Preparation and Access: A Multi-level Analysis of State Policy Influences on the Academic Antecedents to College Enrollment

by

Nathan J. Daun Barnett

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Doctoral Committee:

Professor Edward P. St. John, Chair
Professor Elisabeth R. Gerber
Associate Professor Stephen L. DesJardins
Assistant Professor Larry L. Rowley

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Dedication

To Sharlynn, Valerie, and Cameron who bring balance and joy to my life on a daily basis.

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Table of Contents

List of Figures

List of Tables

Abstract

Preparation and Access: A Multi-level Analysis of State Policy Influences on the Academic Antecedents to College Enrollment

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Nathan J. Daun Barnett

Chair: Edward P. St. John

Does state policy influence how well students are prepared to attend college? For the past 25 years, state and federal policies have focused attention on the high school curriculum with concern about whether or not students would be adequately prepared to pursue postsecondary education by the time they finish high school. Increasingly, states have adopted high school graduation requirement policies and exit exam requirements and a range of strategies to improve student outcomes but few studies have assessed whether those policies have operated in anticipated ways.

This study examines the relationship between high school graduation requirements, exit exams, average school funding per student and the cost of college and two student outcomes important to college access – high school completion and the number of courses completed in the core subjects – among public school students. I utilize the Education Longitudinal Study (ELS:2002) first follow up and transcript survey in combination with state policy indicators to examine these relationships. In an effort to

account for the complex sampling design and to recognize that students are nested within schools, which operate within unique state policy environments, I employ a three-level hierarchical linear modeling (HLM).

The findings demonstrate that policy matters in both anticipated and unexpected ways. Students in local control states are more likely to finish high school in four years than those in graduation requirement states and those in exit exam states are less likely to finish than in non-exam states. African American students in local control states are less likely to finish high school than their White and Asian peers; a gap that does not exist in other states. In terms of course taking, students complete more courses in the core subjects in states with graduation requirement policies. State adopted graduation requirements increase the number of core courses taken but a gap exists between those attend high and low SES schools. On balance, there appear to be greater benefits to adopting state graduation requirements, but greater attention must be paid to mediate the possible influence on high school completion.

Chapter 1

Introduction

For the past 25 years, state and federal policies have focused considerable attention on the high school curriculum. The issuance of *A Nation at Risk* (National Commission on Excellence in Education, 1983) was a call to arms for educators suggesting that as a nation, the U.S. was failing to educate its students sufficiently for future participation in society and the economy. Since 1983, an increasing number of states have adopted state level high school graduation requirements or increased the number of courses and the rigor of the content students are expected to master. By 2004, all but eight states have adopted statewide requirements and the majority of states have increased those requirements at least once since they were initially implemented (National Center for Education Statistics, 2005).[1] These policies are frequently justified on the basis of observed correlational relationships (i.e., Berkner & Chavez, 1997) suggesting that students who take more academically rigorous courses – with math being a particular focus – tend to perform better on achievement tests, are more likely to attend college (St. John, 2006) and ultimately more likely to earn a degree (Perna & Titus, 2006). This set of policy preferences toward better preparing students in high school continues to be a dominant theme in conversations of access to college.

[1] Since 2005, two local control states (MI and IA) have adopted or are in the process of implementing state graduation requirements.

Educators and policy makers know a good deal about the success of well prepared students but little is known about the degree to which those policies have had the intended effects. Better prepared students do score higher on admissions tests (Musoba, 2004a; St. John & Musoba, 2006; St. John, Musoba, & Chung, 2004), enroll in college more frequently (Pelavin & Kane, 1990a), experience greater levels of choice in the institutions they attend (Perna & Titus, 2004b), and complete college (Manski & Wise, 1985) relative to their less prepared peers, but there is less evidence regarding whether the policy has the intended effects. That is a difficult question to answer, but in this study I begin to address this question by considering whether these policies are related to differences in high school completion and the number of courses students complete in the core academic subjects – two important measures of academic preparation.

It is also important to recognize that policies intended to influence high school achievement and preparation do not operate in a policy vacuum. For example, beginning in 2007 Pell eligible students will also be eligible for Academic Competitiveness Grants (ACG) during their first two years of college if they complete an approved high school curriculum (U.S. Department of Education, 2006a). In states with graduation requirements in place, the policy serves as the academic threshold for eligibility. Those same students will also be eligible for National Science, Math Access to Retain Talent (SMART) Grant during their third and fourth years if they are Pell eligible, maintain a 3.0 GPA and pursue one of the approved Science, Math, and foreign language programs (U.S. Department of Education, 2006b). This is an important issue for policy makers because it gets at the question of where states and the federal government should invest

its money in education. In this case, the state policy may indirectly influence whether students can afford to attend college as well.

The movement toward higher and more academically rigorous high school requirements is rationalized to achieve both equity (same high standard) and excellence (academic rigor) (Kazis, Vargas, & Hoffman, 2004). When students take a rigorous curriculum they are likely to be better prepared for college. As such, students better prepared in the core academic subjects are less likely to require remedial education and more likely to complete college in the expected time (Creech, 1997; Hoyt & Sorensen, 2001). But there are tradeoffs to consider. Current estimates indicate that a number of students are adequately prepared for college but cannot afford to attend (Fitzgerald, 2004). It is equally possible that some students may begin to make decisions regarding their high school curriculum based upon their perceived ability to afford college. These are important challenges to college access that should be considered carefully.

Policy makers have chosen the high school graduation requirements as a primary lever which is likely to influence student course-taking patterns – particularly in the core academic subjects. Accountability schemes focus on test scores as the essential metric for student success, assuming that if students take more courses in the core subjects their test scores will improve. The research on this issue indicates that more courses in the core subjects results in higher test scores – because tests are aligned with the core academic subjects.

In this study, I consider high school completion in addition to the number of courses they complete in the core subjects for two reasons. First, high school completion is a necessary pre-condition for college participation and it may become more difficult to

accomplish as high school graduation requirements increase. Second, several researchers (e.g. Hoffman, 1997 and Teitelbaum, 2003) have concluded that high graduation requirements at the school level do not influence the likelihood a student will complete high school, but their research does not test these relationships with state level policy. When either condition is not met, college access may be compromised. In this investigation, both outcomes are considered in addition to a consideration of how these influences may differ across groups of individuals, schools and perhaps even state.

Students that take more advanced courses in the core subjects are likely to score higher on subject specific tests (Zwick, 2002) and those that take more core academic courses and score higher on the tests are also more likely to complete high school (St. John & Musoba, 2006). State policies are typically designed to influence course-taking directly, but as Chaney, Burgdorf, and Atash (1997) suggest, they will also have indirect influences on achievement test scores. States are becoming increasingly involved in decisions affecting high school education and state policies designed to influence the structure and function of high schools have grown, but relatively little about how these policies influence student outcomes. These challenges are compounded by the growing expectation that more and more students attend college (Commission on the Future of Higher Education, 2006). The need for a college education has been growing and states view an investment in higher education as an investment in the future of the state. This study makes an important contribution to our understanding of the complex relationship between state policies and student outcomes – completion and course taking – which are important linkages between what policy makers do and other outcomes including student achievement and college participation.

The findings in this study regarding the influences of state policy on high school completion and student course taking are both illuminating and instructive. Among public school students, those attending high school in local control states are more likely to finish high school in four years than students in states with common graduation requirement policies. The presence of a mandatory exit exam is negatively related to high school completion, which is a potential barrier from a college access perspective. These findings suggest that from a high school completion perspective local control and no mandatory exit exams may represent the right mix of academic preparation policies. However, a closer examination reveals that in local control states, the gap between African American students and White and Asian students is greater, meaning that African American students are less likely to finish high school than their peers in local control states. This is a matter of equity and may require reconsidering the benefits of local control in terms of the high school curriculum and the manner of assessment.

Among the public school students that complete high school in four years, the influence of policy changes. Students attending high school in states that require four English, three math, three science, and three social studies courses (New Basics) complete a full course (in Carnegie units) more than students in local control states and states with less demanding requirements. The analysis also suggests that a college preparatory standard may narrow the gap between low and high income students in terms of the number of courses they complete in the core academic subjects. For students that complete high school then, the adoption of state graduation requirements consistent with the New Basics standard may have a positive influence on the number of courses they complete in the core academic subjects. Combined, it appears that adopting state

graduation requirements may have the positive effects anticipated on course taking and from an equity perspective may be beneficial from an equity perspective for African American students. Similarly, the evidence suggests that adopting mandatory exit exams as a condition of high school completion may not be in the best interest of states in terms of either high school completion or student course taking.

Historical Background

In order to place this study in its appropriate historical context, it is important to consider some of the events that have shaped the policy environment surrounding the high school curriculum. The high school curriculum has been subject to debate since the beginning of the American high school or, at very least, the 20th century comprehensive high school. The reforms designed to constrain the high school curriculum or at least align it with the expectations of college date back for nearly as long as high schools have been in existence. Consider the work of the Committee of Ten in 1896 who proposed a set of college preparatory standards for all students regardless of whether they were bound for college or work. Recent efforts (like increasing graduation requirements) demonstrate an important and substantive shift away from the comprehensive school to a more specifically tailored college preparatory academy and that move has implications for both K-12 and higher education. In the next section, I focus on the more recent history, beginning in the early 1980s, recognizing the approach is not new but the stakes have changed for students, schools, and states.

> Our Nation is at risk. Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world…We report to the American people that

> while we can take justifiable pride in what our schools and colleges have historically accomplished and contributed to the United States and the well-being of its people, the educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a Nation and a people. (National Commission on Excellence in Education, 1983, p. 1)

This was the warning issued to the nation at the beginning of the influential report on education – *A Nation at Risk*. The report concluded that for the first time in our nation's history, the current generation of students would be less well educated than the generation before them. Additionally, the report indicated that American youth were falling behind other nations around the world in terms of their academic abilities, particularly in math and science. Particular attention was paid to the high school curriculum and its relationship to a student's level of preparation for college. The first finding of the Commission suggested that

> Secondary school curricula have been homogenized, diluted, and diffused to the point that they no longer have a central purpose. In effect, we have a cafeteria style curriculum in which the appetizers and desserts can easily be mistaken for the main courses. Students have migrated from vocational and college preparatory programs to "general track" courses in large numbers. The proportion of students taking a general program of study has increased from 12 percent in 1964 to 42 percent in 1979.(National Commission on Excellence in Education, 1983, p. 8)

The National Commission, led by David Peirpont Gardner, made a number of recommendations to then Secretary of Education Terrence Bell on issues ranging from the content of the curriculum to the quality of teaching, but perhaps the most influential and enduring recommendations addressed the finding summarized above. In particular, the commission recommended

> …that State and local high school graduation requirements be strengthened and that, at a minimum, all students seeking a diploma be

> required to lay the foundations in the Five New Basics by taking the following curriculum during their 4 years of high school: (a) 4 years of English; (b) 3 years of mathematics; (c) 3 years of science; (d) 3 years of social studies; and (e) one-half year of computer science. For the college-bound, 2 years of foreign language in high school are strongly recommended in addition to those taken earlier. *(National Commission on Excellence in Education, 1983, p. 17)*

It is difficult to ascertain the degree to which a single report has influenced the trajectory of American education. In fact, a number of efforts were underway at the same time, making similar claims regarding the high school curriculum. The *College Board*, for example, had issued a series of volumes identifying the core areas of the curriculum necessary to prepare students for college (The College Board, 1983). In the same year as the issuance of *A Nation at Risk*, Theodore Sizer and a team of researchers were contracted to conduct a thorough study of the American high school, which lead to the publication of several books including *Horace's Compromise* (Sizer, 1984/2004), the *Shopping Mall High School* (Powell, Farrar, & Cohen, 1985) and others (Hampel, 1986, 1996). The *Shopping Mall High School* in particular, picked up on the theme that students had far too many choices in the high school curriculum, and as a result, students took fewer challenging courses while completing what was minimally expected of them to earn their diplomas.

Ultimately, the nation collectively coalesced around the notion that American education as a system was failing and the high school was the weak link in the chain. The impact of *A Nation at Risk* and these other efforts on the high school curriculum cannot be overstated. In 1980, 13 states had no formal high school graduation requirements, leaving those decisions to local districts (National Center for Education Statistics, 1996). Today, only six states continue to leave high school graduation

requirements completely to the discretion of local agencies (Cavell, Blank, Toye, & Williams, 2005; National Center for Educational Statistics, 2005). [2] By 1992 forty-one states had either adopted state-wide requirements for high school graduation or had increased the numbers of credits required in the core subjects of English, math, science, social studies, and foreign languages (National Center for Education Statistics, 1996). The number of credits required of high school graduates has increased in a number of states since 1992, but in addition to the numbers of courses, state policies have begun to specify the levels of courses students should be required to complete. In 1992, only three states specified that students must complete at least one science course with a laboratory component and none specified the highest level of math required (National Center for Education Statistics, 1996). By 2004, five states required a science with a lab component, 23 specified either a biological science, physical science course, or both, and 17 states required at least Algebra I (seven of which were above that bar). Fewer than half of all states have adopted the full complement of courses articulated in *A Nation at Risk*, but for 25 years state policies have steadily moved in that direction. Today, 24 of the 44 states that have adopted graduation requirements require the same 13.5 to 15.5 Carnegie units (including foreign language for college attendance) recommended by the commission. However, more recent states to adopt these policies have met or exceeded this bar. For example, the newly adopted requirements in Michigan call for 4 years of English, 4 years of math (including Algebra I, Geometry, and Algebra II), 3 years of science (including a biological and a physical science course), 3 years of social studies, and 2 years of the same foreign language (Michigan Department of Education, 2006).

