}$$

Where:

β o = A Constant

β e-rate = The co-efficient of the E-Rate Program funds

Έ Dummy I= A dummy variable for idiosyncratic differences effects

ε = The error term

2.1.1 The Independent Variable: Dollar Amount per Student

Since the dollar amounts given to the schools do not reflect the size of the schools, this would be a problem. This is because it will not be an accurate measure of the E-Rate Programs efficiency, considering a small sized school might receive a large dollar amount and vice versa, causing an uneven dispersion of the data. Therefore, I will correct this problem by simply dividing the total dollar amounts given to the schools by the number of students in each district. This division will result in the "E-Rate Program dollar amount per student" being the new independent variable, of which the outcomes will be run against. As seen in the next chapter, in table 1, the average dollar-amount-per student of the E-Rate Program is about $15.72.

2.1.2 The Dependent Variables: Outcomes

As for the outcomes for this experiment, the academic performance indicators that have been chosen include the following:

(1.) The District Attendance Rate.

(2.) The District Dropout Rate.

(3.) The District Dropout Rate for economically disadvantaged Students.

(4.) S.A.T. (Scholastic Aptitude Test) Scores District Average.

(5.) A.C.T. (American College Test) Scores District Average.

Since the E-Rate Program subsidy might not be the only variable affecting the above outcomes, I have controlled for the effect of other possible independent variables, such as the number of teachers with MBA degrees, size of classrooms, location & population of school districts, number of single parent children etc. Due to these other factors, I have applied the term ceteris paribus (all other things held constant) as I tested for the effect of the E-Rate Program, with the hope of isolating the effect of the E-Rate Program. This was done by retrieving the "fixed-effect" through a program known as STATA. This "fixed-effect" is equivalent to calculating the deviation from the district mean, and running the regression on the deviation. This prevents the idiosyncratic group differences from biasing the results.

CHAPTER III

DATA DESCRIPTION

Now we are going to look at the description of the outcomes listed in the previous chapter in detail. Bear in mind that all of the following only apply to data retrieved from the state of Texas, the second largest and second most populous state in the nation. The above outcomes, and why they have been chosen, must be understood first. Secondly, the effect that the E-Rate Program should have on the above outcomes must also be understood in order to tell if the program is effective or not. Refer to Table 1 below for the summary statistics for the regression.

Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
pamttot	11071	15.71759	47.53162	0	483.9332
damttot	11071	.2959082	.4564706	0	1
nonattend	11024	.043873	.0261203	0	.498
dropout	10673	.0112996	.0194619	0	.305
dropoutecon	10462	.0223429	.0508613	0	.714
colladm	2641	.4880746	.4009038	0	1

sat |	5729	946.1374	86.95209	594	1296
act |	6876	19.87955	1.625601	12.2	26.7

pamttot = Dollar Amount Per Student

damttot = Discount Amount Per Student\

nonattend = Non-Attendance rate

dropout = Dropout rate

dropotecon = Dropout rate for Economically Disadvantaged Students

colladm = College Admission rate

sat = S.A.T. Average

act = A.C.T. Average

3.1 The District Attendance Rate

This, as the name signifies, is the annual rate of attendance for each school district. The student attendance rate is determined by dividing the average daily attendance by the total average daily enrollment. The reason this has been chosen, is that it plays an important role in the determination of the E-Rate Program program's performance, in the sense that if the E-Rate Program is successful, then hopefully we should see increases in the district attendance rate for schools. This means for some reason or the other, students would attend classes more regularly and show up for school more often, maybe because of excitement of using these telecommunication resources. If it is not, then there either would not be a significant change in the attendance rate, or even a drop in it, over the years.

3.2 The District Dropout Rate

The district dropout Rate is calculated using dropouts reported for the year for grades 7 through 12 and dividing by the total enrollment for the year for the same grades. Dropout rates are a one-year indicator of students who left school and are not the inverse of graduation rates. This outcome, if the E-Rate Program is successful, should have a negative relationship with the E-Rate Program i.e. that is, if the E-Rate Program works well, then the drop out rate should reduce as funding from the E-Rate Program continues, and vice versa. If students are affected by it, they would stay in school and be more driven to apply themselves to their studies, since they now have the help of up-to-date telecommunication services. If not, they would not be bothered that much by whether or not they have internet access in their schools.

