# THE PREDICTIVE VALUE OF EDUCATIONAL PRODUCTIVITY INPUT VARIABLES ON THE ACADEMIC SUCCESS OF MODERATE TO LARGE TEXAS HIGH SCHOOLS

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The purpose of this study was to determine the predictive value of selected input variables on the accountability rating of Texas high schools with student populations greater than or equal to 900. Specifically, this study analyzed the effect of student, staff and fiscal input variables in determining the odds of a high school in this study receiving a Low Performing, an Academically Acceptable, or a Recognized rating in the Texas public education accountability system - a system which is based in student performance on state standardized testing. Identifying a set of variables that helps predict campus accountability ratings provides campus administrators and teachers with information to improve student performance on standardized testing.

Using statistical methods to determine the odds of campus ratings based on selected input variables, this study revealed that successful student remediation in mathematics is the most consistent, positive indicator of campus accountability rating out of 60 student, staff and fiscal inputs analyzed. However, the most telling aspect of this study is that inputs such as, teacher experience, teacher campus tenure, teacher degree level, student SAT performance, Advanced Placement testing performance and the percentage of low socioeconomic students were not statistically significant. The wider implications of these findings warrant further research into why these variables seem to have no affect on campus accountability rating.

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# CHAPTER I

# INTRODUCTION

The research conducted on the question of, "*Does money matter in public education?*" is filled with inconclusive evidence (Taylor, 2001). Verification exists in the literature revealing that imposing tax and expenditure limits hinders long-run academic performance of public school students; hence, the current climate of decreased local control and spending limits seems destined for failure (Downes & Figlio, 2001*).* Countering this argument, prior research in educational productivity conflicts directly with the research on tax limits and suggests money matters little in improving student academic performance (Hanushek, 1989). In support of Hanushek's claim, data from nine states analyzed for a relationship between instructional spending and student performance revealed no statistically significant relationship between the two variables (Standard & Poor's, 2005 b).

Yet, other research does support increased instructional spending as it relates to student achievement. Hedges, Laine and Greenwald (1994), in a reanalysis of Hanushek's (1989) data, found that increased instructional spending does increase student performance on standardized testing. As an added challenge to solving the puzzle of educational productivity, most of the research on educational productivity is analyzed at the district level while little analysis of the relationship between inputs and outputs has been done at the most basic level, the campus/school level (Picus, 2003).

In light of these conflicting results on the relationship between instructional spending and student achievement, Taylor (2001) asserts that more recent educational productivity data studies attempt to control for variables that clarify the magnitude of effect educational inputs have on student outcomes through additional analysis. Taylor purports that studies done by Greenwald, Hedges and Laine (1996) provide a clearer analysis of productivity results due to the inclusion of the magnitude of effects of school inputs. Greenwald et al. (1996) used both combined significance testing and effect magnitude estimation methods in their meta-analysis to estimate the effects of school inputs on student outcomes. Picus (1997a) supports this argument by reporting that econometric school productivity research involves a relationship between educational inputs (spending) and schooling outcomes (i.e. standardized testing performance) and the magnitude of those relationships.

To improve studies of educational productivity, Schwartz and Stiefel (2001) propose using lessons learned from studies in economics as a guide to improved educational productivity research. Schwarts and Stiefel recommend using a theory of measuring efficiency, the production function, as a means to measure the maximum amount of output from a given quantity of inputs. Efficiency describes the use and distribution of inputs such that ultimately there is no way to further reallocate resources to make someone better off without making someone or some other entity worse off (Schwarts & Stiefel, 2001).

The concept of efficiency lends itself to a dichotomy: technical efficiency and allocative efficiency (Rolle, 2004). Technical efficiency requires organizations to produce the greatest output possible given the input resources available. Allocative efficiency requires the proper combination of inputs to meet output needs most desired. As it relates to schools, efficiency means that schools should produce the most education possible with the resources they have available, that they use the resources that are the least expensive, and that the level and distribution of education is what the taxpayer prefers, given the alternative uses of their money.

Most educational productivity research has been based on a technical efficiency model (Schwarts & Stiefel, 2001). Educational production function studies have attempted to measure efficiency in schools by analyzing the effect of school inputs on student outcomes while controlling for other variables, such as, the effects of socioeconomic status of the student (Taylor, 2001). The goal of these studies is to produce a quantitative model of educational productivity that allows the prediction of student outcomes given a change in input resources (Hedges, Laine & Greenwald, 1994).

The educational production function lies at the center of the current debate in educational productivity and what it means to understand the utilization and distribution of resources in schools (Monk, Wang & Walberg, 2001). Central to this debate, Hanushek (1989) collected data from 147 separate productivity studies and found no link between increased spending and educational outputs. In his study, Hanushek maintains, "…detailed research spanning two decades and observing performance in many different educational settings provides strong and consistent evidence that expenditures are not systematically related to student achievement" (*p*. 49).

Other researchers, however, continued to find links between spending allocations and student achievement. Counter to Hanushek, Hedges, Laine and Greenwald (1994) determined increases in educational spending do improve student achievement. Reevaluation of Hanushek's data by Hedges, Laine and Greenwald show that, with the possible exception of facilities, there is evidence of statistically reliable relations between education resource inputs and school outcomes. Educational researchers continue to analyze the data looking for links between student achievement and educational inputs (Monk, 2001).

In a study that examined school inputs and student earnings following high school graduation, Betts (1996) found that studies using state-level average inputs found that increases in school spending lead to improvements in earnings. Inversely, when school-level data were examined, results indicate there is no relationship between spending and future earnings. In total, Betts found the higher the level used to measure inputs, the greater the likelihood a statistically significant relationship exists between inputs and earnings.

As researchers struggled to find a valid indicator of educational productivity, policymakers were also coming to terms with a shift in focus from equity in education finance to one of adequacy and the question of what it means to provide an adequate education for all students (Clune, 1997). The State Supreme Court of Kentucky, in 1989, declared the state system of school finance unconstitutional. The court ordered the state legislature to provide a funding system for the state such that each child in Kentucky receives an adequate education. The court laid out seven learning goals that provided a template for what constitutes an adequate education for Kentucky’s school children (National Access Network, n.d.).

Court cases such as the Kentucky case, along with subsequent analysis of disparate spending levels among school districts across the country, drove other states to focus on inequities between high spending levels in some districts and low spending levels in other districts (Ladd, Chalk & Hansen, 1999). Educational researchers, such as

Clune (1997), argue that at a time when the focus in education is on outputs, “equity” guarantees inputs regardless of the outcomes, while “adequacy” means a sufficient level for some outcome.

A focus on adequacy in educational spending produced skepticism with regard to how educational funds were being used and distributed in public education and the social disadvantages facing individuals with poor achievement levels (Ladd et al., 1999). Public education systems in the 1990s began to be scrutinized for high levels of learning at efficient and effective levels of spending.

A perceived lack of efficiency in public education causes political and public entities to seek their own solutions to spending and achievement issues in public education (U.S. Department of Education, 2003 a; Hanushek, 1986). One such solution is the so called *65% Solution*, a movement championed by many state governments throughout the country (Byrne, n.d.). The *65% Solution* is an idea initiated by Republican political advisor Tom Mooney and championed by Overstock.com president and National Advisory President for First Class Education (FCE), Dr. Patrick M. Byrne (*“First Class”, n.d.).* The *65% Solution* proposes designating at least 65% of a school district’s operating budget for *in the classroom* expenses (Byrne, n.d.). In the classroom expenditures are defined by FCE as funds spent on classroom teachers; general instruction supplies; instructional aides; activities, such as field trips, athletics, music and arts; and tuition paid to out-of-district and private institutions for special needs students.

To counter movements such as the *65% Solution*, Bracey (2006) recommends, (a) schools and school districts define improved performance, examine the research literature to determine which practices have been empirically linked to changes in those outcomes, and reallocate funds to attain the improvements; and (b) allocation of new funds or reallocation of existing funds occur at the school level, with district oversight (*p*p. 21-22).

In an effort to validate funding levels, Cooper (1994) developed the School-Site Micro-financial Allocations Model to itemize expenditures at sub-district levels in order to determine the following: 1) educational expenditures at the sub-district level; 2) attainment of expenditures to the function for which they were designed; 3) comparison of budget functions across schools and districts and; 4) the use of sub-district data to compare the level of efficiency and effectiveness in a school. This model found initial positive results for all four questions and suggests there is some type of economically efficient relation between educational inputs and student outcomes as long as the resources reach schools, classrooms and students.

However, major challenges exist that complicate the study of educational productivity (Rolle, 2004). To assist with this issue, newer statistical models have been developed to analyze educational productivity using econometric methodologies (Standard & Poor's, 2005a). Hampel (2004) provides a statistical model for analyzing educational productivity termed the Return on Spending Index (RoSI). The RoSI is a ratio that reflects the average number of assessment proficiency points a school district achieves per $1000 spent per student on core operations (Standard & Poor's, 2005 a).

Additional alternate methods of analyzing school productivity and efficiency have also been suggested by Levin (1993) that include student and district level variables. These considerations have lead researchers, such as Monk (1992), to observe that research in educational productivity does not consider how educational productivity differs significantly from production in other fields of study. As an example, some outcomes of schools are also inputs to later production, such as the knowledge acquired in earlier grades is an input needed for success in secondary education. Monk (1992) emphasizes that many educational inputs are not purchased and are difficult to define and analyze, such as student time and student effort.

Refining the educational production function and defining the level of inquiry are critical to providing a clearer understanding of educational productivity (Taylor, 2001). The majority of school productivity studies have focused on district-level information (Hanushek, 1989; Hedges et al., 1994). This research has produced high variability among efficiency and productivity studies with conflicting results (Taylor, 2001). Data from school-level sources may allow for more clearly defined correlations when discerning links between resources and student outcomes (Monk, 1997).

Understanding school-level productivity and efficiency at the unit of production level may lend greater clarity to and answer questions about the impact of inputs on student outcomes through a greater understanding of the fiscal status of the school (Sherman, et. al., 1996). The ability to analyze input/output relationships at the lower echelon of the individual school campus would allow a more accurate focus on student outcomes at the most basic level (Picus, 2003).

School-level data encompasses a greater variety of data elements beyond basic revenues and expenditures (Picus, 2003). School-level data contain information related to demographics for both staff and students, budget allocations at the program level, teacher pay and experience levels, standardized testing information, population mobility, socioeconomic status, course enrollments, and various other data elements for analysis into the possible effects of input/output variables affecting student achievement (Texas Education Agency, n.d.a).

School-level data could be analyzed over time to provide production-function relationships with greater consistency in the results (Busch & Odden, 1997). School-level data include elements that are integrated, connected and multidimensional. These data would allow researchers and school officials to aggregate and disaggregate data to reveal trends in input/output relationships. The task of analyzing school-level data is complex, yet valuable when used with a clearly defined method of analysis (Picus, 2003).

Prior to the No Child Left Behind Act of 2001, reliable school level data were difficult to obtain (Sherman et al., 1996). One state, Texas, possesses an advanced school-level data collection system referred to as (PEIMS), Public Education Information Management System (Texas Education Agency, n.d.b). The data are used to provide the public with information regarding school and district performance. Data such as these provide the critical elements required to refine the analysis of educational productivity at the unit level.

## Problem Statement

The research problem for this study was to take school level data (unit level data) from the Texas PEIMS data system and build a predictive model to determine the probability of a moderate to large Texas high school campus being *Recognized* or *Low Performing* in the Texas public school accountability rating system. The data elements for this study were retrieved from the Texas Academic Excellence Indicator System (AEIS).

## Purpose of the Study

The purpose of this study was to determine the predictive value of educational productivity input variables on the accountability rating of Texas high schools with student populations greater than or equal to 900. Specifically, this study analyzed the effect of student, staff and fiscal input variables in determining the statistical likelihood of a high school in this study receiving either a Low Performing or Recognized rating in the Texas public education accountability system.

## Research Questions

This study sought to answer the following research questions:

1. Which combination of common student, staff and fiscal input variables found among moderate and large population Texas high schools predicts campus accountability rating?
2. Is one single input variable more effective at predicting campus accountability rating than other variables in the study?

## Definition of Terms

*Accountability Rating*. This refers to the district and campus ratings assigned by the 2007 state accountability system. Districts and campuses are evaluated on performance on the TAKS, SDAA II, completion rate and annual dropout rate. Possible ratings are:

- *Exemplary;*
- *Recognized;*
- *Academically Acceptable;*

- *Academically Unacceptable;*
- *Not Rated: Other;* and
- *Not Rated: Data Integrity Issues*

The above ratings apply to districts (including charter operators) and schools rated under the standard accountability procedures (Texas Education Agency, n.d.a).

*All Funds*. Financial information is broken down by fund type (general fund only and all funds). *All Funds* consists of four fundamental fund groups: General Fund (fund codes 101-199 and 420), Special Revenue Funds (fund codes 200/300/400), Debt Service Funds (fund code 599), and Capital Projects Funds (fund codes 601 and 699). It also includes the Enterprise Fund, and the National School Breakfast and Lunch Program (fund code 701). Within the general fund, fund code 420—Foundation School Program and Other State Aid— is used by charter operators only (Texas Education Agency, n.d.a).

*AP/IB Results***.** These refer to the results of the College Board's Advanced Placement (AP) examinations and the International Baccalaureate Organization's International Baccalaureate (IB) examinations taken by Texas public school students. High school students may take these examinations, ideally upon completion of AP or IB courses, and may receive advanced placement or credit, or both, upon entering college. Generally, colleges will award credit or advanced placement for scores of 3, 4, or 5 on AP examinations and scores of 4, 5, 6, or 7 on IB examinations. Requirements vary by college and by subject tested. Figures 1, 2 and 3 contain the formulas for the AP/IB Tested variable, the examinees that meet or exceed the criterion variable and the variable that measures the number of scores that meet or exceed the established criterion established by the Texas Education Agency.

$$\text{Tested} = \left( \frac{\begin{array}{c}\text{Number of 11th and 12th grade students}\\ \text{taking at least one AP or IB examination}\end{array}}{\begin{array}{c}\text{number of non-special education}\\ \text{11th and 12th grade students}\end{array}} \right)$$

*Figure 1.* Tested formula calculates the percent of students in grades 11 and 12 taking at least one AP or IB examination.

$$\text{Examinees} \geq \text{Criterion} = \left( \frac{\begin{array}{c}\text{Number of 11th and 12th grade AP or IB}\\ \text{examinees who scored at or above criterion}\end{array}}{\begin{array}{c}\text{Number of 11th and 12th grade}\\ \text{AP \& IB examination scores}\end{array}} \right)$$

*Figure 2.* Examinees formula greater than or equal to the criterion score. The percentage of examinees with a score of 3 or greater on Advanced Placement Examinations or 4 or better on International Baccalaureate Examinations; or a combination of both examinations.

$$\text{Scores} \geq \text{Criterion} = \left( \frac{\begin{array}{c}\text{number of 11th and 12th gradeAP \& IB}\\ \text{examination scores at or above criterion}\end{array}}{\begin{array}{c}\text{number of 11th and 12th grade}\\ \text{AP \& IB examination scores}\end{array}} \right)$$

*Figure 3.* Scores greater than or equal to the TEA criterion level. This formula calculates the percentage of total campus scores of 3 or greater on Advanced Placement Examinations or 4 or greater on International Baccalaureate Examinations; or a combination of both examinations.

Note that the denominator used to determine the percentage of students tested does not include 11th and 12th grade students served in special education; however, all students who took at least one AP or IB examination are included in the numerator. The performance of special education students is included in both the numerator and denominator of the other equations (Texas Education Agency, n.d.a).

*Average Teacher Experience* (Average Years Experience of Teachers). Weighted averages are obtained by multiplying each teacher's Full Time Equivalent (FTE) count by years of experience. These amounts are summed for all teachers and divided by the total teacher FTE count, resulting in the averages shown. This measure refers to the total number of (completed) years of professional experience for the individual in any district (Texas Education Agency, n.d.a).

*Average Teacher Tenure* (Average Years of Experience of Teachers with District). Weighted averages are obtained by multiplying each teacher's FTE count by years of experience. These amounts are summed for all teachers and divided by the total teacher FTE count, resulting in the averages shown. This measure refers to tenure, *i.e.,* the number of years employed in the reporting district, whether or not there has been any interruption in service (Texas Education Agency, n.d.a).

*Criterion Score.* This refers to the scores on SAT and ACT college admissions tests, the AP and IB tests, and the new college-ready indicator. For college admissions tests, the criterion scores are at least 24 on the ACT (composite) and at least 1110 on the SAT (total). For AP and IB tests, the criterion scores are at least 3 on AP tests, and at least 4 on IB tests. Please note that each college and university establishes its own score criteria for admitting or granting advanced placement or credit to individual students (Texas Education Agency, n.d.a).

*Economically Disadvantaged.* (Figure 4)The percent of economically disadvantaged students is calculated as the sum of the students coded as eligible for free or reduced-price lunch or eligible for other public assistance, divided by the total number of students (Texas Education Agency, n.d.a).

$$\text{Eco.Dis.} = \left( \frac{\text{Number of students coded as eligible for free or reduced-price lunch or other public assistance}}{\text{Total number of students}} \right)$$

*Figure 4*. Economically Disadvantages Students Formula. The sum of students coded as free or reduced lunch divided by total students.

*Educational Productivity.* While this term has a variety of possible meanings, for the purpose of this study, educational productivity is a measure of inputs that affect a desired outcome (Walberg, 2004). The inputs in this study are the 11 variables taken from the Texas AEIS data and the outcome variable is a dichotomous variable composed of either an Academically Acceptable rating or a Recognized rating on the Texas Academic Excellence Indicator System.

*Production Function.* A production function asserts that a maximum output of some predetermined process or outcome is attained as a function of a set of input factors. If the resources (inputs) are allocated in a way that maximizes their net benefit, then the entity is allocatively efficient. An education production function would produce an outcome from a set of inputs that provided schools and districts with the maximum amount of education possible from the inputs provided. For the purposes of this study, the inputs are the 11 variables taken from the Texas AEIS database and the outcome is a dichotomous variable composed of either an Academically Acceptable rating or a Recognized rating on the Texas Academic Excellence Indicator System (Schwartz & Stiefel, 2001).

*SAT/ACT Results.* Figures 5 – 8 contain the formulas for calculating the SAT/ACT results variables used in this study. These include the College Board's SAT and ACT Inc.'s ACT Assessment. Both testing companies annually provide the Texas Education Agency with testing information on the most recent test participation and performance of graduating seniors from all Texas public schools. Only one record is sent per student. If a student takes an ACT or SAT test more than once, the agency receives the record for the most recent examination taken.

$$\text{Tested} = \left( \frac{\text{Number of graduates who took SAT/ACT}}{\text{Number of non-special education graduates}} \right)$$

*Figure 5*. SAT/ACT Tested. This formula produces the percentage of graduates who took either of the college admissions test.

$$\text{Criterion} = \left( \frac{\begin{matrix}\text{Number of 11th and 12th grade students} \\ \text{taking at least one SAT/ACT examination}\end{matrix}}{\begin{matrix}\text{number of non-special education} \\ \text{11th and 12th grade students}\end{matrix}} \right)$$

*Figure 6.* At/Above Criterion for SAT/ACT. This formula produces the percent of examinees who scored at or above the criterion score on either test (1110 on the SAT, or 24 on the ACT).

$$\text{SAT Mean Score} = \left( \frac{\begin{matrix}\text{Total score (mathematics plus critical reading)} \\ \text{for all students who took the SAT}\end{matrix}}{\text{Number of students who took the SAT}} \right)$$

*Figure 7*. Mean Score SAT. This formula produces the average (mean) score for the campus SAT examination.

$$\text{ACT Mean Score} = \left( \frac{\begin{array}{c}\text{Total composite score for all students}\\ \text{who took the ACT}\end{array}}{\text{Number of students who took the ACT}} \right)$$

*Figure 8*. Mean Score ACT. This formula produces the average (mean) score for the campus ACT examination.

*TAKS* (*Texas Assessment of Knowledge and Skills).* The Texas Assessment of Knowledge and Skills (TAKS) is a comprehensive testing program for public school students in grades 3–11. The TAKS is designed to measure to what extent a student has learned, understood, and is able to apply the important concepts and skills expected at each tested grade level. All TAKS tests in grades 3 through 6 are available in either English or Spanish. The AEIS reports show performance on these separately (Texas Education Agency, n.d.a).

*TAKS Failer Analysis* (Progress of Prior Year TAKS Failers). This indicator provides two measures that show the progress of students who failed the reading/ELA portion or the mathematics portion of the TAKS in the prior year. The first measure is referred to as *Percent of Failers Passing TAKS*. Of the students who failed the TAKS in the prior year, this measure shows the percent that passed the corresponding assessment in the current year. The percentage is calculated using the number of matched students who failed in the prior year but passed in the current year divided by the number of matched students who failed in the prior year. The second measure is *Average Texas Growth Index* (*TGI)*. For students who failed the TAKS in the prior year, this measure shows their average growth (or change) between the prior year and current year. This measure is calculated using sum of individual student TGI values for students who failed in the prior year divided by total number of students with TGI values who failed in the prior year (Texas Education Agency, n.d.a).