[2] The Council of Chief State School Officers (CCSSO) report finds seven states that maintain local control, but in 2005, Michigan adopted a set of graduation requirements, reducing the number to six.

Lee, Croninger, and Smith (1997a) describe the practice of high schools shifting toward providing more courses in the core academic subjects while eliminating non-academic courses as constraining the curriculum. For 25 years states introduced constraints previously left to the discretion of schools and districts. These constraints are not simply a reflection of shifting preferences or state priorities; rather, they call for educators to completely rethink the nature and function of the comprehensive high school. For more than 50 years the comprehensive high school attempted to provide all things for all students, regardless their background or ability. Powell, Farrar, and Cohen (1985) suggest that the result was the "shopping mall high school" with an extensive menu of curricular options and a goal of graduating every student. Policy makers have decided for better or worse, that leaving these decisions in the hands of students, schools, or parents is a problem that has implications for both the individual as well as the broader public good.

Contemporary Context

The recent evolution of state involvement in the high school curriculum is further exacerbated by the growing connection between student's preparation in high school and their opportunities for participation in college as a national imperative.

> …access to American higher education is unduly limited by the complex interplay of inadequate preparation, lack of information about college opportunities, and persistent financial barriers. Substandard high school preparation is compounded by poor alignment between high schools and colleges, which often creates an "expectations gap" between what colleges require and what high schools produce. (U.S. Department of Education, 2006c, p. 1)

On September 9, 2005, Secretary of Education Margaret Spellings announced the formation of a national commission to chart a course for the future of American higher

education (Department of Education, 2006). The commission met for more than a year and issued a set of recommendations to the Secretary for higher education in the 21st century. The Spellings Commission identified college access as the primary challenge for higher education and it further articulated the four most common barriers identified in existing college access efforts: poor academic preparation, lack of information, persistent financial barriers, and the misalignment of high schools and colleges. College access has grown increasingly important over the last 25 years and, while there is general agreement that access to college is important, there is far less agreement on the mechanisms for achieving access for all interested and capable students. In this study, I address the question of academic preparation for college as an essential element of college access. In particular, this study examines the degree to which state policy influences students' preparation in high school.

The current focus on academic preparation as an outcome of background, motivations, and abilities, school characteristics, and state policies is by no means intended to suggest that preparation is more important than any other factor in the college access debate. Rather, this study recognizes that for better or worse, educators, policy makers, and researchers have spent considerable time and energy attempting to improve high school outcomes for students, with the hope that doing so will open the doors of higher education to a cadre of students that might not otherwise attend. The study examines preparation from a broader K-16 college access perspective as a way of bringing two important sets of literature together: higher education literature on college access and K-12 literature on high school outcomes. First, higher education research focuses on the important role of preparation in the context of college access, but only a

few studies consider the influences of policy on student preparation for college while in high school (Musoba, 2004a; St. John, 2004; St. John & Musoba, 2006; St. John, Musoba et al., 2004). Recent works by St. John and colleagues (St. John, 2004; St. John & Musoba, 2006) examining the influence of state math requirement policies on aggregated state level SAT scores, high school diploma type, and college continuation rates are important additional exceptions. K-12 research, on the other hand, explores those factors influencing student preparation in high school, but they seldom address preparation in terms of college attendance and rarely address the influence that college admissions expectations and the cost of attendance may have on a student's high school curricular choices. More recent works that attempt to bridge K-12 and higher education (Advisory Committee on Student Financial Aid, 2001; St. John, 2006) are beginning to address these questions, but a K-16 orientation to the high school to college transition is a relatively recent direction in education research (Kazis et al., 2004; Kirst & Venezia, 2004). Both the higher education and the K-12 perspectives are important in order to develop a full appreciation of the relationship between state policies and students' preparation in high school.

An important challenge to research in this area is that the relationships between the high school curriculum – particularly math courses – and student achievement and college success have been known and understood for many years, extending much earlier than 1983. However, these relationships have been used to justify the adoption of graduation requirement policies, exit exams, and other education reform policies and those policies are typically not evaluated in ways that test whether they improve student outcomes in the expected ways. Clune and White (1992) conducted one of the earliest

studies of the influence of high school graduation requirement policies on student course taking and their findings suggest the policies may work to increase the number of courses students complete in high school. Musoba (2004) utilized state policy variables in a two level hierarchical model examining relationships with admissions test scores and found several relationships between existing policies and student admissions test scores. St. John and colleagues have examined the relationships between state tuition rates and financial aid policies and enrollment, persistence, and completion (St. John, Andrieu, Oescher, & Starkey, 1994; St. John & Asker, 2003). Hanushek and Raymond (2004) considered the influence of testing and high stakes consequences on student test scores. Several state level studies utilize indicators to explore the relationship between policies and aggregated state level outcomes (St. John, 2004; St. John, Chung, Musoba, & Simmons, 2004).

Policies to improve high school preparation have been designed in a variety of ways. A number of high school reform strategies include creating smaller high schools, schools within schools (Lee & Smith, 2001), middle college high schools (Bailey & Morest, 2006), and an array of dual enrollment strategies which allow high school students to earn both high school and college credit simultaneously (Bailey & Mechur Karp, 2003). Intervention strategies like summer bridge programs, mentoring and tutoring programs, and individual high school/college partnerships (Gandara, 2002; Swail & Perna, 2002; Tierney & Hagedorn, 2002) are also a common approach to improving preparation. Recently, state policy makers have focused on increasing course-taking in the core academic subjects (Cavell et al., 2005) while also eliminating remedial education from four-year colleges (Jenkins & Boswell, 2002). Finally, a number of states have

shifted their financial aid strategies away from need-based aid and a historic commitment to providing equal opportunity to low income families and disadvantaged students to those that reward merit; frequently rationalized as a way to incentivize high school academic preparation (Heller, 2004; Turner, Jones, & Hearn, 2004). While merit aid may be intended to influence preparation in direct ways, it is also possible that students' perceived ability to afford college may influence the choices they make in high school as well.

Purpose of the Study

The purpose of this study is to explore the influence of state level policies on the likelihood students will complete high school and if so, the degree to which they are prepared for college – at least in terms of the number of courses they complete in the core academic subjects of English, math, science, and social studies. More specifically how do state level graduation requirements, exit exams, K-12 funding and public university tuition policy influence (1) whether students complete high school in four years and (2) the number of courses they complete in the core academic subjects while in high school? In particular, and unique to most analyses of student course-taking patterns and achievement, this study utilizes a K-16 framework to conceptualize the problem. Kirst (2003) and others (Mintrop, Milton, Schmidtlein, & MacLellan, 2004; Venezia, Kirst, & Antonio, 2002) have made important contributions in recent years, attempting to conceptualized stronger alignment between two largely independent education "systems." In this study I utilize K-16 alignment theory to conceptualize the relationship between college cost and student preparation for college while in high school.

A K-16 orientation to this problem provides a new way to think about what is already known on the topic and suggests a more complex array of influences affecting students' decisions to prepare for, attend and complete college. By K-16, I mean that the two separate and discrete systems of K-12 and higher education are thought of as interdependent and that the influences of one system can influence outcomes for the other. It is generally accepted that student experiences in K-12 education influence future opportunities in college, but seldom does research consider whether the existing higher education context within which a student resides while in primary and secondary education might also influence the types of choices students encounter and the decisions they make about college. For example, public university tuition is one way to think about how college can affect students' decisions while in high school and is included as a state level variable. Similarly, the presence of need-based aid may signal to students whether college is affordable for them. Opportunities for dual enrollment might provide another example, but the data are not sufficient to evaluate.

K-12 education researchers have examined some of the important linkages between the policy lever of state level high school graduation requirements and high school outcomes including course-taking patterns, achievement scores, and completion. Chaney, Burgdorf, and Atash (1997), for example note that

> Logically, one would not expect graduation requirements to directly affect student achievement. Rather, the assumed linkage depends upon several intermediate hypotheses: Graduation requirements affect student course-taking, course-taking affects student achievement, and students have the potential to attain higher achievement if they make changes in there course-taking (p. 23).

Perhaps the most important assumption in the sequence is that students could attain more if they were required to do so. In fact, this same assumption is made in the

Shopping Mall High School (Powell, Farrar, & Cohen, 1985) and it undergirds the movement toward greater academic expectations for all students. However, during the 1990s – a period when many states were increasing requirements – state aggregated high school completion rates showed declines (Musoba, 2004a). By examining differences in high school completion across states, we can begin to see if these policies are related to the likelihood a student will complete high school.

Education policy researchers have focused attention on the relationships between students' level of high school preparation and whether they apply to and attend college but seldom do they account for how policy influences on college access are mediated through these outcomes. One of the early studies to find that student preparation was of primary concern for student's opportunities for success in college was conducted by Manski and Wise (1983). In this seminal work, the authors conclude that many more students were qualified to be admitted to college but that their probability for success, if they had chosen to go, would have been very low. The implication then was that they had finished high school prepared to attend but not well enough to succeed in college.

Pelavin and Kane (1990b) conducted another study in this area for the *College Board* and the U.S. Department of Education to explore the enrollment gaps between Black and White students and differences by family income and found that when students completed Geometry or above, the differences by race nearly disappeared. Pelavin and Kane acknowledge that non-White students were also less likely to take advanced math than their White counterparts. The relationship between higher levels of math and college attendance was not surprising or even new, but the Pelavin and Kane study illustrates an important limitation of much of the higher education literature in this area.

The study assumed that the gap between White and Black students was a consequence of inadequate preparation, and the way to reduce the gap was to improve preparation; a conclusion that neglects a number of important influences on preparation beyond the control of students, including disparities in economic conditions and the quality of schooling available.

A number of more recent national reports focus attention on differences by socio-economic status and suggest that if students were better prepared for college while in high school they would gain access to college (Adelman, 1999, 2004; Berkner & Chavez, 1997). However, these studies frequently treat a students' level of preparation as exogenous; a static characteristic of the individual as they begin the college decision process. This assumption is untenable in large part because students do not enjoy equal opportunities to prepare for college (Musoba, 2004a). Lee and Smith (2001) point out that the structure of schools and the elements of reform attempted in many school districts vary by the socioeconomic composition of schools and as a result, outcomes differ as well. Like race, SES is an important factor in college access, but it also reflects important differences in students' opportunities to prepare for college to start.

Kozol's (2005) more recent exposition of school inequalities illustrates this point. In his earlier work Kozol (1991) casts light on the substantial disparities between America's richest and poorest school districts. He suggests that today, even with some progress equalizing funding for schools, enormous inequities persist across the country, particularly in urban communities. These disparities have very real implications for college preparation because under-resourced schools are not only limited by an inability to offer advanced courses, but also in their ability to pay qualified teachers or to provide

adequate guidance. This is compounded by the challenges inherent in serving lower income students that do not have the same resources at home or in their communities as their higher SES and White peers.

Despite a growing and persistent recognition of these problems, policy makers continue to craft policies designed to influence preparation without a consideration of whether these policies have the intended impact. Equally, they tend to neglect the cost of college and the need for financial assistance in students decisions to prepare for college. Consider recent efforts articulated by the National Governor's Association (NGA). The NGA (2005) has been particularly invested in college participation as a mechanism for improving state economic growth and their focus has been the improvement of high schools to better prepare students for college. Researchers across education agree that preparation is part of the problem, but the focus on the high school neglects the fact that a number of students complete high school prepared for college and yet cannot afford to attend (Advisory Committee on Student Financial Aid, 2002; Fitzgerald, 2004).

Research Questions

The current study is intended to address one overarching question: Does state policy influence individual educational outcomes pertinent to college access? State policy makers are working with great energy to improve K-12 education and college opportunity is an important motivating force behind the change. In an effort to operationalize this question, I pose two more specific sub-questions: (1) Are graduation requirement policies, exit exams, and K-12 funding related to students' completion of high school? (2) For those that finish high school, are graduation requirements, exit exams, K-12 funding, average public tuition, and need-based aid related to how well students prepare

for college as measured by the number of courses completed in the core academic subjects?