3.3 The District Dropout Rate for Economically Disadvantaged Students

This is mostly the same as above except that instead of using every dropout for the year, in the calculation of the dropout rate, it instead uses the dropouts by only the economically disadvantaged students. This outcome will prove very helpful mainly because the E-Rate Program is specifically aimed at helping a lot of poor districts, and districts that are at the lower end of the digital divide. Therefore, if the relationship of this outcome is negative i.e. if it reduces as E-Rate Program funding continues, then that means that it could also be helping to keep kids from poorer families in school, and vice versa. It could also help prove whether one of the E-Rate Program's aims of helping poorer school districts is successful or not.

3.4 SAT & ACT Scores

The SAT & ACT scores are used by colleges and universities to compare ones' academic skills with students from around the country (and sometimes the world). They are also very good measures of an individual's academic performance. Therefore, if their averages are increasing (decreasing) along with increasing or continuing of E-Rate Program funding, then this is a very good reflector of the E-Rate Programs success (or failure).

3.5 College Admission

The college admission rate, like the name implies, is the percent of students that go on to college after high school. It measures the amount of high school graduates that are admitted into college. This could serve as a very significant factor in determining the success of the E-Rate Program because college admission can be categorized as one of the most important reasons for high school education. Thus, if this is affected by the E-Rate Program, then that serves as a direct tie to whether the high school is succeeding or failing in its attempt to help its students be admitted into college.

3.6 Other Applicable Concepts

In addition to the description of the outcomes above, we will also describe the different kinds of data that are to be expected from the regressions. Recall that due to other factors that might affect the outcomes, the effect of the E-Rate Program needs to be isolated in order for more accurate results, and this is done via methods described in the previous chapter. This gives us the “fixed-effect”, otherwise seen as “f.e.” on the regression tables. Other significant data that help determine the results are given in the following chapter.

3.6.1 Dummy Variables

A dummy variable is a numerical variable used in regression analysis to represent subgroups of the sample in a study. In research design, a dummy variable is often used to distinguish different treatment groups. In the simplest case, we would use a 0 or 1 dummy variable where a factor is given a value of 0 if it is in the control group, which is other factors that might affect the outcomes besides the E-Rate Program. We could also use a 1 if it is in the treated group, which includes the E-Rate Program amounts. Dummy variables are useful because they enable us to use a single regression equation to represent multiple groups. This means that we do not need to write out separate equation models for each subgroup. The dummy variables act like 'switches' that turn various parameters on and off in an equation.

This particular statistical concept of the dummy variable would be another less complicated way of isolating the effect that the E-Rate Program has on the given outcomes and will be included within the regression containing the fixed-effect of the independent variable on the dependent variable.

3.6.2 The Coefficient

The coefficient is used to interpret the relationship between the independent and dependent variables. It measures the effect that the independent variable has on the dependent variable. If there is no relationship between the predicted values and the actual values the correlation coefficient is zero. As the strength of the relationship between the predicted values and actual values increases, so does the coefficient. Let us look at an example of the coefficient. Take for instance, the coefficient of the regression of college admission run against the E-Rate Program dollar amounts. If the coefficient is 0.000123, this means that for every $1 increase spent on students, the college admission rate goes up by 0.000123. Despite the positive effect, the statistical significance of this coefficient depends on the t-statistic.

3.6.3 The T-Statistic

The t-statistic is a measure of how confident we are that the coefficient is different from zero. One computes this statistic by subtracting the hypothesized value from the statistical estimate and then dividing by the estimated standard error. In many, but not all situations, the hypothesized value would be zero. There is an indication that the hypothesized value is reasonable when the t-statistic is close to zero. Alternately, there is an indication that the hypothesized value is not large enough when the t-statistic is large and positive. Finally, one has an indication that the hypothesized value is too large when the t-statistic is large negative.

CHAPTER IV

RESULTS, DECODING, & APPLICATIONS

4.1 Regression Analysis Results

Here is what has come to be determined after the data has been analyzed via regression analysis. With reference to the table below, we will go through each result pertaining to the different outcomes.

