The Effect of the National School Lunch Program (NSLP) on Educational Attainment

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Introduction

Although nutrition is essential for everyone, it is especially important for children because nutrition affects aspects of growth and development that will impact the future health of children. These aspects of growth and development include behavior, cognitive abilities, weight, and habits. However, not all families are financially capable of providing their children with healthy and nutritious meals daily. Therefore, Congress initiated the reduced price/free lunch program for low-income families in the 1940s to address nutritional issues and other concerns. In the 1960s, Congress passed the National School Lunch Program (NSLP).

The NSLP is a federally funded program overseen by Food and Nutrition Services of the United States Department of Agriculture (USDA). The NSLP operates in over 100,000 public and non-profit private schools and in residential child-care institutions (FNS, 2013). The program provided nutritious, low-cost or free lunches to more than 31 million children daily in 2012. Any child who attends a participating school may purchase a meal through the NSLP, but only children from families with incomes at or below 130% of the poverty level are eligible for free meals. To be eligible for reduced price meals, family incomes must be between 130-185% of the poverty level, but children from families with incomes over 185% of poverty must pay full price. For fiscal year 2012, the NSLP cost $11.6 billion.

The FNS mission is to "increase food security and reduce hunger in partnership with cooperating organizations through providing children and low-income people access to food, a healthful diet, and nutrition education in a manner that supports American agriculture and inspires public confidence" (FNS, 2013). The ongoing responsibility of FNS is to provide access to nutritionally balanced meals to children, partially through the NSLP. This responsibility includes administering the Healthy, Hunger-Free Kids Act of 2010, which authorizes funding

and policy setting (nutrition requirements, reimbursement rates, and income eligibility) for child nutrition programs. School districts that choose to take part in the lunch program get cash subsidies and food from FNS for each meal they serve. However, to receive the cash subsidies, the school districts must meet the nutritional policy requirements set by FNS.

At the state level, education agencies administer the program and operate through agreements with local school food district authorities. While school lunches must meet federal meal requirements, local school food authorities make the decisions regarding food preparation and the specific foods that are served. These local authorities also set their own prices for the full-price meals served to students, but these meal services must be operated as a non-profit program.

The NSLP is an opt-in system, meaning that school districts are not automatically enrolled to participate in it. To participate, school districts must file an application with the NSLP. However, school districts have other options to feed students, which include schools setting their own prices for a wider variety of foods served or utilizing a private company to provide student meals. Although these alternative options could be cost saving, they could result in less healthy food choices for students.

Given the options school districts have to feed their students, this thesis will explore the benefits students receive by having nutritious meals served at school. This thesis will identify whether participation in the meal programs in schools improves educational output levels, measured by graduation rates. Analysis within the thesis will include a cost and benefit analysis of the school administration's choice to participate in the program. Most existing literature and research on the NSLP focus on the relationship between meal program participation and the

associated health effects, such as reducing the obesity rate. This thesis, however, will focus its analysis on the educational outcomes that can be attributed to the programs.

Literature Review

Hinrichs (2010) estimated the effects of NSLP participation in the mid-1900s on adult health outcomes and educational attainment. Hinrichs hypothesized that if time spent in school is more productive for healthy students, and then the NSLP could increase the maximum level (i.e. years) of education that individuals receive. By using a sample of individuals born in the mainland 48 states from 1941-1956, Hinrichs tested education attainment levels with NSLP participation rates. The equation he used is:

$$y_{isct} = \beta * \text{exposure}_{sc} + x'_{isct}\gamma + \alpha_s + \alpha_c + \alpha_t + \varepsilon_{isct}$$

The dependent variable is years of education measured in year *t* for an individual *i* born in year *c* from state *s*. Furthermore, $exposure_{sc}$ is the average participation rate in NSLP as a student, measured on a scale of 0-100. This variable is calculated for each side yearly by dividing the number of students participating in the NSLP by the size of the population aged 5-17 years old and multiplying by 100. The remaining variables represent individual data on race and state level income data on per capita income, in addition to state, birth cohort, and year dummy variables.

Hinrichs's results show a significant positive relationship between NSLP participation and years of educational attainment. If exposure to NSLP increases by 10% for women, results show an average increase of 0.365 years in education and nearly a year increase for men. Hinrichs notes a reverse causality concern because individuals must be enrolled in schools in order to participate in the lunch program; meaning that higher school enrollment may be caused by NSLP participation.

Sorhaindo and Feinstein (2006) explored the relationship between nutrition and factors that impact educational outcomes. These include physical development, cognition and ability to concentrate, and school life. Physical development is the most difficult to separate from nutritional outcomes, since nutrition deficiencies first impact the brain, then affect physical outcomes.

Unhealthy diet can lead to deficiencies in cardiovascular health, immunity, and dyspraxia. These health issues can lead to greater physical development problems, such as challenges with motor control, attention, and coordination. With these types of problems, students can have a difficult time performing basic school tasks and assignments, reducing school success and reducing academic performance.

Diet impacts a child's short term and long term thinking abilities. Iron and zinc deficiencies are usually associated with weak neuropsychologic function, growth retardation and development, reduced immunity, and vulnerability to sickness. Furthermore, Sorhaindo and Feinstein noted the link between vitamin B deficiencies and reduced cognitive scores in adolescence. Sorhaindo and Feinstein also found that iron deficiency could cause developmental challenges in the central nervous system that later impact cognition. Lower standardized math test scores were observed among students with iron deficiencies. The iron deficient students were twice as likely to score below average on math tests.

Sorhaindo and Feinstein's research suggests that with healthier meals containing the nutrimental supplements that children need, such as zinc, iron, and vitamins, the likelihood of normal growth, development, and cognition is increased. Thus, the authors argued that nutrients could raise academic performance. While media influences children's eating habits and advertising does not convey the healthiest messages to children, there is the potential for

improvement through government interventions. These interventions, through food programs, suggest the benefits of implementing federally assisted meal programs in school settings.

Behrman (1996) suggested using an explicit measure, such cognitive achievement, instead of an implicit measure as a framework to estimate the effect of health and nutrition on education. Behrman argued that the link between good health and educational achievement only holds under two conditions. First, it must be that health status effects cognitive achievement is shown, not that children with higher achievement are healthier. Second, the observed indicators cannot be correlated with unobserved variables. An example of an observed indicator can be test scores or grades. If the observed indicators and unobserved variables are correlated, the association between health and achievement may represent the effect of unobserved variables instead. Most behavioral and experimental studies do not meet these two conditions because those studies do not control for household members making choices that affect their children's health and education.