*Texas Success Initiative* (*TSI)* Higher Education Readiness Component. The Texas Success Initiative (TSI) is a program designed to improve student success in college. It requires students to be assessed in reading, writing and mathematics skills prior to enrolling in college, and to be advised based on the results of that assessment.

Students may be exempted from taking a test for the Texas Success Initiative if they have a high enough score on their exit-level TAKS tests for mathematics and English language arts, as set by the Texas Higher Education Coordinating Board (THECB). The qualifying scores are scale scores of 2200 on their TAKS mathematics and English language arts with a written composition score of 3 or higher on the writing component. This indicator shows the percent of students who achieved this level or proficiency by subject (Texas Education Agency, n.d.a)

## Assumptions

It is assumed that all data reported to the state of Texas by participant public high schools and school districts are accurate. It is further assumed that the data stored in the Texas Academic Excellence Indicator System (AEIS) are accurate.

## Limitations

Data for this study were drawn completely from publicly accessible databases maintained by the Texas Education Agency (TEA) through their website on Texas public schools and school districts ("Texas Education Agency", n.d.c.). Only the data maintained on moderate to large (≥ 900 students) Texas high schools were used in the study. Hundreds of data elements are maintained by the TEA on public high schools in Texas; however, only variables from three categories were used in this study. The categories represented in the study were student variables, staff variables and fiscal variables.

## Significance of the Study

By identifying a methodology that possesses predictive value in determining campus academic success, researchers, school district administrators and campus administrators could be armed with valuable indicators to help identify critical educational productivity measures in Texas schools. Further, these indicators could be used as an analytical tool for investigation into methods for improving the educational productivity of other schools. Future implications for this research could allow for continued analysis of other AEIS variables in order to refine the predictive ability of this type of analysis.

## Organization of the Study

This study was organized into five chapters. Chapter 1 provides an introduction, statement of the problem, purpose of the study, research questions, definition of terms, assumptions and limitations of the study, significance of the study, and organization of the study. Chapter 2 is a review of the relevant literature, and Chapter 3 explains the methods used in the research. Chapter 4 provides a presentation of the results and analysis of the data. Chapter 5 explains the results of the study and provides recommendations for future research.

# CHAPTER II

# REVIEW OF LITERATURE

## Introduction

For over 30 years, numerous studies have been conducted on the effects of school inputs on student outcomes. Many have focused on the results of standardized testing as a measure of educational outcomes while others have focused on educational attainment or labor market earnings. As a matter of convenience, practicality and availability, district and state level data have been the primary source for educational productivity studies. The results of these studies have been highly variable and produced conflicting results (Taylor, 2001).

To strengthen the reliability of educational productivity research, Picus (2003) argues that the ability to analyze input/output relationships at the campus level might allow for more accurate results on student outcomes at the most basic level of educational productivity, the school. Busch and Odden (1998) also state that if schools are to be held accountable, more school level data and school level analyses are needed. Hence, a clear understanding of the forces that have driven educational productivity research are critical to understanding the relationship between educational inputs and their affect on student outcomes.

## Economics as a Model for Educational Productivity

Educational productivity research or research in educational efficiency includes studies of educational inputs as they relate to student academic achievement (Walberg, 2004). Educational productivity studies that relate per pupil spending to academic performance are econometric studies dealing with the relationships between economic forces as they apply to schools (Picus, 1997a). Specifically, econometric school productivity research involves a relationship between educational inputs (spending) and schooling outcomes (i.e. standardized testing performance).

Educational productivity and school efficiency are similar to estimating efficiency and productivity in business firms (Schwartz & Stiefel, 2001). Analyses of both schools and businesses deal with conceptual and empirical data in measuring outputs and inputs. While correlations can be drawn, it is difficult to extricate the causality of the relationships between inputs and outputs in both schools and businesses. Schwarts and Stiefel recommend using the production function, a theory of measuring efficiency, as a proposed method to measure the critical output from a given quantity of input variables in analyses of educational productivity.

A statistical model for productivity with the intent of measuring school efficiency is measured as a production function (Picus, 1997a). Efficiency in economics deals, in its most general sense, with the use and distribution of resources in a way that allows no one or no entity to be better off than any other person or entity within the organization (Schwartz & Stiefel, 2001). Hanushek (1986) defines economic efficiency as a relationship between the inputs, their price and the production function. Efficiency is also defined as a measure of productivity considering the relative costs and benefits of alternative production strategies (Gavin, 1999).

Efficiency in education is enhanced either by improving desired outcomes at a given level of resources or by maintaining or increasing results as the level of inputs is reduced (King & MacPhail-Wilcox, 1994). Researchers in education finance and economics are concerned with two types of efficiency in the production of learning outcomes in schools: technical efficiency and allocative efficiency (Rolle, 2004).

Technical efficiency is achieved when output levels cannot be maintained with decreased input or when output levels cannot be increased with currently maintained input levels (Rolle, 2004). Technical efficiency considers only the process of combining inputs to produce desired outcomes, but does not take into account the costs of the inputs themselves (King et al., 1994). Allocative efficiency is achieved when all available resources are exhausted resulting in any level of defined maximum output. In other words, allocative efficiency is the extent to which a set of finite resources are deployed so as to produce maximum benefit (Rolle, 2004). A measure of educational productivity can be attained through the use of the production function (Schwartz & Stiefel, 2001).

## The Production Function

The production function concept in education is based on the assumption that education itself corresponds to some technology which has to be identified and efficiently used within a school (Vandenberghe, 1999). Studies using the production function employ statistical methods to determine the relationship between inputs and outputs (Taylor, 2001).

The production function measures the maximum amount of output per a given quantity of input (Schwartz & Stiefel, 2001). Productivity studies analyze the factors that underlie productivity growth (Bartlesman & Doms, 2000). Some factors that have been examined include managerial ability, technology, human capital and regulation. Consequently, the purpose of productivity studies is to analyze the relative importance of the interactions between these and other factors.

Hanushek (1986) refers to educational production functions as input-output analyses or cost-quality studies that examine the relationship between different inputs and outcomes of the educational process. Hedges, Laine & Greenwald (1994) suggest that production function studies attempt to produce a model of the relationship between educational inputs and outcomes. The authors state that the goal of these studies is to produce a quantitative model of educational productivity that allows the prediction of student outcomes given a change in input resources. An example given by Hedges et al. (1994) demonstrates how the mean achievement on standardized testing would change if per pupil expenditures was increased by $100. These changes might be indicative of more cost effective methodologies, strategies or means to produce greater educational outputs.

Examples of educational outputs are results on standardized tests and dropout rates. Educational inputs include teacher/student ratios, teacher experience and per pupil expenditures. Monk (1992) defines a production function as a model which links outcomes, inputs, and the processes that transform outputs into inputs in schools.

Educational production function studies have attempted to measure efficiency in schools by analyzing the effect of school inputs on student outcomes while controlling for other variables, such as the effects of the socioeconomic status of the student (Taylor, 2001). The statistical methods and levels of estimation in these studies have been varied. Some studies used outcomes based on student achievement on standardized testing, while others have focused on educational attainment and earning levels as adults (Wenglinsky, 1997).

Educational productivity, measured as a production function, is estimated through statistical techniques that rely on regression methods to measure the relationship between a mix of inputs and some identified output (Picus, 1997a). Gazzerro and Hampel (2004) demonstrated the use of production function methodologies using “Error Band” analysis to identify outperforming and underperforming school districts using standardized test performance as they relate to the size of the low socioeconomic population in the district. Error band analysis as it relates to the Gazzerro and Hampel method refers to a performance zone (confidence intervals) or range of test proficiency associated with a given number or proportion of economically disadvantaged students (Standard & Poor’s, 2005 a).

Studies in educational productivity fall into three categories: input-output studies, effective practice studies and studies of the environmental effects in which schools function (Ladd, 1999, pp. 139-140). Picus (2003) refers to these three categories as efficiency, effectiveness and equity (*p*. 17). When taken as a corporate whole of educational productivity research, these three views produce conflicting results. It is important to maintain the distinction between the three research “lenses” when analyzing educational productivity research.

Studies such as those by Coleman (1966), Hanushek (1989), Gazzerro and Hampel (2004), and Hedges et al. (1994) use the production function concept as it applies to educational productivity to provide information related to input/output correlations (input/output studies). Educational inputs are then identified for their effects on outputs through empirical analysis. Picus (2003) defines educational productivity as the improvement of student outcomes with little or no additional financial resources or a consistent level of student performance at a lower level of spending (*p*.16). Results from econometric empirical analyses provide significant information for making educational decisions. Policy makers and administrators can then use this information to select the best inputs for the greatest output (Vandenberghe, 1999).

## Alternate Methods of Analysis

In addition to using production function models to analyze educational productivity, other methods exist to extract meaning from educational data. A derivative of the production function model, used to estimate adequate resource levels in school districts, is the Economic Cost Function (ECF) approach (Picus, Odden & Fermanich, 2003). The ECF uses regression analysis to determine per pupil expenditures and a desired performance level to estimate adequate resource levels for schools.

In other studies, Reschovsky and Imazeki (2003) used cost function analysis to determine the characteristics of a school district that lead to variations in the costs of achieving a specified improvement in student performance. Using data from Texas schools for the 1995-1996 school year, Reschovsky and Imazeki developed a cost function index they suggest could be used to guarantee every district in Texas has sufficient fiscal resources to achieve state-imposed performance goals.

Economists have suggested that educational production functions may also be modeled using multiple outputs from a single input (Chizmar & Zak, 1983). These studies purport that interactions between educational outputs, such as affective and cognitive, are intertwined and modeling these interactions may be important to the validity of the production function used to derive the effects of a certain input. Chizmar and Zak (1983) contend that modeling outputs in the cognitive and affective domains as joint products is preferable to studies in which a single input is used as a predictor of a single output.

## An Historical Perspective on Educational Productivity

Studies using the input-output production function to measure productivity in schools can be traced to *Equality of Educational Opportunity,* a study conducted by Coleman (1966). In the "Coleman Study" mandated by the Civil Rights Act of 1964, 3000 schools were evaluated for inputs into the educational process and for their effect on student achievement. Coleman concluded that the amount of money available to schools had little to do with student academic achievement; rather, certain social factors such as socioeconomic status were more important to student success in school.

Jencks (1972), in support of Coleman and with more immoderate findings, affirmed that outcomes in education were primarily inherent, reliant on the unchangeable characteristics of the students themselves. Jencks further acknowledged that all external inputs are secondary or insignificant with regard to the production of educational outcomes.

Based on the Coleman Report and the Jencks' findings, and an ever increasing public tax burden to fund education, Americans as a whole, during the 1970s, believed the public education system was failing. Consequently, in the early 1980s, states began to pass laws limiting educational spending (Rolle, 2004). Bolstering of the argument for limited spending and evidence of a failing educational system came in 1981.

On August 26, 1981, Secretary of Education Terrell H. Bell created the National Commission on Excellence in Education and directed it to report on the quality of education in America to the American people by April 1983 ("National Commission," 1983). This report was titled *A Nation at Risk: The Imperative for Educational Reform.* States responded to *A Nation at Risk* with legislative action establishing mandates that included directives for accountability and numerous changes in education policies. Commissions were created at the state level to study state education systems, which led to recommendations for system reforms (Bell, 1993).

*A Nation at Risk* shifted the focus of educational research in finance away from equity to educational productivity (Rolle, 2004). The report affirmed, “The twin goals of equity and high-quality schooling have profound and practical meaning for our economy and society, and we cannot permit one to yield to the other in principle or in practice” (U.S. Department of Education, 1983, ¶ 23). Bell suggested that the nation’s poor academic performance was due to misguided priorities: a pursuit of equity at the expense of productivity. Researchers also echo this sentiment. Odden (1986) reinforced the committee’s findings by stating that avoiding issues of efficiency in educational reform should not be lost in the search for equity, but rather continue to include research on educational inputs and student outcomes.

Gavin (1999) claims that education is the one institution specifically intended to promote equal access to society’s benefits and rewards. Questioning if equality of educational opportunity cannot be achieved by a simple equalization of resources, Gavin asks, *What can be done?*

The answer pursued over the past 20 plus years is in educational productivity. Two factors overwhelm efforts to promote equality of educational opportunity: scarcity of educational resources and the effects of parents’ socioeconomic status (Windham &

Chapman, 1990). Increased efficiency is the only means by which access can be expanded.

## Research Produces Conflicting Views

Following *A Nation at Risk,* research in educational productivity has produced conflicting views. Limited spending legislation was supported by research in educational productivity (Mann & Inman, 1984). Mann and Inman claimed that improvements in the quality of public schools do not require additional resources. Mann and Inman declared, “There is evidence that achievement can be changed [by manipulation of] school variables within existing resources, through [an] Instructionally Effective Schools’ approach” (*p*. 256).

Work by Hanushek (1986) supported Mann and Inman. Hanushek collected data from 147 separate productivity studies and found no link between increased spending and educational outputs. Hanushek maintains, “There appears to be no strong or systematic relationship between school expenditures and student performance” (*p*. 1162). To arrive at this conclusion, Hanushek divided the results of his research into five categories: (a) positive relationship that is statistically significant; (b) positive relationship that is not statistically significant; (c) negative relationship that is statistically significant; (d) negative relationship that is not statistically significant; and (e) relationship cannot be determined (Picus, 2003, p. 18). Hanushek suggests that what is needed to make schools more efficient and thereby more productive is to change the incentive structures facing schools so that they are motivated to act in ways that use resources efficiently (Hanushek, 1997).

Vandenberghe (1999) supports Hanushek (1986), Coleman (1966), Jencks (1972) and others in maintaining that there appear to be no clear relationships between expenditure per student and student achievement. He further holds that the only well established result is that socio-economic origin is decisive, citing Glennerster (1991). He continues by observing that schools differ dramatically in quality but there is no statistical or econometrically observable connection between inputs and outputs.

More current research by Standard & Poor's (2005 b) also contends that no statistically significant relationship exists between instructional spending allocations and student performance on reading and math assessments for nine states evaluated. Using a linear regression model, Standard & Poor's School Evaluation Services (SES) evaluated standardized test scores from Minnesota, Ohio, Louisiana, Texas, Kentucky, Florida, Kansas, Arizona and Colorado and found that no statistically significant relationship exists between instructional spending allocations and percentage of students scoring at or above the proficient level on state math and reading assessments.

Others have questioned the validity of the "money doesn't matter" argument. Alexander (1998) comments that the consequences of prior productivity studies (Coleman, 1966; Jencks, 1972; et al.) were to give academic authority to the nurtured impression that public schools had not much actual value as a social mechanism for conveying knowledge or for creating greater economic viability or social equality. Alexander contends that these studies cast doubt on public education's ability to significantly affect student outcomes due to the significant influence of forces outside the school system. However, Alexander argues that current research with better, more precisely designed, studies reveal different results. Mounting research sheds new light and significantly diminishes the confusion that money doesn't matter.

In one such study, Hedges, Laine & Greenwald (1994), in a reevaluation of Hanushek's (1989) research, found that increased spending does increase student outcomes – money does matter - where Hanushek had found no significant relationship between spending and student outcomes  Reevaluation of Hanushek's data by Hedges, Laine and Greenwald showed that, with the possible exception of facilities, there is evidence of statistically reliable relations between educational resource inputs and school outcomes. The relationship between resource inputs and outcomes was more positive than negative and showed a greater effect in the Hedges, Laine, and Greenwald study than in the Hanushek study.

Taylor (2001), in further analysis of this data, concluded that Hanushek's vote-counting method, used to evaluate his data, failed to take into account critical variables and that the Hedges, Laine and Greenwald (1994) research more accurately reflected the effect size of educational spending on student achievement. Educational researchers continue to scrutinize the data, looking for links between student achievement and educational inputs (Monk, 2001).

Card and Krueger (1992), prior to the Hedges et al. (1994) study, supported Hedges with regard to increased spending, although their evidence is not based on the production function, but rather the wage earning capacity of individuals following graduation from high school. After controlling for socioeconomic status and cost variations, this study found that men educated in high-quality schools had, on average, more years of schooling and higher wage earnings. In conclusion, this study suggests that earning differentials appear to be composed of two parts, a direct return due to higher skills obtained from a quality education and an indirect return due to students in higher quality schools staying in school longer, leading to greater adult earnings.

Betts (1996), in opposition to Card and Krueger (1996), purports different findings for school inputs and adult earnings. In a study that examined school inputs and student earnings, Betts found that studies using state-level average inputs showed that increases in school spending lead to improvements in earnings.

Inversely, when school-level data were examined, results indicated that there is no relationship between spending and future earnings. Overall, Betts (1996) found that the higher the level used to measure inputs (state vs. district vs. school-level data), the greater the likelihood a statistically significant relationship exists between inputs and earnings. Additional conclusions revealed in this study also indicate links between inputs and adult earnings for students who were in elementary school before 1960. Students in elementary school after 1960 showed no such links between inputs and earnings.

Wenglinsky (1997) found that the impact of spending on student achievement came in stages. Fourth grade data revealed increased spending on instruction and district level administration led to increased teacher/student ratios (smaller class sizes), which in turn led to higher achievement in mathematics. Eighth grade data revealed an increase in expenditures on instruction and central administration led to increased teacher/student ratios and improved school environment or climate, and the improved climate reduced behavior problems and increased student achievement in mathematics.

Additional findings in this study also concluded that school-level administration and teacher education levels could not be linked to improved student achievement.

Wenglinsky's (1997) research on class size is supported by one of the largest econometric longitudinal studies to address educational productivity ever conducted, the Tennessee STAR experiment (Krueger, 1999). The Tennessee STAR (Student/Teacher Achievement Ratio) experiment was a longitudinal study that examined 11,600 kindergarteners in 80 schools and their teachers to determine the effects of class size on student achievement. The students and teachers were followed over a four year period. The experiment concluded that reduced class size does affect student performance outcomes.

Rebell and Wardenski (2004) assert, "It is clear that we no longer need to debate whether money matters. We know that it does - the focus now should be on how to ensure that adequate funding is provided to all our schools" (*p*. 35). Murnane (1991) also contends that it is narrow-minded to deduce that more money cannot improve the educational output of schools; however, funds for low achieving students will help only some districts due to inefficiencies in their organizational structure and management.

Some efforts have been made to determine exactly how much money matters (Bracey, 2006). Bracy submits that the national average for instructional spending by public school districts is 61.4% of a school district's total budget. Bracey also reports that one group, First Class Education (FCE), using National Center for Educational Statistics (NCES) data, argued that states spending over 64% of their budgets on classroom expenses showed the highest standardized test scores in 2003.

This *65% Solution* is an idea initiated by Republican political advisor Tom Mooney and championed by Overstock.com president and National Advisory President for First Class Education, Dr. Patrick M. Byrne (*"First Class", n.d.).* The *65% Solution* proposes designating at least 65% of a school district's operating budget for *in the classroom* expenses (Byrne, n.d.). In the classroom expenditures are defined as funds spent on classroom teachers; general instruction supplies and various other instructional items or services focused in the classroom.

The origin of the FCE definition of *in the classroom* expenses is itself derived from the National Center for Educational Statistics definition of instructional spending (Department of Education, 2003 c). In this definition, instruction includes those activities dealing directly with interactions between teachers and students. This instruction may be provided for students in a school classroom, in another location [home, athletic field, gymnasium, band rehearsal hall] and in other learning situations. It may also be provided through some other approved medium, such as distance learning or through the Internet (*p*.121).

Bracey (n.d.) contends FCE's *65% Solution* is flawed with regard to several critical areas. Bracey argues that the *65% Solution* assumes schools are funded adequately. However, recent court cases argue to the contrary (as cited in Neeley, December 5, 2005). Bracey (n.d.) further explains that empirical data do not support the contention that existing money can be reallocated to classroom expenditures and improve student performance while reducing waste.

There is also no direct outcome component linked to the *65% Solution* input argument (Bracey, 2006). The lack of an outcome measurement is a deviation from current outcome-based education initiatives that are most strictly outcome-based (“North Central,” n.d.). Bracey (2006) recommends that (a) schools and school districts define “improved performance,” examine the research literature to determine which practices have been empirically linked to changes in those outcomes, and reallocate funds to attain the improvements; and that (b) allocation of new funds or reallocation of existing funds occur at the school level, with district oversight (*p*p. 21-22).

Recent research in educational productivity also challenges the *65% Solution*. Data collected by Standard and Poor’s School Evaluation Services (SES) indicate the amount of money spent on instruction in public school districts shows no statistically significant relationship to student academic success as measured by standardized tests (Standard & Poor’s, 2005 b). This research reveals there is no correlation between any spending level and student performance. Yet, counter to the Standard & Poor’s argument (2005 b), Rebell (2004) and Greenwald et al. (1996) assert that increased spending does make a difference.