Table 2: Regression Analysis Results

	Attendance Rate	District Dropout Rate	District Dropout rate for Econ. Disadv.	S.A.T. Average	A.C.T. Average	College Admission
Coef.	0.00000554*	-0.0000226**	-0.0001186**	0.25101**	0.0005083	0.0043595**
T-stat	-2.47	-6.81	-9.45	9.96	1.49	11.98
R-square	0.0029	0.0035	0.0100	0.0004	0.0099	0.0634

* Indicates significance at 10% level

** Indicates significance at 1% level

4.1.1 Attendance rate

The coefficient, 0.00000554, implies that for every extra dollar spent on the students, the attendance rate increases by 0.000554%. This is clearly a positive effect, as more students are now attending school than were without the E-Rate Program subsidy. The t-statistic, abs (2.47), and its significance at the 1% level, means that we are 99% confident that the attendance rate will go up by 0.000554% for an additional E-Rate Program dollar spent on each student. Since the t-statistic is greater than the rule-of-thumb, 2, this implies that the E-Rate Program does have a positive effect on the attendance rate.

4.1.2. Dropout rate

From the coefficient above, -0.0000226, implies that for every extra dollar on the students, the dropout rate decreases by 0.00226%. The t-statistic, abs (6.81), being greater than 2, and its significance at the 10% level, implies that we are 90% confident that that the dropout rate will decrease by 0.00226% for every additional dollar that the E-Rate Program spends on the students.

4.1.3. Dropout rate for the economically disadvantaged

The coefficient, -0.0001186, implies that for every extra dollar spent on the students, the rate decreases by 0.01186%. The t-statistic, abs (9.45), and its significance at the 10% level, supposes there is 90% confidence that the dropout rate for the economically disadvantaged students will go down by the above amount. Since one of the E-rate Program's chief functions is helping school in poor districts, the above coefficient and its supporting t-statistic do show that it is efficient to an extent, in achieving this particular goal.

4.1.4 SAT Averages

The coefficient of the average SAT implies that for every extra dollar spent on the students, the SAT average increases by 0.25101 points. The t-statistic, 9.96, and its significance at the 10% level, state that there is 90% confidence that the E-rate program does have an effect on the SAT average and as a matter of fact, will go up by more than a quarter of a point when an additional dollar is spent per student.

4.1.5. ACT Averages

With regards to the ACT average, the coefficient, 0.0005083, implies that for every extra dollar spent on the students, the attendance rate increases by 0.05083 points. However, with a t-statistic of 1.49, which is less than the rule-of-thumb, 2, it is not safe to say that we are very confident that the E-rate Program has the above effect on the ACT average scores, unless the t-statistic is rounded of to the nearest whole number.

4.1.6. College Admission

The college admission rate, according to the table above, goes up by 0.43595%, with a dollar increase in E-Rate Program spending on students. With a t-statistic of 11.98, and its significance at the 10% level, it is safe to say that we are 90% confident that the above increase takes place when there is a dollar increase in the subsidy spending.

Bare in mind that when E-rate spending increase by a dollar, because there are about four million students in Texas, spending goes up by about $4 million. Therefore, whether the changes above are significant or cost effect depends on if there are other existing factors that can affect the variables much more efficiently than the E-Rate Program or not. Results regarding this reason are inconclusive due to the limited research of this project.

4.2 Applications

According to the Texas Education Agency, Texas has approximately 4 million students in high school. This means that for every additional dollar that the government spends per student, it is basically spending $4 million dollars. We have seen the coefficients of the regression and have interpreted them. Now, let us look at more practical applications. Below is a table that shows how much the government would have to spend via the E-rate Program to achieve certain hypothesized goals, or improvements. For instance, observe the non-attendance rate. In order for the government to decrease the non-attendance rate by 0.1%, that is, in order for the government to add 1,755 students to the number of students attending classes, it would have to spend over $700 million.