This study considers five state level policies – high school graduation requirements, mandatory exit exams, average school funding for the state, average tuition at a public university, and average need-based aid per full-time equivalent (FTE) student granted in a state. In the three level framework, I am interested in the potential direct influences of these policies on the probability a student completes high school and their level of preparation if they do (level 1), on the variation of average outcomes among schools (level 2 intercept), and the variation among groups within schools (level 2 slopes). I will also consider whether these policies are related to the aggregate differences observed at the state level (level 3 intercept). The school is an important level in the overall conceptualization of the problem – students are educated in schools and policies are primarily designed to influence school behaviors – but that is not the primary focus of this study. So while school characteristics are included to reflect what is currently known in the literature, the analyses will focus on state policy and how it operates at several levels. Similarly, at the individual level, student characteristics known to be related to their educational outcomes are included as controls in an effort to suggest that any potential observable differences are independent of a students' race, sex, or family background.

In the current chapter, I have laid the foundation and established a context for understanding why it is important to consider how state education reform policies influence student outcomes. Additionally, I pose three research questions that will be addressed throughout the study. In chapter two I examine, in greater detail, the literature

that informs our current understanding of the complex relationships between individual characteristics, school structures, and state policies and a range of individual outcomes, which include high school completion and course taking in high school. The research draws upon theory and research in sociology, economics, K-12, and higher education literature and forms the basis for the development of a new conceptual framework for this study.

Chapter 3 discusses the methodology employed to address these questions. In this chapter I describe three sources of data utilized in this investigation, consider the strengths and limitations of the data describe the analytic method (HLM), and provide detailed summaries of the models and the variables in each analysis. Chapter 4 examines high school completion among public school students in the U.S. utilizing the three level framework established in chapter 2 (Figure 2.1) and Chapter 5 focuses in on the number of courses completed by only those public school students who finished high school within four years (Figure 2.2). The concluding chapter summarizes the findings of the study and addresses possible implications for both research and policy.

Chapter 2

Review of Literature

The current study conceptualizes the relationship between state education reform policies and two student outcomes – high school completion and student course taking in the core academic subjects – as a three level problem. Students make choices regarding the courses to take based upon influences of parents, peers, and personal motivations. Those students are nested within schools that offer varying levels of opportunity, quality of instruction, availability of resources and availability of college counseling and support.[3] Finally, schools are nested within states which are becoming increasingly invested in schools and as such are committing greater resources and imposing greater regulation on schools. In practice, schools are nested within districts which are then nested within states, but given the nature of the data available for this study and the considerable overlap between school and district decisions regarding high school course requirements and other policies of interest, the district level is not considered. Previous research has focused on individual level influences on student course-taking in high school, the influences of schooling and the structure of schools on individuals choices and opportunities, and more recently a few studies have considered how state level demographics and policies influence educational outcomes aggregated at the state level.

[3] Schools are also nested within districts, which are nested within states however, this added layer of nesting has been ignored for two reasons. First, is a limitation of the data. In the Education Longitudinal Study (ELS) students are sampled within schools. Second, in most cases, district and school policies will be identical, particularly with respect to the courses students are required to take and how much money is spent per student.

To date, there has not been a study of state policy and its relationship to high school completion and college preparation at all three levels.

I examine the conceptual and empirical literature beginning with the individual and moving out ecologically to the school and then to the state. In many ways, the development of research in this area mirrors this structure. All of this work is imbedded in the sociological literature exploring the persistent social stratification in the U.S. Early studies began by looking at ones origins as predictive of their destinations – where origins were characteristics of the individual and family background and destinations were measured by income and occupation. Quickly, education was found to be an important intervening factor, one strand of research focuses on how early characteristics influence educational outcomes, and another utilizes education as an explanatory factor for relative socio-economic position.

Beginning with the application of social reproduction theory to education, the role of schools were understood and conceptualized to play an important role in student opportunities. The important point of research existing at level 2 is a growing recognition that students are nested within schools and both their structure and the function – academic organization – play an important role in shaping the lives and educational outcomes of students. By extension, a similar evolution has occurred at the state policy level. Relationships between student characteristics and student outcomes suggested a new way to think about the role schools play with the logic being that if better students complete more demanding courses and as a result enjoy better outcomes after school, then schools should try to make all students do what the successful students have done. A similar logic has been employed for state policy. "Good schools" focus on

college preparatory courses and as a result, their students perform better on a range of measures and enjoy greater future opportunities, leading to recommendations that states should make all schools do what "successful" schools have done. This assumption has been tested at the school level, but is remains too soon to conclude that the same will be true at the state level.

In the sections that follow it is clear that a good deal of research has been done at level 1. The same is true at level 2 though with slightly more mixed results. And there are some important contributions at level 3 examining relationships between state policies and student outcomes. However, few studies have conceptualized and tested these relationships in a 3-level framework.

Individual Level – Human Capital and Status Attainment Theories

Scholars examine the high school educational experience and college access from a number of important perspectives. Sociologists, educational researchers both at the K-12 and higher education levels, and systems theorists have all made important contributions to our collective understanding of student pathways through high school and into college. Social theorists have considered the question of student outcomes in high school from primarily two different perspectives. Blau and Duncan (1967) utilized a status attainment framework to examine social stratification in society and the process of social mobility. Status attainment theorists generally focus on characteristics and aptitudes of the individual but ignore the influence of larger societal structures. The theory assumes that differences between one's origins and their destinations depend largely upon the individual. The second perspective, social reproduction, suggests the structure of a capitalist society is critical in the understanding of social stratification and

mobility (Bowles & Gintis, 1976). Human capital theory provides a useful point of entry to a discussion of status attainment theory because it rests upon a similar set of assumptions and emerges in the literature slightly before Blau and Duncan's seminal work on attainment theory.

Human Capital Theory. Theodore Schultz (1961) and Gary Becker (1964) are credited with elevating human capital to the forefront of the economics literature (Langelett, 2002). Schultz began the conversation by addressing the apprehension of the field to quantify human beings in the same ways economists had done with other forms of capital. Both Schultz and Becker explored how certain Western economies grew at much faster rates than other nations and both recognized the limitations of current models that considered only increases in "land, man-hours, and physical reproducible capital" (Schultz, 1961, p. 1). Langelett, suggested both macro- and microeconomic applications exist, where the latter says "[i]ndividuals may increase their own amount of human capital through a variety of training and educational experiences" (Langelett, 2002, p. 2). DesJardins and colleagues (1997) described human capital theory in the context of college choice and noted "a student's college choice decision is based upon the expected net benefits (utility) of attending a particular institution" (p. 5). Paulsen (2001) has defined human capital as "the productive capacities – knowledge, understandings, talents, and skills – possessed by an individual or society" (p. 56), and as such describes the investment in human capital as the expenditures intended to augment these productive capacities.

Human capital is a useful lens through which to view the decisions students make and the utility of pursuing education beyond high school. Research based upon human

capital theory considers student outcomes ranging from whether students apply to or are enrolled in college (Manski & Wise, 1983) to individual long-term wages (Paulsen, 2001). Additionally, researchers have considered the influence of college costs and tuition subsidies on enrollment and persistence decisions (Heller, 2002; St. John et al., 1994; St. John & Asker, 2003). Others have examined the development of human capital and its influence on long term earnings. For example, Levine and Zimmerman (1995) found that women taking more math courses in high school experienced higher wages and more frequent entry into technical fields.

A number of researchers examine the formation of human capital and the role of student academic experiences. DesJardins and colleagues (1997) explored both the completion of college preparatory courses and the completion of a set of university established prerequisite courses in the context of human capital theory and found that college preparatory courses, particularly those in science and foreign language, had an impact on student's decisions to apply to a single institution. Similarly, Dalton Conley (2001) utilized human capital theory to investigate the number of years of schooling as an outcome, and Perna and Titus (2004a) used student achievement and the level of high school preparation as proxy measures for human capital as an independent variable, explaining differences in the type of postsecondary institution attended. A critical assumption of human capital theory in the context of higher education, is that students make rational investment decisions based upon the anticipated costs of college (net any subsidy for attendance) both direct (tuition and fees) and indirect (foregone wages) weighed against the likely benefits of earning a degree. The final critical linkage is that

an increase in the amount of education results in increased productivity and increased wages for the individual and profit for employers.

Student decisions regarding college are influenced by a number of non-economic factors, but college cost is an important factor to consider. In the context of this study, human capital theory suggests that college cost may influence not only decisions regarding whether to apply to, attend, persist through, or complete college, but may also influence decisions regarding how to prepare for college or work after high school – assuming students begin weighing the potential costs and benefits earlier than junior or senior year in high school.

Status Attainment Theory. The early roots of status attainment theory are traced to Blau and Duncan (1967) who suggested that occupational prestige was the stratifying characteristic in the American economic structure. They developed a methodology for quantifying occupational prestige (which was associated with wages) and found that prestige, in addition to race and socio-economic status, was an important stratifying feature. These relationships were relevant to studies of education because high prestige positions were commonly associated with higher levels of education. Sewell and Shah (1967) in a study of Wisconsin students, examined the effects of SES (including father's occupation), intelligence as measured by a mental ability test, and sex on three outcomes: a student's college plans, their attendance, and whether they completed college. They found that SES and intelligence had strong direct effects on college attendance and graduation and that they also had considerable indirect effects on degree attainment mediated through college plans. Sewell and Hauser (1972) noted that early studies of

status attainment emanated from comparisons of a son's origins with his destination; or stated differently, a father's occupational status and the eventual occupation of the son.

Goldman and Tickamyer (1984) identified three characteristics of attainment models: (1) individuals were the unit of analysis and stratification was the process whereby they attained positions in the social structure based on their characteristics and resources, (2) positions within social structures were measured as interval level variables reflecting underlying hierarchies of value, prestige, positions and occupations were conceptualized as continuous scale variables rather than discrete social positions, and (3) linear regression techniques allowed researchers to develop and test causal models of relationships between individual characteristics and the level of occupational prestige an individual achieves over time. Early critics decried status attainment as atheoretical, but Horan (1978) suggested the theory could be understood in terms of the assumptions it makes, particularly with respect to the nature of occupations and a universal understanding of their relative prestige in society. Further, "the model treats stratification as a series of individuated choices taking place on an open market, which requires the assumption of market homogeneity for the population under study" (p. 540) suggesting that everyone has the same opportunity to choose and the market treats everyone the same. Knottnerus (1987) claims status attainment theory ignores class as a structural impediment to mobility in part, because the theory developed at a time when vertical mobility was high, meaning a greater number of individuals were moving up the economic ladder.

The theory does not ignore stratification, but rather suggests that social strata are permeable and rates of mobility are high (Knottnerus, 1987). In this view, status

attainment advocates recognized women and minorities fare less well in terms of wages and occupational prestige, but suggested that their relative failure in the marketplace was a consequence of other common factors – notably college aspirations, high school preparation, and college attendance.

Like human capital theory, status attainment theory focuses on economic stratification and the differences in wages among workers (Bibb & Form, 1977). Bibb and Form (1977) are critical of status attainment theory because it has focused greater attention on occupational prestige than wages. In their comparative analysis, they suggest both sociological and economic models should be considered because "the former lack comprehensiveness and precision and the latter fail to consider social structural variables" (p. 974). Human capital theory is important relative to the dominant status attainment approach because what has been learned about the effects of education on wages has changed societies' perception of the value of higher education, as may be seen in increasing student aspirations for college. If the human capital proposition that students make rational choices about whether to invest in themselves based on the combined costs (both direct and opportunity costs) and the anticipated benefits is accepted, then what is learned through countless studies indicating the economic benefits of attending college may give the consumer greater confidence in his investment. Conversely, rising costs may suggest to a potential student that the cost is greater than the likely return on investment.

Empirical Literature on Attainment. A unique feature of the early status attainment literature – which fed into the perception that it was methodologically driven and atheoretical – was the utilization of path analysis to explore both direct effects of

variables on outcomes and indirect effects mediated through other variables. The studies by Sewell and Shah (1967) and Sewell and Hauser (1972) are illustrative. The essential form of the path analytic framework is this: (1) both SES and mental ability are considered exogenous meaning the antecedents of them are not considered in the model, (2) aspirations, peer influences, and academic performance are considered endogenous variables because they are thought to both mediate the effects of SES and ability and exert an independent effect upon the outcome, (3) which is some measure of educational attainment, occupational prestige or income. Wilson and Portes (1975) demonstrate that each relationship within the path analytic structure is optimally supported by some theoretical justification for its inclusion in the model. For example the relationship they suggest between academic performance and aspirations is based on symbolic interaction theory, which had not been tested directly by the time of their study.