Figlio and Winicki (2005) found that school districts that faced potential sanctions in Virginia's Standards of Learning (SOL) reacted by changing the nutritional content of lunches served on test days. [1] Although the NSLP has nutritional standards, there is flexibility in fulfilling nutritional standards over the course of a week or a day.[2] School accountability is a federal law, in which all states must evaluate schools based on the percentage of students who meet proficiency standards on statewide tests. Some schools in Virginia "gamed" the accountability system through altering the nutritional content in the meals served from the NSLP on test days. Using 1999-2000 USDA information for elementary lunch menus from a random sample of 23

[1] The SOL is Virginia state's school accountability system.
[2] In order for schools to get reimbursed in cash subsidies, states have to meet nutritional standards. Not meeting nutritional standards means the schools will not get reimbursed for that particular serving to x amounts of students.

school districts in Virginia, Figlio and Winicki compared nutritional content during test days to non-test days.

Filgio and Winicki hypothesized schools threated with sanction are the schools with the most incentive to change the nutritional content to maximize student performance on test. They found that during test periods in threatened schools, school lunches averaged a higher number of calories than in non-test periods.[3] Other nutritional content, such as Vitamin A and C, were also lower during the testing periods than non-testing periods, but fat percentage remained constant over the two periods. They tested to see if the increase in calories was associated with gains in test scores. By regressing the test pass rates on the pass rates in the previous year and measuring differences in calories during the testing periods, they found that the effect of calorie manipulation is positive. When the nutritional content of food was increased on test days, pass rates increased by 11%, 6%, and 6% for mathematics, English, and history/social studies respectively. However, due to the small sample size of 23 school districts, results should be interpreted cautiously. Filgio and Winicki argued that the changes in lunch calories on test days are targeted at short-term improvements in school performance, as opposed to a long-term strategy of providing students a healthy and nutritious diet.

Belot and James (2009) evaluated the impact of healthy school meals on educational outcomes through the 2004 "Jamie Oliver Feed Me Better" campaign in the United Kingdom. This campaign, led by celebrity chef Jamie Oliver, introduced healthier changes to the meals offered in schools in Greenwich compared to prior model of cheap, fat, salty, and sugary foods. According to the authors, school meals are "the most obvious instruments for policy intervention in children's diet". Because almost all students eat a meal during lunchtime, targeting school lunches is a convenient way to introduce diet changes. By implementing reduced price meal

[3] For non-sanctioned schools, total calories in lunches were found to be lower during testing periods.

programs, policymakers can limit the diet disparities between children from more privileged backgrounds and those from less privileged backgrounds. Lastly, children are not always the individual decision makers regarding the food they eat. Therefore, children's food consumption is up to the hands of others and these decision makers should make responsible choices.

Belot and James used a difference-in-differences approach model to compare Key 2 test score outcomes in primary schools before and after the change to healthier school meals.[4] Specifically, Belot and James analyzed the effect of Oliver's healthy meal campaign on the percentage of students that reach level 3 or more, 4 or more, or 5 in English, math, and science respectively.[5] Results show an increase of up to 6% for students who reached level 4 in English and up to 8% for students who reached level 5 in Science. One drawback of this study is that Belot and James did not have information on whether the students in their sample actually ate the healthier food or not, since the regression model included all students who are eligible for free school meals. This distinction means that the findings should be interpreted with caution.

Coates (2003) used an empirical approach to estimate factors that impact educational attainment, defined by student scores on the Illinois Goal Assessment Program test in mathematics, reading, or writing. The academic years of focus are 1994-1997 and the schools in the sample come from over 800 districts in Illinois, totaling more than 2,500 schools. Variable definitions for Coates's empirical model are presented below in Figure 1.

Figure 1: Coates's Variable Definitions

Variable	**Definition**
WHITE	Percentage of white students enrolled in the school
ENROLL	Number of students enrolled in the school
FOREIGN	Percentage of eligible students for bilingual education

[4] Key Stage 2 is legal term for four years of schooling in England, where students are between ages 7-11.
[5] Children are assessed based on Attainment Levels that range from 1-5, with 1 being the lowest. The highest performing students are awarded a level 5.

LOWINCOME	Percentage of students from low income families[6]
INVOLVE	Percentage of students whose parents made at least one contact with the student's teaches during the academic year
ATTEND	Percentage of students who attended school daily
MOBILITY	Percentage of students who enroll in or leave a school during the academic year
SIZE	Enrollment divided by the number of classes on the first day of school
WHITEACH	Percentage of district's teachers who are white
MASTERS	Percentage of district's teachers with a Master's degree or more
EXPERIENCE	Average years of teaching experience for teachers in the districts

Other variables included measure the average minutes of mathematics, science, and social studies instruction daily. There is also a dummy variable to identify the year of observation. Coates notes that variables measuring teacher salaries and per-pupil expenditures are excluded. Salary is typically determined by education and experience, in which both variables are included in the model. Furthermore, per-student expenditures are highly correlated with the teacher-student ratio.

Coates's education production function with instructional times results in 1995 indicate mixed results for instruction time's effects on test scores. Time spent in instructing mathematics has a positive and significant effect on both reading and mathematics. Instruction time in English has a positive coefficient on reading, mathematics, and writing scores, but the variable is insignificant. The positive coefficients for both mathematics and English instruction time are both quite small. Time spent instructing social science has a negative effect on test scores for the three subjects and is insignificant. These results suggest that instruction in mathematics is beneficial for cross subject testing, but instruction time in English and social science does not make a difference.

[6] Low income families are defined as families receiving public assistance, living in institutions for neglected or abused children, being supported in foster homes with public funds, or eligible for free or reduced price lunches.

Coates results suggest the importance of socio-economic status, but show mixed results for teacher characteristics. The *LOWINCOME, WHITE, MOBILITY, ATTEND,* and *INVOLVE* variables have the expected positive coefficients and are statistically significant. For example, as one more student attends school daily, a school's average reading score is expected to increase by 7.5 points. The reading scores are also expected to decrease by 0.7 points with an increase of one student from a low-income family. The percentage of teachers who attained a master's degree or more has a positive and significant effect on test scores for all test areas. However, average teacher experience is never significant and positive for reading, mathematics, and writing. Additionally, the percentage of teachers who are white has negative coefficients for the three test areas.

Houtenville and Conway (2007) explored the role that parental involvement plays in student achievement. They also examined the factors associated with parental effort, which includes school resources and whether parents improve or crowd out the effects of school resources. Houtenville and Conway used the National Education Longitudinal Study (NELS) on over 24,000 eighth-grade students, their teachers, and school administrators to estimate an education production function. The NELS retests the same students every two years. Houtenville and Conway use data from the eighth and tenth grade student surveys and examinations.