Table 3: Applications

Outcomes	Hypothesized Goal	Cost per Student	Cost (Texas Wide)
Non-Attendance	0.1% (1,755)	$180.50	$722,021,661
Dropout Rate	1% (452)	$442.48	$1,769,911,504
Dropout Rate for Econ. Dis.	1% (89,372)	$84	$337,268,128
S.A.T. Average	1% (9.46)	$0.04	$159,356
A.C.T. Average	1% (0.1988)	$19.67	$78,693,685
College Admission	1% (19,523)	$2.29	$9,175,364

Refer to the table above and notice that factors involving better performing students are more cost effective than the factors involving students that would fall under the same category that “dropouts” fall under. For instance, in order to attain a one-percent decrease in the dropout rate, it would cost the E-Rate program $1.7 billion dollars; however, to raise the college admission rate by 1%, that is by 19,523 students, it would cost only a little over $1.7 million. From this, we can conclude that for better performing students, for instance students that graduate from high school, or students that take standardized tests, as well as those that regularly attend classes, the E-Rate program is cost effective. However, for poor performing students, and students that dropout for various reasons, the E-rate Program is rather expensive.

CHAPTER V

CONCLUSION

With regards to the effect of the E-rate Program on schools in poor districts, the program does happen to be having a positive effect on the different factors that were analyzed. Since most of the applicants for the E-rate discount are schools in need, then the above results also apply to schools in poor districts.

Like aforementioned, referring the previous chapter, we have drawn from the application of the results that the E-Rate is effective and inexpensive for better performing students, while it is relatively expensive for poor-performing students, and students that do not attend classes regularly. However, this judgment of the E-Rate Program's compatibility with "poor-performing students" factors can only be justified via the existence of other programs that can yield cheaper costs to attain the same goals.

Despite the differences that the E-rate Program reveals in cost effectiveness pertaining to the different outcomes, one thing must be noted. This is that the program does show positive reports for all of the factors that were involved in the project. Although some appear to be less cost-effective than the others, the program does show expected relationships as far as the observed factors. S.A.T. and A.C.T. scores increase, attendance rates and college admission rates increase, and dropout rates, as well as the dropout rate for economically disadvantaged students, both decrease, all when "E-Rate Program" spending for schools and libraries increases.

The level of significance of the results that the program reveals, depends on the fixed effects of other potential programs that could have some sort of influence on the above dependent variables e.g. teachers with masters degrees, bigger classrooms, etc. Since the scope of the research of this project is limited to the fixed-effect that the E-rate Program has on the factors, it is not safe to say that there are not any other existing factors that can give better results that those of the E-rate Program. However, if no such programs exist, then the E-rate Program is on the right track. The federal government could be advised to keep funding these schools but devise more effective programs for poor performing students, or “dropouts”; all this is given that the E-rate is the most effective education-enhancing program out there. Further research could involve the inclusion of other potential independent variables besides the E-Rate Program in order to run multiple-regression analyses. Doing this will return results that are not specific to only one independent variable. Thus the results can be compared, revealing the most significant independent variable.