The same challenge may be true of race in status attainment models. Researchers debate the extent to which status attainment models differ with respect to race, meaning they may be better predictors of attainment for White than Black students. Subsequent to the work of Blau and Duncan, researchers recognized that differences in attainment existed between White and Black students, but existing models were not sufficient to explain differences across groups. Several researchers (Hanson & Ginsburg, 1988; K. R. Wilson & Allen, 1987) have hypothesized that structural influences of the family, peer networks, and the school were more critical to the future success of Black students than White students as measured by high school achievement and degree attainment. Wolfle (1985) had previously concluded that the attainment processes for Whites and Blacks were essentially the same, arguing that a student's social class was driving the differences

observed by race. But Morgan (1996) argued the processes were different and that the change in expectations between Black and White students may have a separate effect beyond social background. The debates regarding the role of race continue to include additional structural features of the college (Pascarella, Smart, & Stoecker, 1989), the choices students make about which college to attend (Hossler & Stage, 1992) and additional forms of capital beyond human capital (Perna, 2000). In these cases, a relationship between race and attainment may clearly exist, but there are a variety of theories about why this is so, and often it is not clear which set of theories informs the research (Massey, 2003).

Analysis using the Attainment Model. An important limitation of status attainment theory in education research is actually a consequence of its strength. Status attainment has become such an important foundation for studies of the college participation research that the roots of the theory are often minimized or neglected altogether. Consider the evolution of student choice theory as an illustration. Hossler and Stage (1992), drawing upon status attainment theory, define the College Choice Model as a stage theory describing the student choice process (predisposition, search, and the choice phases). Their study is grounded in the status attainment literature, but works drawing upon their choice theory may not recognize the early roots. Consider the work of Hurtado and colleagues (1997) who utilize Hossler and Stage's three-stage choice model to examine the choice process among racial/ethnic minority students, but make no mention of status attainment theory. Hurtado's work is clearly part of the status attainment literature, by virtue of its reliance on Hossler and Stage, but it may not be clear to the reader that the work is situated as such, with the same sets of assumptions.

Reports by Berkner and Chavez (1997), Horn and Carroll (1997),and Adelman (1999) on college access and success provide additional important illustrations of the disconnect between the underlying theories and the empirical expositions in education policy research. Many test the same relationships found in status attainment models, yet they are not explicitly grounded in status attainment theory that signals the reader that there is a particular set of assumptions guiding their work. Status attainment may be an appropriate theoretical model for these studies, but stating the theory clearly from the beginning would help researchers situate the work in a particular line of research, which in turn, would signal to researchers the limitations of the assumptions and subsequent claims.

One frequently cited study conducted by Cliff Adelman examined students' college completion (1999). His toolbox study creates a measure of 'academic intensity' or strength of curriculum and suggests that it is the leading contributor to degree attainment. It also reaffirms deeply held assumptions of status attainment theory, particularly that attendance gaps can be closed by the schools. Consider this quote by Adelman (1999):

> It [the tool box] tells us that if degree-completion lags for any student or group of students, the situation is fixable. We learn where to take the tool box, and what tools to use…to admit that some students are not prepared for the academic demands of the particular higher education environment in which they initially find themselves seems to be some form of heresy in the research traditions on this issue (p. 83).

Status attainment assumes that schools, by way of the curriculum, are vehicles for mobility. If students take the recommended courses, they will succeed. Adelman never situates his work in the context of status attainment theory, but he situates constructs like academic resources in the works of contemporary education researchers (Akerhielm,

Berger, Hooker, & Wise, 1998; Alexander, Cook, & McDill, 1978; Alexander & Eckland, 1977; Alexander, Holupka, & Pallas, 1987). While the academic intensity index called "academic resources" may be important, his model does not include the cost of college or the availability of financial aid, which are also known to be important factors for students, particularly in the context of human capital theory.

School Level - Social Reproduction by Tracking

In many ways, social reproduction theory offers a critique of status attainment theory. It also provides a way to think about the role schools play in terms of measurable student outcomes. Bowles and Gintis (1976) provide the foundation upon which the social reproduction literature is built in education literature. They argue that schools alone could not change or appreciably reconcile the inequalities of income and status mobility because they are reflections of the broader social and economic capitalist structure in America. So long as a hierarchical division of labor exists, schools serve as a sorting mechanism of students for their roles in the economy. A substantial body of literature following this line of inquiry has explored the practice of tracking in high school (Alexander et al., 1978; Alexander, 2002; Gamoran, 1987; Gamoran, Porter, Smithson, & White, 1997; Oakes, 1982; Oakes & Wells, 2004) and the findings generally suggest that tracks exist in high school, that teaching and learning differs tremendously by track, that low income and racial and ethnic minorities are more frequently found in general and vocational tracks, and that long-term economic opportunities increase at higher track levels. What is less clear in this body of research is the degree to which students are able to move across tracks. Stated differently, do institutions track students in ways that prevent movement through their high school curriculum? For example,

Powell, Farrar, and Cohen (1985) suggest that a significant problem with the high school is the enormous variety experienced in terms of curricular options for students. It may be the case that students choose their track based upon some other set of factors than the structure imposed by the school.

Where status attainment theory draws upon the work of Weber, social reproduction traces its roots to Marx. Both theories were concerned with social stratification in society and the process of social mobility, but they differ in important ways. Status attainment theory focuses on the stratification of prestige of a father's occupation and its relation to a son's future occupation, where social reproduction is concerned with economic stratification. Status attainment theory assumes that differences between one's origins and their destinations depends largely upon the individual, while social reproduction suggests the structure of a capitalist society is critical in the understanding of social stratification and mobility. In that respect, social reproduction might also be viewed an expansion or a revision of status attainment theory.

The Bowles and Gintis Hypothesis. Schooling in Capitalist America (Bowles & Gintis, 1976) provides the foundation upon which the social reproduction in education argument is built. Bowles (1973) suggested three prevailing explanations for intergenerational economic status transmission – status attainment theory focusing on the role of education, the culture of poverty and the role of parents and communities, and the genetic perspective put forth by Jensen (1973) and Herrnstein and Murray (1994). Bowles and Gintis (1976) wrote their seminal work beginning in the late 1960s and were commenting on a generation of school reform efforts that were largely unsuccessful in terms of creating equal opportunities for all Americans. They were critical of the

dominant paradigm suggesting that privileged classes were “concerned [about inequality, which was] tempered by a hardy optimism that social programs could be devised to alleviate social distress and restore a modicum of social harmony” (p. 5). They argue that schools alone could not change or appreciably reconcile the inequalities of income and status mobility because they were reflections of the broader social and economic capitalist structure in America. So long as a hierarchical division of labor existed, schools would serve to sort students for their roles in the economy. Specifically, "schools legitimate inequality through the ostensibly meritocratic manner by which they reward and promote students and allocate them to distinct positions in the occupational hierarchy" (p.11). Bowles and Gintis assumed an optimistic perspective on the potential of education to change society (1976, 2002), but their enthusiasm is tempered by their conviction that in order for education to reduce inequalities of opportunity, larger social and economic structures also required change. This is a significantly different proposition than that offered by status attainment theory because mobility then is contingent upon social structures beyond the control of the individual.

Oakes (1982) examined school curriculum tracking and found “the relationships in schools reproduce the consciousness of workers by fragmenting students into groups where different capabilities, attitudes and behaviors were rewarded” (p. 197). Tracking, according to Oakes, was the “organizational structure within schools that separates students into groups [by ability, but which is] largely reflective of their social origins” (p. 198). She examined data from 25 secondary schools to consider the degree to which classrooms, teacher behaviors, and student learning differed by curriculum track and she found that significant differences existed. In her study she asked three questions: (1)

How do students and teachers relate, (2) How do students and peers relate, and (3) Does the type of learning interaction vary by track? She found distinct differences in support of the Bowles and Gintis hypothesis where lower track students were more passive, had lower aspirations, exhibited more negative and disruptive behavior toward one another and were treated in a more punitive and authoritarian manner by teachers than higher track peers. Her work did not assess whether the differences corresponded with occupational strata so it is not direct evidence that schools train students differently for occupational roles, but it is suggestive.

Tracking is the principal structural feature of schools affecting the types of courses students take and subsequently, the level of preparation they receive for college. There is general agreement that low SES and minority students exhibit lower levels of mobility and as such are disproportionately represented in low economic strata, but there is less consensus on the role of schools in that process. Alexander and Eckland (1977) found the composition of schools affected whether or not a student attended a selective college which, in turn, affected both the likelihood of degree attainment and subsequent wage potential. Griffin and Alexander (1978) found significant occupational and earning differences which they attribute partially to differences between schools, but more substantially to differences within schools. More recently, researchers have found participation in an academic track (versus non-academic) is a strong predictor of achievement, college application, and college attendance (Alexander et al., 1978), that attending elite private institutions constitutes a form of charter extending additional benefits to high SES students in the admissions process for selective colleges (Persell & Cookson Jr., 1985), and that tracking has an effect on a number of non-academic

outcomes including satisfaction with school, extracurricular involvement, and self esteem (Vanfossen, Jones, & Spade, 1987).

Gamoran (1987) draws as an important distinction between schools (structures) and schooling (what is taught) and finds schooling effects in terms of the number of courses taken in math and science that extend beyond the effects of an identified track. He suggests there are also psycho-social implications for being in a given track. In a subsequent study, Gamoran and Mare (1989) show that tracking may have positive effects on students. Equally, they suggest that there are two ways to think about tracking. One position on tracking is to focus on equality among groups, which is the position taken by most critics of tracking. The other is to suggest that tracking promotes maximization of education for each individual and leads to greater overall productivity. They find evidence that tracking maximizes both math achievement scores and the likelihood of high school graduation. Gamoran and Mare conducted several simulations and found that if all students had taken the same curriculum, differences between groups would have been smaller, and that tracks compensate girls and African American students for initial disadvantages, which runs counter to earlier findings. Oakes (1992) recognized tracking as a complex problem that extends well beyond the curriculum students take and requires widespread structural change along technical, normative, and political dimensions.

One final line of tracking inquiry looks more systematically at the courses students take by track. Stevenson, Schiller, and Schneider (1994) examine sequences of opportunities in math and science, suggesting that taking the appropriate sequences is what really matters for future opportunities and find that the math sequence is more

important than that of science. Spade, Columba, and Vanfossen (1997) examine math and science course taking at six high schools matched by class and found that better schools, irrespective of class, offered more upper level courses, provided more systematic guidance to students and conducted broader assessments of students strengths when making placements. All of these issues affect achievement, but in the context of both status attainment and social reproduction, they matter more with respect to where students go after high school – college or the workforce. In the context of this study it is not specifically relevant, but as students progress from high school to college, systematic differentiation of opportunities is mediated through institutional stratification discussed by Brint and Karabel (1989).

The issue of whether students have the ability to choose their courses in high school remains an unresolved debate in the K-12 education literature. From the perspective of social reproduction theory, the inequitable distribution of opportunities across schools coupled with the existence of curricular tracks prevents students from making meaningful curricular choices. There is clearly evidence to suggest that tracks exist and that student outcomes differ by track. Conversely, from the *Shopping Mall High School* perspective – which suggests that students have far too many choices – in the absence of effective guidance from parents, counselors, or teachers students will follow a path of least resistance to the completion of the high school diploma (Powell et al., 1985). Evidence in this area demonstrates that choices abound and that many students will choose courses following a path of least resistance to the diploma. In this study, I do not address tracking directly, but I assume that students experience some

degree of choice in their high school curriculum and that schools constrain that choice set in a number of ways that may differentially affect students.

Analysis of Social Reproduction Theory. Tracking in high school creates a complex set of challenges for students that is, at best, difficult to navigate and, at worst, intentionally designed to maintain the existing class structure. Critics of both practices are concerned about the structural impediments preventing students from becoming upwardly mobile as the status attainment advocates would suggest. However, when attempting to study the problem, both sets of literature appear to modify status attainment models rather than propose something radically different, typically adding school level variables for aggregate SES of the school, racial composition, track membership of the high school student or college selectivity and tuition cost in higher education.

More than others, Oakes work suggests that student experiences differ dramatically by track level, but her study is unique because the classroom is the level of analysis. This is important because tracks may not be as rigid as one might expect. Powell, Farrar, and Cohen (1985) suggested there were an infinite number of "tracks" that students followed and that the barriers between tracks were largely permeable. Both critics and proponents acknowledge (and handle differently) the fact that transcripts do not identify a "track" and that as many as 40% of students identify different tracks in different survey years. This means that either tracks are permeable or students are not consciously aware of being members of a particular track.

What has not been discussed to this point is whether students in vocational tracks are adequately trained for participation in community colleges or vocational/technical programs. The current class structure does not value this articulation, but if the two

curricula were effectively aligned and students who attended a two-year college from this track earned more than they would have without the college education, they may experience a net benefit, even if they have not appreciably changed their initial social strata. One critical assumption in the literature considering social stratification is the desire of upward social mobility, but seldom is there a discussion of potential downward mobility; an important question for future research.

Finally, though seldom explored, tracking is precisely the organization of course requirements, differing for student academic ability. The very existence of tracks is an artifact of the vocational/social efficiency movements. At the time, tracks suggested different though valuable pathways to a high school diploma. The effects of tracking at that time may have been less problematic because the economic structure still valued practical vocational training. The notion of different curricular paths today runs counter to the prevailing belief in the same high standard for all students.