The variables used for Houtenville and Conway's study represent parental effort and school resources. The five variables that represent parental efforts are how frequently parents (1) discuss activities or events of interest to their child, (2) discuss what the child studied in class, (3) discuss selecting classes or programs at school, (4) attend a school meeting), and (5) volunteer at their child's school.[7] Houtenville and Conway considered the first two variables "dinnertime" measures of parental effort, while the last three variables as more "school-related"

[7] The response options are never, sometimes, or often.

effort measurements. Two approaches are used to represent school resources, which are, (1) a summary measure: per-student expenditures on teaching salaries, and (2) a set of five school characteristics: the student-teacher ratio, lowest salary received by a teacher, the percentage of teachers with a master's or doctoral degree, the percentage of the student population not in the subsidized lunch program, and the percentage of nonminority students in the student body. The last two characteristics are used to reflect the extent to which a child's peers come from typically lower income families. There are additional variables included in the study too, such as family income, number of siblings, child achievement, single parent families, and parental education.

Results suggest that parental effort has a positive impact on student achievement and its effect is larger than the effect of school resources. Parents also respond to an increase in school resources by reducing their effort or involvement at their children's school. In combination, the results suggest that parents offset the effects of improved school resources on student achievement. Houtenville and Conway's research shows that parental effort is not well captured by including time-invariant measures, such as parental characteristics. Omitting parental effort from student achievement estimations can potentially cause serious omitted variable bias.

Economic Theory

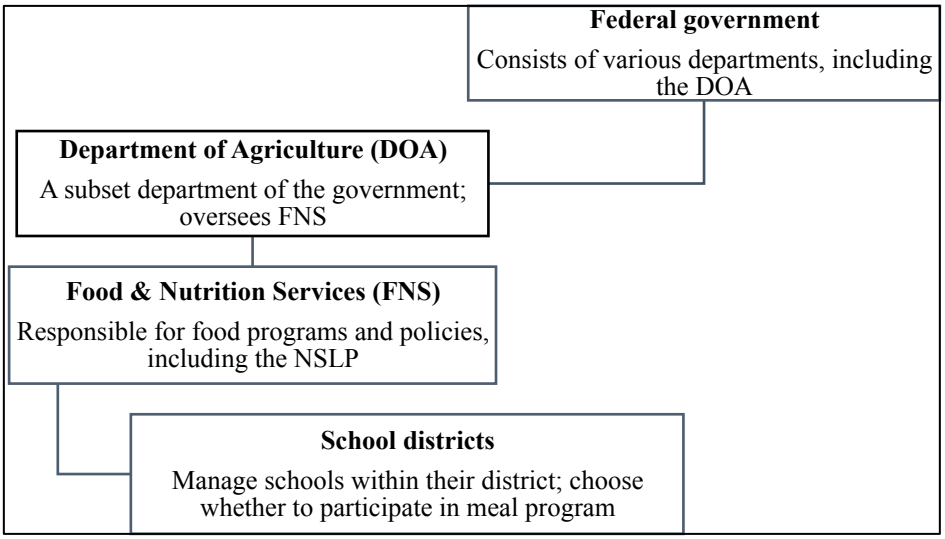
The main agents of interest for this thesis are the school districts, which are the decision makers at the local (i.e. state) level. School districts are state fiscal agents of the education system and are responsible for allocating funds provided from the federal and state government to deliver educational services to students. These expenditures include teacher salaries, academic and extra-curricular programs, capital, and meal program participation. Although the school districts have many decisions to make, the decision of focus for this thesis is the use of funds for participation in the NSLP.

While the school districts are the main agents in this thesis, the role of FNS is also important. FNS's decisions alter the requirements and policies for the meal program. Changing food program policies means altering the required nutritional content of meals served in the NSLP. For example, making food program policies stricter could mean requiring school districts to serve more fruits and vegetables during a lunch meal, which could potentially be more costly to the school districts.

FNS is an essential decision maker because federal meal program policy changes affect the school districts' costs. School districts must follow FNS meal program policies to qualify for reimbursement rates. Without following FNS meal program requirements, school districts incur all of the costs for providing meals.[8] Therefore, the school districts will take the FNS's decisions regarding food program policies as given, making the decisions and objectives of FNS important to the school districts' choice of participation.

The diagram below illustrates the relationship between the various organizations involved with the NSLP participation choice.

Figure 2: NSLP Organization Relationships



[8] The cost of the school districts is net of any payments made by the students participating in the program.

The school districts' objective function is to maximize educational output yearly. Educational output can be measured in a number of ways; graduation rates, test scores, attendance rates, or grade point average for example. For simplification purposes, it is assumed that all school districts have the same objective function. This assumption may not be true in practice, as some school districts may have different goals such as minimizing costs, attracting the best students to apply, or retaining the most coveted teachers. However, all districts want to accomplish the purpose of schooling, which is educating students, while staying within their operating budget. Therefore, regardless of the objective possibilities a district could have, all possibilities yield essentially the same outcome of more learning at the lowest cost per student.

FNS's goal is to increase food security and alleviate hunger through providing children and low-income people access to food (FNS, 2013). FNS believes that no American should go hungry, and therefore, it implements programs such as the NSLP. However, FNS also tries to achieve a "health" goal. FNS aims to increase food security and lower hunger rates with nutritious and healthy foods rather than with fatty, unhealthy foods.

Given the school districts' objective to maximize educational output, the production function can be represented as:

Equation 1: Education Production Function

$$E = f(A, H, Q, R, L, P) \quad (1)$$

Educational output (E) depends on students' attributes (A), home environment (H), quality of education (Q), resources (R), school location (L), and peer group (P).

Student attributes are a very important factor in determining educational output. Student attributes concern what students bring to the school and classroom that are not a function of the school. For example, individual student motivation and dedication vary per student and are not

determined by the school. Higher levels of motivation and dedication most likely contribute to higher levels of educational output, while lower levels are likely to negatively impact educational output. Other examples of relevant student attributes include the degree to which a student is responsible, organized, and cares about excelling in school.

Home environment deals with the parental interactions of the students. Healthy child-parent relationships and upbringing are expected to increase the chances of success in schooling. Healthy child-parent relationships can include characteristics such as positive reinforcement, nightly family dinners, parent-child bonding activities, in addition to parental support and attendance at the child's extracurricular activities. Children are usually more emotional stable with a strong and healthy parent relationship, which contributes to happiness levels and the ability to concentrate in school. Parents also establish home environments that can hinder or promote educational learning (O'Sullivan, 2012). A home environment that encourages watching television, playing video games, and doing other activities consistently instead of reading, studying, or doing homework can negatively impact educational output. Parents could also help their children with homework and reward strong school performance, which may boost student motivation levels.