APPENDIX A

STATA REGRESSION RESULTS & SUMMARY ANALYSIS

Appendix A Content

```
------------------------------------------------------------------------------------------
-------
       log:  J:\Research\Chuka\reg.log
  log type:  text
 opened on:  21 Mar 2005, 15:54:37

.
. set mem 30m

Current memory allocation

                    current                                 memory usage
    settable          value     description                 (1M = 1024k)
    --------------------------------------------------------------------
    set maxvar         5000     max. variables allowed           1.733M
    set memory           30M    max. data space                 30.000M
    set matsize         400     max. RHS vars in models          1.254M
                                                            -----------
                                                                32.987M

.
. set more off

.
. insheet using "J:\Research\Chuka\mgd.csv", clear
(44 vars, 13137 obs)

.
. drop if num == .
(18 observations deleted)

.
. tsset num year, yearly
       panel variable:  num, 1902 to 254902
        time variable:  year, 1993 to 2004, but with gaps

.
. gen pamt1 = amt1/students
(1928 missing values generated)

. gen pamt2 = amt2/students
(1928 missing values generated)

. gen pamt3 = amt3/students
(1928 missing values generated)

. gen pamttot = pamt1+pamt2+pamt3
(1928 missing values generated)
```

```
. gen amttot = amt1+amt2+amt3

. gen damttot = (pamttot > 0)

.
. gen year1993 = (year == 1993)

. gen year1994 = (year == 1994)

. gen year1995 = (year == 1995)

. gen year1996 = (year == 1996)

. gen year1997 = (year == 1997)

. gen year1998 = (year == 1998)

. gen year1999 = (year == 1999)

. gen year2000 = (year == 1990)

. gen year2001 = (year == 2001)

. gen year2002 = (year == 2002)

. gen year2003 = (year == 2003)

. gen year2004 = (year == 2004)

.
. gen nonattend = (100 - attend)/100
(896 missing values generated)

. replace dropout = dropout/100
(8692 real changes made)

. replace dropoutecon = dropoutecon/100
(7196 real changes made)

. replace colladm = colladm/100
(3142 real changes made)

.
. drop if pamttot > 500
(2048 observations deleted)

.
. sum pamttot damttot nonattend dropout dropoutecon colladm sat act

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
     pamttot |     11071    15.71759    47.53162          0   483.9332
     damttot |     11071    .2959082    .4564706          0          1
```

```
   nonattend |     11024     .043873    .0261203          0       .498
     dropout |     10673    .0112996    .0194619          0       .305
 dropoutecon |     10462    .0223429    .0508613          0       .714
-------------+--------------------------------------------------------
     colladm |      2641    .4880746    .4009038          0          1
         sat |      5729    946.1374    86.95209        594       1296
         act |      6876    19.87955    1.625601       12.2       26.7

.
. xtreg nonattend pamttot if pamttot < 500 , fe

Fixed-effects (within) regression               Number of obs      =     11024
Group variable (i): num                         Number of groups   =      1226

R-sq:  within  = 0.0006                         Obs per group: min =         1
       between = 0.0153                                        avg =       9.0
       overall = 0.0029                                        max =        10

                                                F(1,9797)          =      6.11
corr(u_i, Xb)  = 0.0468                         Prob > F           =    0.0134

------------------------------------------------------------------------------
   nonattend |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     pamttot |  -5.54e-06   2.24e-06    -2.47   0.013    -9.94e-06   -1.15e-06
       _cons |   .0439603    .000095   462.79   0.000     .0437741    .0441465
-------------+----------------------------------------------------------------
     sigma_u |  .03520385
     sigma_e |  .00925842
         rho |  .93530835   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(1225, 9797) =    63.41          Prob > F = 0.0000

. xtreg dropout pamttot if pamttot < 500, fe

Fixed-effects (within) regression               Number of obs      =     10673
Group variable (i): num                         Number of groups   =      1181

R-sq:  within  = 0.0049                         Obs per group: min =         1
       between = 0.0075                                        avg =       9.0
       overall = 0.0035                                        max =        10

                                                F(1,9491)          =     46.33
corr(u_i, Xb)  = 0.0051                         Prob > F           =    0.0000

------------------------------------------------------------------------------
     dropout |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     pamttot |  -.0000226   3.32e-06    -6.81   0.000    -.0000291   -.0000161
       _cons |   .0116578    .000141    82.67   0.000     .0113813    .0119342
-------------+----------------------------------------------------------------
     sigma_u |  .02001567
     sigma_e |  .01351639
```

```
         rho |  .68680493   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(1180, 9491) =    10.64          Prob > F = 0.0000

. xtreg dropoutecon pamttot if pamttot < 500, fe

Fixed-effects (within) regression               Number of obs      =     10462
Group variable (i): num                         Number of groups   =      1168

R-sq:  within  = 0.0095                         Obs per group: min =         1
       between = 0.0097                                        avg =       9.0
       overall = 0.0100                                        max =        10

                                                F(1,9293)          =     89.24
corr(u_i, Xb)  = -0.0333                        Prob > F           =    0.0000

------------------------------------------------------------------------------
 dropoutecon |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     pamttot |  -.0001186   .0000126    -9.45   0.000    -.0001433    -.000094
       _cons |   .0242397   .0005336    45.43   0.000     .0231937    .0252857
-------------+----------------------------------------------------------------
     sigma_u |  .02793413
     sigma_e |  .05056795
         rho |  .23380715   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(1167, 9293) =     1.01          Prob > F = 0.3692

. xtreg act pamttot if pamttot < 500, fe

Fixed-effects (within) regression               Number of obs      =      6876
Group variable (i): num                         Number of groups   =       957

R-sq:  within  = 0.0004                         Obs per group: min =         1
       between = 0.0290                                        avg =       7.2
       overall = 0.0099                                        max =         8

                                                F(1,5918)          =      2.22
corr(u_i, Xb)  = -0.1394                        Prob > F           =    0.1360

------------------------------------------------------------------------------
         act |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     pamttot |   .0005083   .0003409     1.49   0.136      -.00016    .0011767
       _cons |   19.87294   .0130885  1518.35   0.000     19.84728     19.8986
-------------+----------------------------------------------------------------
     sigma_u |  1.3905444
     sigma_e |  1.0211478
         rho |  .64965796   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(956, 5918) =    11.85           Prob > F = 0.0000

. xtreg sat pamttot if pamttot < 500, fe