This study considers characteristics of schools commonly associated with an inequitable distribution of opportunity to non-majority and low income students, including the percent of the school's enrollment made up of minority students, the percent of students qualifying for free or reduced lunch, and the quality of teachers. Social reproduction and the influence of educational structures and the characteristics of schools on students represent an important set of influences overlooked in the status attainment literature. The theory is limited however, in two ways. First, it allows for less student choice in curricular decisions than might be supportable given the evidence. Second, like status attainment, it does not account for the potential influences of state

level policy on student level outcome – a critically important linkage as policy makers attempt to improve academic preparation through policy initiatives.

School Effects Literature. K-12 educational researchers primarily consider student outcomes in high school from a pipeline perspective, suggesting that if the nature and structure of schooling were improved upon, student outcomes would improve. Methodological advances like the development of hierarchical linear modeling techniques have opened opportunities for research that more accurately reflects the complex array of factors likely to influence student outcomes. Lee, Croninger and Smith (1997) – testing the constrained curriculum hypothesis – found that when schools adopt a more limited set of curricular options in the core academic subjects, students perform better on achievement tests and exhibit no difference in terms of high school graduation. Finn, Gerber, and Wang (2002) and others have expanded the pipeline conversations to consider the effects of the size of the school, the preparation of teachers (Goldhaber & Brewer, 2000; Teitelbaum, 2003), the influence of accountability (Hanushek & Raymond, 2004) and testing (Schiller & Muller, 2003), and the degree to which districts adapt to state policy changes regarding the high school curriculum (Sipple, Killeen, & Monk, 2004). With the exception of Chaney, Burgdorf, and Atash (1997) and less directly the earlier work by Clune and White (1992), few K-12 educational researchers consider the implications of high school success in the context of college preparation.

Prior to *A Nation at Risk*, a number of states had adopted rigorous state-level graduation requirements. Sebring (1987) utilized the High School and Beyond (HSB) and College Entrance Exam Board (CEEB) surveys to compare student outcomes across states with different sets of graduation requirements; New York and Pennsylvania had

among the highest state requirements and California and Illinois near the lowest. She found that controlling for prior achievement, a positive relationship existed between course taking and living in high requirement states and separately, CEEB scores were higher on average in those same states. The implication, which has been reinforced in subsequent policy research at different points along the education pipeline, is that increasing requirements will improve student outcomes and future life chances (Adelman, 1999; Berkner & Chavez, 1997; Horn & Carroll, 1997).

Clune and White (1992) published another of the early studies in this strand of research as they looked at the impact of increasing graduation requirements for low achieving students in high requirement states. This study was important for a number of reasons. First, they recognized that increasing requirements at the state level was only likely to affect students enrolled in low achieving schools whose requirements were most likely below the recommended standard. It would not affect a number of schools that had already adopted similarly high standards prior to the policy change. Clune and White examined student transcripts using a time series design and found student course-taking patterns changed both in terms of the number of courses completed in core content areas and in terms of the rigor of those courses. They also acknowledged that, while not significant across the entire study, specific schools experienced a decline in vocational course-taking by students. Clune and White did not explicitly test the assumptions of the *Shopping Mall High School* but its influence was present. Powell, Farrar and Cohen (1985) found that the majority of students were lost in the comprehensive high school and as such, were not achieving their full potential. In the absence of a clear curriculum and strong guidance, students did what was necessary to get by. David Labaree (1997a,

1997b) expresses a similar concern when he suggests that competing goals and an emphasis on status attainment compel students to complete the minimum to earn the credential. By testing curricular changes in schools with low expectations, Clune and White were testing these assumptions and their evidence suggests the hypothesis may have some merit. Clune and White did not, however, consider whether high school completion rates were influenced by the adoption of higher standards in those low achieving schools.

Both Sebring (1987) and Clune and White (1992) were considering the challenge of student achievement as a two level problem, but they lacked the methodological sophistication now available to researchers. Lee, Croninger and Smith (1997) were able to advance the early work by introducing the use of hierarchical linear modeling (HLM) to research on school characteristics and student outcomes. They ground their analysis in the historical evolution of the American high school and the distinction between the comprehensive model of all things to all people and the constrained curriculum approach found most prominently in Catholic schools (Lee & Smith, 2001). They utilize multilevel modeling techniques to consider the degree to which the constrained curriculum hypothesis holds and whether constraining the curriculum within a school results in a more equitable distribution of student outcomes. Their findings suggest very strongly that constraining the curriculum to the core academic subjects in a school has a positive influence on student achievement and there is less variability on those outcomes by race and socio-economic status in high constraint schools – suggesting a more equitable distribution of outcomes.

The findings from Lee, Croninger and Smith (1997) are important and instructive, but they can be extended in three ways. First, because the sample is restricted to high school graduates, their findings do not generalize to those who either failed to complete school or followed an alternative pathway to the high school diploma. Most recent national estimates demonstrate that approximately 68.8% of high school students graduated in 2005 (National Center for Higher Education Management Systems, 2005). Approximately one third of all students do not finish high school in four years, which might suggest that changes in curricular expectations may be related to high school completion in ways Lee et al. could not test. Second, their work examines achievement at two levels, with students nested within schools. In their analysis schools represent the level at which the policy is implemented. As was demonstrated earlier, states have increasingly chosen to implement graduation requirements and it is possible to examine the relationship between those policies at the state level and outcomes at the student level. Third, I can examine the courses taken in the core subjects as an important intermediate outcome that Clune and White (1992) introduced earlier. Chaney, Burgdorf, and Atash (1997) utilized the same NAEP data and supplemental high school transcript (HSTS) study as Lee et al.. and report partly contradictory results. Their findings suggest that "…relatively few students were affected by the requirements, either because students took more than was required or they took courses that did not affect their achievement" (p. 229). They distinguish between students that complete the minimum or less from those that exceed expectations and find that students taking fewer courses experienced a marginal positive influence on achievement from higher requirements where those that exceed requirements saw no change. In some ways, this is consistent with the intent of

Clune and White's work as they focused only on the schools (and by extension the students) most likely to be influenced by the policy.

Hoffer (1997) examined the relationship between requirements and student achievement utilizing the National Education Longitudinal Study (NELS) and concluded that students attending schools requiring three math courses do not differ significantly from those attending schools requiring two courses. He found that "…graduation requirements affect course-work and course-work affects achievement, but graduation requirements do not affect achievement" (p. 592), suggesting a complex and indirect relationship between the policy lever and the intended outcome. Additionally, Hoffer utilizes logistic regression to consider the influence of graduation requirements on the probability of dropping out of high school and he finds no relationship. The finding is not surprising given that only 10% of the NELS cohort had effectively dropped out, but it does not account for how well students were prepared for college or work by the time they completed high school. This is an important limitation of Hoffer's analysis, but it is also reflects a missing piece across the range of studies in this area. It does matter whether or not students complete high school but it also matters how well prepared they are for college or work by the time they finished.

High school graduation is not the primary focus of most studies of graduation requirements. Tietelbaum (2003) suggests that the question of high school graduation has largely been settled

> There was initial fear that some students might drop out of school rather than complete an extra math or science course. Several researchers [including Clune and White (1992) and Hoffer (1997)] have studied this issue and have found there is no association between increasing high school graduation requirements and student drop out rates…in light of these findings, the topic is not addressed here (p. 32).

This assumption is based upon analyses limited by methodology and should be a very real concern, particularly for schools most likely to be influenced by state graduation requirements. When schools or districts elect to adopt a set of requirements, they are able to adapt the system accordingly so that students are able to complete high school at comparable rates. As Hoffer suggests, this might include introducing more lower-level courses which dilute the curriculum. Conversely, increased requirements might be adopted by schools that serve a population of students that are already capable of achieving that standard. When the state constrains the curriculum, schools that might not have made that curricular choice are now compelled to do so. The hypothesis is that students in previously lower requirement schools may experience lower probabilities of completing high school when states increase graduation requirements.

All of these studies share some commonalities. First, they are all primarily interested in school organizations and their influence on student outcomes, and they all include individual level controls for socio-economic status (SES), race, and prior achievement in order to isolate the effects of high school practice on student achievement. These studies utilize either NAEP or NELS which both have strengths and limitations, and they either conclude that high school graduation is not affected by increasing the number of courses students are required to take or researchers choose not to consider the question at all. Lee, Croninger, and Smith provide the most sophisticated analysis but even their work is limited on the question of completion. First, they utilize HLM and second, their constructs to approximate the constraint of the curriculum are stronger, considering both the offerings of the school as reported from the school course-offerings file and separately in terms of the variability in the actual patterns of student

course-taking. However, because their sample is limited to high school graduates, their work provides little insight into how these policies influence non-graduates.

What is equally interesting in this set of analyses is that while race and class are important elements to consider at the individual level, this research recognizes that the racial and class make up of the school student body may also have a separate and more complex influence on student outcomes. Hierarchical modeling techniques allow researchers to consider these relationships in ways that were either difficult or not previously possible. The studies in this area make an assumption that state policy is either negligible or unimportant, but if Clune and White are correct in their assessment that state graduation policies do influence course taking in low achieving schools, state policy may matter differently depending upon the characteristics of the school.

State and System Level Research

Curriculum theories were rooted in the relationship between high schools and colleges, status attainment theory explored individual characteristics and their influence on college access, and social reproduction theory emphasized the structural constraints present at the institutional level. At the state level, K-16 institutional alignment theory suggests the alignment of two systems – K-12 and higher education – is the primary challenge to greater college access from the perspective of the state. A number of education policy advocates have made recent calls for better alignment of K-16 education (Haycock, 1999; Kirst & Bracco, 2004; Venezia et al., 2003) and the development of college knowledge (Conley, 2005). Recently, Kirst and colleagues (Kirst & Venezia, 2004) explored system alignment empirically and suggest that students are under-prepared for college because they are not well informed regarding what four year

colleges expect for admissions or what college costs. Musoba (2004a) utilizes hierarchical linear modeling techniques to partition variance at two levels – state and individual – and to assess the influence of state education reform policies. Her findings make the policy conversation a bit more complex, suggesting a negative relationship between the policies and SAT scores but a positive relationship between the slope of the relationship between taking advanced math and SAT scores. St. John (2006) examined the effects of state policies by examining students nested within states. His work has shown that higher math requirements for example, are positively related to both SAT test scores and college enrollment among high school graduates, but also negatively influence whether a student graduates from high school.

The K-16 Alignment Framework. The notion of aligning aspects of education to create a seamless learning environment through college is not a new idea. This sort of alignment was central to *Committee of Ten* conversations regarding the alignment of high school courses with college admissions expectations (National Education Association, 1894). Dewey (in Orrill, 2001) discussed the importance and the complexities of such an alignment, and a variety of educators proposed organizing structures for the entire system, which included the common 8+4+4 organization of elementary, secondary, and higher education, the 6+3+3 variation (Conant, 1959), and the 6+4+4 (Koos, 1946) experimental model to bridge the high school and college curriculum. Koos (1946) wrote as an advocate for the 6+4+4 model, both to achieve greater equity as well as economic efficiency, and looked at two cases where the model was attempted. The junior college movement embodied a similar philosophy, at least in terms of vertical curriculum integration, based upon the belief that the first two years of general study in college are

more conceptually aligned with the last two years of high school than the last two of college (Hutchins, 1933/1983; Koos, 1928/1983; Orrill, 2001).

Over the past 10 years policy and education researchers have begun to examine education in terms of one K-16 system, rather than two or more disjointed arrangements. As many as 25 states have initiated PK-16 efforts (Education Commission of the States, 2002; Van de Water & Rainwater, 2001) that range from simple acknowledgement of the natural connections of the two systems (e.g., admissions expectations and remedial education) to more coherent changes in the curricular expectations at both high school graduation and college admissions (e.g., alignment of content standards, high school exams, and college placement tests) (Bueschel & Venezia, 2004; Oregon University System, 2001). The Stanford Bridge Project (Kirst & Venezia, 2001; Venezia et al., 2003) was the first comprehensive national study of this emerging education trend and they concentrated their efforts on six case studies in Oregon, Texas, Maryland, Georgia, Illinois, and California. The theory underlying the work of the Bridge Project is that institutions and systems send signals indicating what is required of students and the current misalignment of K-12 and higher education results in poor signals and policy incoherence (Kirst & Bracco, 2004). When signals are sent from either system without effective coordination with the other, the result is inequitable access to information. For example, when K-12 sets graduation standards without consulting colleges regarding admissions and placement expectations, the result is higher rates of remediation and lower levels of persistence. However, when signals are sent through joint cooperation, they believe the message is more coherent and students, parents, teachers, and counselors share a common understanding.