Home environment is also a function of nutrition and health. Parents have the responsibility of promoting a healthy lifestyle to their children through providing food and encouraging exercise. Students do not have the ability to choose the foods they eat for the most part, as parents are typically the decision makers for children. Majority of existing research today shows that healthier, more nourished students have higher levels of learning. Physical activity is associated with weight control, improved mood and energy, and the combat of health conditions and diseases. In looking back at the Literature Review section, Sorhaindo and Feinstein found

that healthier meals with nutrimental supplements increase the likelihood of cognition and development. If parents foster and encourage a healthy lifestyle for children, the likelihood of raising educational attainment levels increases.

Home environment is dependent upon the education and income levels of the parents as well. Typically, children from higher income and college-educated families have parents who could provide a more effective support system. These parents are more likely to encourage and have the financial ability to support continued learning and education. Children from lower income and less educated families often have to deal with issues such as malnutrition, poverty, less time from parents, and crime. The presence of these other factors can have a negative effect on educational output.

Education quality mainly concerns teacher quality. Teacher quality can be measured by education level, academic ability, teaching experience, communication skills, or certification status. Highly qualified teachers can make a difference in student learning and performance in the classroom. Not only would higher quality teachers inspire and motivate their students to succeed in school, but they can also present more challenging material that could increase students' cognitive and critical thinking capabilities.[9]

Students need specific resources at schools to complete required schoolwork. Examples of resources include books, desks, chalkboards, lab equipment, and computers. Providing students with these resources addresses an equity issue present at schools. The financial ability of school districts is important, as it determines how many resources the district can provide for its students. Although school districts vary in what they can afford or choose to provide students, the ability to provide more resources is preferable because it would provide students with access

[9] A higher quality teacher has the potential to affect students well-beyond school years, too. For example, if student achievement gains are much larger from a higher quality teacher, lifetime earnings could be greater.

to resources that can help improve academic performance. School resources can also go beyond material goods; it could include providing meal programs, as well as extracurricular programming. These types of resources provide students with important factors that impact education, such as exercise activity and nutrition.

An important part of school resources concerns implementing programs that address childhood nutrition. Often times, many families are unable to afford to provide their children with the recommended diet nutrition levels of food daily. Hinrichs proved that a significant positive relationship exists between participation in the lunch program and years of schooling. The meal program is an essential part of the school resource input because it creates a way for schools to compensate children with the recommended food nutrition levels that they may not be receiving from their home environment. By including the meal program as a school resource, higher levels of performance and success are more likely to be attained by the student.

School location concerns the surrounding area of the school and could potentially affect the types of students that the school attracts. Because attendance in most school districts is by neighborhood assignment, families do not necessarily choose what schools their children go to. Instead, children attend neighborhood schools, which generates a peer effect. Good students from higher income areas typically attend school with other high-income peers, causing a peer pressure to succeed in school to develop. In the opposite case, students who do not perform as well in class attend low-income schools that do not have much expectation or pressure to succeed in class. The conglomeration of certain types of students at schools, based on the location, could potentially lead to some schools naturally having higher or lower levels of educational output. Furthermore, crime is related to school location. If a school is located in a high crime neighborhood, students may have reduced learning levels from not paying attention in

class, causing schools to allocate additional portions of their budget to safety measures as opposed to spending on education.

A student's peer group can have a positive or negative effect on academic performance. Students who are associated with academically motivated, smart, and responsible peers are likely to attend class, pay attention, learn, and ultimately perform better in school. On the other hand, being associated with less motivated students who partake in activities that are counterproductive to learning could negatively impact a child's school performance. The child may be likely to skip class and the desire for learning could decrease. O'Sullivan (2012) noted that a motivated peer group promotes academic achievement because the teacher is able to spend more time teaching instead of disciplining students.

Although the school districts want to maximize educational output, there are factors that may prevent them from achieving their goal. First, school districts have an operating budget that they cannot overspend. With a limited budget, schools must make allocation decisions each academic year that could come at the expense of education spending. Second, there are state or federal level policy constraints that school districts must follow. For example, school districts must follow minimum wage laws, physical education time requirements, and nutrition requirements for meals served. Last, the quality and quantity of both students and teachers can be a limitation to school districts. Without qualified teachers, school administrators may run into many challenges in producing a successful educational program. Quality students are needed too, as there are performance standards (e.g. test scores) that must be met in some states. The quantity side of the argument involves yearly student enrollment and retention goals, which can result in schools shutting down if the standards are not met.

Empirical Model and Results

The empirical model is based on the educational production function. This model is estimated using data from a single year, 2010, for the 50 United States. The data used come mainly from government resources. Most data come from the Census Department, Department of Education, Department of Agriculture, and the Digest of Education Statistics. The independent variables represent the various input categories that impact educational attainment (i.e. graduation rates).[10]

High school graduation rates from public schools, the dependent variable, measure educational attainment. The Department of Education calculates graduation rates by dividing the number of students earning a regular diploma by an adjusted cohort that includes the number of first-year students four years ago, plus transfer students who transferred, and minus those who passed away, or could not complete the four years due to academic or personal reasons and consequently dropped out.

The empirical model takes the following form:

Equation 2: Educational Attainment Empirical Model

$$grad = \beta_0 + \beta_1 nslp + \beta_2 home + \beta_3 sparent + \beta_4 ptratio + \beta_5 pcy + \beta_6 instruct + \beta_7 masters + u \quad (2)$$

Variable definitions and descriptive statistics for the dependent and independent variables are presented in Figure 3. The home ownership rate (*HOME*), single parent measure (*SPARENT*), and per capita income variable (*PCY*) capture elements of the student's home environment. The quality of education is represented through the instructional days of school required by the state

[10] Educational output (E) depends on students' attributes (A), home environment (H), quality of education (Q), resources (R), school location (L), and peer group (P).

(*INSTRUCT*), how many pupils teachers have on average (*PTRATIO*), and the percentage of teachers with a master's degree (*MASTERS*).

The variable of particular interest for this thesis is the National School Lunch Program (*NSLP*) variable. NSLP measures the total number of National School Lunch Program meals served in the state per student. This measure includes all meals, not solely the reduced price and free meals, which have been served in the program for the nine school months a year. This variable represents choice resources offered by the school districts to all students and will provide the test for the importance of a healthy and nutritious diet on educational achievement. The variable is scaled to represent the number of meals served per student, rather than total meals served, adjust for state sized differences.