```

```
Fixed-effects (within) regression               Number of obs      =      5729
Group variable (i): num                         Number of groups   =       871

R-sq:  within  = 0.0200                         Obs per group: min =         1
       between = 0.0114                                        avg =       6.6
       overall = 0.0004                                        max =         8

                                                F(1,4857)          =     99.10
corr(u_i, Xb)  = -0.1278                        Prob > F           =    0.0000

------------------------------------------------------------------------------
         sat |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     pamttot |     .25101   .0252144     9.96   0.000     .2015784    .3004417
       _cons |   943.1742   .8883931  1061.66   0.000     941.4326    944.9159
-------------+----------------------------------------------------------------
     sigma_u |  71.888549
     sigma_e |  63.356105
         rho |  .56283884   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(870, 4857) =     6.81           Prob > F = 0.0000

. xtreg colladm pamttot if pamttot < 500, fe

Fixed-effects (within) regression               Number of obs      =      2641
Group variable (i): num                         Number of groups   =      1030

R-sq:  within  = 0.0819                         Obs per group: min =         1
       between = 0.0379                                        avg =       2.6
       overall = 0.0634                                        max =         3

                                                F(1,1610)          =    143.63
corr(u_i, Xb)  = -0.2249                        Prob > F           =    0.0000

------------------------------------------------------------------------------
     colladm |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     pamttot |   .0043595   .0003638    11.98   0.000      .003646     .005073
       _cons |   .4596907   .0093558    49.13   0.000       .44134    .4780414
-------------+----------------------------------------------------------------
     sigma_u |  .16839509
     sigma_e |  .46513786
         rho |  .11587958   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(1029, 1610) =     0.22          Prob > F = 1.0000

.
. xtreg nonattend damttot , fe

Fixed-effects (within) regression               Number of obs      =     11024
Group variable (i): num                         Number of groups   =      1226
```

```
R-sq:  within  = 0.0057                         Obs per group: min =         1
       between = 0.0496                                        avg =       9.0
       overall = 0.0081                                        max =        10

                                                F(1,9797)          =     55.94
corr(u_i, Xb)  = 0.0649                         Prob > F           =    0.0000

------------------------------------------------------------------------------
   nonattend |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     damttot |  -.0016681    .000223    -7.48   0.000    -.0021053   -.0012309
       _cons |   .0443686   .0001101   402.91   0.000     .0441527    .0445844
-------------+----------------------------------------------------------------
     sigma_u |  .03513605
     sigma_e |  .00923498
         rho |  .93538178   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(1225, 9797) =    63.40          Prob > F = 0.0000

. xtreg dropout damttot , fe

Fixed-effects (within) regression               Number of obs      =     10673
Group variable (i): num                         Number of groups   =      1181

R-sq:  within  = 0.0260                         Obs per group: min =         1
       between = 0.0314                                        avg =       9.0
       overall = 0.0171                                        max =        10

                                                F(1,9491)          =    253.62
corr(u_i, Xb)  = 0.0111                         Prob > F           =    0.0000

------------------------------------------------------------------------------
     dropout |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     damttot |  -.0051776   .0003251   -15.93   0.000    -.0058149   -.0045403
       _cons |   .0128695   .0001627    79.10   0.000     .0125505    .0131884
-------------+----------------------------------------------------------------
     sigma_u |  .01987836
     sigma_e |  .01337185
         rho |  .68846635   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(1180, 9491) =    10.79          Prob > F = 0.0000

. xtreg dropoutecon damttot , fe

Fixed-effects (within) regression               Number of obs      =     10462
Group variable (i): num                         Number of groups   =      1168

R-sq:  within  = 0.0549                         Obs per group: min =         1
       between = 0.0051                                        avg =       9.0
       overall = 0.0391                                        max =        10

                                                F(1,9293)          =    540.23
```

```
corr(u_i, Xb)  = -0.1602                        Prob > F           =    0.0000

------------------------------------------------------------------------------
 dropoutecon |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     damttot |  -.0280489   .0012068   -23.24   0.000    -.0304145   -.0256834
       _cons |   .0309811   .0006094    50.84   0.000     .0297866    .0321756
-------------+----------------------------------------------------------------
     sigma_u |  .02838196
     sigma_e |   .0493947
         rho |  .24821057   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(1167, 9293) =     1.17          Prob > F = 0.0001

. xtreg act damttot , fe

Fixed-effects (within) regression               Number of obs      =      6876
Group variable (i): num                         Number of groups   =       957

R-sq:  within  = 0.0031                         Obs per group: min =         1
       between = 0.0001                                        avg =       7.2
       overall = 0.0010                                        max =         8

                                                F(1,5918)          =     18.58
corr(u_i, Xb)  = -0.0073                        Prob > F           =    0.0000

------------------------------------------------------------------------------
         act |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     damttot |    .135955   .0315371     4.31   0.000     .0741308    .1977791
       _cons |   19.84406    .014799  1340.90   0.000     19.81505    19.87307
-------------+----------------------------------------------------------------
     sigma_u |   1.387554
     sigma_e |  1.0197397
         rho |  .64930602   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(956, 5918) =    12.07           Prob > F = 0.0000

. xtreg sat damttot , fe

Fixed-effects (within) regression               Number of obs      =      5729
Group variable (i): num                         Number of groups   =       871

R-sq:  within  = 0.0873                         Obs per group: min =         1
       between = 0.0083                                        avg =       6.6
       overall = 0.0392                                        max =         8

                                                F(1,4857)          =    464.81
corr(u_i, Xb)  = -0.0383                        Prob > F           =    0.0000

------------------------------------------------------------------------------
         sat |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