The theory assumes a relatively simple structure within a state of one K-12 system and one system of higher education that, with effective policies and more integrated methods of providing information, can be aligned to create one system. It also assumes that for the vast majority of students, one rigorous set of courses is ideally suited to prepare all students for college and the workforce (American Diploma Project, 2002; Conley & Venezia, 2003). The theory also suggests that, despite common perceptions, the persistent need for remedial education in community colleges necessitates a higher standard for all students and not just those who attend four-year colleges. It also contends that many community college enrollees plan to pursue a four-year degree (much like the concerns raised earlier by Brint and Karabel) and do not because they received weak and inconsistent signals from different portions of the system. The theory suggests a final set of assumptions regarding the sequencing of events. If systems are more intentionally aligned and stronger, more coherent messages are sent, students will prepare themselves more effectively in high school, and counselors, parents and teachers will be able to provide more adequate and informed support. In turn, more students will attend college, remedial education rates will fall, and many more students will earn degrees. This set of assumptions will be further addressed later in the paper.

Empirical Research on K-16 Alignment. Researchers exploring these emerging organizational constructs suggest several common metrics to judge the degree to which the alignment issues have been resolved and have found several points of misalignment that must be addressed. According to Kirst (2004), the single strongest indication of the misalignment problem is the persistent need for remedial education, particularly in community colleges. There is a debate among researchers regarding the nature, extent,

and cost of remediation (Boylan, Saxon, & Boylan, 1999; Breneman & Haarlow, 1998; Gumport & Bastedo, 2001; Hauptman, 1991; Lewis & Ferris, 1996; Merisotis & Phipps, 2000), but alignment theory suggests that remediation is a consequence of poor and inconsistent signals of expectations from colleges – particularly community colleges commonly perceived as having no standards beyond high school graduation – to students. In addition, the high levels of aspirations combined with lower participation rates and dwindling persistence from the first to second year of college suggests, according to the theory, that students do not have the right information to make informed decisions and be successful in college (Conley, 2005).

An important barrier to students, in the context of this theory, is that high schools send one signal regarding what it takes to successfully complete high school and colleges send another (or many others) about what it takes to gain admission and be successful in college. Haycock (1999) is critical of efforts to increase state standards for high school graduation without addressing two issues: the level of the courses and the assessments that result. Since 1980, the number of credits required of students to graduate high school has steadily increased, but taking more courses does not necessarily translate into higher levels of proficiency. Kirst (2004) acknowledges that more students are taking college preparatory courses than 20 years ago but only a fraction of graduates today have what he considers a full college preparatory curriculum. Assessments are a particular concern and it may reflect the most obvious point of disjuncture between the two systems. Recall that at the turn of the 20th century, the *College Board* exams tested what students learned in high school *and* placed them into the appropriate college course. Today, students face three sets of tests in most cases (Boswell, 2000): end of course or

high stakes exit exams from high school, college admissions exams sponsored by ETS and ACT (if they plan to attend a four-year college), and college placement exams in math, English, chemistry and foreign languages (in some cases). According to analyses conducted as part of the Bridge Project, the content of these tests vary considerably and as such cannot be utilized interchangeably (Venezia et al., 2002).

In states with existing K-16 articulation structures, researchers found several commonalities that inform their thinking on how to improve upon the signals sent to students, parents and educators. First, most students are not aware of college admissions requirements. For example, most students overestimate the number of math and sciences courses necessary for admission to state colleges (Antonio & Bersola, 2004; Mintrop et al., 2004). Next, students were likely to overestimate the cost of attending college (Merchant, 2004; Turner et al., 2004); a finding consistent with perspectives put forth by the American Council on Education (2004). Finally, researchers found that teachers and guidance counselors were ill prepared to provide accurate information and as a result, information was asymmetrically available to high achieving and frequently, high SES students relative to others (Bueschel & Venezia, 2004; Turner et al., 2004; Vargas, 2004).

Analysis of Alignment Theory. Considering the relationship between the level of preparation a student receives in high school and the access they have to college from the systems perspective provides important insights and adds a level of complexity that extends the previous approaches. However, the theory is not without its limitations, the first of which is the lack of evidence supporting its embedded hypotheses and assumptions. In fact, there are relatively few states that have actually attempted the sort of alignment proposed by Kirst and others. Consequently, the entire body of evidence

that begins to explore the system alignment theory rests primarily upon the work conducted as part of the Stanford Bridge Project. That, in and of itself, does not suggest the findings should be discarded; rather it is offered as a note of caution.

More important are the assumptions mentioned earlier. There are varied opinions on the extent to which policy can actually affect student outcomes, and that is exactly what is proposed here. It is not that people doubt the possibility, but rather that policies in education tend to change so quickly there is seldom time or political will to effectively assess the outcomes of such policies. St. John et al.. (2002) and others (Hanushek & Raymond, 2004; Perna & Titus, 2004a) are attempting to assess the effects of policy in a number of attendance and degree attainment models, but more needs to be done. In the case of alignment theory, there is no evidence that if the vast majority of non-selective institutions in a given state adopt one common, rigorous standard for admission, that such a policy will appreciably affect student's course-taking patterns. Perhaps the most difficult assumption to reconcile is that two systems can reasonably be aligned as one. Dewey articulated the complexity of this challenge 100 years earlier (Orrill, 2001) and the picture is more complex today. Today it is still important to ask whether alignment is a desirable goal. Advocates of the theory suggest that it is, but to do so, education must return to a variation of the theory of formal discipline. That is to say that all students should be held to one high standard in order to complete high school, thus reaffirming the vision of the *Committee of Ten* from more than a century earlier.

This assumption begs the question: At what level should students expect to choose vocational pathways? The comprehensive model suggested high school for most students and college for others. If all students take the same demanding core curriculum,

vocational pathways should be explored in college while the high school focuses on general education. In this case, it might make more sense to make some level of college compulsory and provide state money to support that level of education, perhaps K-14. The theory of formal discipline also suggests the same curriculum is the right preparation for all vocational pathways, which diminishes the value of the vocational and technical curriculum currently offered in most high schools. Is it really better for students who pursue a vocational trade to complete the core curriculum consistent with the four-year degree? And if it is more desirable, how does this affect the current structures of the schools?

Finally, this theory does not take into account one of the important conceptual contributions of the social reproduction theorists – specifically Brint and Karabel – that institutions are motivated by self interest. Alignment advocates suggest the necessity of an incentive structure for K-16 collaboration and the possibility for holding the systems jointly accountable. Currently, no state education system operates in a manner where this assumption could be tested. In this case, it must be asked if a K-16 council and a combination of policy levers can ameliorate the problems of self interest of K-12 and institutions of higher education? Further, this theory faces a structural challenge that was not as limiting when early 20th century education reformers spoke of aligning the two systems – the structure of our capitalist labor economy. Today educators and policy makers face the challenge of creating universal college access, which was nowhere near the case in 1900. Instead, alignment kept the door open for many students recognizing that few would attend postsecondary education. This system worked well in terms of training and placing workers in the various levels of the economy. It works less well

today if the same high standard is set for all and the labor market cannot keep pace with the number of four-year college graduates produced. Kirst and others would argue that community college students need this training to become successful at any level, but that assumption should be reconsidered. They acknowledge the problem that remedial students do not earn degrees, but perhaps the problem in this case is that remediation assumes a four-year standard and a transfer articulation mission when community colleges are increasingly emphasizing terminal programs. All of this suggests that there is promise in this new line of inquiry but more work must be done to address some of these questions.

A New Conceptual Model

In the prior sections of chapter 2, I reviewed relevant literature from sociology, economics, education, and policy. Each set of literature provides an important perspective in relation to educational outcomes for students. The chapter begins with a consideration of social and economic stratification and the relationship between individual factors and socio-economic outcomes. Social reproduction theory and the school effects literature both contribute to our collective understanding of the important influences of the structure and function of schools in relation to student academic success. The school effects literature also contributes methodologically by introducing hierarchical linear modeling to the repertoire. The sections conclude with a consideration of multi-level modeling among higher education researchers and the introduction of alignment theory and the K-16 approach to education reform. While all of these perspectives shed light on the complexities inherent in attempts to improve student

outcomes, none of them adequately deals both conceptually and methodologically with the three levels of influence – individual, school, and state.

In this final section of chapter 2 I present a refined conceptual framework, which builds upon the prior work and lends itself to multi-level modeling techniques. This study explores three levels by examining students nested within schools, nested within states. The combination of these three levels allows for a fuller consideration of how individual, school, and state factors are related to and potentially influence whether students complete high school and, if so, how well prepared they are when they finish. In particular, the K-16 alignment perspective makes a unique contribution to the discussion of the high school curriculum reform policies and student completion and course taking outcomes because it recognizes that college opportunity may have an influence on students' decisions and outcomes while in high school. In this study, I am testing the multi-level college access framework, including elements of K-16 alignment theory, while simultaneously recognizing the important influences of both school and individual level characteristics.

In this study I am interested in two student outcomes – high school completion and course taking in the academic subjects – and each employs a slightly different model. In the first analysis, I am testing specifically whether graduation requirement policies or mandatory exit exams are negatively related to the likelihood a public school student will complete high school. Lee et al. (1997) introduce the constrained curriculum hypothesis in a two level analysis of students nested within schools and found that changing the academic organization of schools will improve student achievement while also improving the equitable distribution of opportunity across socio-economic status. In the high school

completion analysis, I examine whether imposing that same constraint at the state level makes it more difficult for some students to complete high school. I hypothesize that increasing the high school graduation requirements at the state level will negatively influence the likelihood a student will complete high school. Stated differently, local control states positively affect the likelihood students will complete high school. At the state level, I also hypothesize that average K-12 funding per student will influence high school completion.[4] Figure 2.1 provides a visual depiction of the conceptual framework for high school completion as a student level outcome.

In both figures 2.1 and 2.2 two separate sets of arrows are utilized to demonstrate relationships tested in the analysis. The solid arrows reflect fixed effects of predictors at levels 1, 2, and 3 on the outcomes under investigation. In figure 2.1 the outcome is high school completion and the solid arrows represent predictors of whether students complete high school in four years. The dotted arrows reflect a different set of relationships which maximize the potential of hierarchical linear modeling. Note that each dotted arrow is drawn to a solid arrow rather than an outcome. These arrows represent predictors of slopes as outcomes and reflect interactions of predictors at one level with those at another. For example, in figure 2.1, a dotted arrow is drawn from high school graduation requirements at the state level to Race and SES at the individual level. The dotted arrow represents the hypothesis (or two in this case) that state policy influences the differences between high and low income students or African American and White and Asian students. At the end of each results chapter similar figures will be included with notation indicating which coefficient tests each relationship.

[4] It would be preferable to include average funding per student at the school level, but that data is not available in the existing data set.

Figure 2.1.
Conceptual Framework Examining Relationship Between State Policy Student Completion of High School