Taylor (2001) questions what policy makers are to learn from such contradictory studies and asserts that more recent educational productivity data studies attempt to control for variables that clarify the effect educational inputs have on student outcomes by considering additional input variables, thereby giving some explanations for the different outcomes of the various studies on educational productivity. These new insights into the economics of education are essential to understanding productivity in schools (Monk, Wang & Walberg, 2001).

## Equity to Adequacy

Through the 1970s and 1980s, litigation in regard to school finance focused on horizontal equity, vertical equity and fiscal neutrality (Hadderman, 1999). Within the last 15 years, there has been a change in focus from defining equality in school finance to an emphasis on what constitutes the major components of a basic, adequate education (Yudof, Kirp, Levin & Moran, 2002). This shift in the political and judicial landscape caused educational productivity research to move away from a focus on equity to an emphasis on productivity and the question of what constitutes adequate spending levels in public education (Monk, 1997).

Evidence of disparate spending levels among school districts drove states to focus on inequities between high spending levels in some districts and low spending levels in other districts (Ladd, Chalk & Hansen, 1999). In the 1990s, reform efforts shifted focus from equity to student performance and to what criteria constitute an adequate education. Educational researchers, such as Clune (1997), argued that at a time when the focus in education is on outputs [student performance], “equity” guarantees inputs regardless of the outcomes, while “adequacy” means sufficient for some outcome.

Reschovsky and Imazeki (2003) assert that increasing academic performance of students is a potential important step toward improving the quality of education in the United States. The authors also emphasize that if cost differences are substantial among school districts, then imposing performance standards without increasing state funding will not allow districts with above-average costs to educate their students to meet the imposed state standards.

A focus on adequacy in educational spending produces skepticism with regard to how educational funds are being used and distributed in public education and the social disadvantages facing individuals with poor achievement levels (Ladd et al., 1999). Public education systems began to be scrutinized for high levels of learning at efficient and effective levels of spending. Hence, education finance research shifted its focus from equity to adequacy and the study of educational productivity.

Odden (2003) reports that two key factors shifted the focus of school finance to adequacy. One factor was whether the differences in dollars per pupil produced substantive differences in educational opportunities or student learning and whether fiscal resources produced important differences in student outputs (educational productivity). The second factor was providing a link between dollars and outputs in a standards based environment.

Odden and Clune (1995) also argue that educational productivity has been low due to increased spending and little or no increases in student achievement. According to Odden and Clune, several reasons exist for low productivity in schools: (a) poor resource distribution; (b) unimaginative use of money at the district and school levels; (c) bureaucratic organization in schools; (d) failure to focus on results; (e) focus on services; and (f) practices that drive up costs.

## Determining What Impacts Educational Productivity

Adequate spending-level studies show that strategies do exist to increase educational productivity (Odden & Clune, 1995). Standard and Poor’s (2005 b) SES suggest that how the money is allocated and spent may be the most crucial component of instructional spending and that evaluating districts that have the most resource-effective practices (i.e. high achievement and low spending) will offer critical insight into how instructional resources should be allocated. Prior to the Standard & Poor's studies, Picus (2000) offered the same conclusion by suggesting that regardless of what impact additional funds might have, it is important that existing resources be used efficiently.

In an evaluation of current school-level studies, Picus (2003) declares that although schools could have different spending patterns and produce more student learning, current spending patterns are not irrational. Improving school productivity is not to be accomplished by attacking administrative costs, but rather working to determine what boosts student learning and making sure spending patterns support those strategies.

In research prior to Picus' work, Cooper (1993) warned that true productivity relations between inputs and student outcomes are still unknown. Cooper asserts that understanding how resources are used within schools is an important element in discovering a clear picture of educational productivity.

Cooper (1994) developed the School-Site Micro-financial Allocations Model to itemize expenditures at sub-district levels in order to determine educational expenditures at the sub-district level. The purposes of the model were to determine the following: Can expenditures be attributed to the function for which they were designed? Can budget functions be compared across budget functions, schools and districts? Can accurate sub-district data be used to determine the level of efficiency and effectiveness in a school? This model found initial positive results for all four questions and suggests there is some type of economically efficient relationship between educational inputs and student outcomes as long as the resources reach schools, classrooms and students.

This argument is echoed by Picus (2003), in which he contends that one of the problems with educational productivity studies is that they do not take into consideration the similarity with which school districts spend the resources available to them. Resource allocation patterns across school districts are remarkably alike despite differences in total per pupil spending, student characteristics and district attributes (Cooper et al., 1994).

In line with greater specificity arguments, Verstegen and King (1998) found the following do have some impact on educational outcomes: (a) teacher characteristics; (b) adequate levels of teacher training, verbal ability and years of experience; (c) administrative policies; (d) adequate levels of collaborative management; (e) low student/teacher ratios and small class sizes; (f) fiscal and physical capacity; (g) adequate levels of expenditures per student; (h) high teacher salaries; and (i) contemporary buildings and facilities. Barnett (1994) contends that if these identified areas do make a difference in educational productivity, then research studies should focus on new investigative measures. These include: (a) new measures of financial accounting; (b) what educational services financial resources actually purchase; and (c) which services are actually provided to students.

Similarly, Adams (1997) linked human and financial resource policy decisions to student outcomes in an effort to determine the allocation of money. Adams asserts that it is necessary for education finance policy developers, implementers and consumers to understand how and why human and financial resources were allocated in any particular manner.

Ferguson (1991), in a seminal study of educational resources in Texas, analyzed different categories of school expenditures to determine which were important in improving student learning. Threshold effects were found for instructional expenditures – there are expenditure levels where funding has a clear and direct impact on student achievement. These differences in the quality of school, based on teachers' performances on a statewide recertification exam, accounted for approximately 30% of the variation in standardized reading scores.

Ferguson (1991) also determined that once elementary school teachers had at least five years experience, additional experience did not increase their effectiveness at improving student test scores. High school teachers, however, with nine or more years experience produced better results than those with less experience. Additional findings in this study suggest that reducing the number of students per teacher below 18 improved student outcomes and class sizes larger than 23 pupils reduced student achievement significantly. The conclusion is that experienced teachers should be retained and should receive ample classroom materials.

Although there is clear evidence that adequacy can be achieved, Rolle (2004) contends that there are major challenges that complicate the study of educational productivity. These include accurately measuring inputs and outcomes and selecting the proper mathematical functional form to determine the role of innate intelligence of the student. Recently, newer statistical models have been developed to analyze educational productivity using econometric data (Standard & Poor's, 2005a). Others, such as Rivkin et al. (2005), provide panel data from the Texas Schools Project that analyze school level inputs and student outcomes using multilevel models.

## Statistical Methods for Analyzing Educational Productivity

Hampel (2004) provides a statistical model for analyzing educational productivity with a production function, the Return on Spending Index (RoSI). The return on spending index is a return indicator designed to simultaneously examine academic and financial performance in a demographic context (Standard & Poors, 2005 a).

Defined, the return on spending index is a ratio that reflects the average number of assessment proficiency points a school district achieves per $1000 spent per student on core operations (Standard & Poors, 2005 a). This allows for the analysis of inputs and outputs together in the context of return on resources.  A higher RoSI is more advantageous than a lower RoSI; however, demographics and variations in cost from one geographic area to the next need to be considered before any attempt to compare school districts is initiated.

If the RoSI is inverted, it becomes an indicator of the average amount of money spent per student based on a chosen spending variable (Hampel, 2004). This indicator is referred to as the Performance Cost Index (PCI). Districts with lower PCI values may indicate that the district engages in more cost efficient methods to produce student success.

When analyzing data for return on resources and per student costs, a method for determining outperforming and underperforming school districts is needed. Gazzerro and Hampel (2004) present the “Error Band” method for analyzing statistically significant academic performance with regard to enrollment of economically disadvantaged students. This method uses a performance zone defined by confidence intervals for any given number of economically disadvantaged students and their performance on some form of standardized testing.

Coleman (1966) originally established that the average level of student performance declines as the proportion of students living in poverty increases. These findings are supported by Gazzerro & Hampel (2004). However, there are school districts that beat the odds with regard to student performance and above average populations of economically disadvantaged students. These districts can be identified using the “Error Band” Method (Gazzerro & Hampel, 2004).

Employing linear regression as a statistical analysis model and an error band derived from the standard error of the regression, a band can be defined with differing levels of statistical significance to identify outliers that are exceptions to the regression model (Gazzerro & Hampel, 2004). These outliers, if above the error band, are outperforming districts while those below the error band are underperforming districts.

As outperforming districts are identified, it is advantageous to quantify a district’s level of performance in relation to its percentage of economically disadvantaged students in order to identify the magnitude of their academic achievement for comparison purposes (Hampel, 2005). The Risk-Adjusted Performance Index is used to analyze academic achievement in relationship to a district’s proportion of economically disadvantaged students (Hampel, 2005).

Using the Risk-Adjusted Performance Index, information can be obtained from the position of the district’s Return on Spending Index with regard to the regression line (residual). If a school district’s performance is measured relative to its location to the regression line, a school with a higher economically disadvantaged population can have a greater Risk-Adjusted Performance Index than a school with fewer economically disadvantaged students and a greater absolute return on spending (Hampel, 2005).

Alternate methods for analyzing school productivity and efficiency exist that differ markedly from the input/output production function approach. Levin (1993) suggests outcomes are multiple, jointly produced, and difficult to weigh against one another. Outcomes are not all translatable into a standard form which makes it very difficult to place value on them in general. According to Levin, outcomes also have to do with the level at which they should be measured. Researchers have been interested in various outcomes: (a) individual students, (b) classes of students, (c) schools, (d) school districts, (e) states, (f) nations, (g) ethnic groups, (h) age groups, (i) gender groups, and others (Levin, 1993).

## Improving Methodologies

Fortune and O'Neil (1994) argue there are numerous conceptual flaws that exist in production function analysis methodologies that undermine the appropriateness of the model for analyzing productivity and funding equity. These flaws lie in the inability of students to have equal access to resources provided by the state and districts. The answer is, rather than looking for associations in the data, comparisons between districts are in order.

Monk (1992) observes that research in educational productivity does not consider how educational productivity differs significantly from production in other fields of study. Some outcomes of schools are also inputs to later production, such as the knowledge acquired in earlier grades is an input needed for success in secondary education. Monk emphasizes that many educational inputs are not purchased and are difficult to define and analyze, such as student time and student effort.

Alternate forms of educational productivity and efficiency could be used with more traditional methods. Several studies confirm the critical role of intra-organizational attributes (Vandenberghe, 1999). These studies demonstrate that critical attributes cannot be directly related to the amount of monetary resources made available and cannot be purchased in the market place, like teachers, facilities, textbooks or computers.

Other researchers in support of the critical role of intra-organizational attributes found that math achievement was influenced most by advanced course work in mathematics and that reading was most influenced by grades in English courses (Thomas, 2002). Thomas further found that both reading and science are strongly affected by the education level of the parents and that grades, family background and time spent on homework all had an impact on achievement outcomes.

## School Level Research

Some researchers suggest a student-centered approach to educational productivity (Levin, 1993). A first requirement is to focus direct research on students and how they experience school. These studies would determine how students perceive instruction, discipline and the organization as a whole. Once identified, these student perceptions could be used to design experiments as a means of studying educational productivity. In support of Levin's recommendations, Berne and Stiefel (1994) contend there is a growing belief that the most critical activities are closest to the child, such as those at the school-level, hence studies at this most basic level of school organization will yield the most accurate picture of the effects of inputs on educational outcomes.

Studies of alternate productivity indicators in business lend insight into productive schools as well. High performance business firms that show high levels of productivity possess extensive training programs, compensation linked to worker performance and employee involvement in decision making (Kling, 1995). In educational research, five additional practices have been identified and linked to more productive schools (Levin, 1997). These practices are, clear objectives with measurable outcomes; incentives that are linked to success on the measurable objectives; efficient employee access to useful information for decisions; along with two additional practices - the ability to adapt to meet changing conditions and the use of the most productive technologies consistent with cost constraints. Levin refers to these five efficiency practices as x-efficiency attributes of productive schools.

Hanushek (1986) also argues that more productive schools could be viewed as schools that have combined some of the five x-efficiency organizational attributes. Vandenberghe (1999) states that x-efficiency schools possess clear objectives about what they are attempting to achieve with clear acceptance and agreement by all participants. These objectives are associated with measurable outcomes that provide a method for assessing school performance. The stakeholders must receive incentives tied to student success. These incentives can be intrinsic or extrinsic. Vandenberghe continues, information must be made available to provide feedback on best practice implementation of new pedagogical practice and schools must evolve to meet individual student needs and changing social demands.

In support of Vandenberghe’s best practice implementation, Darling-Hammond (1998) found statistical support for teacher training and its effect on increased student achievement. Teachers that are well trained in pedagogical practice and that work in settings that allow them to know their students are critical elements of successful learning.

Vandenberghe (1999) reports that schools possess a coordination function provided by the administration, primarily through the principal and through professional autonomy for teachers that effects efficiency. Efficiency then is tied to a balance between organizational structure and teacher autonomy in a specified, exclusive manner that guarantees a certain level of efficiency. This balance is either supplied by leadership itself, the mere combination of the critical organizational features, or some combination of both.

To analyze these coordination functions more closely, as well as other school inputs and outputs, a system of analysis closer to the “unit of production,” such as the school-level rather than the district-level, would be of greater value when studying the relationship between inputs and student outcomes (Picus, 2003, p.78).

The majority of school productivity studies have focused on district-level information (Hanushek, 1989; Hedges et al., 1994). These studies indicate that, on average, school districts nationwide spend 60 percent of their funds on instruction and the remaining 40 percent on additional educational services such as administration, maintenance and operations, instructional support, transportation and food service (Odden, A., Monk, D., Nakib, Y., & Picus, L., 1995).

Closer analysis indicates that although spending is relatively the same on a percentage basis in all states, vast differences do exist (Odden et al., 1995). Although the same 60/40 ratios exists in comparison states, one state may spend more than twice as much per pupil as another state. Herein lies one of the many difficulties in analyzing district level data (Picus, 2003).

As with equity and adequacy arguments, growing dissatisfaction with public education has resulted in a reform movement that has shifted the focus of attention away from the district level to the school site (Sherman et al., 1996). Data from school-level sources could allow for more clearly defined correlations when discerning links between resources and student outcomes (Monk, 1997).

Decades of research analyzing district-level data searching for links between student outcomes and spending levels have been inconclusive (Hanushek, 1989; Hedges et al., 1994; Standard & Poor's, 2005 b). The research using district-level data on expenditures and efforts to link this data to individual student achievement create high variability among efficiency and productivity studies and produce conflicting results (Taylor, 2001).

Berne and Stiefel (1994) cite three reasons why the school district as the unit in school finance analysis is being challenged: (a) across school districts, states, and even countries, there is a growing belief that the most critical activities are closest to the child, such as those at the school level; (b) there is increasing interest in measuring and focusing on processes, outputs, and outcomes, rather than financial inputs alone; and (c) the rapid advancement of technology now makes it possible to collect and analyze information at the school level.

Research into school-based management suggests that high involvement management may enable schools to improve services to create high performance schools (Wohlstetter, Smyer & Mohrman, 1994). Understanding school-level productivity, efficiency and production at the unit of production level may lend greater clarity to and answer questions about the impact of inputs on student outcomes through a greater understanding of the fiscal status of the school (Sherman, et. al., 1996). School-level data, including data from fiscal resources, teacher data and student data, will help focus attention on student outcomes at the educational unit level, the school (Picus, 2003).

The process of school-level data collection has been analyzed and seven areas have been identified that could be used in data analysis to reveal important insights into the process of educational efficiency (Busch & Odden, 1997). These areas include (a) governance, (b) accountability, (c) effectiveness, (d) equity, (e) adequacy, (f) comparability of data, and (g) longitudinal analysis.

The ability to analyze input/output relationships at the lower echelon of the individual school campus would allow a more accurate focus on student outcomes at the most basic level (Picus, 2003). If schools are to be held accountable and managed more efficiently at the site level, there is an urgent need for site-specific information as policymakers and educators seek to understand educational productivity (Odden & Busch, 1998). A call for better use of school data was also echoed by Microsoft founder Bill Gates as he addressed the United States Senate committee that oversees education and labor (“eSchool”, 2007).

School-level data encompass a greater variety of data elements beyond basic revenues and expenditures (Picus, 2003). School-level data contain information related to demographics for both staff and students; budget allocations at the program level; teacher pay and experience levels; standardized testing information; population mobility; socioeconomic status; course enrollments and various other data elements for analysis into the possible effects of input/output variables affecting student achievement (Texas Education Agency, n.d.a).

Analysis of these areas and the efficient use of educational resources could help better understand the 60/40 split between instructional spending and other school expenditures (Monk, 1997). The data could be used to reveal how resource allocation affects student outcomes though grade-level data, school type, program and curricular area. Additional analysis could reveal how school policies drive school behavior (Busch & Odden, 1997).

Additional data could be gleaned from longitudinal analysis (Picus, 2003). School-level data could be analyzed over time to provide production-function relationships with greater consistency in the results. School-level data need to include data elements that are integrated, connected and multidimensional (Busch & Odden, 1997). These data would allow researchers and school officials to aggregate and disaggregate data to reveal trends in input/output relationships. The task of analyzing school-level data is complex, yet valuable when used with a clearly defined method of analysis (Picus, 2003, p.100).

Goertz and Stiefel (1998), in an introduction to a special issue of *The Journal of Education Finance,* identify several factors that emphasize issues of importance when analyzing school-level data: (a) school-level data lead to public comparisons among local schools; (b) the public have difficulty understanding the various data elements when reporting school-level data; (c) principals generally have the greatest power and discretion when making fiscal decisions at the campus level; and (d) data related to money, position, outcomes and demographics should be integrated into one database.

Few states collect school data (Sherman et al., 1996). One state, Texas, possesses an advanced school-level data collection system referred to as PEIMS, Public Education Information Management System (Texas Education Agency, n.d.b). The data are used to provide the public with information regarding school and district performance. There has been limited analysis of the Texas PEIMS data with regard to what the data mean to student success or educational productivity (Picus, 2003).

Research from studies into the levels of productivity in business indicate levels of responsibility given to the unit level of production produce the most efficient and profitable businesses (Lawler, 1986). Odden and Busch (1998) point out that if schools are to be held accountable, more school-level data and school-level studies are needed.

Fiscal data, student data and teacher data are readily available and accessible from the Texas Academic Excellent Indicator System for Texas schools (Texas Education Agency, n.d.c). These data include teacher salary information, teacher experience in total and within a district, and campus-based student performance criteria on exams, such as performance on state standardized tests, the Scholastic Aptitude Test (SAT) and Advanced Placement (AP) exams (Texas Education Agency, n.d.b). Additionally, student demographic data, such as numbers of economically disadvantaged students, and fiscal data containing information on instructional expenditures and money spent on school leadership are also available in the Texas databases for analysis.

Using data elements from student, teacher and fiscal databases provides a multitude of input data from which to analyze student outcomes and educational productivity at the school level (Picus, 2003). Evaluation of district-level data shows that across the country, school districts are quite similar, especially with regard to spending allocations at the district level (Picus, 2003, p.79). Studies in educational productivity at the school level could produce a much clearer picture of the effects inputs have on student outcomes. In one recent study using state-wide school level data from the Texas Schools Project at the University of Texas at Dallas, Rivkin et al. (2005) found statistically significant evidence that linked inputs such as teacher experience and teacher degree level to student productivity outcomes. Studies such as the Rivkin study support the argument that school-level data research is needed to provide clear evidence of the relationship between school inputs and educational productivity (Picus, 2003).

The ultimate goal of studies in educational productivity, educational effectiveness and educational efficiency is to improve the quantity and quality of education for all children (Rolle, 2004). Knowing whether high performing schools use resources differently than other schools could prove beneficial in resolving the debate over whether and to what extent money and other resources matter in schools (Picus, 2003, p.22).

## Summary

Numerous studies in educational productivity have been conducted over the last 35 years. Most have produced conflicting results. To study educational productivity, researchers have relied on the educational production function to determine the effect of educational input variables on student outcomes. Models of productivity research have come from business, primarily from studies in economics.

During the 1980s and 1990s, various educational reform movements, driven by policymakers, and subsequently the courts, focused educational productivity research on what constituted an adequate, efficient education for public school students. The unit of study in these research efforts was primarily the school district, with inclusive results. New methodologies have been proposed to analyze educational productivity at a more precise unit of concentration, the campus. If schools are to be held accountable for the adequate education of students, studies must be focused at the unit level of educational productivity, the individual school. This study examined the school-level variables that may impact a campus accountability rating assigned by the Texas Education Agency.

# CHAPTER III

# METHOD

## Purpose of the Study

The purpose of this causal-comparative study was to determine the predictive value of educational productivity input variables on the accountability ratings of Texas high schools with student populations greater than or equal to 900. Specifically, this study analyzed the effect of student, staff and fiscal input variables in determining the odds of a high school in this study receiving either a Low Performing or Recognized rating in the Texas public education accountability system.