```
     damttot |   44.36937   2.058005    21.56   0.000     40.33475      48.404
       _cons |   934.2028    .979252   954.00   0.000      932.283    936.1226
-------------+----------------------------------------------------------------
     sigma_u |  70.769961
     sigma_e |  61.140503
         rho |  .57261301   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(870, 4857) =     7.21           Prob > F = 0.0000

. xtreg colladm damttot , fe

Fixed-effects (within) regression               Number of obs      =      2641
Group variable (i): num                         Number of groups   =      1030

R-sq:  within  = 0.2205                         Obs per group: min =         1
       between = 0.1180                                        avg =       2.6
       overall = 0.1896                                        max =         3

                                                F(1,1610)          =    455.35
corr(u_i, Xb)  = -0.2279                        Prob > F           =    0.0000

------------------------------------------------------------------------------
     colladm |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     damttot |    .631628   .0295998    21.34   0.000     .5735697    .6896862
       _cons |   .4115426   .0090785    45.33   0.000     .3937356    .4293496
-------------+----------------------------------------------------------------
     sigma_u |  .16241262
     sigma_e |  .42860157
         rho |  .12556272   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(1029, 1610) =     0.25          Prob > F = 1.0000

.
. log close
       log:  J:\Research\Chuka\reg.log
  log type:  text
                         closed on:  21 Mar 2005, 15:54:44
```

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BIOGRAPHICAL INFORMATION

Chuka Uchenna Ikokwu was born and raised in Lagos, Nigeria. He began kindergarten at the young age of three and finished elementary school at the age of nine. By fifteen, Chuka had graduated from high school at Igbinedion Education Center, a multi-educational institution based in Benin City, Nigeria. He then came to the United States of America in 2000 and graduated from the Columbus State Community College with an Associate of Arts Degree, in December 2002. He currently resides in Dallas, Texas. Chuka is a senior at the University of Texas at Arlington and a candidate for the Honors Bachelor of Science in Economics, with a minor concentration in Business Administration. He hopes to work for a top consulting firm, post graduation, and hopes to use his research experience, gained from projects like this one, to help companies become more effective and increase their value.