Figure 3: Education Production Function Variable Definitions and Statistics

Variable	Definition	Mean	Standard Deviation
GRAD	The percentage of high school graduates in the state	82.28	7.02
NSLP	National School Lunch Program (NSLP) meals served per student in the state annually	107.87	18.30
HOME	Percentage of the state population that are home owners	38.83	5.64
SPARENT	Percentage of the state population that are single-parent families	69.05	4.92
PTRATIO	The state average pupil-teacher ratio	33.38	5.21
PCY[11]	Statewide average per capita income ($)	14.30	2.83
INSTRUCT	Instructional days of school required by the state	46.65	12.47
MASTERS	Percentage of teachers in the state with a master's degree	178.32	4.16

There are expected signs that the variables should have on the coefficients to represent the effect on graduation rates. First, the number of meals served in the meal program (*NSLP*) is expected to have a positive effect on graduation rates. This prediction echoes studies regarding

[11] In thousands of dollars

the effects of healthy nutrition and diet on cognitive abilities and school performance. Second, *HOME* and *PCY* are expected to increase graduation rates because these are measurements of home environment wealth. As families are better off financially, it is expected that parents would have the means to provide their children with resources that increase the likelihood of school achievement. Contrary to the *HOME* and *PCY* variables, the *SPARENT* measure is expected to have a negative effect on graduation rates. Children raised in single-parent families generally have weaker academic performance due to less disposable income, parental contact, family time, and higher levels of psychological stress and emotional instability. Last, *INSTRUCT* and *MASTERS* are expected to have a positive impact on graduation rates. These variables are the proxies for education quality and represent characteristics that are preferable at school. The other education quality proxy, *PTRATIO*, is expected to have a negative sign. It is typically assumed that smaller class sizes equate to more individualized attention from teachers, thus increasing school performance. Therefore, as the number of students per teacher increases, graduation rates are expected to decrease.

The model does not include all potential influences for educational attainment levels due to data issues. The model does not contain variables that control for school location, student peer group effects, and parental involvement; as this information is very difficult to quantify on a statewide level. Specific variables such as teacher salaries and per pupil expenditures were excluded due to their correlations with variables included in the model.[12]

Figure 4 presents the results of the regression estimating graduation rates across the United States in 2010.

[12] Teacher salaries are excluded because salaries are generally determined by the teachers' education level, which conflicts with the master's degree variable. Per-pupil expenditures are excluded because it is highly correlated with the pupil-teacher ratio and the meal program data.

Figure 4: Education Production Function Results: Dependent Variable NSLP

Variable	Coefficient	T-statistic
NSLP	0.09	1.87***
PCY	0.27	1.38
HOME	0.55	2.63**
SPARENT	-0.78	-4.64*
PTRATIO	0.41	1.21
MASTERS	0.07	1.01
INSTRUCT	0.48	2.45**
$R^2 = 0.5364$ Number of observations = 47 states[13]		

* Denotes statistically significant coefficient at the 1% level
** Denotes statistically significant coefficient at the 5% level
*** Denotes statistically significant coefficient at the 7% level

Due to the varying state population sizes, heteroskedasticity potentially could be a problem. The Breusch-Pagan test indicated no problem with the non-constant error terms, and no corrections were needed.

The estimates of the equation reiterate the importance of socio-economic status and home environment, as found by Coates, measured by *HOME* and *SPARENT*. These variables have the expected signs and *HOME* and *SPARENT* are statistically significant at the 5% and 1% levels respectively. For every 1% increase in the home ownership rate, the graduation rate is expected to increase by 0.55%. On the other hand, for every 1% increase in percentage of single-parent families present in the United States, graduation rates are expected to decrease by 0.78%. The results show that being raised in a "traditional" family with financial means to be a homeowner increases educational attainment.

The *PCY* variable may not appear significant in the regression, but there is a theoretical and statistical reason to include it in the model. With the model as it currently stands, graduation

[13] There are 47 observations because Florida, Hawaii, and Maryland did not report the statistics for the percentage of teachers who have master's degrees.

rates are expected to increase by 0.27% for each $1,000 increase in the average per capita income. Studies show that income gap continues to affect graduation rates. According to a 2011 study by the National Center of Education Statistics (NCES) from the Department of Education, the dropout rate of students living in low-income families is five times greater for students from high-income families. The *PCY* variable is also included due to its multicollinearity. Income is highly negatively correlated with both home ownership rates and single parent families. The variable *PCY* has a -0.35 and -0.36 correlation coefficient with *SPARENT* and *HOME* respectively. If *SPARENT* is dropped from the equation, then *PCY* has a significance level of 1% and is expected to increase graduation rates by 0.59% for every $1,000 increase in average per capita income. The multicollinearity of *PCY* with *SPARENT* and *HOME* bias its effect on graduation rates and lowers its significance level. Therefore, despite its insignificance level, *PCY* is included as a variable in this equation because of its impact on graduation rates based on past studies and research and statistical reasoning.

Estimates of the educational quality characteristics – *PTRATIO, MASTERS,* and *INSTRUCT* – contain both expected and unexpected results. The one unexpected result is the positive sign on *PTRATIO*. This result suggests that having more students per teacher increases graduation rates, contrary to expectations. The common expectation is that smaller class sizes provide students with more individualized attention from teachers, which should contribute to higher levels of understanding and academic performance. However, higher pupil-to-teacher ratios are cost saving for schools, which could allow for increased expenditure per-pupil on non-teacher resources such as the NSLP, extra-curricular programs, and supplies. The additional benefits from these resources could increase graduation rates. Nonetheless, the pupil-teacher ratio coefficient is not statistically significant; hence the actual effect could be zero.

The *MASTERS* proxy for educational attainment has the expected positive sign. As the percentage of teachers who have master's degrees increases by 1%, the graduation rate is expected to increase by 0.07%. The *MASTERS* measure is not significant, however, no evidence of multicollinearity exists. The insignificance of the *MASTERS* variable could be due to the fact that the variable measures the total percentage of teachers with a masters degree, whether the teachers work in the subject areas related to their masters degree or not.

The other proxy for educational attainment, *INSTRUCT,* shows that more school days required by the state has a positive effect on graduation rates. For every additional day that the state requires schools implement into the academic calendar, graduation rates are predicted to increase by 0.48%. The *INSTRUCT* variable is also significant at the 5% significance level. The t-statistic and coefficient of the *INSTRUCT* variable suggests that a higher state requirement on number of school days would improve educational attainment levels.

The coefficient on the *NSLP* variable is both positive and significant. As the number of meals served per student increases by one meal yearly, the graduation rate is expected to increase by 0.09%. The small effect could be attributed to the variable's correlation with other variables included in the regression model. For example, the correlation of *NSLP* and *INSTRUCT* is 0.29. If there are more school days in a year, then schools have more opportunities to serve NSLP meals, thereby the meals served per student increases with more school days. If the *INSTRUCT* variable is dropped from the regression, then the *NSLP* variable is significant and the coefficient increases to 0.13.