## Participants

The participants included Texas high schools in operation during the 2004-2005 (N = 430), 2005-2006 (N = 423) and 2006-2007 (N = 444) school years with a minimum enrollment of 900 students and serving grades 9-12, 10-12 or 11-12. Smaller high schools were excluded to ensure an adequate representation of all student subgroups (White, African American, Hispanic and Low Socioeconomic) as high schools in districts with low student enrollment may lack adequate, diverse representation of all student groups (Byrd & Drews, n.d.).

The demographic composition of the high schools was, on average, White (M = 39.1%, SD = 29.4%), African American (M = 15.3%, SD = 19.5%), Hispanic (M = 42.3%, SD = 31.1%), Low SES (M = 44.2%, SD = 26.4%) for the 2004-2005 school year; White (M = 37.7%, SD = 29.0%), African American (M = 16.3%, SD = 19.9%), Hispanic (42.6%, SD = 30.7%), Low SES (M = 46.0%, SD = 26.4%) for the 2005-2006 school year; and White (M = 36.8%, SD = 28.6%), African American (M = 15.8%, SD =

19.3%), Hispanic (M = 44.9, SD = 30.5), Low SES (M = 46.0%, SD = 25.6%) for the 2006-2007 school year.

These campuses maintained an average enrollment of 1935.44 students enrolled (SD = 687.9) for the 2004-2005 school year; 1985.57 students enrolled (SD = 730.3) for the 2005-2006 school year; and 1972.5 students enrolled (SD = 729.2) for the 2006-2007 school year.

Participant campuses spent an average of $3811.41 dollars per pupil on instruction (SD = $557.30) in 2004 – 2005; $3854.80 dollars per pupil on instruction (SD = $541.90) in 2005 – 2006; and $3934.71 dollars per pupil on instruction (SD = $590.7) in 2006 - 2007. However, when adjusted for inflation, the dollars per pupil spent on instruction in 2004 – 2005 actually exceeds the 2006 – 2007 dollars per pupil amount by $111.71 (“U.S. Department of Labor, n.d.).

## Variables Examined

### *Dependent Variable*

The dependent variable in this study was a multinomial categorical variable which indicates whether a school is Low Performing, Academically Acceptable or Recognized based on performance criteria outlined by the Texas Academic Excellence Indicator System (AEIS). One of the primary performance indicators in the AEIS system is the assessment instrument used by the state of Texas to assess student academic progress, the Texas Assessment of Knowledge and Skills (TAKS) test (Texas Education Agency, n.d.d., pp. 7-10).

The TAKS test is part of the Texas Assessment of Knowledge and Skills program, a comprehensive testing program for Texas public school students in grades

3-11. The TAKS program is designed to measure the extent a student has learned, understood, and is able to apply the knowledge and skills outlined in the Texas Essential Knowledge and Skills (TEKS) state curriculum at each grade level tested. Every TAKS test is directly linked to the Texas Essential Knowledge and Skills (TEKS), the state-mandated curriculum for Texas public school students (Texas Education Agency, n.d.d., pp. 7-10).

Students in grades 3 – 11 are tested during the spring semester of each school year. Students in grade 3 are tested in reading and mathematics; grade 4 in reading, mathematics and writing; grade 5 in reading, mathematics and science; grade 6 in reading and mathematics; grade 7 in reading, mathematics and writing; grade 8 in reading, mathematics, social studies and science; grade 9 in reading and mathematics; grade 10 in English language arts, mathematics, science and social studies; and grade 11 in English language arts, mathematics, science and social studies. The 11th grade exam is an exit-level test that students are required to pass in order to qualify for high school graduation, in addition to earning graduation course credits in the various high school subject areas (Texas Education Agency, n.d.d., pp. 11-22).

This study was conducted at the campus level using campus level data from the Texas Academic Excellence Indicator System (AEIS), school years 2003/2004 through 2006/2007 (Texas Education Agency, n.d.c.). Schools in Texas are given an AEIS report card that includes information about a school's academic performance, student population characteristics, staff characteristics and financial statistics. Schools are also rated on this system using a four-level rating indicator. The AEIS system rates schools as Academically Unacceptable (low performing), Academically Acceptable, Recognized or Exemplary.

Each AEIS rating level is derived from meeting minimum percentage standards of student academic performance criteria on the TAKS test in math, science, language arts, reading and social studies (Texas Education Agency, n.d.d., pp. 11-22). Additional criteria from performance on State Developed Alternative Assessments (SDAA II) for special education students and completion rates from prior school year graduating seniors are also included in the rating system.

The AEIS system also analyzes student subgroup performance. The subgroup categories analyzed include an All Students subgroup, African American subgroup, Hispanic subgroup, White subgroup and Economically Disadvantaged subgroup. The methodology for analysis is derived by taking the number of students passing the Texas Assessment of Knowledge and Skills exam and dividing that number by the number of students tested.

Minimum size requirements must also be met for these subgroups to be included in the rating system. Any student group with fewer than 30 students tested is not evaluated. Additionally, student subgroups with 30 to 49 students that also comprise 10% of all students tested are evaluated and if there are at least 50 students within a student subgroup, it is evaluated (Texas Education Agency, n.d.d., pp. 11-22). Each student subgroup rating is calculated subject-by-subject and, therefore, the number of student subgroups evaluated may vary between subjects in the same school.

A campus must meet minimum established percentage standards in all subgroups and subject indicators (up to 36). Failure to meet the minimum criteria for any of the 36 indicators will cause a campus not to meet a defined level of performance and the campus will drop to the lowest level of performance in that failed subgroup. The Academically Acceptable standard varies by subject, while the Recognized and Exemplary levels of performance are standard for each subject. Exemplary levels must meet 90% passing levels and Recognized levels are set at 75% passing for the students tested. Academically Acceptable standards vary: ELA/reading, writing and social studies require at least 65% passing; mathematics at least 45% passing; and science at least 40% passing (Texas Education Agency, n.d.d, p. 11). The Recognized level was selected for this study over the Exemplary level due to the small number of moderate to large high school campuses possessing the Exemplary status (Texas Education Agency, n.d.c)

### *Independent Variables*

Numerous variables exist in the AEIS database that could have been analyzed for this study. The variables selected were chosen because they are representative of several broad input categories, such as teacher inputs, financial inputs, student performance inputs, and administrative inputs that could affect student outcomes.

*Advanced Course/Dual Enrollment Completion.* This indicator is based on a count of students who complete and receive credit for at least one advanced course in grades 9-12. Advanced courses include dual enrollment courses. Dual enrollment courses are those for which a student gets both high school and college credit (Texas Education Agency, n.d.a).

*AP/IB Results.* This variable refers to the results of the College Board’s Advanced Placement (AP) examinations and the International Baccalaureate

Organization's International Baccalaureate (IB) examinations taken by Texas public school students. Students receiving advanced placement scores of 3, 4, or 5 on AP examinations and scores of 4, 5, 6, or 7 on IB examinations are used to calculate this statistic (Texas Education Agency, n.d.a, p.15).

*Average Teacher Tenure.* Weighted averages were obtained by multiplying each teacher's FTE count by years of experience. These amounts weresummed for all teachers and divided by the total teacher full-time equivalent (FTE) count, resulting in the averages shown. This measure refers to tenure, i.e., the number of years employed in the reporting district, whether or not there has been any interruption in service (Texas Education Agency, n.d.a, p. 6).

*Average Teacher Experience.* Weighted averages were obtained by multiplying each teacher's FTE count by years of experience. These amounts were summed for all teachers and divided by the total teacher FTE count, resulting in the averages shown. This measure refers to the total number of (completed) years of professional experience for the individual in any district (Texas Education Agency, n.d.a., p. 6).

*Average Teacher/Administrative Salary.* This statistic is calculated for teachers in three ways: a salary average for total years of experience, a salary for beginning teachers and as an average total base salary for all teachers. Total base administrative salaries are included as a separate data element. Total pay for teachers within each experience group is divided by the total teacher full-time equivalents for the group (Texas Education Agency, n.d.a, p.6).

*Class Size Averages by Grade and Subject.* These values show the average class size for secondary classes (by subject) for selected subjects. The class size averages are computed by the Texas Education Agency based on the teacher role and class schedule information (Texas Education Agency, n.d.a, p.8).

*Number of Students per Teacher*. This shows the total number of students divided by the total teacher full-time equivalent FTE count (Texas Education Agency, n.d.a, p.20).

*Percentage of Economically Disadvantaged Students.* The percent of economically disadvantaged students is calculated as the sum of the students coded as eligible for free or reduced-price lunch or eligible for other public assistance, divided by the total number of students (Texas Education Agency, n.d.a., p.15).

*Prior Year TAKS Failer Analysis* (*Progress of Prior Year TAKS Failers).* This indicator provides two measures that show the progress of students who failed the reading/ELA portion or the mathematics portion of the TAKS in the prior year.

The first measure is referred to as Percent of Failers Passing TAKS. Of the students who failed the TAKS in the prior year, this measure shows the percent that passed the corresponding assessment in the current year. The percentage is calculated using the number of matched students who failed in the prior year but passed in the current year divided by the number of matched students who failed in the prior year. The second measure is Average TGI Growth. For students who failed the TAKS in the prior year, this measure shows their average growth (or change) between the prior year and current year. This measure is calculated using the sum of individual student TGI values for students who failed in the prior year divided by the total number of students with TGI values who failed in the prior year (Texas Education Agency, n.d.a, pp. 20-21).

*Professional Staff*. This is a full-time equivalent (FTE) count percentage of teachers, professional support staff, and campus administrators. Each type of professional staff is shown as a percentage of the total staff FTE.

*Recommended High School Program.* The percent of graduates who were reported as having satisfied the course requirements for the Texas State Board of Education Recommended High School Program. This statistic is calculated using the number of graduates reported with graduation codes for Recommended High School Program or Distinguished Achievement Program divided by number of graduates (Texas Education Agency, n.d.a, p. 22).

*Return on Spending Index for Selected Spending Functions.* The Return on Spending Index (RoSI) (see Figure 9) for these variables measures the average return, in terms of student proficiency, on the money spent by a school district or school in a particular area on core activities (i.e. instruction or school leadership). This metric reveals the average level of student performance produced for a given level of spending. Although the index is not specifically a measure of marginal return, it is a proxy for exploring the relationship between student academic achievement and spending levels. The index provides a measure to be considered when evaluating comparative educational productivity of similar schools or school districts.

Values are expressed in units that indicate the percentage of students achieving proficiency on TAKS testing for every $1,000 spent per student in some area, such as instruction or school leadership. Generally, the higher the Return on Spending Index value, the better the return on spending, relative to schools with similar challenges and spending levels. This index is modified from work done by Gazzerro and Hampel (2004) and by Hampel (2004, 2005) at Standard & Poor's School Evaluation Services.

$$\text{Return on Spending Index} = 1000 \times \left( \frac{\begin{array}{c}\text{\% Students Passing}\\ \text{All TAKS Tests}\end{array}}{\begin{array}{c}\text{Total Spending on Some}\\ \text{Function per student}\end{array}} \right)$$

*Figure 9.* Return on Spending Index (RoSI)

*SAT/ACT Results.* These variables include information from the College Board's SAT and ACT, Incorporated's ACT assessments. Both testing companies annually provide the agency with testing information on the most recent test participation and performance of graduating seniors from all Texas public schools. Three indicators are examined in this study: percentage of graduates who took either the SAT or ACT; percentage of students at or above the TEA scoring criteria (1110 or the SAT or 24 for the ACT); and the mean score for the SAT or ACT (Texas Education Agency, n.d.a, pp. 22-23).

*Students with Disciplinary Placements.* The percent of students placed in alternative education programs under Chapter 37 of the Texas Education Code. This statistic is calculated using the number of students with one or more disciplinary placements divided by the number of students who were in attendance at any time during the school year (Texas Education Agency, n.d.a, p. 27).

*Student Mobility Percentage.* A student is considered to be mobile in a Texas public school if he or she has been in membership at the school for less than 83% of the school year (*i.e.,* has missed six or more weeks at a particular school). This rate was calculated at the campus level by dividing the number of mobile students in the prior school year by the number of students who were in membership at any time during the prior school year (Texas Education Agency, n.d.a., p. 19).

*Student Teacher Ratio.* The number of students divided by the total teacher full-time equivalent count (Texas Education Agency, n.d.a., p. 19)

*Teachers by Degree.* This is a district level statistic (the only district level statistic in the study). This statistic shows the distribution of degrees for teachers in the district. The full-time equivalent (FTE) counts of teachers with no degree, bachelor's, master's, and doctorate degrees are expressed as a percent of the total teacher FTEs (Texas Education Agency, n.d.a, p. 34).

*Texas Growth Index* (*TGI).* The Texas Growth Index (TGI) is an estimate of a student's academic growth on the TAKS tests over consecutive years, in consecutive grades. A *TGI* of zero means that the year-to-year change in average scale score is equal to the average predicted changes as calculated in the comparison years/grade levels. Positive scores indicate larger than expected growth and negative scores indicate smaller than expected growth.

*Texas Success Initiative* (*TSI).* The Higher Education Readiness Component. The Texas Success Initiative (TSI) is a program designed to improve student success in college. It requires students to be assessed in reading, writing and mathematics skills prior to enrolling in college, and to be advised based on the results of that assessment.

The qualifying scores are scale scores of 2200 on their TAKS mathematics and English language arts with a written composition score of 3 or higher on the writing component. This indicator shows the percent of students who achieved this level or proficiency by subject (Texas Education Agency, n.d.a, p. 34).

*Total Operating Expenditures by Function.* The total operating expenditures grouped by function of expense. The values used in this study are per pupil operating expenditures by function divided by the total number students in membership (Texas Education Agency, n.d.a, p. 35).

### *Procedure/Data Analysis*

Odden and Busch (1998) stated that school-level data are needed if true measures of accountability are to be implemented at the school level. In Texas, various forms of data are available and accessible from the Texas Academic Excellent Indicator System (AEIS) for Texas schools (Texas Education Agency, n.d.c). Teacher salary information; teacher experience in total and within a district; and campus-based student performance criteria on exams, such as performance on state standardized tests, the Scholastic Aptitude Test (SAT) and Advanced Placement (AP) exams are all easily accessible (Texas Education Agency, n.d.b). Picus (2003) stated that school districts across the country are quite similar in their practice and productivity. Picus (2003) also stated that analysis of school level data could prove beneficial in determining what spending levels matter in schools.

In order to focus on the educational productivity issue at the campus level, this study used campus-level data obtained from the Texas Education Agency for the academic years 2003 - 2004 through 2006 – 2007 for high schools with 900 or more students in grades 9 – 12. The data were used to analyze selected input variables and the effect they have at the school level for increasing educational productivity as measured by campus accountability ratings in Texas based on standardized testing performance (TAKS). All AEIS data were analyzed using a multinomial logistic regression model to analyze each school year as a separate entity, producing three separate sets of results.

The student input variables examined in this study were average class size in the core (math, science, English/language arts and social studies) subjects; SAT/ACT performance and participation; advanced course performance and participation; number of students following the Recommended High School Program; percentage of students in disciplinary alternative education programs (DAEP); percentage of economically disadvantaged students; campus mobility; TAKS Failer analysis; Texas Growth Index analysis and the Texas Success Initiative.

Staff variables examined in this study were teacher tenure; teacher experience; percentage of minority staff; teacher full-time equivalents based on years of teaching experience; teacher/student classroom ratios; district-level statistics pertaining to percentage of teaching staff with bachelor’s, masters or doctorate degrees; average campus level administrative salaries and average campus level teaching salaries broken down by years of experience. Fiscal variables included in the analysis were Return on Spending Indexes for instruction, instructional leadership, school leadership, instruction related services and student support services; and per pupil spending totals for instruction, instructional leadership, school leadership, instructional related services, student support services and total per pupil spending per campus.

## Multinomial Logistic Regression

Multinomial logistic regression analysis is a specialized form of regression that is used to predict and explain the effects on independent variables on a categorical dependent variable rather than a metric dependent variable as in multiple regression. Multinomial logistic regression was the analytical method used in this study. This statistical method was employed to analyze the relationship between the categorical dependent variable, school accountability rating, and the independent staff, student and fiscal variables. The variate in logistic regression represents a single multivariate relationship with regression-like coefficients indicating the relative impact of each predictor variable on the dependent variable (Hair, et. al, 2006, p. 275). Multinomial logistic regression can be used to predict dependent variables on the basis of continuous and/or categorical variables. The impact of these predictor variables is explained in terms of odds ratios (Garison, 2008).

Multinomial logistic regression is similar in many ways to multiple regression. However, rather than predicting Y from a group of predictor variables, multinomial logistic regression predicts the probability of Y occurring given known values of the predictor variables (Field, 2005, pp. 219-220). Figure 10 presents the basic equation for multinomial logistic regression.

$$P(Y)=\frac{1}{1+e^{-(b_0+b_1X_1+b_2X_2+\ldots b_nX_n+\varepsilon_i)}}$$

*Figure 10.* Multinomial Logistic Regression Equation

Multinomial logistic regression applies maximum likelihood estimation to determine the probability of a certain event occurring (the dependent outcome). The method does not assume linearity of relationship between the independent variables and the dependent variable nor does it require normally distributed independent variables or homoscedasticity assumptions be met. For this reason, there is no need to analyze the data for these qualities prior to running the analysis model. Logistic regression does require independent observations and that the independent variables be linearly related to the logit (i.e. logarithm of the odds) of the dependent variable.

Using the multinomial logistic regression model, the study will predict the probability of a campus being Low Performing or Recognized using Academically Acceptable as the reference category. Analyses of the log-likelihood statistic generated by the Statistical Package for the Social Sciences were used to determine how well the statistical model fits the data. Analysis of the *Exp b* statistic to measure the effect of a change in the odds of each outcome variable (Low Performing or Recognized) occurring as a result of a unit change in a predictor variable was used to analyze the effect of each of these variables variable.

The data entry method applied was the forced entry method. Some researchers have recommended this method for theory testing because other methods, such as stepwise methods, are likely to be influenced by random variation in the data (Studenmund, 2000, as cited in Field, 2005, p.226).

Missing values were checked for and deleted, because the sample size of this analysis would be enough to maintain adequate statistical power after deletion of missing values to detect medium to large effects (school years 2004-2005 (N = 430), 2005-2006 (N = 423) and 2006-2007 (N = 444) (Field, 2005, p.32). Residuals were examined to analyze the effect outliers may have with regard to excessive influence on the model. Standardized residuals were used, along with analysis of residual plots.

Standardized residuals greater than ± 2.0 to 2.5 were carefully treated as potential outliers that might influence the data (Field, 2005, p.246). Schools with standardized residuals greater than or equal to 2.0 were removed from the data and the model was reevaluated. If the model with the outliers removed improved the classification accuracy rate of the more than 2%, the model with the outliers removed was interpreted (Schwab, 2007b).

Multicollinearity was examined to determine if there is a strong correlation between predictor variables in the model. Standard errors (S.E.) for each independent variable were examined for evidence of multicollinearity. Independent variables with S.E. values greater than or equal to 2.0 were evaluated for possible removal from the model. Confidence intervals for odds ratios (*Exp(B)*) were reported as an indicator of the range of a change values in the odds resulting from a unit change in each predictor variable (Field, 2005, p.254).

## Summary

This study determined the predictive value of selected input variables on the academic success of moderate to large Texas high schools. Using multinomial logistic regression, the study determined the odds of a school being either Recognized or Academically Acceptable in the Texas accountability system, based on the effect of 11 input variables taken from the Academic Excellence Indicator System (AEIS), a state database housing data on public school districts and individual schools in Texas.

# CHAPTER IV

# ANALYSIS

The purpose of this study was to determine the predictive value of educational input variables on the academic success of Texas high schools with student populations greater than or equal to 900. This study examined the effect of three categories of campus based input variables - student, staff and fiscal - on campus accountability rating during three school year periods 2004 - 2007. Each school year was analyzed separately.

Multinomial logistic regression was the mode of analysis used in this study. The statistical significance of the chi-square statistic generated by the likelihood ratio tests was used to determine variables included in the model for each category and for the group of combined study variables for each of the three yearly data sets. Original logistic coefficients (B) were used to determine direction of relationship with regard to group inclusion (i.e. recognized, academically acceptable or low performing).

Exponentiated logistic coefficients or odds ratios (exp(b)) of included variables were evaluated to determine the effect of the magnitude of the change in the odds value of each variable (Hair, et. al., 2006, p. 365). Proportional by chance accuracy rates were compared to overall accuracy rates to determine usefulness of the multinomial logistic regression model. To determine the greatest level of predictive accuracy for the model, a 25% improvement in the overall accuracy rate for each analysis was the selected standard (Schwab, 2007a). The results of the study are reported below. In total, 60 variables were included in this study for each year analyzed - 30 were student variables, 19 were staff variables and 11 were fiscal variables.