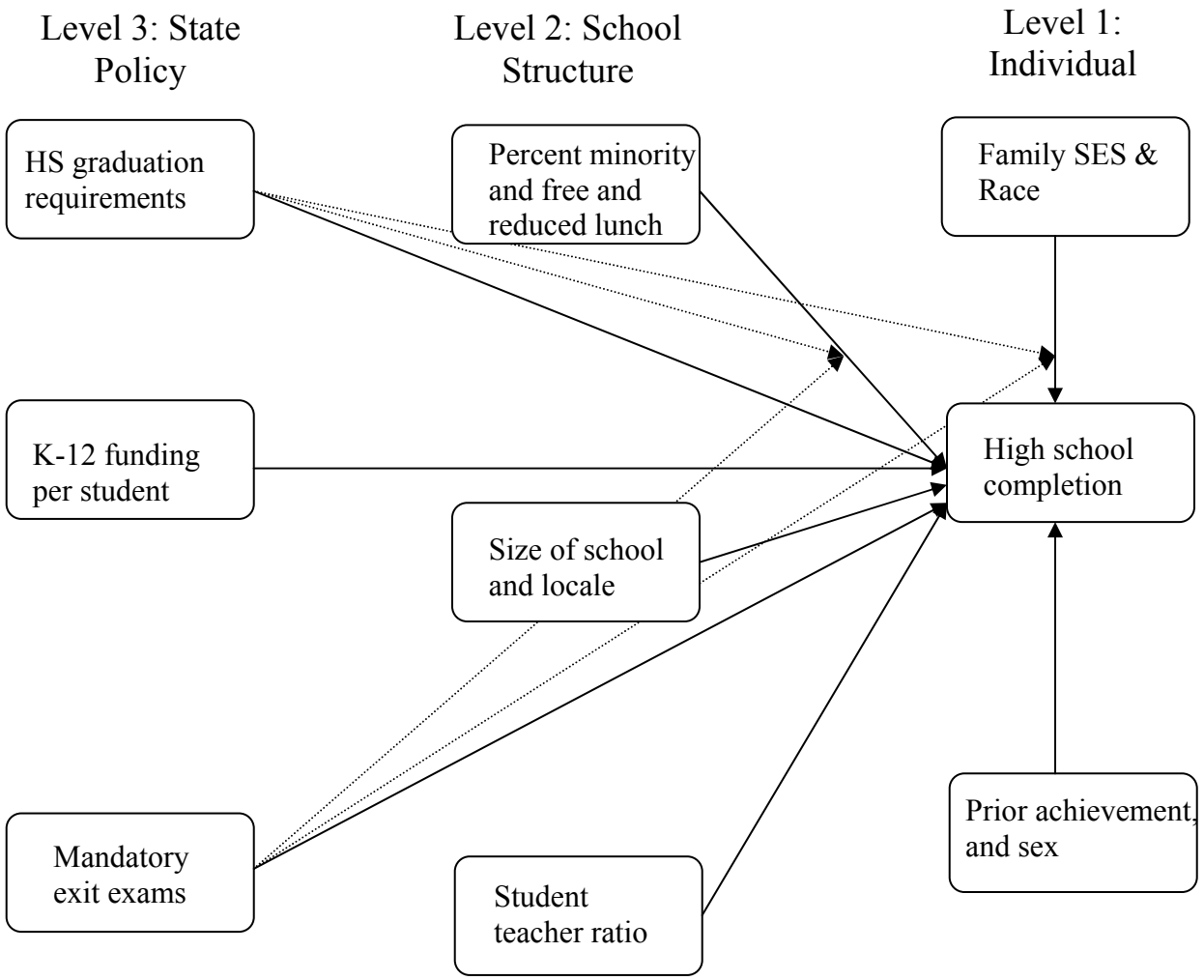


Figure 2.1 also illustrates that at the school level, I am principally controlling for characteristics of the school structure commonly considered to influence student outcomes, which includes the size of the school, the ratio of students per teacher, the percent minority enrolled, the percent of students qualifying for free or reduced lunch (as a proxy for the collective SES of the school), and the location of the school in terms of urbanicity. The first two school characteristics have specific policy implications that warrant their inclusion in the model. The size of the school has been a focus of reform initiatives in recent years, most notably those undertaken by the Bill and Melinda Gates Foundation. The focus on smaller schools and schools within schools is pushing states to reconsider what high schools should look like and it is fundamentally challenging the notion of a comprehensive high school. The student-teacher ratio is both a pedagogical issue and a financial one. In this study, the ratio of students to teachers acts as a proxy for school funding. The cost for providing elementary and secondary education is largely a function of personnel. A lower ratio of students to teachers then suggests higher average funding per student. The pedagogical implications are important with respect to student achievement as measured by scores on exit exams and end of course exams, they would be less direct in terms of student completion. In the context of this study, I am not able to test the influence of the academic organization of the school on high school completion (Lee et al., 1997), which would include the number of courses offered by the schools in each subject,[5] and the concentration of students completing a college

[5] The number of courses in a given subject would be inversely proportional to the degree of constraint placed upon the high school curriculum. The fewer the course options, the greater the constraint.

preparatory curriculum,[6] but that should be considered in future studies. The variance components model will allow for an estimate of the percentage of variation at each level, and I will assume that some portion of variance unexplained at level 2 (school) will be associated with the academic organization of the school.

At the individual level I control for factors known to be related to student outcomes. Demographically, I control for race, sex, and socio-economic status (SES). Race is a persistent and important reality facing students and while I do not attempt to explain its influence, it is important to acknowledge the reality that race matters and that policy influences should be considered controlling for those factors known to be related to the outcome. The same is true for sex. For many years, educators, activists, and policy makers have focused attention on female students, particularly in terms of their under-representation in college. In some respects today, the outcomes for males are now lagging behind females. Prior achievement is an important consideration as well. Students already prepared to succeed while in elementary school will complete high school, irrespective of changes in policy. It is important then to control for prior achievement as a way to test whether these policies affect the likelihood that less prepared students will complete high school.

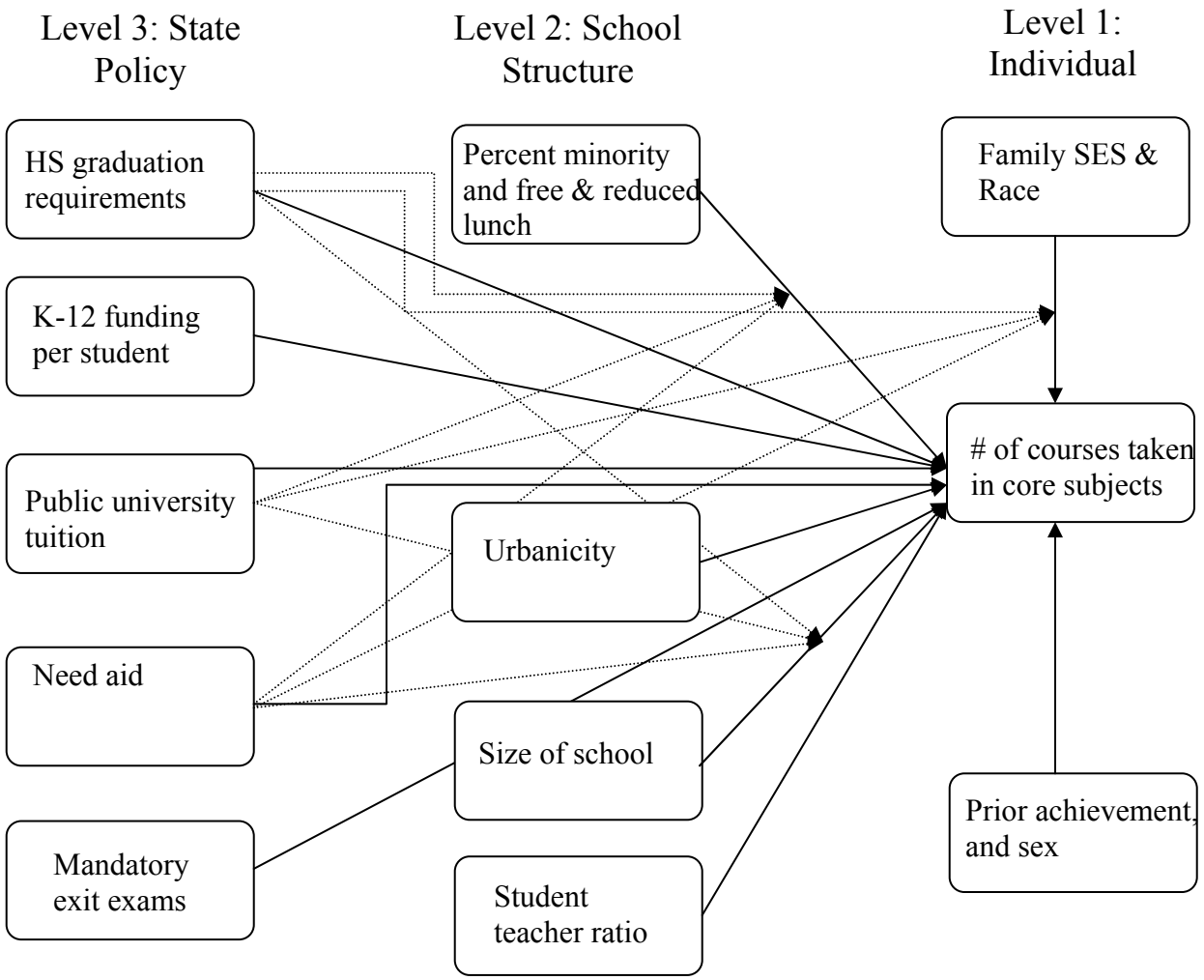
The second analysis conducted as part of this study examines the relationships between state high school graduation requirements and exit exams and the number of courses students complete in core academic subjects. The number of courses students complete is the primary policy lever for high school graduation requirements. Clune and White (1992) demonstrate that high graduation requirement states are positively related to the number of courses students take in the core subjects. The degree to which policies

[6] For example, either a self report item indicating track in school or a transcript designation for the same.

directly influence students are the primary focus of the K-16 alignment literature. When K-12 and postsecondary systems are aligned, students are adequately informed and make decisions based upon accurate information. When they are not well aligned – as is commonly the case in the U.S. – these policies may not be influential directly, or they may act in ways not consistent with the intended outcomes. Since the publication of the *Shopping Mall High School* (1985), researchers have assumed that many students do what is minimally necessary to finish high school with little thought for what is expected in college or work. Implicit is the notion that more students could complete a "college preparatory curriculum" if required to do so (and assuming all schools offered the more demanding curriculum). In this study, I hypothesize that increased graduation requirements at the state level will be positively related to increased course taking in the core subjects for students who complete high school. Figure 2.2 provides a conceptual framework for the high school course taking analysis.

Mandatory exit exams are intended to influence students' academic preparation in high school, though in a slightly different way. They are designed to assess whether students have learned what is minimally expected of them while in school. Hanushek and Raymond (2003) suggest that these policies have an impact on student achievement when the policy is accompanied by consequences for schools. Assuming the well documented and positive relationship between course taking and student achievement, I hypothesize that exit exams will be positively related to the number of courses students take in the core academic subjects (including math, science, social studies, and English).

Figure 2.2.
Conceptual Framework Examining Relationship Between State Policy Student Course Taking in the Core Academic Subjects



Consistent with alignment theory, I hypothesize that students perceived college opportunity may influence the choices they make regarding whether or not to take more courses in the core academic subjects. For many students the cost of college has an important influence on whether or not they will be able to attend and, if so, what type of institution they will be able to afford. Consistent with alignment theory, I hypothesize that the cost of college will influence whether a student will take more courses in the core subjects. There are two dimensions of cost I consider in this study. The first is the average in-state cost of tuition at a public four-year college or university. A primary concern for many policy makers is that students over-estimate the cost of college and select themselves out of the college going process as a result. In this study, I treat public tuition as a signal to students how much a college education will cost. The second measure I utilize reflects the provision of need-based grant aid for college. In reality, few students pay the full sticker price of college and another clear signal a state can send is to provide adequate need-based aid to minimize the financial burden for those least able to afford college. In this study, I hypothesize that increasing tuition negatively influences the number of courses students complete in the core subjects because they will only do what is minimally necessary to complete high school. I hypothesize the opposite relationship to exist between the availability of need-based aid and the courses students complete, because need-based aid would reduce the cost of college for low-income students who are most sensitive to price.

In addition to examining the direct effects of states and schools on individual outcomes, HLM provides the added advantage of being able to test random effects of cluster level factors. Using slopes as outcomes, researchers can examine whether a

particular policy may operate differently within schools, depending upon the characteristics of the schools. Similarly, at the individual level I test whether high school graduation policies influence the relationship between both race and student SES and high school course taking. Lee et al. (1997) suggest that constraining the curriculum at the school level provides for a more equitable distribution of outcomes on achievement by SES. Assuming that the graduation requirement policy signals to students what is necessary to prepare for the future, the hypothesis is that low-income students in states with more demanding requirements would complete more courses in the core subjects than students in low requirement or local control states.

In this study, I test three random effect relationships associated with the high school graduation requirements. At the school level, equitable distribution of opportunity is a critical policy issue. Schools serving low-income students and those in urban settings tend to demonstrate lower than average student outcomes. I do not have measures of school quality available, but the data include measures for poverty (percent free or reduced lunch) and percent minority both of which are associated with lower graduation rates and less opportunity to participate in college. From an equity perspective, state policy should either improve outcomes for these schools (negative relationship to the slope) or at very least should not have a negative impact.

Consistent with Figure 2.1, the second model (Figure 2.2) includes dashed arrows reflecting relationships between explanatory variables at level 3 and slopes at levels 1 and 2 associated with the equitable distribution of course taking in the core academic subjects. In this model I hypothesize that both the graduation requirements policies and the factors related to college cost (tuition and need-based aid) are related to the equity

relationships approximated with the race and class at the individual level and between schools. Figure 2.2 provides an illustration of the conceptualization of student course taking as an outcome.

In this chapter both high school completion and student course taking in the core subjects has been conceptualized as three level problems where students are nested within schools which operate within unique state policy contexts. Chapter 3 describes the data used in the study, operationalize the constructs, review the methodological approach, examine the advantages and limitations, discuss both intercepts and slopes as outcomes, and provide formulas for the analysis.

Chapter 3

Methodology

Data Sources

In this study, I use the Education Longitudinal Study (ELS:2002) – the most recently available national longitudinal study of students pathways through education. The survey includes three key sources of data: (1) the base year survey which includes students' background characteristics and family information, (2) the school survey which includes characteristics of the high schools students attend, and (3) first follow up survey and the transcript study including students' actual course-taking information as well as their high school graduation status. The transcript is particularly important as it includes all of the pertinent coursework as well as the outcome variable indicating high school completion.