Although the effect of *NSLP* on *GRAD* is represented with a small positive coefficient, the significance level provides evidence that participating in the lunch program helps push schools toward their goal of maximizing educational output. This finding echoes past research

regarding the effect of healthy meals on educational attainment, such as Belot and James study in 2009. Since the NSLP provides nutritious meals, students gain the effects of better cognitive development and ultimately higher levels of educational achievement. While these results suggest that schools should increase the number of meals served per student in the meal program, it is possible, due to diminishing marginal productivity, that the return to *GRAD* could become negative.

A quadratic specification allows for a test of the diminishing marginal effect of *NSLP* on *GRAD*. In this quadratic specification, only *NSLP* and $NSLP^2$ are included as independent variables, with *GRAD* as the dependent variable. The specification yields:

Equation 3: NSLP Quadratic Equation

$$grad = 39.60 + 0.75nslp - 0.003nslp^2 \quad (3)$$

The estimated equation implies that *NSLP* has a diminishing effect on *GRAD*, meaning that the return of the meals served on graduation rates can become negative at some point. This point can be found by solving the equation below, where β1 and β2 are the coefficients from Equation 3 and x* is the number of meals when the change in graduation rate becomes negative:

$$x^* = |\widehat{\beta 1}/(2\widehat{B2})|$$

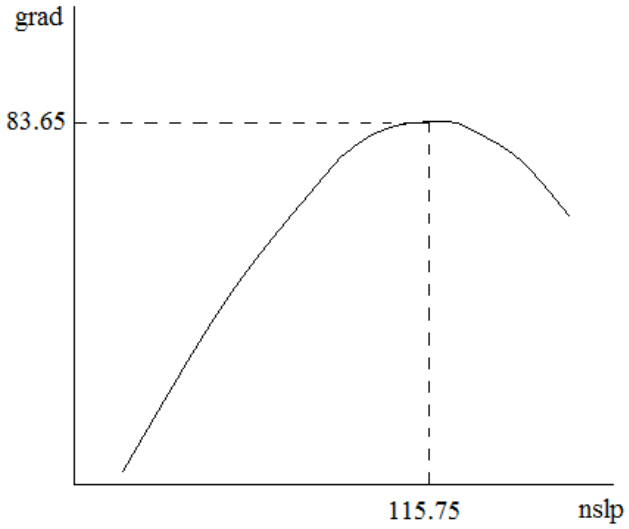
Before the calculated turning point, *NSLP* has a positive effect on *GRAD,* but after the turning point, *NSLP* has a negative effect on *GRAD*. The turning point from Equation 3 is:

$$nslp_{\text{turning point}} = 0.7595978/(2)0.0032813 = 115.75$$

The results show that the marginal effect on *GRAD* for *NSLP* has becomes zero when the 115.75 meals are served per student. When schools serve less than 115.75 meals per student yearly, there is a positive effect on *GRAD*, but when the meals served is greater than 115.75, graduation

rates decrease. A graphical representation of the diminishing effect of *NSLP* on *GRAD* is shown in Figure 5 below:

Figure 5: Graphic Quadratic Relationship between *GRAD* and *NSLP*



The right side (i.e. the diminishing side) of the curve could be ignored if only a small percentage of states serve more than 115.75 meals per student yearly. However, 13 states, or about 28% of the sample, serve more than 115.75 meals per student yearly, which is too high of a percentage to ignore.[14]

The original regression model from Equation 2 shows that the effect of participating in the NSLP is positive and significant, but it fails to show what factors impact a school's decision to opt into the program. To explore why schools opt into the program, a cost based model is used. The dependent variable is the *NSLP* variable and the independent variables measure a student's home environment, health status, and school characteristics. The variable definitions for this regression and regression results can be viewed in Figure 6 below.

[14] It is possible that the return to graduation rates becomes negative at some point, but it is questionable whether it truly happens when students are served more than 115.75 meals yearly. The estimated effect of *NSLP* on *GRAD* could be biased because no other factors have been controlled for. Although a specific "turnaround point" is difficult to calculate in a real-world situation, the idea that serving more meals stops being beneficial in regard to educational attainment levels at some point is something that school districts should consider yearly. More research needs to be done regarding this idea.

Figure 6: NSLP Model Variable Definitions and Statistics

Variable	Definition	Mean	Standard Deviation
NSLP	National School Lunch Program (NSLP) meals served per student in the state annually	107.88	18.30
OBES	The average obesity rate in the state	26.93	3.19
GRAD	The percentage of high school graduates in the state	82.28	7.02
SALARY[15]	The average teacher salary in the state	52.12	7.39
HOME	Percentage of the state population that are home owners	69.05	4.92
EXPEND[16]	Average per-pupil expenditures by state	12.23	2.97
POVERTY	The average poverty rate in the state	14.68	3.12

There are expected signs on the coefficients that the independent variables should display. First, *OBES* is expected to have a positive effect on the number of meals served. One of the main objectives of the lunch program is to provide students with the recommended daily nutrition levels to combat undesired health conditions. If obesity, a measure of body fat, increases, then the number of NSLP meals served should subsequently increase to combat obesity. Second, *GRAD* is expected to omit a positive sign. Equation 2 showed that participating in the meal program helps schools attain their yearly goal of maximizing educational output. If graduation rates increase, meals served would also increase to continue the positive trend of schools obtaining their yearly goal. Third, *SALARY* should have a negative effect on meals served because increased teacher compensation means that less budget allocation is given to implement the meal program. Fourth, *HOME* is expected to have a positive effect on *NSLP*. A higher percentage of homeowners would generally mean that families are better off financially, specifying less need for the lunch program. On the other hand, *POVERTY* is predicted to have a negative effect on *NSLP* for reasons opposite of the homeownership rate story. Lastly, *EXPEND* will have a positive sign because there is a cost-side to implementing the NSLP. Both *EXPEND*

[15] In thousands of dollars
[16] In thousands of dollars

and *NSLP* should move in the same direction since spending is needed to serve lunch meals to students.

Figure 7: NSLP Model Results

Variable	Coefficient	T-statistic
OBES	2.60	2.98*
GRAD	0.82	2.66**
SALARY	-1.67	-4.48*
HOME	-1.21	-2.31**
EXPEND	2.44	2.59**
POVERTY	1.64	1.64***
$R^2 = 0.5677$ Number of observations = 50 states		

* Denotes statistically significant coefficient at the 1% level
** Denotes statistically significant coefficient at the 5% level
*** Denotes statistically significant coefficient at the 10% level

The estimated coefficients indicate the importance of two variables specifically, *SALARY* and *OBES*. These variables have the expected signs and are statistically significant at the 1% level. As the average teacher salary increases by $1,000, the number of NSLP meals served to students decreases by almost two meals per year. This finding suggests that schools may be trading off higher salaries for meal provision. Due to a limited operating budget, schools can increase teacher compensation or provide more resources, such as the NSLP, to their students. Either would arguably move the schools toward accomplishing their yearly goal of maximizing educational output. Higher teacher salary could attract better quality teachers, potentially increasing educational attainment. School districts face the question of which choice – higher teacher compensation or more student resources – would best move them toward their goal of maximizing educational output.