## Descriptive Statistics

### *Year 1 Descriptive Statistics*

Table 1 displays the descriptive statistics for the staff variables evaluated in the Year 1 study. School administrator base salary averages ranged from a maximum $93,736.00 to a minimum $48,193.00 with a mean salary average of $66,175.79 and a standard deviation of $6186.00. Teacher base salary averages for teachers with 1 to 5 years of teaching experience ranged from a maximum $43,318.00 to a minimum $26,604.00 with a mean salary average of $36,695.24 and a standard deviation of $3246.88.

Table 1

*Descriptive Statistics 2004-2005 Staff Variables*

| Variable | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|
| School Admin Total Base Salary Average | 66175.7900 | 6185.98800 | 48193.00 | 93736.00 |
| Teacher 1-5 Years Base Salary Average | 36695.2400 | 3246.88200 | 26604.00 | 43318.00 |
| Teacher > 20 Years Base Salary Average | 53207.1000 | 4319.09700 | 39804.00 | 63215.00 |
| Teacher Tenure Average | 8.1265 | 2.15829 | 2.62 | 16.17 |
| All Staff Minority Full Time Equiv Percent | 31.6499 | 26.01247 | .00 | 96.59 |

Teachers with more than 20 years experience had a base salary average maximum of $63,215.00 to a minimum of $39,804.00 with a mean base salary average of $53,204.10 and a standard deviation of $4319.10. Teacher tenure average expressed as years employed on the campus ranged from a maximum of 16.17 years to a minimum of 2.62 years with a mean year average of 8.13 years and a standard deviation of 2.16 years. The percentage of full-time equivalent minority staff on campuses in the study ranged from a maximum 97% to a minimum 0% with a mean average percentage of 31.7% and a standard deviation of 26.01%.

Campus staff variables omitted from the logistic regression model due to multicollinarity are not listed in the staff variable descriptive table. These variables include: teacher base salary averages for teachers with 6 to 10 years of experience; teacher base salary averages for teachers with 11 to 20 years of experience; full-time equivalent percentages for beginning teachers, teachers with 1-5 years experience, 6-10 years experience, 11-20 years experience and more than 20 years experience; total teacher experience averages for all staff on a campus; beginning teacher full-time equivalent (FTE) percentage by campus; student teacher ratios; teacher total base salary averages; beginning teacher base salary averages; and district level percentages of teachers with master’s degrees, bachelors degrees and doctorate degrees, respectively.

Table 2 displays the descriptive statistics for the student variables in the Year 1 study. Average science class size ranged from a maximum 43.2 students per class to a minimum 15.3 students per class with a mean of 23.04 students per class and a standard deviation of 3.65 students. Average class size for social studies classes ranged from a maximum 45.8 students per class to a minimum 17.6 students per class with a mean of 24.6 students per class and a standard deviation of 3.8 students.

Students meeting the Texas Education Agency established criteria on the Scholastic Aptitude Test (SAT) of 1110 and 24 on the American College Testing examination (ACT) ranged from a maximum of 70.7% of all students taking the SAT to a minimum of 0% with a mean percentage of 23% and a standard deviation of 15.4%. The mean SAT score (Test-takers SAT Rate) ranged from a maximum 1186 to a minimum 664 with an average mean score of 958 and a standard deviation of 100.

Table 2

*Descriptive Statistics 2004-2005 Student Variables*

| Variables | Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|
| Class Size: Sec Science – Avg. Size | 23.039 | 3.6511 | 15.3 | 43.2 |
| Class Size: Sec Soc. Stud. – Avg. Size | 24.635 | 3.8301 | 17.6 | 45.8 |
| SAT/ACT: All Students % Above Criterion | 22.992 | 15.3989 | .0 | 70.7 |
| SAT/ACT: All Students Test - Takers SAT Rate | 957.970 | 99.9820 | 664.0 | 1186.0 |
| Eco. Dis. Percent | 44.295 | 26.1433 | 1.5 | 97.9 |
| Campus Mobility Percent | 20.120 | 6.2818 | 4.5 | 41.6 |
| Percent of 2004 TAKS Math Student Failers Who Passed 2005 TAKS Math | 29.250 | 9.6230 | 9.0 | 71.0 |
| Texas Success Initiative All Students Mathematics Rate | 45.660 | 15.7090 | 6.0 | 88.0 |

Campus mobility percentage ranged from a maximum 41.6 percent to a minimum 4.5 percent with a mean mobility percentage of 20.1 and standard deviation of 6.28. The percentage of students failing the 2004 TAKS math exam that passed the 2005 TAKS math exam ranged from a maximum 71% to a minimum 9% with a mean percentage of 29.25% and a standard deviation of 9.6%.

The Texas Success Initiative (TSI), also referred to as the Higher Education Readiness Component, refers to a scale score on the Texas Assessment of Knowledge and Skills (TAKS) exam of 2200. The percentage of students meeting this criterion ranged from a maximum 88% to a minimum 6% with a mean average of 45.7% and a standard deviation of 15.7%.

Student variables omitted from the logistic regression model due to multicollinarity are not listed in the student variable descriptive table. These variables include: class size averages in English and mathematics classes; the percentage of students taking the SAT/ACT exams; campus mean ACT score; advanced course/dual enrollment completion rates for all students and economically disadvantaged students; the percentage of students on the recommended high school program – all students and economically disadvantaged students categories; the percentage of students scoring above the criterion level on advanced placement and international baccalaureate courses; the percentage of students taking advanced placement or international baccalaureate courses; the percentage of student scores above the criterion level on advance placement and international baccalaureate courses; the percentage of students assigned to a disciplinary alternative educational setting

(DAEP); the percentage of students that failed the 2004 TAKS reading/ELA exam who passed the 2005 TAKS reading/ELA exam for both the all students category and the economically disadvantaged students category; the percentage of students that failed the 2004 TAKS exam in mathematics but passed the 2005 TAKS mathematics exam in the economically disadvantaged students category; the Texas Growth Index for mathematics and reading in both the all students category and economically disadvantaged students category; and the percentage of students meeting the Texas Success Initiative (TSI)/Higher Education Readiness component score (TAKS score) for economically disadvantaged students in mathematics and for both all students and economically disadvantaged students in reading.

Table 3 contains the fiscal variables analyzed in the Year 1 study. The Return on Spending Index (RoSI) for instruction had a maximum index score of 26.24 and a minimum index score of 2.89 with a mean index of 13.42 and a standard deviation of 5.06. Instructional spending per pupil ranged from a maximum $6578.00 to a minimum $2765.00 with a mean spending level of $3805.02 and a standard deviation of $558.31. Expenditures on instructional leadership ranged from a maximum $428.00 per pupil to a minimum of zero dollars spent on instructional leadership per pupil with a mean spending level of $88.03 and a standard deviation of $48.24.

Table 3

*Descriptive Statistics 2004-2005 Fiscal Variables*

| Variables | Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|
| RoSI Instruction | 13.4146 | 5.06035 | 2.89 | 26.24 |
| Expenditure by Function-Instruction Per Pupil, All Funds | 3805.0200 | 558.30600 | 2765.00 | 6578.00 |
| Expenditure by Function-Instructional Leadership Per Pupil, All Funds | 88.0300 | 48.24400 | 0.00 | 428.00 |

Fiscal variables omitted from the logistic regression model due to multicollinarity are not listed in the fiscal variable descriptive table. These variables include: the return on spending indexes for instructional leadership, school leadership, instruction related services and support services; and expenditures per student from all available funds for school leadership, the total school program,  instruction related services and support services. Table 4 contains the combined study variables chosen for the Year 1 study. Variables from the three groups of variables in Tables 1, 2 and 3 above were combined for the study group analysis.

The study variables from all three groups (staff, student, fiscal) were combined and were analyzed using multinomial logistic regression. In the initial model, the complete set of study variables from the staff, student and fiscal groups were analyzed for multicollinearity - standard errors greater than or equal to 2.0 in the parameter estimates of the analysis - (Schwab, 2007a). Variables shown to have standard errors greater than 2.0 were removed from the analysis one at a time beginning with the variable with the largest standard error. Subsequent analyses using this method were conducted repeatedly until the final group of study variables produced no standard errors above 2.0. Note that Table 4 contains the variables that remained after the analysis for multicollinarity.

A number of variables were omitted from the combined analysis in this study due to multicollinearity. These variables were: all fiscal variables; teacher base salary averages for teachers with 1-5 years experience; minority staff full-time equivalents percentages; class size averages for both science classes and social studies classes; and campus mean SAT scores.

Table 4

*Descriptive Statistics 2004-2005 Study Variables*

| | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|
| School Admin Total Base Salary Average | 66175.7900 | 6185.9880 | 48193.00 | 93736.00 |
| Teacher > 20 Years Base Salary Average | 53207.1000 | 4319.0970 | 39804.00 | 63215.00 |
| Teacher Tenure Average | 8.1265 | 2.15829 | 2.62 | 16.17 |
| SAT/ACT: All Students % Above Criterion | 22.9920 | 15.3989 | .00 | 70.70 |
| Eco. Dis. Percent | 44.2950 | 26.1433 | 1.50 | 97.90 |
| Campus Mobility Percent | 20.1200 | 6.2818 | 4.50 | 41.60 |
| Percent 2004 TAKS Math Students Failers Who Passed 2005 TAKS Math | 29.2500 | 9.6230 | 9.00 | 71.00 |

*(table continues)*

Table 4 (*continued).*

| | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|
| Texas Success Initiative All Students Mathematics Rate | 45.6600 | 15.7090 | 6.00 | 88.00 |

*Year 1 Bivariate Statistics*

Spearman's rho correlation analysis was conducted on each group of variables (i.e. staff, student, fiscal and combined study variables) to determine levels of statistically significant correlation between variables. Table 5 contains the Spearman's rho bivariate correlations for the staff variables.

Statistically significant correlations exist among school administration base salaries and teacher base salaries for 1-5 years experience and for teachers with more than 20 years experience and teacher tenure (*p* < .01). Additionally, statistically significant correlations exist between base salary averages for teachers with 1-5 years experience; base salary averages for teachers with more than 20 years experience (*p* < .01) and minority staff full-time equivalents (*p* < .05).

Table 5

*Spearman' s rho Correlations for 2004 – 2005 Staff Variables*

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| School Admin Total Base Salary Average (1) | 1.00 | | | | |
| Teacher 1-5 Years Base Salary Average (2) | .537** | 1.000 | | | |

(*table continues)*

Table 5 (*continued).*

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Teacher > 20 Years Base Salary Average (3) | .542** | .824** | 1.000 | | |
| Teacher Tenure Average (4) | .135** | -.043 | .171** | 1.000 | |
| All Staff Minority Full Time Equiv Percent (5) | .049 | .107* | .266** | .332** | 1.000 |

*N*=430; ** *p* <.01 level (2-tailed); * *p* < .05 level (2-tailed).

Statistically significant relationships exist among teacher base salary averages for teachers with more than 20 years experience and minority staff full-time equivalents and teacher tenure averages (*p* <.01). Lastly, statistically significant correlations exist between teacher tenure and minority staff full-time equivalents (*p* < .01).

Table 6 contains the Spearman's rho bivariate statistics for the student variables in the Year 1 data. Statistically significant correlations exist between average class size in science classes and average class size in social studies classes (*p* < .01). Average class size in social studies correlates positively with SAT/ACT students scoring above the established criteria and negatively with percentage of economically disadvantaged students (*p* <.05). Average social studies class size also correlates significantly with student TAKS failers and the TSI all students mathematics rate (*p* < .01). All variables show a statistically significant correlation with all students scoring above criteria on SAT/ACT with the exception of average science class size.

Table 6

*Spearman's rho Correlations for 2004 - 2005 Student Variables*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Class Size: Science- Avg. Size (1) | 1.000 | | | | | | | |
| Class Size: Soc Stud Avg. Size (2) | .758** | 1.000 | | | | | | |
| SAT/ACT: All Students % Above Criterion (3) | .032 | .120* | 1.000 | | | | | |
| SAT/ACT: All Students Test-Takers SAT Rate (4) | -.017 | .071 | .952** | 1.000 | | | | |
| Eco. Dis. Percent (5) | -.047 | -.115* | -.856** | -.808** | 1.000 | | | |
| Campus Mobility Percent (6) | .004 | -.047 | -.629** | -.628** | .697** | 1.000 | | |
| Percent of 2004 Student Failers Who Passed 2005 TAKS Math(7) | .042 | .152** | .584** | .582** | -.653** | -.598** | 1.000 | |
| Texas Success Initiative All Students Math Rate (8) | .044 | .129** | .847** | .822** | -.804** | -.668** | .734** | 1.000 |

*N*=430; ** *p* <.01 level (2-tailed); * *p* < .05 level (2-tailed).

The mean SAT score statistic (# 4) correlates strongly with all variables except average class sizes in science and social studies (*p* < .01). Percentages of economically disadvantaged students significantly correlate with all variables except average science class size. Campus mobility percentages significantly correlate with all variables except the class size variables. Both percentage of student TAKS mathematics failers and TSI all students math rate percentages correlate significantly with all variables except average class size in science (*p* < .01).

Spearman's rho correlations for the fiscal variables are contained in Table 7. Correlations exist between the Return on Spending Index (RoSI) for instructional spending and both per pupil instructional spending and per pupil spending on instructional leadership. Instructional spending per pupil is also correlated to per pupil spending on instructional leadership (*p* < .01).

Table 7

*Spearman's rho Correlations for 2004 - 2005 Fiscal Variables*

| | 1 | 2 | 3 |
|---|---|---|---|
| RoSI – Instruction (1) | 1.000 | | |
| Expenditure by Function-Instruction Per Pupil, All Funds (2) | -.559** | 1.000 | |
| Expenditure by Function-Instructional Leadership Per Pupil, All Funds (3) | -.308** | .265** | 1.000 |

*N*=430; ** *p* <.01 level (2-tailed).

Bivariate correlations were also established for the combined study variables. Table 8 contains the correlations for the combined study variables. Base administrative salary average is correlated to the teacher base salary average for teachers with more than 20 years experience and also teacher tenure averages ($p < .01$). Teacher salary averages for teachers with more than 20 years experience is also correlated with teacher tenure average, SAT/ACT all students criterion average and campus mobility percentage ($p < .01$). This variable is also correlated with the percentage of economically disadvantaged students and the TSI mathematics rate ($p < .05$).

Teacher tenure is correlated with SAT/ACT all students criterion, percent economically disadvantaged students, campus mobility percentage, TAKS math failers and the TSI mathematics rate ($p < .01$). The SAT/ACT all students criterion is correlated to percent economically disadvantaged students, campus mobility, TAKS mathematics failers and TSI mathematics rate ($p < .01$). There are strong correlations among the remaining variables, campus mobility percentage, TAKS mathematics failers and TSI all students math rate as well ($p < .01$).

Table 8

*Spearman' s rho Correlations for 2004 - 2005 Combined Analysis Variables*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| School Admin Total Base Salary Average (1) | 1.000 | | | | | | | |
| Teacher > 20 Years Base Salary Average (2) | .542** | 1.000 | | | | | | |

*(table continues)*

Table 8 *(continued).*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Teacher Tenure Average(3) | .135** | .171** | 1.000 | | | | | |
| SAT/ACT: All Students % Above Criterion (4) | .059 | -.128** | -.192** | 1.000 | | | | |
| Eco. Dis. Percent (5) | -.078 | .108* | .332** | -.856** | 1.000 | | | |
| Campus Mobility Percent (6) | -.029 | .187** | .215** | -.629** | .697** | 1.000 | | |
| Percent of 2004 TAKS Math Failers Who Passed 2005 TAKS Math (7) | .074 | -.080 | -.239** | .584** | -.653** | -.598** | 1.000 | |
| Texas Success Initiative All Students Mathematics Rate (8) | .075 | -.100* | -.171** | .847** | -.804** | -.668** | .734** | 1.000 |

*N*=430; ** *p* <.01 level (2-tailed); * *p* < .05 level (2-tailed).

## Analysis

Academically Acceptable campuses were used as the reference category for Recognized campuses and Low Performing campuses in the multinomial logistic regression model. The analysis of all four categories of predictor variables (student, staff, fiscal variables and combined study variables) were entered into separate multinomial logistic regression analyses.

For each analysis, the likelihood ratio test was analyzed for statistical significance using the chi-square statistic. To create more parsimonious groups of input variables for each category, variables that were not statically significant were dropped from each of the four models (student, staff, fiscal and combined study variables) and additional logistic analyses were conducted for each group of variables to produce the more efficient (*p*arsimonious) model (Garson, 2008). However, if dropping a variable that was not statistically significant from the group lowered the overall predictive power of the model, the variable was included in the analysis.

### *Results of Year 1 Staff Variable Analysis*

The model fitting analysis supports a statistically significant relationship between the staff variables and the campus accountability rating ($\chi^2 = 56.31$, $df = 10$, $N = 419$, $p < .001$). Table 9 contains the likelihood ratio test for the staff variables.

Table 9

*Likelihood Ratio Tests 2004 – 2005 Staff Variables*

| | Model Fitting Criteria | Likelihood Ratio Tests | | |
|---|---|---|---|---|
| Effect | -2 Log Likelihood of Reduced Model | Chi-Square | df | Sig. |
| Intercept | 206.316 | 31.831 | 2 | .000 |
| School Admin Total Base Salary Average | 179.804 | 5.319 | 2 | .070 |
| Teacher > 20 Years Base Salary Average | 183.102 | 8.617 | 2 | .013 |
| Teacher Tenure Average | 176.677 | 2.192 | 2 | .334 |
| Teacher 1-5 Years Base Salary Average | 176.040 | 1.555 | 2 | .459 |

*(table continues)*

Table 9 *(continued).*

| | Model Fitting Criteria | Likelihood Ratio Tests | | |
|---|---|---|---|---|
| Effect | -2 Log Likelihood of Reduced Model | Chi-Square | df | Sig. |
| All Staff Minority Full Time Equiv. Percent | 203.910 | 29.425 | 2 | .000 |

*Note.* The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Note that in the analysis of staff variables the teacher base salary statistic for teachers with more than 20 years experience ($\chi^2 = 8.62$, $p < .05$) and the minority staff full-time equivalent percentage ($\chi^2 = 29.43$, $p < .001$) are statistically significant with regard to their relationship with the dependent variable. The remaining variables in the analysis, administrative base average salary ($\chi^2 = 5.32$, $p > .05$), teacher tenure ($\chi^2 = 2.19$, $p > .05$) and teachers with 1 to 5 years experience salary average ($\chi^2 = 1.56$, $p > .05$) are not statistically significant.

Table 10 presents the parameter estimates and odds ratios for the staff variables for low performing schools, which suggest that both administrative base salary average ($p < .05$) and minority staff full-time equivalent percentage ($p < .01$) are statistically significant. Although the school administrative base salary average is statistically significant in distinguishing between low performing and academically successful campuses in the parameter estimates, it is not statistically significant in its overall relationship to the dependent variable in the likelihood ratio test. Therefore, the significance of this variable should not be interpreted (Schwab, 2007a).

Table 10

*Parameter Estimates Staff Variables 2004 - 2005 Low Performing Schools*

| Variable | B | Std. Error | Wald | Sig. | *Exp(B)* | 95% Confidence Interval for *Exp(B)* Lower Bound | 95% Confidence Interval for *Exp(B)* Upper Bound |
|---|---|---|---|---|---|---|---|
| Intercept | -17.401 | 5.284 | 10.846 | .001 | | | |
| School Admin Total Base Salary Average | .000 | .000 | 4.862 | .027 | 1.000 | 1.000 | 1.000 |
| Teacher > 20 Years Base Salary Average | .000 | .000 | .020 | .888 | 1.000 | 1.000 | 1.000 |
| Teacher Tenure Average | .200 | .162 | 1.527 | .217 | 1.221 | .890 | 1.676 |
| Teacher 1-5 Years Base Salary Average | .000 | .000 | .094 | .759 | 1.000 | 1.000 | 1.001 |
| All Staff Minority Full Time Equiv. Percent | .041 | .015 | 7.857 | .005 | 1.042 | 1.012 | 1.072 |

*Note.* The reference category is: Academically Acceptable

Full-time equivalent minority staff percentage (*Exp*(*B)* = 1.042, 95% *CI* = 1.012 – 1.072) is significant in its overall relationship to accountability rating and, for every unit increase in this variable, the odds of a campus being a low performing campus increase by 1.042 times. The remaining staff variables are not interpreted due to a lack of statistical significance in both their overall relationship to the dependent variable and in their ability to distinguish between levels of accountability.

Table 11 contains the parameter estimates and odds ratios for recognized schools, using the academically acceptable accountability rating as the reference category. Note that minority staff full-time equivalent percentage ($p < .01$) is the only variable that is interpreted at this level due to its statistical significance in its overall relationship to the dependent variable – accountability rating – and its ability to distinguish between levels of accountability. The remaining variables are not to be interpreted for recognized schools. Full-time equivalent minority staff percentage (*Exp* (*B)* = .901, 95% *CI* = .845 - .962) decreases the odds of a campus being a recognized school by 10% for a one unit increase in this variable. The remaining variables are not to be interpreted due to their lack of statistical significance in either their overall relationship to the dependent variable or in their inability to distinguish between levels of accountability (Schwab, 2007a).

Table 11

*Parameter Estimates Staff Variables 2004 – 2005 Recognized Schools*

| | | | | | | 95% Confidence Interval for *Exp(B)* | |
|---|---|---|---|---|---|---|---|
| Variable | B | Std. Error | Wald | Sig. | *Exp(B)* | Lower Bound | Upper Bound |
| Intercept | -18.609 | 5.240 | 12.610 | .000 | | | |
| School Admin Total Base Salary Average | .000 | .000 | .879 | .348 | 1.000 | 1.000 | 1.000 |
| Teacher > 20 Years Base Salary Average | .000 | .000 | 7.471 | .006 | 1.000 | 1.000 | 1.001 |
| Teacher Tenure Average | -.124 | .164 | .573 | .449 | .883 | .640 | 1.218 |
| Teacher 1-5 Years Base Salary Average | .000 | .000 | 1.478 | .224 | 1.000 | .999 | 1.000 |
| All Staff Minority Full Time Equiv. Percent | -.104 | .033 | 9.914 | .002 | .901 | .845 | .962 |

*Note.* The reference category is: Academically Acceptable

To determine the utility of the model for predicting group membership, classification accuracy was used to compare predicted group membership based on the multinomial logistic model to the actual, known group membership, which is the value for the dependent variable. The benchmark chosen as a rate of improvement over chance alone is 25%. If the independent variables had no relationship to campus accountability rating, there remains a chance of being correct in predictions of group membership to some degree. This is referred to as by chance accuracy. The estimate of by chance accuracy is the proportional by chance accuracy rate, computed by summing the squared percentage of cases in each group (Schuab, 2007a).

The case processing summaries found in Table 12 and Table 13 contain the predicted classification rates from the logistic model for predicting group membership. The proportional by chance accuracy rate for this model is 88.2% and the actual predictive value of the model is 93.6%.

Table 12

*Case Summary for Staff Variables 2004 – 2005*

| Totals | N | Marginal Percentage |
|---|---|---|
| Recognized | 14 | 3.3% |
| Low Performing | 12 | 2.9% |
| Academically Acceptable | 393 | 93.8% |
| Valid | 419 | 100.0% |
| Missing | 0 | |
| Total | 419 | |
| Subpopulation | 419 | |

*Note.* The dependent variable has only one value observed in 419 (100.0%) subpopulations.

Table 13

*Classification Table for 2004 – 2005 Staff Variables*

| Observed | Predicted | | | |
|---|---|---|---|---|
| | Recognized | Low Performing | Academically Acceptable | Percent Correct |
| Recognized | 0.0 | 0.0 | 14.0 | 0.0% |
| Low Performing | 0.0 | 0.0 | 12.0 | 0.0% |
| Academically Acceptable | 1.0 | 0.0 | 392.0 | 99.7% |
| Overall Percentage | 0.2% | 0.0% | 99.8% | 93.6% |

A 25% improvement in the proportional by chance accuracy rate is desired to interpret this model at its greatest level of usefulness at predicting campus accountability ratings. Therefore, improvements that produce less than 25% improvement in the model should be interpreted with caution (Schwab, 2007a).

*Results of Year 1 Student Variable Analysis*

Model fitting analysis supports a statistically significant relationship between the staff variables and campus accountability rating ($\chi^2 = 243$, *df* = 16, *N* = 430, $p < .001$). Table 14 contains the likelihood ratio tests for the student variable analysis. Note that all student variables, with the exception of SAT/ACT test takers rate for all students ($\chi^2 = 2.1$, $p > .05$) and the percentage of economically disadvantaged students ($\chi^2 = 1.8$, $p > .05$) which are not statistically significant in their relationship to campus accountability, the remaining student variables are statistically significant with regard to their overall relationship to campus accountability.

Table 14

*Likelihood Ratio Tests 2004 – 2005 Student Variables*

| Effect | Model Fitting Criteria | Likelihood Ratio Tests | | |
|---|---|---|---|---|
| | -2 Log Likelihood of Reduced Model | Chi-Square | df | Sig |
| Intercept | 58.162 | 4.747 | 2 | .093 |
| Class Size: Sec Science – Avg. Size | 68.213 | 14.798 | 2 | .001 |
| Class Size: Sec Soc. Stud. – Avg. Size | 73.826 | 20.411 | 2 | .000 |
| SAT/ACT: All Students % Above Criterion | 62.140 | 8.725 | 2 | .013 |
| SAT/ACT: All Students Test - Takers SAT Rate | 55.483 | 2.068 | 2 | .356 |
| Eco. Dis. Percent | 55.264 | 1.849 | 2 | .397 |
| Percent of 2004 TAKS Math Student Failers Who Passed 2005 TAKS Math | 92.291 | 38.875 | 2 | .000 |
| Campus Mobility Percent | 67.966 | 14.551 | 2 | .001 |
| Texas Success Initiative All Students Mathematics Rate | 67.902 | 14.487 | 2 | .001 |

*Note.* The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Table 15 displays the parameter estimates and odds ratios for the student variables for low performing schools. Note that only average class size in science (*p* <

.05) and average class size in social studies ($p < .05$) are statistically significant in their ability to differentiate between academically acceptable and low campus performance. Specifically, for each unit increase in average class size in science classes (*Exp*(*B)* = 2.9, 95% *CI* = 1.33 – 6.5), campuses have a 2.9 times greater chance of being low performing campuses, whereas for each unit increase in average class size in social studies (*Exp*(*B)* = .31, 95% *CI* = .12 – .77), campuses have a 69% less chance of being low performing campuses. The remaining student variables are not interpreted due to a lack of statistical significance in either their overall relationship to the dependent variable (Schwab, 2007a).

Table 15

*Parameter Estimates Student Variables 2004 - 2005 Low Performing Schools*

| | | | | | | 95% Confidence Interval for *Exp(B)* | |
|---|---|---|---|---|---|---|---|
| Variable | B | Std. Error | Wald | Sig. | *Exp(B)* | Lower Bound | Upper Bound |
| Intercept | 8.322 | 15.624 | .284 | .594 | | | |
| Class Size: Sec Science – Avg. Size | 1.080 | .405 | 7.107 | .008 | 2.944 | 1.331 | 6.512 |
| Class Size: Sec Soc. Stud. – Avg. Size | -1.182 | .471 | 6.282 | .012 | .307 | .122 | .773 |
| SAT/ACT: All Students % Above Criterion | -.546 | .335 | 2.654 | .103 | .579 | .300 | 1.117 |
| SAT/ACT: All Students Test - Takers SAT Rate | -.006 | .018 | .126 | .722 | .994 | .960 | 1.029 |
| Eco. Dis. Percent | .001 | .051 | .000 | .988 | 1.001 | .905 | 1.107 |
| Campus Mobility Percent | .137 | .111 | 1.514 | .219 | 1.147 | .922 | 1.427 |

*(table continues)*

Table 15 *(continued).*

| Variable | B | Std. Error | Wald | Sig. | *Exp(B)* | 95% Confidence Interval for *Exp(B)* | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| Intercept | 8.322 | 15.624 | .284 | .594 | | | |
| Percent of 2004 TAKS Math Student Failers Who Passed 2005 TAKS Math | .006 | .186 | .001 | .976 | 1.006 | .698 | 1.448 |
| Texas Success Initiative All Students Mathematics Rate | -.208 | .107 | 3.778 | 1 | .052 | .812 | .659 |

*Note.* The reference category is: Academically Acceptable.

The parameter estimates and odds ratios for student variables as they relate to recognized campuses are contained in Table 16. The percentage of students scoring above the SAT/ACT established criterion score ($p = .05$), the percentage of economically disadvantaged students ($p < .05$) and the campus mobility percentage ($p < .05$) are all statistically significant in differentiating campus accountability ratings.

Table 16

*Parameter Estimates Student Variables 2004 - 2005 Recognized Schools*

| Variable | B | Std. Error | Wald | Sig. | *Exp(B)* | 95% Confidence Interval for *Exp(B)* Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|
| Intercept | -109.785 | 56.247 | 3.810 | .051 | | | |
| Class Size: Sec Science – Avg. Size | -.690 | .528 | 1.710 | .191 | .501 | .178 | 1.411 |
| Class Size: Sec Soc. Stud. – Avg. Size | .801 | .425 | 3.553 | .059 | 2.227 | .969 | 5.119 |
| SAT/ACT: All Students % Above Criterion | -.634 | .324 | 3.830 | .050 | .531 | .281 | 1.001 |
| SAT/ACT: All Students Test - Takers SAT Rate | .072 | .051 | 2.031 | .154 | 1.075 | .973 | 1.187 |
| Eco. Dis. Percent | -.948 | .398 | 5.693 | .017 | .387 | .178 | .844 |
| Campus Mobility Percent | .622 | .225 | 7.655 | .006 | 1.863 | 1.199 | 2.895 |
| Percent of 2004 TAKS Math Failers Who Passed 2005 TAKS Math | .528 | .274 | 3.714 | .054 | 1.695 | .991 | 2.900 |
| Texas Success Initiative All Students Mathematics Rate | .528 | .274 | 3.714 | 1.000 | .054 | 1.695 | .991 |

*Note.* The reference category is: Academically Acceptable

However, the percentage of economically disadvantaged students variable was not significant in its overall relationship to campus accountability and therefore was not interpreted in this analysis. Campuses with an increasing percentage of students scoring above the SAT/ACT scoring criterion (*Exp*(*B)* = .53, 95% *CI* = .281 – 1.0) have a 47% less chance of being recognized campuses. Campuses with increased levels of student mobility (*Exp*(*B)* = 1.9, 95% *CI* = 1.2 – 2.9) have a 1.9 times greater chance of being recognized campuses. The remaining student variables are not interpreted due to a lack of statistical significance in either their overall relationship to the dependent variable or in their ability to distinguish between levels of accountability, or both (Schwab, 2007a).

The case processing summary is found in Table 17 and the predicted and observed values for the model are found in Table 18. The proportional by chance accuracy rate for the student variable model is 84.3% and the actual predictive value of the model is 96%. A 25% improvement in the proportional by chance accuracy rate is desired to interpret this model at its greatest level of usefulness when predicting campus accountability ratings. Therefore, this student variable model should be interpreted with caution.

Table 17

*Case Processing Summary Student Variables 2004 - 2005*

| Totals | N | Marginal Percentage |
|---|---|---|
| Recognized | 21 | 4.9% |
| Low Performing | 15 | 3.5% |
| Academically Acceptable | 394 | 91.6% |
| Valid | 430 | 100.0% |
| Missing | 0 | |
| Total | 430 | |
| Subpopulation | 430 | |

*Note.* The dependent variable has only one value observed in 430 (100.0%) subpopulations.

Table 18

*Classification Table Student Variables 2004 - 2005*

| Observed | Predicted | | | |
|---|---|---|---|---|
| | Recognized | Low Performing | Academically Acceptable | Percent Correct |
| Recognized | 18.0 | 0.0 | 3.0 | 85.7% |
| Low Performing | 0.0 | 10.0 | 5.0 | 66.7% |
| Academically Acceptable | 1.0 | 3.0 | 390.0 | 99.0% |
| Overall Percentage | 4.4% | 3.0% | 92.6% | 97.2% |

### *Results of Year 1 Fiscal Variable Analysis*

A statistically significant relationship exists between the fiscal variables analyzed in this study and campus accountability rating ($\chi^2 = 235$, *df* = 6, *N* = 430, $p < .001$). Table 19 contains the results of the likelihood ratio tests for the fiscal variables. Note that all three fiscal variables are statistically significant in their overall relationship to the dependent variable in the study, campus accountability rating: Return on Spending Index (RoSI) for instruction ($\chi^2 = 213$, $p < .001$); instructional spending per pupil ($\chi^2 = 27.95$, $p < .001$); and spending on instructional leadership per pupil ($\chi^2 = 8.7$, $p < .001$).

Table 19

*Likelihood Ratio Tests 2004 – 2005 Fiscal Variables*

| | Model Fitting Criteria | Likelihood Ratio Tests | | |
|---|---|---|---|---|
| Effect | -2 Log Likelihood of Reduced Model | Chi-Square | df | Sig. |
| Intercept | 172.374 | 90.682 | 2 | .000 |
| RoSI Instruction | 295.011 | 213.319 | 2 | .000 |
| Expenditure by Function-Instruction Per Pupil, All Funds | 109.643 | 27.951 | 2 | .000 |
| Expenditure by Function-Instructional Leadership Per Pupil, All Funds | 90.398 | 8.705 | 2 | .013 |

*Note.* The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Parameter estimates and odds ratios fro the staff variables for both low performing and recognized schools are found in Table 20. Note that only spending for instructional leadership (*p* =.135) in the recognized schools category is not statistically significant.

The remaining variables in the recognized category, the RoSI for instruction (*Exp*(*B)* = 4.8, 95% *CI* = 2.42 – 9.35, *p* < .001) and the per pupil spending figure on instruction ((*Exp*(*B)* = 1.006, 95% *CI* = 1.003 – 1.010, *p* =.001), are statistically significant in distinguishing between recognized and academically acceptable schools.

When considering only fiscal variables as they relate to campus accountability rating, an increase in the Return on Spending Index improves the odds of a campus being recognized 4.8 times while a one unit increase in total instructional spending per pupil increases the odds of being a recognized campus by a marginal 1.006 times.

The RoSI for instruction (*Exp*(*B)* = .118, 95% *CI* = .04 – .347, *p* < .001); per pupil spending on instruction (*Exp*(*B)* = .998, 95% *CI* = .997 – 1.0, *p* < .05); and per pupil spending on instructional leadership (*Exp*(*B)* = .966, 95% *CI* = .936 – .998, *p* < .05) are statistically significant in differentiating between low performing and academically acceptable schools. Campuses have an 82% less chance of being low performing with each unit increase in the instructional RoSI and a 1% less chance of being low performing with regard to both per pupil spending on instruction and on instructional leadership.

Table 20

*Parameter Estimates Fiscal Variables 2004 - 2005 Recognized and Low Performing Schools*

| Recognized Campuses | | | | | | 95% Confidence Interval for *Exp(B)* | |
|---|---|---|---|---|---|---|---|
| Variable | B | Std. Error | Wald | Sig. | *Exp(B)* | Lower Bound | Upper Bound |
| Intercept | -58.105 | 13.523 | 18.461 | .000 | | | |
| RoSI Instruction | 1.559 | .345 | 20.462 | .000 | 4.755 | 2.420 | 9.345 |
| Expenditure by Function-Instruction Per Pupil, All Funds | .006 | .002 | 11.979 | .001 | 1.006 | 1.003 | 1.010 |

*(table continues)*

Table 20 *(continued).*

| Recognized Campuses | | | | | | 95% Confidence Interval for *Exp(B)* | |
|---|---|---|---|---|---|---|---|
| Variable | B | Std. Error | Wald | Sig. | *Exp(B)* | Lower Bound | Upper Bound |
| Intercept | -58.105 | 13.523 | 18.461 | .000 | | | |
| Expenditure by Function-Instructional Leadership Per Pupil, All Funds | .018 | .012 | 2.233 | .135 | 1.018 | .994 | 1.043 |

| Low Performing Campuses | | | | | | 95% Confidence Interval for *Exp(B)* | |
|---|---|---|---|---|---|---|---|
| Variable | B | Std. Error | Wald | Sig. | *Exp(B)* | Lower Bound | Upper Bound |
| Low Performing | | | | | | | |
| Intercept | 22.088 | 6.694 | 10.888 | .001 | | | |
| RoSI Instruction | -2.135 | .549 | 15.115 | .000 | .118 | .040 | .347 |
| Expenditure by Function-Instruction Per Pupil, All Funds | -.002 | .001 | 4.984 | .026 | .998 | .997 | 1.000 |
| Expenditure by Function-Instructional Leadership Per Pupil, All Funds | -.034 | .016 | 4.327 | .038 | .966 | .936 | .998 |

*Note.* The reference category is: Academically Acceptable

The proportional by chance accuracy rate for this model is 83.4% and the actual predictive value of the model is 95%. A 25% improvement in the proportional by chance accuracy rate is desired to interpret this model at its greatest level of usefulness at predicting campus accountability ratings; therefore, this fiscal variable model should be interpreted with caution. Table 21 and Table 22 contain the proportional by chance accuracy rate and the model classification accuracy table for the fiscal variables in the analysis.

Table 21

*Case Processing Summary for Fiscal Variables 2004 - 2005*

| Total | N | Marginal Percentage |
|---|---|---|
| Recognized | 22 | 5.0% |
| Low Performing | 17 | 3.9% |
| Academically Acceptable | 400 | 91.1% |
| Valid | 439 | 100.0% |
| Missing | 0 | |
| Total | 439 | |
| Subpopulation | 439 | |

*Note.* The dependent variable has only one value observed in 439 (100.0%) subpopulations

Table 22

*Classification Table for Fiscal Variables 2004 - 2005*

| Observed | Predicted | | | |
|---|---|---|---|---|
| | Recognized | Low Performing | Academically Acceptable | Percent Correct |
| Recognized | 15.0 | 0.0 | 7.0 | 68.2% |
| Low Performing | 0.0 | 10.0 | 7.0 | 58.8% |
| Academically Acceptable | 5.0 | 3.0 | 392.0 | 98.0% |
| Overall Percentage | 4.6% | 3.0% | 92.5% | 95.0% |

## Results of Year 1 Combined Study Variable Analysis

The variables from each of the three groups of variables (staff, student and fiscal) were analyzed together in order to determine the combined effect of all variables in this study on campus accountability rating. As in the previous analyses, variables that were not statistically significant in their overall relationship to the dependent variable were dropped from the model to produce a more parsimonious model, with the exception of

Teacher Tenure Average. This variable is not statistically significant with regard to its overall relationship with the dependent variable; however, it was retained in the model because elimination lowered the classification accuracy of the analysis.

To achieve parsimony in the model, fiscal variables were dropped from the final analysis, producing a model that contains the variables that are of greatest importance in determining the best overall relationship to campus accountability rating (Garson, 2008). Model fitting analysis supports a statistically significant relationship between the study variables and campus accountability rating ($\chi^2 = 234$, *df* = 16, *N* = 433, *p* < .001).

Table 23 contains the likelihood ratio tests for the combined study variable model. All study variables are statistically significant in their overall relationship to campus accountability rating, with the exception of the Teacher Tenure Average (*p* = .064) which was retained in the model.

Table 23

*Likelihood Ratio Tests 2004 – 2005 Combined Analysis Variables*

| | Model Fitting Criteria | Likelihood Ratio Tests | | |
|---|---|---|---|---|
| Effect | -2 Log Likelihood of Reduced Model | Chi-Square | df | Sig. |
| Intercept | 84.021 | 1.524 | 2 | .467 |
| Admin Total Base Salary Average | 91.858 | 9.361 | 2 | .009 |
| Teacher > 20 Years Base Salary Average | 89.872 | 7.375 | 2 | .025 |
| SAT/ACT:All Stud. % Above Criterion | 88.498 | 6.001 | 2 | .050 |

*(table continues)*

Table 23 *(continued).*

| | Model Fitting Criteria | Likelihood Ratio Tests | | |
|---|---|---|---|---|
| Effect | -2 Log Likelihood of Reduced Model | Chi-Square | df | Sig. |
| Intercept | 84.021 | 1.524 | 2 | .467 |
| Campus Mobility Percent | 99.328 | 16.831 | 2 | .000 |
| Percent 2004 TAKS Math Students Failers Who Passed 2005 TAKS Math | 119.831 | 37.334 | 2 | .000 |
| Texas Success Initiative All Students Mathematics Rate | 89.899 | 7.402 | 2 | .025 |
| Teacher Tenure Average | 88.009 | 5.512 | 2 | .064 |

*Note.* The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Odds ratios and parameter estimates for the combined analysis related to low performing schools are found in Table 24. School administrative base salary average (*Exp*(*B)* = 1.0, 95% *CI* = 1.0 – 1.0, *p* < .05); teachers with more than 20 years experience base salary average (*Exp*(*B)* = 1.0, 95% *CI* = .999 – 1.0, *p* < .05); campus mobility percentage (*Exp*(*B)* = 1.28, 95% *CI* = 1.041 – 1.585, *p* < .05); and Texas Success Initiative math rate (*Exp*(*B)* = .874, 95% *CI* = .773 – .998, *p* < .05) are statistically significant in distinguishing between low performing and academically acceptable ratings. Although statistically significant, school administrative base salary average and teacher base salary average for teachers with more than 20 years experience provide no indication of being able to distinguish between accountability rating due to even odds ratios (i.e. 1.0 Exp (B)). A unit increase in the campus mobility percentage increases the odds of a campus being low performing by 1.28 times. Campuses have approximately a 13% greater chance of being academically acceptable schools as opposed to low performing for each percentage point increase in the Texas Success Initiative math rate.