Although the graduation regression from Equation 2 includes the *NSLP* variable, it does not include *SALARY* due to its high correlation with *MASTERS*. The absence of *SALARY* from

Equation 2 makes it challenging to draw conclusions about which choice would move schools closer to their goal. If *MASTERS* is replaced with *SALARY* in Equation 2, then the estimated coefficient on *SALARY* is 0.20. This coefficient means that as teacher salary is increased by $1,000, then the expected increase on graduation rates is 0.20%. However, the *SALARY* variable is insignificant, so it is possible that schools should be urged to increase the availability of student resources, as opposed to higher teacher compensation, to increase graduation rates.

Health status, measured by obesity, plays a large role in a school district's decision to participate in the program. When *OBES* increases by 1%, *NSLP* is expected to increase by over two meals yearly. The obesity epidemic in the United States has increased over recent years; currently over 60 million adults or over 30% of the American adult population are considered obese (Ogden, Carroll, Kit, & Flegal, 2012). Low-income families generally have less access to both healthy food choices and opportunities for physical activity, so obesity statistics are typically higher for this group. Because the FNS goal is to increase food security and alleviate hunger with nutritious and healthy foods through the NSLP, the positive effect of *NSLP* on *OBES* makes sense. The estimated equation suggests that schools can reduce obesity and improve nutritional diets with lunch program participation. Improved health is likely to be part of the explanation for why increasing the number of lunch meals served improves graduation rates.

A student's home environment characteristics, measured by *HOME* and *POVERTY*, also impact school participation levels in the meal program. As *HOME* increases by 1%, *NSLP* decreases by 1.21 meals per student yearly. As *POVERTY* increases by 1%, the *NSLP* increases by 1.64 meals. The expected signs on these variables reinforce the NSLP goal of offering reduced-price or free meals to families from lower-income families to offset nutrition and health deficiencies.

School characteristics, measured by *GRAD* and *EXPEND*, also affect the NSLP participation. As *GRAD* increases by 1%, *NSLP* is expected to increase by almost one meal. Schools may realize the educational attainment value obtained from participating in the lunch program and increase the meals served. Furthermore, as schools increase *EXPEND* by an additional $1,000, *NSLP* is expected to increase by almost 2.5 meals per student per year. However, this finding should be interpreted with caution, since schools inherently need to spend more per student to increase the number of meals served. The expenditure variable does not control for expenditures made exclusively outside of the NSLP resources.

Public Policy

Revisiting Figure 2: NSLP Organization Relationships reminds us that the NSLP is governed by a hierarchical structure. The Obama Administration has actively been trying to move toward healthier meal program requirements and standards to improve nutritional levels. Healthier meals are associated with other positive effects such as health, productivity, energy levels, cognitive capabilities, and school performance. One of President Obama's goals for the Department of Agriculture was to make healthier school meals a priority and to end childhood obesity in a generation (FNS, 2013). In 2010, President Obama legislated the Healthy Hunger-Free Kids Act to allow the Department of Agriculture to make reforms to the meal program.

There are key school meal policies that were implemented by signing the Healthy Hunger-Free Kids Act (FNS, 2013). First, the nutritional standards increased for serving school meals. More whole grains, fruits, vegetables must be included in the lunches now. Low-fat milk dairy products must also be included in the meals. In addition, less sodium and fat are required as well. Second, the portions served for meals changed. The menus are now planned for grades K-5, 6-8, and 9-12 respectively to reflect the correct assumed meal size portions. Lastly, additional

funding is now available for schools that meet the new standards. For every lunch served in accordance with the new standards, schools will be reimbursed an additional six cents. This change is the first reimbursement rate increase in 30 years.

While the presidential effort to increase nutritional levels has good intentions, the plan has caused unexpected results in meal program participation rates (Dinan, 2014). The new requirements to meet the federal nutritional standards have made it difficult for schools to comply with the rules. For example, some school districts have switched to fresh produce from canned foods to adhere to the new nutrition policies. This change has increased shipment frequency and the labor necessary to unload and prepare foods. The new standards have made meals more expensive for students and roughly one million students across the United States have stopped buying NSLP meals. Since last year, over 300 school districts have opted out of the meal program altogether, many of which opted out to avoid the new meal program requirements.

Schools opting out of the program suggest that a variable from Equation 3 has been affected, thereby decreasing the numbers of meals served per student. The variable that has been affected is part of the unobserved variable, which is the policy piece handed down from the federal government level. The standards required for the meal program must have a balance; the standards must be affordable for school districts to continue to participate while consecutively maintaining appropriate levels of nutrition that will continue to benefit students. The Healthy Hunger-Free Kids Act has retained the appropriate levels of nutrition, but its too expensive for schools to continue to participate in the program.

Although the Obama administration legislated the Healthy Hunger-Free Kids Act in 2010 mainly for health and nutrition reasons, the act unintentionally hinders educational attainment levels given the situation today. Interpreting Equation 2 suggests that with less program

participation, graduation levels decrease. Since participation is too costly for some school districts now, perhaps there are other avenues that schools and government should look toward for maximizing educational attainment. Further interpretation of Equation 2 shows that the *NSLP* variable does not have the largest impact on graduation rates. Rather, the *SPARENT* has largest effect. The coefficient on the *NSLP* variable is 0.09, while the coefficient on the *SPARENT* variable is -0.78. The *SPARENT* variable also omits a t-statistic of -4.64 and p-value of 0.00, showing that it has a statistically significant impact on graduation rates at the 1% level. Government policy could address this area to help guide school districts in maximizing graduation rates.

Single-parent families are becoming more prominent in society. In 2012, nearly 26 million, or 35%, of children in the United States were raised in a single parent family structure due to reasons of divorce, death of spouse, adoption, a parent leaving, etc. (Kids Count Data Center, 2012). There has been an increase in the number of children born outside of a traditional marriage structure and growth in divorce rates that have contributed to the proportion of children growing up in single-parent families for the past few decades (Parke, 2003). Children from single-parent families are generally found to be disadvantaged across a large range of outcomes, including educational attainment, as compared to children who grow up with both parents. Because the future success of children depends on the family structure they were raised in, the large presence of single-parent families today has created concern for public policy.