Table 24

*Parameter Estimates Study Variables 2004 – 2005 Low Performing Schools*

| | | | | | | 95% Confidence Interval for *Exp(B)* | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Wald | Sig. | *Exp(B)* | Lower Bound | Upper Bound |
| Intercept | -1.463 | 5.764 | .064 | .800 | | | |
| School Admin Total Base Salary Average | .000 | .000 | 4.568 | .033 | 1.000 | 1.000 | 1.000 |
| Teacher > 20 Years Base Salary Average | .000 | .000 | 4.579 | .032 | 1.000 | .999 | 1.000 |
| SAT/ACT:All Students % Above Criterion | -.237 | .140 | 2.872 | .090 | .789 | .600 | 1.038 |
| Campus Mobility Percent | .250 | .107 | 5.460 | .019 | 1.284 | 1.041 | 1.585 |
| Percent 2004 TAKS Math Students Failers Who Passed 2005 TAKS Math | -.100 | .104 | .922 | .337 | .905 | .737 | 1.110 |
| Texas Success Initiative All Students Mathematics Rate | -.135 | .063 | 4.628 | .031 | .874 | .773 | .988 |
| Teacher Tenure Average | .447 | .234 | 3.633 | .057 | 1.563 | .987 | 2.474 |

*Note.* The reference category is: Academically Acceptable

The remaining study variables are not statistically significant with regard to a low performing campus accountability rating due to the lack of statistical significance in their overall relationship to the dependent variable, their ability to differentiate between low performing and academically acceptable accountability ratings, or both.

Table 25 contains the odds ratios and parameter estimates for the recognized schools in the combined study variable analysis. Campus mobility percentage (*Exp*(*B*) = .525, 95% *CI* = .304 – .907, *p* < .05) and the percentage of students failing the 2004 TAKS math exam that passed the 2005 TAKS math exam (*Exp*(*B*) = 1.47, 95% *CI* = 1.183 – 1.8, *p* < .001) are both statistically significant with regard to distinguishing between recognized and academically acceptable accountability ratings.

Campuses have a 47% less chance of receiving a recognized accountability rating for every unit increase in the campus mobility statistic. Conversely, for each unit increase in the percentage of students that failed the 2004 TAKS math exam but passed the 2005 TAKS math exam, a campus has a 1.47 times greater chance of receiving a recognized accountability rating.

Table 25

*Parameter Estimates Study Variables 2004 – 2005 Recognized Schools*

|  |  |  |  |  |  | 95% Confidence Interval for *Exp(B)* |  |
|---|---|---|---|---|---|---|---|
|  | B | Std. Error | Wald | Sig. | *Exp(B)* | Lower Bound | Upper Bound |
| Intercept | -13.528 | 11.858 | 1.302 | .254 |  |  |  |
| School Admin Total Base Salary Average | .000 | .000 | 1.647 | .199 | 1.000 | 1.000 | 1.000 |
| Teacher > 20 Years Base Salary Average | .000 | .000 | 1.177 | .278 | 1.000 | 1.000 | 1.001 |

*(table continues)*

Table 25 *(continued).*

| | B | Std. Error | Wald | Sig. | *Exp(B)* | 95% Confidence Interval for *Exp(B)* Lower Bound | 95% Confidence Interval for *Exp(B)* Upper Bound |
|---|---|---|---|---|---|---|---|
| Intercept | -13.528 | 11.858 | 1.302 | .254 | | | |
| SAT/ACT:All Students % Above Criterion | -.103 | .082 | 1.582 | .209 | .902 | .768 | 1.059 |
| Campus Mobility Percent | -.644 | .279 | 5.339 | .021 | .525 | .304 | .907 |
| Percent 2004 TAKS Math Students Failers Who Passed 2005 TAKS Math | .382 | .109 | 12.255 | .000 | 1.465 | 1.183 | 1.815 |
| Texas Success Initiative All Students Mathematics Rate | .140 | .120 | 1.367 | .242 | 1.150 | .910 | 1.454 |
| Teacher Tenure Average | -.230 | .294 | .608 | .436 | .795 | .446 | 1.416 |

*Note.* The reference category is: Academically Acceptable

The remaining study variables are not statistically significant with regard to a low performing campus accountability rating due to their inability to differentiate between low performing and academically acceptable accountability ratings, their overall statistical significance to the dependent variable, or both. The proportional by chance accuracy rate for this model is 83.2% and the actual predictive value of the model is 96%. A 25% improvement in the proportional by chance accuracy rate is desired to interpret this model at its greatest level of usefulness at predicting campus accountability ratings; therefore, this combined variable model should be interpreted with caution as the overall increase in predictive values is only 12.8%. Table 26 and

Table 27 contain the proportional by chance accuracy rate and the model classification accuracy tables respectively (Schwab, 2007a).

Table 26

*Case Summary Combined Study Variables 2004 - 2005*

| Totals | N | Marginal Percentage |
|---|---|---|
| Recognized | 22 | 5.1% |
| Low Performing | 17 | 3.9% |
| Academically Acceptable | 394 | 91.0% |
| Valid | 433 | 100.0% |
| Missing | 0 | |
| Total | 433 | |
| Subpopulation | 433 | |

*Note.* The dependent variable has only one value observed in 433 (100.0%) subpopulations

Table 27

*Classification Table Combined Study Variables 2004 - 2005*

| Observed | Predicted | | | |
|---|---|---|---|---|
| | Recognized | Low Performing | Academically Acceptable | Percent Correct |
| Recognized | 17 | 0 | 5 | 77.3% |
| Low Performing | 0.0 | 9.0 | 8.0 | 52.9% |
| Academically Acceptable | 3.0 | 1.0 | 390.0 | 99.0% |
| Overall Percentage | 4.6% | 2.3% | 93.1% | 96.1% |

## Results of Year 2 Combined Study Variable Analysis

The Year 2 (2005 – 2006 school year) study variables were identified using the same process as Year 1 study variables. The variables from each of the three groups of variables (staff, student and fiscal) were analyzed together in order to determine the combined effect.

As in the previous Year 1 analysis, variables from each group (staff, student and fiscal) that were not statistically significant in their overall relationship to the dependent variable were dropped from the respective models to produce more parsimonious models for each variable group analysis. The variables from the three groups were combined to form the combined study variables for the Year 2 analysis. Model fitting analysis supports a statistically significant relationship between the study variables and campus accountability rating ($\chi^2 = 267$, *df* = 18, *N* = 423*, p* < .001).

Table 28 contains the likelihood ratio tests for the combined study variable model. All study variables are statistically significant in their overall relationship to campus accountability.

Odds ratios and parameter estimates for the combined analysis related to recognized schools are found in Table 29. Advanced Courses All Students Percentage (*Exp*(*B)* = 1.18, 95% *CI* = 1.028 – 1.356, *p* < .05); Campus Mobility Percentage (*Exp*(*B)* = .584, 95% *CI* = .351 – .970, *p* < .05); SAT/ACT: All Students Test -Takers SAT Rate (*Exp*(*B)* = .954, 95% *CI* = .920 – .990, *p* < .05); and Texas Success Initiative Math Rate (*Exp*(*B)* = 1.3, 95% *CI* = 1.022 – 1.646, *p* < .05) are statistically significant in distinguishing between recognized and academically acceptable ratings. Note that no fiscal variables were statistically significant in this analysis.

Table 28

*Likelihood Ratio Tests 2005 – 2006 Combined Analysis Variables*

| Effect | Model Fitting Criteria | Likelihood Ratio Tests | | |
|---|---|---|---|---|
| | -2 Log Likelihood of Reduced Model | Chi-Square | df | Sig. |
| Intercept | 134.162 | 3.878 | 2 | .144 |
| Advanced Courses All Students Percentage | 138.303 | 8.019 | 2 | .018 |
| AP/IB All Students Percent Students Scoring Above Criterion | 139.243 | 8.959 | 2 | .011 |
| AP/IB All Students Percent Scores Above Criterion | 141.775 | 11.492 | 2 | .003 |
| Campus Mobility Percent | 142.379 | 12.095 | 2 | .002 |
| SAT/ACT: All Students Test -Takers SAT Rate | 138.636 | 8.352 | 2 | .015 |
| Percent of 2005 TAKS Math Student Failers Who Passed 2006 TAKS Math | 147.100 | 16.816 | 2 | .000 |
| Texas Success Initiative All Students Mathematics Rate | 147.478 | 17.194 | 2 | .000 |
| Texas Success Initiative All Reading Rate | 139.291 | 9.007 | 2 | .011 |
| Teacher Tenure Percentage | 141.619 | 11.335 | 2 | .003 |

*Note.* The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Campuses have a 1.18 times greater chance of being recognized campuses for each unit increase in the percentage of students taking advanced courses. Campuses have a 42% greater chance of being academically acceptable for every percentage increase in campus mobility. Additionally, campuses that show an increase in the number of test takers for the SAT exam have a 4% greater chance of being academically acceptable. Further, improvement in the Texas Success Initiative math rate increases a campus' likelihood of a recognized rating by 1.3 times.

Table 29

*Parameter Estimates Study Variables 2005 - 2006 Recognized Schools*

|  |  |  |  |  |  | 95% Confidence Interval for *Exp(B)* |  |
|---|---|---|---|---|---|---|---|
|  | B | Std. Error | Wald | Sig. | *Exp(B)* | Lower Bound | Upper Bound |
| Intercept | 22.615 | 15.831 | 2.041 | .153 |  |  |  |
| Advanced Courses All Students Percentage | .166 | .070 | 5.556 | .018 | 1.181 | 1.028 | 1.356 |
| AP/IB All Students Percent Students Above Criterion | -.031 | .156 | .039 | .844 | .970 | .715 | 1.316 |
| AP/IB All Students Percent Scores Above Criterion | .071 | .160 | .196 | .658 | 1.074 | .784 | 1.469 |
| Campus Mobility Percent | -.538 | .259 | 4.318 | .038 | .584 | .351 | .970 |
| SAT/ACT: All Students Test -Takers SAT Rate | -.047 | .019 | 6.236 | .013 | .954 | .920 | .990 |
| Percent of 2005 TAKS Math Student Failers Who Passed 2006 TAKS Math | .120 | .082 | 2.124 | .145 | 1.128 | .959 | 1.326 |
| Texas Success Initiative All Students Mathematics Rate | .260 | .122 | 4.579 | .032 | 1.297 | 1.022 | 1.646 |
| Texas Success Initiative Reading Rate | .068 | .040 | 2.860 | .091 | 1.070 | .989 | 1.158 |
| Teacher Tenure Percentage | -.329 | .293 | 1.260 | .262 | .720 | .405 | 1.278 |

*Note.* The reference category is: Academically Acceptable

Table 30 contains the parameter estimates and odds ratios for low performing schools in this combined analysis. AP/IB All Students Percent Students Scoring Above Criterion (*Exp*(*B)* = .855, 95% *CI* = .766 – .955, *p* < .01); AP/IB All Students Percent Scores Above Criterion (*Exp*(*B)* = 1.23, 95% *CI* = .1.079 – 1.391, *p* < .01); Campus Mobility Percent (*Exp*(*B)* = 1.14, 95% *CI* = 1.024 – 1.261, *p* < .05); Percent of 2005 TAKS Math Student Failers Who Passed 2006 TAKS Math (*Exp*(*B)* = .787, 95% *CI* = .684 – .906, *p* < .05); Texas Success Initiative Math Rate (*Exp*(*B)* = .848, 95% *CI* = .761 – .944, *p* < .05); and Teacher Tenure Average (*Exp*(*B)* = 1.433, 95% *CI* = 1.12 – 1.832, *p* < .05) are statistically significant in distinguishing between low performing and academically acceptable ratings.

Table 30

*Parameter Estimates Study Variables 2005 - 2006 Low Performing Schools*

| | | | | | | 95% Confidence Interval for *Exp(B)* | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Wald | Sig. | *Exp(B)* | Lower Bound | Upper Bound |
| Intercept | 7.242 | 5.804 | 1.557 | .212 | | | |
| Advanced Courses All Students Prctg. | -.012 | .038 | .104 | .747 | .988 | .917 | 1.064 |
| AP/IB All Students Percent Students Scoring Above Criterion | -.156 | .056 | 7.719 | .005 | .855 | .766 | .955 |
| AP/IB All Students Percent Scores Above Criterion | .203 | .065 | 9.832 | .002 | 1.225 | 1.079 | 1.391 |
| Campus Mobility Percent | .127 | .053 | 5.759 | .016 | 1.136 | 1.024 | 1.261 |

*(table continues)*

Table 30 *(continued).*

| | B | Std. Error | Wald | Sig. | *Exp(B)* | 95% Confidence Interval for *Exp(B)* Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|
| Intercept | 7.242 | 5.804 | 1.557 | .212 | | | |
| SAT/ACT: All Students Test - Takers SAT Rate | -.003 | .006 | .213 | .644 | .997 | .986 | 1.009 |
| Percent of 2005 TAKS Math Student Failers Who Passed 2006 TAKS Math | -.239 | .071 | 11.210 | .001 | .787 | .684 | .906 |
| Texas Success Initiative All Students Math Rate | -.165 | .055 | 9.057 | .003 | .848 | .761 | .944 |
| Texas Success Initiative All Reading Rate | -.064 | .029 | 5.016 | .025 | .938 | .886 | .992 |
| Teacher Tenure Percentage | .360 | .125 | 8.217 | .004 | 1.433 | 1.120 | 1.832 |

*Note.* The reference category is: Academically Acceptable

Campuses have approximately a 15% greater chance of being academically acceptable for every unit increase in the percentage of students scoring above the criterion on AP/IB exams. Campuses have a 1.23 times greater chance of being low performing for each unit increase in the total percentage of scores above the criterion on AP/IB exams.

Additionally, for every unit increase in student mobility percentage, a campus has a 1.14 times greater chance of being low performing. Those campuses that show an increase in the number of students passing the 2006 TAKS math exam that failed the 2005 TAKS math exam have approximately a 22% greater chance of being an academically acceptable campus.

Further, campuses that improve their student performance on the Texas Success Initiative for math have a 16% greater chance of being academically acceptable. Finally, campuses that show an increase in the overall average percentage of teacher tenure on a campus have a 1.43 times greater chance of being low performing.

The proportional by chance accuracy rate for this model is 76.4% and the actual predictive value of the model is 94.1%. A 25% improvement in the proportional by chance accuracy rate is desired to interpret this model at its greatest level of usefulness at predicting campus accountability ratings; therefore, this combined variable model should be interpreted with caution (Schwab, 2007a). Table 31 contains the proportional by chance accuracy rate for this analysis. Table 32 contains the model classification accuracy information for the Year 2 combined analysis.

Table 31

*Case Summary Combined Study Variables 2005 - 2006*

| Totals | N | Marginal Percentage |
|---|---|---|
| Recognized | 16 | 3.8% |
| Low Performing | 40 | 9.5% |
| Academically Acceptable | 367 | 86.8% |
| Valid | 423 | 100.0% |
| Missing | 0 | |
| Total | 423 | |
| Subpopulation | 423 | |

*Note.* The dependent variable has only one value observed in 423 subpopulations

Table 32

*Classification Table Combined Study Variables 2005 - 2006*

| Observed | Predicted | | | |
|---|---|---|---|---|
| | Recognized | Low Performing | Academically Acceptable | Percent Correct |
| Recognized | 13.0 | 0.0 | 3.0 | 81.3% |
| Low Performing | 0.0 | 28.0 | 12.0 | 70.0% |
| Academically Acceptable | 3.0 | 7.0 | 357.0 | 97.3% |
| Overall Percentage | 3.8% | 8.3% | 87.9% | 94.1% |

## Results of Year 3 Combined Study Variable Analysis

The Year 3 (2006 – 2007 school year) study variables were identified using the same process as Year 1 and Year 2 study variables. The variables from each of the three refined Year 3 groups of variables (staff, student and fiscal) were analyzed together in order to determine the combined effect.

As in the previous analyses, variables from each group (staff, student and fiscal) that were not statistically significant in their overall relationship to the dependent variable were dropped from the respective models to produce more parsimonious models for each variable group analysis. The variables from the three groups were combined to form the combined study variables for the Year 3 analysis. Staff, student and fiscal variables were included in this analysis.

Based on the model fitting analysis, a statistically significant relationship exists between the study variables and campus accountability rating ($\chi^2 = 250$, *df* = 18, *N* = 444, *p* < .001). Table 33 contains the likelihood ratio tests for the combined study variable model. All study variables contained in this table are statistically significant in their overall relationship to campus accountability rating.

Table 33

*Likelihood Ratio Tests 2006 – 2007 Combined Analysis Variables*

| Effect | Model Fitting Criteria | Likelihood Ratio Tests | | |
|---|---|---|---|---|
| | -2 Log Likelihood of Reduced Model | Chi-Square | df | Sig. |
| Intercept | 126.623 | 53.801 | 2 | .000 |
| Per Pupil Spending School Leadership | 98.112 | 25.290 | 2 | .000 |
| SAT/ACT: All Students % Above Criterion | 81.730 | 8.908 | 2 | .012 |
| Base Salary Average Beginning Teachers | 83.055 | 10.233 | 2 | .006 |
| 2006 TAKS Math Student Failers Who Passed 2007 TAKS Math | 159.384 | 86.562 | 2 | .000 |
| Texas Success Initiative All Students Reading Rate | 83.912 | 11.090 | 2 | .004 |
| Return on Spending Index Instructional Leadership | 87.489 | 14.667 | 2 | .001 |
| Return on Spending Index School Leadership | 109.759 | 36.937 | 2 | .000 |
| Return on Spending Index Instructional Related Services | 91.550 | 18.728 | 2 | .000 |
| Return on Spending Index Support Srvs. | 102.960 | 30.138 | 2 | .000 |

*Note.* The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Note that this analysis contains all three categories of study variables in the final parsimonious group (i.e. student variables, staff variables and fiscal variables). Other study groups lacked at least one of the three groups of study variables.

Table 34 contains the parameter estimates and odds ratios for recognized schools in this combined analysis. Base Salary Average for Beginning Teachers (*Exp*(*B)* = 1.0, 95% *CI* = .999 – 1.0, $p < .05$); Percent of 2006 TAKS Math Student Failers Who Passed 2007 TAKS Math (*Exp*(*B)* = 1.26, 95% *CI* = 1.075 – 1.48, $p < .01$); and Texas Success Initiative Reading Rate (*Exp*(*B)* = 1.24, 95% *CI* = 1.031 – 1.494, $p < .05$) are statistically significant in distinguishing between recognized and academically acceptable ratings.

The remaining variables are not statistically significant with regard to predicting campus accountability rating. Beginning teacher base salary average is negligible as an odds ratio equaling 1.0 (Exp (B) = 1.0) indicates only 50/50 odds for this statistic. Schools in the Year 3 analysis have a 1.26 times greater chance of being recognized as opposed to academically acceptable for every unit increase in the percentage of students passing the 2007 TAKS mathematics exam that failed the TAKS mathematics exam in 2006. Also, campuses have a 1.24 times greater chance of being recognized campuses for every unit increase in the percentage of students meeting the Texas Success Initiative reading rate criterion.

Table 34

*Parameter Estimates Study Variables 2006 - 2007 Recognized Schools*

| | B | Std. Error | Wald | Sig. | *Exp(B)* | 95% Confidence Interval for *Exp(B)* Lower Bound | 95% Confidence Interval for *Exp(B)* Upper Bound |
|---|---|---|---|---|---|---|---|
| Intercept | -28.501 | 15.492 | 3.385 | .066 | | | |
| Per Pupil Spending School Leadership | .021 | .023 | .808 | .369 | 1.021 | .976 | 1.069 |
| SAT/ACT: All Students % Above Criterion | -.011 | .070 | .024 | .876 | .989 | .862 | 1.134 |
| Base Salary Average Beginning Teachers | .000 | .000 | 5.742 | .017 | 1.000 | .999 | 1.000 |
| Percent 2006 TAKS Math Students Failers Who Passed 2007 TAKS Math | .232 | .082 | 8.069 | .005 | 1.261 | 1.075 | 1.480 |
| Texas Success Initiative All Students Reading Rate | .216 | .095 | 5.200 | .023 | 1.241 | 1.031 | 1.494 |
| Return on Spending Index Instructional Leadership | -.001 | .001 | .578 | .447 | .999 | .997 | 1.001 |
| Return on Spending Index School Leadership | .014 | .041 | .111 | .739 | 1.014 | .936 | 1.099 |
| Return on Spending Index Instructional Related Services | -.007 | .004 | 3.631 | .057 | .993 | .986 | 1.000 |
| Return on Spending Index Support Services | .018 | .012 | 2.331 | .127 | 1.018 | .995 | 1.043 |

*Note.* The reference category is: Academically Acceptable

The parameter estimates and odds ratios for the low performing campuses are found in Table 35. Note that compared to previous analyses in this study (i.e. Year 1 and Year 2), several of the variables in this Year 3 analysis are fiscal variables. Per pupil spending on school leadership (*Exp*(*B)* = .956, 95% *CI* = .931 – .982, *p* = .001); SAT/ACT: All Students % Above Criterion (*Exp*(*B)* = 1.23, 95% *CI* = 1.053 - 1.427, *p* < .01); Percent of 2006 TAKS Math Student Failers Who Passed 2007 TAKS Math (*Exp*(*B)* = .432, 95% *CI* = .279 – .670, *p* < .001); Return on Spending Index for School Leadership (*Exp*(*B)* = .756, 95% *CI* = .651 – .879, *p* < .001); Return on Spending Index for Instruction Related Services (*Exp*(*B)* = .963, 95% *CI* = .938 – .988, *p* < .01); and Return on Spending Index for Student Support Services (*Exp*(*B)* = 1.076, 95% *CI* = 1.027 – 1.127, *p* < .01) are statistically significant in distinguishing between low performing and academically acceptable ratings.