There has been a general consensus among existing research that living in a single-parent family is negatively correlated with a child's educational performance. De Lange, Dronkers, and Wolbers (2013) stressed that many more children deal with the negative effects of single-parenthood yearly, such as economic deprivation, a decrease in the quality and quantity of

parental contact, and a decline in parental support and effect control. Furthermore, single-parent families are often characterized as lower-income, which has a detrimental effect on children's well being and development, and accordingly, school performance. Barajas (2012) noted that children raised in single-parent families generally score lower on tests of cognitive functioning and standardized testing, receive lower grade point averages, and complete fewer years of school when compared to children from a traditional family structure. Pong, Dronkers, and Hampden-Thompson (2003) compared the education achievement gap between children in single-parent families versus traditional parents in 11 countries.[17] The authors found that national policies have offset the negative outcomes of being raised in a single-parent family in other countries and perhaps a more generous United States welfare policy could result in greater academic equality among children.

Although over a fourth of America's children are growing up in single-parent family households, there are hardly any laws or policies that are specifically directed toward assisting these families and children. It could be the case that a fair number of single-parent families do not need financial assistance from the government. However, single-parent families suffer economic hardship due to one less working person in the family and are often associated with low-income levels for this reason. Children from single-parent families sometimes perform worse in school because they have less financial means and resources than their peers raised in traditional family structures. The suggestions I make regarding policies that have the potential to help single-parent families, and ultimately educational attainment levels, are based on the assumption that single-parent families are associated with low-income levels. Theoretically,

[17] The countries examined are Australia, Austria, Canada, England, Iceland, Ireland, Netherlands, New Zealand, Norway, Scotland, and the United States.

these policies will account for the absence of the missing parent and put single-parent families in a financial position as if both parents were present.

The first policy recommendation I make is child support enforcement. The Office of Child Support Enforcement, under the United States Department of Health and Human Services, partners with federal, state, and local governments to promote parental responsibility so that children receive support from both parents even when they live in separate households. There is no universal federal law regarding child support services; state and local authorities usually handle child support enforcement situations. However, Title IV-D agencies exist in each state, which require by federal law to provide child support enforcement services to anyone who requests it (Department of Justice, 2014). If an individual fails to pay child support services as ordered by a court, the individual is punishable by federal law.

Policy requiring child support enforcement should reduce poverty in single-parent households by providing an income level as if both parents were present. If child support enforcement is required, the financial effect of the second parent's absence could be diminished. Children would then have the financially capability to pursue all activities and extracurricular programs as if both parents were present. This financial capability could mean being able to hire a private tutor for the child to assist with homework as the single-parent is at work and unable to help the child himself or herself, for example. However, the transaction costs associated with having a national enforcement on child support may be too high to implement this policy. The absent parent's identity must be established, the parent must be located, a child support request must be filed, and payments must be collected. Furthermore, there could be negotiation costs related to how much the parent pays. While federal child support enforcement could assist many single-parent families, its implementation could be very difficult.

An alternative policy recommendation I make to reduce single-parent poverty levels is the earned income tax credit (EITC). Unlike raising the minimum wage, the EITC targets poor and low-income families. The EITC provides cash assistances through the income tax system to low-income families based on their earnings and family structure (Congressional Budget Office, 2014). The EITC adds onto peoples' labor market earnings if they are in a low-income family and adds on more if people have children to give additional financial assistance. The EITC is an effective and efficient way to put money into the hands of low-income people. Although this policy is not specifically directed to single-parent families, many single-parent families fall in the low-income bracket.

With higher income from the EITC or child support enforcement, single parents would have the ability to further encourage and financially support the educational attainment levels of children despite the lack of another parent in the household. For example, there could be the possibility to locate in a nicer and safer neighborhood with high quality public schools. Alternatively, the single parent may have the financial means to send the child to school of his or her preference and to participate in additional extracurricular activities. These activities could be sports or music related, more academic programs, or culturally enriching programs that could improve the child's interpersonal skills, teamwork, and intellectual curiosity. By bringing single-parent families to higher levels of income, there could be a positive impact on learning and ultimately academic performance.

Conclusion

The goal of this thesis was to identify whether participation in the NSLP improves educational output levels, measured by graduation rates. Results from the empirical model showed that participation in the program is associated with higher graduation rates. Participating

in the program gives students access to satisfactory levels of nutrition that may be unavailable in the student's home environment. Nutrition positively impacts the growth and development of children and when schools participate in the NSLP, students' achievement in schools increase. Therefore, when schools districts opt into the program, schools move toward their yearly objective of maximizing educational attainment.

Although NSLP participation improves graduation rates, schools must remain cautious of how many meals they are serving per student. The quadratic function showed that it is possible, due to diminishing marginal productivity, for the return to graduation rates from meals served to become negative at some point. Perhaps serving more meals reduces the funds that schools can allocate to other inputs, such as hiring better quality teachers that have a larger effect on educational attainment. The net effect of less spent where the marginal benefit is larger on educational attainment and more spent on low marginal gains from the NSLP could result in a reduction in attainment.

Public policy must achieve a balance for the school districts to provide healthy, but also affordable, meals to children. With the current policy through the Healthy-Hunger Free Kids Act, over 300 school districts have already opted out of the program due to the high cost of meeting new nutrition standards. Not participating in the program adversely affects children from receiving a healthy meal daily, lower obesity rates, higher cognitive functioning, and maximizing academic performance. If that is the case, then perhaps public policy should look toward other areas to strengthen the educational achievement of children.

Equation 2 results showed that participating in the meal program does not have the largest effect on graduation rates. Instead, the single parent variable has the largest effect. Single-parent families are commonly (not always) associated with lower income levels. This idea turns

the discussion of how to best raise incomes of the worst off in society to get the single-parent families to an earning level as if both parents were present. The two policies I suggested utilizing are child support enforcement and the EITC.

While these policy recommendations give suggestions regarding how to lift income levels of single-parent families, it is important to remember that the low educational achievement levels and family structure association is not just an income related issue. Often children from single-parent families perform worse in school for reasons unrelated to income, such as the decrease in parental contact, lack of an essential parental role model, low levels of motivation, change in values and behavior, and stress associated with having one less parent. These adverse effects of single-parenthood on educational attainment are very difficult for public policy to address and correct for.

The home environment input, such as the prominence of single-parent families, of the production function is outside of the school districts' control. Instead, improvements made to the home environment are for government concern, intervention, and public policy. School districts have the ability to opt in and out of programs as they see fit to achieve their yearly objective, but regardless of what they do, the public policy piece by government has a much larger impact on the educational attainment levels in the United States. Because school districts are limited in what they can do regarding the maximization of educational attainment, we must rely on effective government policy to see ideal results out of the education system.

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