Table 35

*Parameter Estimates Study Variables 2006 - 2007 Low Performing Schools*

| | | | | | | 95% Confidence Interval for *Exp(B)* | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Wald | Sig. | *Exp(B)* | Lower Bound | Upper Bound |
| Intercept | 56.998 | 15.394 | 13.709 | .000 | | | |
| Per Pupil Spending School Leadership | -.045 | .013 | 11.013 | .001 | .956 | .931 | .982 |
| SAT/ACT: All Students % Above Criterion | .207 | .079 | 6.849 | .009 | 1.230 | 1.053 | 1.437 |
| Base Salary Average Beginning Teachers | .000 | .000 | 1.081 | .299 | 1.000 | 1.000 | 1.000 |
| Percent 2006 TAKS Math Students Failers Who Passed 2007 TAKS Math | -.839 | .224 | 14.047 | .000 | .432 | .279 | .670 |

*(table continues)*

Table 35 *(continued).*

|  | B | Std. Error | Wald | Sig. | *Exp(B)* | 95% Confidence Interval for *Exp(B)* Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|
| Intercept | 56.998 | 15.394 | 13.709 | .000 |  |  |  |
| Texas Success Initiative All Students Reading Rate | .107 | .062 | 2.963 | .085 | 1.113 | .985 | 1.257 |
| Return on Spending Index Instructional Leadership | .000 | .000 | 1.904 | .168 | 1.000 | 1.000 | 1.001 |
| Return on Spending Index School Leadership | -.279 | .077 | 13.260 | .000 | .756 | .651 | .879 |
| Return on Spending Index Instructional Related Services | -.038 | .013 | 8.010 | .005 | .963 | .938 | .988 |
| Return on Spending Index Support Services | .073 | .024 | 9.450 | .002 | 1.076 | 1.027 | 1.127 |

*Note.* The reference category is: Academically Acceptable

Campuses have a 1.23 times greater chance of being low performing for each unit increase in the percentage of students meeting the criterion on ACT/SAT exams. An increase in students passing the 2007 math TAKS that failed the 2006 math TAKS exam improves a campus' chances of attaining an academically acceptable rating by 57%. While increases in the Return on Spending Indexes for student support services and instruction related services have a negligible effect on accountability rating, an increase in the Return on Spending Index for School Leadership improves a campus' chances of being academically acceptable status by 24%.

The proportional by chance accuracy rate for this model is 82.9% and the actual predictive value of the model is 96.2%. A 25% improvement in the proportional by chance accuracy rate is desired to interpret this model at its greatest level of usefulness at predicting campus accountability ratings; therefore, this combined variable model should be interpreted with caution.

Table 36 and Table 37 contain the proportional by chance accuracy rate and the model classification accuracy tables respectively.

Table 36

*Case Summary Combined Study Variables 2006 - 2007*

| Totals | N | Marginal Percentage |
|---|---|---|
| Recognized | 12 | 2.7% |
| Low Performing | 29 | 6.5% |
| Academically Acceptable | 403 | 90.8% |
| Valid | 444 | 100.0% |
| Missing | 0 | |
| Total | 444 | |
| Subpopulation | 444(a) | |

*Note.* The dependent variable has only one value observed in 444 (100.0%) subpopulations

Table 37

*Classification Table Combined Study Variables 2006 - 2007*

| Observed | Predicted | | | |
|---|---|---|---|---|
| | Recognized | Low Performing | Academically Acceptable | Percent Correct |
| Recognized | 6.0 | 0.0 | 6.0 | 50.0% |
| Low Performing | 0.0 | 23.0 | 6.0 | 79.3% |
| Academically Acceptable | 2.0 | 3.0 | 398.0 | 98.8% |
| Overall Percentage | 1.8% | 5.9% | 92.3% | 96.2% |

## Summary

This study examined the effects of three categories of input variables on campus accountability rating during three consecutive years. Student variables, staff variables and fiscal variables were analyzed using multinomial logistic regression analysis. Several variables proved to have a statistically significant effect on campus accountability rating.

The Year 1 analysis showed that increases in campus mobility had a negative effect on accountability rating. The Texas Success Initiative in math and the number of students passing the TAKS math exam that had failed it the year before both had significant positive effects on campus accountability rating.

In the Year 2 analysis, increases in the percentage of total scores above the criterion on AP/IB exams, student mobility and teacher tenure averages had a negative effect on campus accountability while the percentage of students meeting the criterion on AP/IB exams and the percentage of students passing the TAKS math exam that failed the previous year had a positive effect. Schools in the Year 2 analysis comparing recognized and academically acceptable campuses were affected positively by the Texas Success Initiative in math and by the number of students taking advance courses. Conversely, these same schools were affected negatively by campus mobility rates and the percentage of test takers on the SAT exam.

The final analysis for the Year 3 low performing/academically acceptable schools comparison was affected positively by students passing the TAKS math exam that had failed it the prior year and by the Return on Spending Index for school leadership, while the numbers of students meeting the criterion on the ACT/SAT exam had a negative effect. Schools in the recognized/academically acceptable Year 3 comparison were affected positively by the Texas Success Initiative rates in reading and by the number of students passing the TAKS math exam that had failed it the prior year.

Campuses that seem to provide quality remediation with regard to their students that fail TAKS exams, particularly TAKS math exams, increase their odds of more favorable accountability ratings. However, other variables proved to have negative effects, such as student mobility, or no effect, such as teacher experience. A discussion of these findings follows in Chapter V of this study.

# CHAPTER V

# RESULTS

## Discussion

The purpose of this study was to determine the predictive value of educational productivity input variables on the accountability rating of moderate to large Texas high schools, thereby establishing a model for evaluating educational productivity at the unit level of performance. This study analyzed the effect of student, staff and fiscal input variables in determining the likelihood of a moderate to large Texas high school (a school with greater than 900 students) receiving either a Low Performing, Academically Acceptable or Recognized rating in the Texas public education accountability system using school-level data from the Texas PEIMS data system.

This study revealed a number of campus level variables that have a statistically significant effect on educational productivity. Chapter V summarizes the findings of the study addressing the research questions posed in Chapter I. The conclusions, recommendations for practice, and future research are based on these findings and are centered on the original research questions.

### *Research Question 1*

> *Which combination of common student, staff and fiscal input variables found among moderate and large population Texas high schools predict campus accountability rating?*

This study demonstrates that student variables are better at predicting campus accountability rating than both staff variables and fiscal variables. Specifically, campus mobility percentage showed a statistically significant relationship with campus accountability as well as the ability to differentiate between campus accountability ratings in Year 1 and Year 2 analyses. When comparing recognized campuses to academically acceptable campuses, and academically acceptable campuses to low performing campuses in this study, the chance of a campus receiving the lower accountability rating diminished from as little as 13% to as much as 48% as the magnitude of the campus mobility percentage variable increased. This study supports findings from other studies which report the negative influence of student mobility on numerous aspects of student achievement, student social development and student psychological health (Rumberger, 2003). Yet, one unique group of students, those in families of armed forces personnel, seem to be immune from the negative effects of mobility, due in part to possible differences in the school culture found in the Department of Defense Education Activity (DoDEA) school system (Smrekar & Owens, 2003).

Both the Texas Success Initiative math rate variable and the Texas Success Initiative reading rate variable demonstrate a statistically significant positive relationship to campus accountability rating. The Texas Success Initiative math rate variable increases the chance that a campus would be recognized from as little as 1.15 times to as much as 1.3 times when comparing academically acceptable and recognized campuses; and increases the chance that a campus would be academically acceptable from 13% to as much as 15% when comparing academically acceptable and low performing campuses.

The Texas Success Initiative reading rate variable increases the chance that a campus would be recognized from as little as 1.07 times to as much as 1.24 times when comparing academically acceptable and recognized campuses. The reading rate variable also increases the chance that a campus would be academically acceptable by 15% when comparing academically acceptable and low performing campuses.

The percentage of student failers taking the TAKS math exam in a previous year and passing the TAKS math exam the following year increases the chance that a campus would be recognized from as little as 1.13 times to as much as 1.47 times when comparing academically acceptable and recognized campuses. The TAKS failer variable also increases the chance that a campus would be academically acceptable from 21% to as much as 57% when comparing academically acceptable and low performing campuses.

### *Research Question 2*

*Is one single input variable more effective at predicting campus accountability rating than other variables in the study?*

The percentage of student failers taking the TAKS math exam in a previous year and passing the TAKS math exam the following year was the only variable that was consistently statistically significant in the Year 1, Year 2 and Year 3 analyses in both its relationship to campus accountability and in its ability to differentiate between campus accountability ratings. For each unit increase in the TAKS failer variable, schools stood as much as a 1.47 times greater chance of being recognized rather than academically acceptable, and as much as a 57% greater chance of being academically acceptable rather than low performing. Because this variable exerts such a large influence on campus accountability rating it follows that diligent remediation efforts for students that fail the TAKS exams, specifically in math, can hold a great deal of promise for improving not only student success, but also the chances of improving campus accountability ratings.

## Conclusions

This study sought to determine what educational input variables predict campus accountability rating and if there a group of similar variables and/or a single variable that was more effective at predicting campus accountability rating in moderate to large Texas high schools. Three years of data (Year 1: 2004-2005; Year 2: 2005-2006; and Year 3: 2006-2007) were analyzed separately and screened for input variables that would consistently predict campus accountability. In total, 60 variables were included in this study for each year analyzed. Of the 60 variables analyzed each school year, 30 were student variables, 19 were staff variables and 11 were fiscal variables.

Each analysis (i.e. Year 1, Year 2 and Year 3) produced a separate parsimonious subgroup of the 60 variables that were found to be statistically significant in their relationship to campus accountability rating and in their ability to differentiate between levels of accountability. Student variables, such as student mobility and TAKS math performance were the most consistent variables throughout each analysis at predicting campus accountability rating. Only the percentage of student failers taking the TAKS math exam in a previous year and passing the TAKS math exam the following year was consistently statistically significant in Year 1, Year 2 and Year 3.

Numerous variables in any given analysis, such as teacher tenure, teacher experience, administrative salaries, student teacher ratios, class size, the percentage of economically disadvantaged students, the percentage of students enrolled in college or dual credit courses, teacher degree level, per student spending, SAT/ACT performance and AP/IB performance were initially considered and then removed from the model due to multicollinarity, or removed in favor of a more parsimonious model (Garson, 2008). Many of these variables were not found to be statistically significant with regard to their overall relationship to campus accountability rating.

As an example, Rivkin, Hanushek and Kain (2003), in an evaluation of Texas school level data, found that there is absolutely no evidence that having a master’s degree improves teacher quality. Similar findings in this study suggest that schools in districts with larger percentages of advanced degreed teachers also have no effect on student academic achievement as measured by campus accountability rating. The Rivkin (2005) study also reports that class size has little to do with achievement growth after 5th grade. Once again, in support of these findings, this study concludes that class size in high school core curriculum areas (i.e. math, science, social studies, and language arts) has no overall statistically significant relationship to campus accountability rating and hence, no statistically significant relationship to improved educational productivity.

However, other studies have linked some of these excluded variables to student achievement gains or decline. Bishop (1998) argues that increased achievement levels on performance-based external exit exams, of which advanced placement exams are an example, signal increased teaching and learning in the core subjects. Yet, for the purposes of this study, performance on advanced placement exams and percentages of students meeting the established criterion on these exams show no statistically significant relationship to campus accountability rating, which is itself reflective of student achievement on the campuses analyzed in this study.

Hampel (2004) demonstrated a strong correlation between the percentage of economically disadvantaged students and its negative effects on the performance levels of school districts on standardized testing. However, this study finds that the percentage of economically disadvantaged students explains less than 1% of the variance in campus accountability rating as measured by overall student performance on standardized testing.

As in this study, other studies support the exclusion of the select variables mentioned above with regard to their effect on student achievement. Darling-Hammond (1999) found that the benefits of teacher experience on student achievement level off after approximately five years and there is little if any improvement beyond that point. In the same study, Darling-Hammond also determined that teachers trained in 5-year preparatory programs are as effective as more senior teachers, thereby supporting the finding in this study that teacher experience has no statistically significant effect on student achievement as reflected in campus accountability ratings.

Additionally, Rivkin et al. (2005) found that improvement gains in teacher quality and its effect on student achievement increase significantly in the first year of teaching, marginally over the next few years and then almost none after three years of experience. This once again reflects the findings in this study that increases in average teacher experience levels at the individual campus have no statistically significant effect on student achievement. Rivkin et al. (2005) also found no evidence that having a master’s degree improves teacher quality, a finding supported by this study as well.

Note also in this study that certain input variables, such as improved SAT/ACT performance in the Year 2 and Year 3 analyses, have a negative impact on accountability rating – a finding that is somewhat counterintuitive. This finding might be explained, however, by a smaller population of college bound students, that as a group perform better on the SAT, while the school in general suffers from systemic issues that lead to low standardized test performance. This is certainly an aberrant finding that warrants further investigation.

## Recommendations

Haas (2005) exposes the sheer economic impossibility facing public education in achieving a 100% passing rate on standardized tests for math and science as demanded by NCLB/AYP by the year 2014. And yet, the U.S. Secretary of Education and the Bush Administration push forward with their own highly controversial agenda aimed at expanding the standardized testing movement from public education into higher education (King, 2008). Regardless of the fate of standardized testing, for the immediate future, public school districts and campuses in the state of Texas must deal with its consequences, namely dealing with the state accountability system and its rating of districts and campuses. To remain above state scrutiny and possible state accountability interventions, the results of this study warrant an assessment and consideration of its findings by administrators in schools of moderate to large student enrollments (Texas Education Agency, n.d.c.).

The finding by this study that improved (*p*assing) performance on standardized math exam scores in the year following a failed exam is a strong, consistent indicator of campus accountability and is worthy of further investigation. The state of Texas requires schools and districts to provide remediation programs for students that fail one or more portions of the TAKS exam (Texas Administrative Code, n.d.; Texas Education Code, n.d.). There are no clear cut guidelines for these programs and districts and schools have great latitude in how they are structured and implemented. This study would suggest that perhaps quality remediation programs for students that failed TAKS exams, particularly math exams, would improve the chance of a campus being recognized or improve the chance of low performing campus becoming academically acceptable.

This recommendation for improved, structured remediation programs is supported by research on other remediation programs. Griffith (1999) found that freshmen entering four-year colleges and universities in Texas, and placed in remedial courses at the college level based on having failed their first administration of the Texas Academic Skills Program (TASP) exam, had a 62% greater chance of passing the math portion, an 80% greater chance of passing the reading portion and a 97% greater chance of passing the writing portion of the TASP exam on the second administration.

Newman, Britt and Lauchner (2006) also report that nurses found to be at risk of failing licensure exams through diagnostic testing have a greater chance of passing licensure exams when they enter into an intensive remediation program prior to examination. Based on the findings of this study and from studies such as these mentioned here, it appears clear that quality structured remediation programs aimed at TAKS failers and diagnostic testing of at risk testing candidates would provide a clear avenue for improved campus accountability ratings for schools in Texas public school systems.

The Texas Success Initiative criteria for both reading and math, which are indicators of college success, were significant at predicting the campus accountability rating in two of the three yearly analyses conducted in this study. A clear focus by campuses on college preparedness might help improve these indicators and hence campus accountability. This recommendation is supported by the process in which the Texas Success Initiative was developed through the criteria established by the Higher Education Readiness Component of the TAKS exam (Texas Education Agency, n.d.e.).

The Texas Success Initiative criterion, a scale score of 2200 on both the math and reading portions of the TAKS, was established using data gathered from ‘successful’ college freshmen (i.e. those with a 2.0 GPA after the first semester of college and no remedial courses in the first semester) and college freshmen deemed not ready for college (i.e. freshmen in remedial courses the first semester of college) (Texas Education Agency, n.d.e.). Based on this information, it is clear that improving student performance on the TAKS exams to levels that meet or exceed a scale score of 2200 in both the reading and math exams will not only have significant effects on campus accountability ratings, but will also likely provide improved success for entering college freshmen.

## Future Research

Certain relevant facets of this study warrant further investigation. Because campus accountability ratings are reflective of underlying student achievement gains or the lack thereof, the recommendations for future research in this section make reference to this underlying force as the impetus for improved accountability ratings and also the larger issue of improved levels of educational productivity. First, the negative aspects of student mobility on student achievement (as manifested in campus accountability ratings) revealed in this study call for action on how to deal with this academically detrimental issue. Numerous studies have shown the negative effects of high student mobility rates on student achievement, yet many of the studies fail to control for variables such as prior achievement, socioeconomic status and other outside variables, and the research in this area lacks a common definition of student mobility (Mehana & Reynolds, 2004).

Second, this study supports other findings on the lack of influence teacher experience and teacher degree levels have on student achievement. Darling-Hammond (1999) reports that the effects of teacher experience tend to level off after five years and that although differences in teacher quality can be seen in teachers with 1-3 years of experience, as compared to veteran teachers, new teachers coming from 5-year preparatory programs are just as effective as veteran teachers. A Washington state study on teacher effectiveness also found teacher experience had little effect on student achievement (Washington State, 2007). Rivkin et al. (2005) also reports similar findings. The fact that such findings are repeated in numerous studies demonstrates a clear need for research into an understanding of ‘why’ teacher quality begins to level off after the first few years of teaching.

Third, teacher degree levels and their influence on teacher quality present another area that could benefit from further investigation. This study found no statistically significant relationship between campus accountability rating, a measure of student achievement, and teachers’ advanced degree level. Both the percentage of master’s degrees and doctoral degrees possessed by teachers were analyzed at the district level for schools in this study. In this study, there was no statistically significant relationship between advanced degrees and student achievement as measure by campus accountability rating. This finding on the lack of improved teacher quality through advanced degree level supports similar findings by Rivkin et al. (2005) and a Washington State (2007) study.

The findings associated with degree level, along with the findings on teacher experience, have led some researchers to conclude that to improve teacher quality, states should provide personal performance incentives to those teachers and administrators that demonstrate the greatest levels of student achievement (Hanushek, 2006). Reasoning that because common ideas about how to identify a good teacher do not hold up in the data, the obvious alternative is to provide performance incentives for educators – common ideas being experience and degree level. Incentive programs have, however, proven to be controversial and difficult to implement (Odden & Wallace, 2006; Gaines, 2007).

To only analyze the art and practice of teaching from the perspective of experience and advanced degrees would seem shallow at best. Rather than moving immediately into controversial incentive programs as the only alternative to improving quality teaching, perhaps it is more important to determine the uncommon characteristics and practices behind good teaching and quality educational organizations. Argyris (1992) points out that if organizations are to survive, they must deal with the concept of organizational learning. Yet, Argyris contends, most people do not know how to learn, in business, government or education. Therefore, a final recommendation from this study would be to pursue further research into what comprises a quality educational organization and to further delve into the minutia and apparently uncommon practice of good teaching. These would appear to be additional obvious alternatives to improving teacher quality, perhaps more obvious than monetary incentives.

## Summary

This study sought to identify variables that possess some predictive value in determining the campus accountability rating for moderate to large Texas high schools, which in turn would reflect increased levels of educational productivity. Schools that do the best job of remediation with regard to their students that fail TAKS exams, particularly TAKS math exams, appear to have the best chance for favorable accountability ratings and increased levels of productivity. Other variables proved to have negative effects, such as student mobility, yet there are studies that demonstrate student mobility is not always a detriment to student achievement in select student populations, such as the children of military personnel.

An additional important outcome of this study was the identification that certain variables have no significant relationship to campus accountability rating - variables that intuitively should have an effect on student achievement, but do not, based on the findings of this study and others. Of these variables, it is perhaps teacher experience and teacher degree level, which hold the greatest value in determining why these highly sought after teacher qualifications and characteristics do not exert a positive force on student achievement as measured by campus accountability rating.

The accountability system will be with public education in Texas for all of the foreseeable future. As long as student achievement levels drive this accountability system, it is imperative that campus administrators are equipped with the knowledge of what affects their accountability status so that they might make informed decisions about student achievement issues. Campuses should be held accountable for educational outcomes, but they should also be given the insight, knowledge, tools and the resources needed to provide quality instruction for all students, so that student achievement is at its highest level for all schools.

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