For considering variability at the state level, St. John and colleagues (St. John, 2004; St. John, Chung et al., 2004) have established a method for developing indicators of relevant state level policies from publicly available data. The high school graduation requirements and the mandatory exit exam indicators are two variables created from publicly available information. The Education Digest compiled by the National Center for Education Statistics (NCES) serves as a starting point, followed by the annual reports of the Council of Chief State School Officers (CCSSO). Average school funding figures were gathered from the Common Core of Data (NCES) and the tuition figures were calculated using school survey data from the Integrated Postsecondary Education Data

System (IPEDS). The average in-state tuition for all public four-year colleges and universities in 2002 was utilized in the analysis.[7] Prior work in this area linked similar education reform policies (including math course requirements, state content standards, and mandatory exit exams) existing between 1990-1992 with the National Education Longitudinal Study (NELS:88-2000) to examine the influence of those policies on admissions test scores, high school graduation rates, and college continuation (St. John, 2006). The policy context surrounding education has changed dramatically in 12 years and ELS in combination with policy indicators applicable to the graduating high school class of 2004 will provide similar but more current policy relevant insights.

Sample

ELS: 2002 employs a two stage sampling design. In the first stage, 1,268 of 27,000 high schools were randomly selected to be representative of all high schools. Of those schools sampled, 1,221 public, Catholic, and other private high schools were identified as eligible. Those schools were contacted and 752 participated in the study for a 67.5% school response rate.[8] Participating schools were asked to submit lists of 10th grade students, and approximately 26 students were sampled from each school. Consistent with prior NCES sponsored longitudinal studies, ELS: 2002 oversamples students from Asian and Hispanic backgrounds. The total eligible sample of students from the 752 high schools was 17,591. The sample for this study is further refined to include only those students with transcripts available (n=14,920 students from 743 schools in all 50 states). Students without transcript data had to be dropped from the

[7] Because tuition is conceptualized as a signal regarding the cost of college, I lagged tuition by two years approximating the amount college would cost while in tenth grade.

[8] For a more detailed description of the sample, readers are referred to the ELS: 2002 User's manual listed in the references.

analysis because they lacked data on the outcome variables, thus sample is reduced to n=14,010 after cases with missing data are removed from the analysis.

The first analysis in this study examines high school completion and utilizes a sample of all public school students for two reasons. First, state level policies apply directly to public schools and, as such, are likely to influence student opportunities in those schools. Second, the data are limited at the school level because only public school characteristics are available (linked with the Common Core of Data collected by the National Center for Education Statistics). Including Catholic or other private school attending students would result in considerable missing data at the school level of the analysis.[9] In order to conduct this analysis, the sample is limited to include only public school students with transcripts available resulting in an initial sample of 11,700 students. The actual analytic sample reduces to n=9,757 students in 494 public schools in 43 states because seven states had too few participating schools to allow for adequate variation at level 2.

The second analysis for course taking in the core subjects utilizes a smaller subsample of public school students who actually complete high school in four years. I chose to limit this sample because completing high school is related to the number of courses a student completes. If a student drops out early, they will have completed fewer courses than their graduating counterparts, making it difficult to know whether the policy had an influence on course taking or if it was the fact that they did not complete high

[9] In the future, it may be useful to explore whether state policies influence private school choice, but it is beyond the scope of this investigation.

school in four years.[10] The final sample is limited in the same ways as the previous model in terms of the number of units at levels 2 and 3, and after removing the 22% of students that did not complete high school in four years, the final analytic sample for high school course taking is 7,593 nested in 484 public schools in 43 states.

Limiting the samples in each of the analyses results in trade-offs. In the high school completion analysis, the results account for school level factors, but do not generalize to private school students. In the course taking analysis, limiting the sample reduces the potential endogeneity problem with respect to whether their attendance at private institutions is related to the state policy, but it does so at the expense of knowing how these policies influence the course taking of non-completers. Similar tradeoffs are inherent in secondary data analysis of large scale studies and do not diminish the findings, but the results must be understood in the context of the population to which the analysis accurately generalizes.

Weights

The purpose of weighting a sample is to adjust for the unequal probability for selection into a study so that findings generalize to the intended population. Two weights were utilized in this analysis. First, the school weight was calculated in a series of steps. The school weight is calculated as the inverse of the probability a school was selected for participation. Those weights were adjusted for field test sampling because field test schools were eliminated from the sample frame. School weights were further adjusted to account for the probability of the school being released from the study. The school

[10] Mathematically, it introduces a form of endogeneity into the analysis because the missing variable associated with other predictors is also related to the outcome. Reducing the sample removes this potential bias. It is important to remember that the results only generalize to high school completers.

weight included in the transcript study is applied to the descriptive analyses of school level data and the multi-level models.

ELS student weights are included to generalize to three populations – tenth graders in 2002, twelfth graders in 2004, and tenth grade schools in 2002. In this study I utilize the student transcript weight [F1TRSCWT], which allows transcript analyses to be generalized to the full population of high school seniors in 2004. The student level weight is calculated as the inverse of the probability that a student will be selected for participation in the study. Applying the weight expands the sample size to the population parameters, so in order to return the number to an effective sample size, a relative weight is calculated as the transcript weight divided by the mean of the transcript weight. The relative weight is then applied to the data so that the sample is representative of the population of public school 12th graders in 2004.

Non-Response

Non-response is an important potential source of bias in a large scale nationally conducted study. If respondents are significantly different from non-respondents, particularly when non-response rates are high, inferences may be misleading and may not generalize to the intended population. According to NCES (Ingels, Pratt, Rogers, Siegel, & Stutts, 2005),

> For ELS:2002, student response is defined as the sample member completing at least a specified portion of the questionnaire. The response rate was above 85 percent overall and for most domains (see section 3.4 for a description of the domains). However, the response rate was below 85 percent for four domains (spring 2002 sophomores who were dropouts, transfer students, homeschooled, or early graduates), so a student-level non-response bias analysis was conducted for these domains. The final overall student weighted response rate was 88.7 percent. Although the overall response rate was above 85 percent and a non-response bias

> analysis is not required by NCES standards, a bias analysis for base-year sophomores was conducted for the purposes of quality and completeness using both the cross-sectional and panel weights (pp. 105-106).

A review of the non-response analysis demonstrates there is very little bias introduced based on the student or school level characteristics utilized in the current study. The non-weighted sample demonstrates some significant bias based on sector (Catholic level) and race (other level) but when weights are applied these differences disappeared. The NCES analysis concludes that while some non-response bias is possible, it is likely to be negligible.

Benefits of Utilizing ELS: 2002

There are a number of important benefits to utilizing the Education Longitudinal Study (ELS) 2002 for this study. First, the sampling procedure coupled with the application of weights allows for the data to generalize to a national population of public high school students. Similarly, the data have been sampled in a way that allows for generalizations to be made about high schools in 2004. Second, ELS is the most recent longitudinal study conducted by NCES and it allows for the consideration of recent state policies. The National Education Longitudinal Study (NELS) study of a cohort of 8th graders in 1988 has been frequently utilized for these sorts of analyses but those students attended high school in the early nineties and as such, were subject to a dramatically different policy environment.

In particular, graduation requirement and exit exam policies have changed dramatically at the state level in recent years, and ELS is recent enough to examine whether these policies account for some of the existing variation in student level

outcomes. Third, the transcript data have been organized and summarized in several ways to allow researchers to explore course taking patterns in a variety of ways. This is an improvement over prior longitudinal studies and it is informed by the research of the past 15 years. For example, where in NELS, the number of math courses were summarized and an ordinal variable of highest math completed was created by NCES, in ELS, summaries of course taking are done in three different ways: (1) Courses are categorized according to the most recent revision of the Secondary School Taxonomy (SST), which reflect the standards defined by NCES to categorize transcript data (2) courses equated to the categories utilized in NELS and (3) courses equated to the High School and Beyond (HSB) study. In each of those studies, course taking was captured in slightly different ways and to maintain comparability, multiple coding schemes have been utilized. It also provides summaries of total courses, core and academic courses, and Carnegie units. The key advantage for this study is the use of the SST and the summary of core courses, which provides categories most consistent with the state level policies discussed earlier.

A fourth benefit is the large number of schools and states available in this data. For a three level hierarchical model, there must be a sufficient number of units at each level and ELS provides data for 51 state level units (including Washington DC), 580 public high schools, and 11,700 students, making a three level analysis possible. Finally, NCES has taken the additional step of linking school level data from the Common Core of Data (CCD) to the school level data for students in the study. Previously, it was possible to link these data, but it was a cumbersome procedure which introduced the

added possibility of error from improperly identifying and merging CCD data onto the existing student data set.

Limitations of ELS: 2002

As with any large scale longitudinal study utilized for secondary analysis, ELS has its limitations. Even with a non-response bias analysis, missing data remain a problem for quantitative studies and it makes generalizability more challenging. The first limitation of this study is that while a good deal of school level data is available for public schools, much less is available for private institutions. As a result, it is difficult to consider the role of private education or the characteristics of those schools in this analysis and as such, those schools are not included in the analysis. Second, even among public schools there is sufficient missing data to prevent the testing of certain hypotheses. For example, in the context of system alignment and the concern over the flow of information, it would be useful to consider the presence of guidance counseling (student/counselor ratio). However, missing data made the inclusion of the variable untenable and the relationship cannot be tested in this analysis. Similarly, Lee, Croninger, and Smith (1997) conceptualize the academic organization of the school as an influence on achievement and while the academic organization may be similarly important to consider at the school level, data on school course offerings are not available in ELS. Finally, even with transcript data, there remain some important limitations. The data set includes the full range of courses taken by students, but the categorization of those courses is limited by the tremendous variation in course offerings and quality of courses offered by schools. Student courses are categorized utilizing the Secondary School Taxonomy (U.S. Department of Education & National Center for Education

Statistics, 1998) which provides a good deal of standardization across course titles, but it cannot account for the potential variability in the *quality* of those courses across schools.

However, even with these limitations, there is no better source of data available to explore the important policy questions examined in this study and the cost of attempting to collect better data would be prohibitive. The result is that the analyses conducted herein, like most, should be interpreted with caution, recognizing the limitations and encouraging other forms of analysis. Large scale quantitative analyses are useful in terms of illuminating patterns and identifying underlying relationships, but they may not provide sufficient detail to know why those relationships exist (or not).

Analytic Method

The questions posed in this study are most appropriately addressed utilizing multilevel modeling techniques. Cheong, Fotiu, and Raudenbush (2001) demonstrate that in cases where data are constructed at multiple levels, hierarchical modeling produce more efficient point estimates and robust standard errors than a single level analysis. However, the choice of method may still depend upon the purpose of the research. Cheong et al.. (2001) suggest that if the interest of the research "focuses on variability at different levels, it is essential to specify the structure accurately" (p. 413). Their research also demonstrates that if researchers are only interested in inferences regarding the coefficients, robust standard errors for a single level analysis may be sufficient.

Using single level regression techniques such as OLS to examine a multi-level research question may produce misleading results due to a variety of errors, including aggregation bias, mis-estimated standard errors, and heterogeneity of regression slopes (Luke, 2004). The risk of Type I error for the state and school level independent variables

increases when OLS is applied to a multilevel dataset, since the degrees of freedom used to estimate significance are based on the number of students rather than the number of states (or schools) in the sample. Inferential errors, including the atomistic fallacy (which assumes that associations at the individual level are analogous to those at the group level) and the ecological fallacy (the inverse of the atomistic fallacy where associations at the group level are assumed to be consistent at the individual level), commonly result from the use of single level analysis on multilevel issues as well. In addition, Hierarchical Linear Modeling (HLM) is a methodological approach that can make an important contribution to our understanding of campus issues and challenges, many of which are multilevel in nature. In college, students are nested within majors, which are situated within schools; students taking courses may differ on grades according to an instructor; instructors may differ by discipline or by tenure rank. The clustered nature of our campuses adds to the complexity of understanding and answering the questions posed regarding the operations and outcomes of college.

Hierarchical Models (HM) and the more general class of mixed effects models are the most conceptually and methodologically appropriate in this study for two reasons. First, the relationship between state level policy and student level outcomes is a multilevel problem reflected by a hierarchical structure. Students are nested within schools which are situated within state policy contexts. All three levels are hypothesized to influence student course taking patterns and their likelihood of completing high school, and hierarchical modeling provides a tool for dealing with the nested nature of the data. Second, the Education Longitudinal Study (ELS) data employs a complex sampling design of students clustered within classrooms chosen from a random selection of schools

across the entire country. The data have been collected in a manner that requires analytic tools that can adequately account for variance at all three levels. A number of studies discussed in the literature review utilize HLM and the software developed by Raudenbush and Bryk (2002).

I conduct two types of analyses in this study. The first is the Hierarchical Linear Modeling (HLM) for a continuous outcome of the number of courses completed in the core academic subjects. Like simple OLS, the HLM model for a continuous outcome assumes the outcome is a linear function of the explanatory variables, that the random effects (error terms) are normally distributed with homogeneous variance. The second analysis utilizes the Generalized form (HGLM) with a logit link function to examine high school completion as a dichotomous outcome. Utilizing a linear probability model to estimate a binary outcome violates the traditional linear model assumptions, specifically the error terms are not normally distributed and are not homoskedastistic. A dichotomous outcome has only two values and when linear modeling techniques are utilized, there are no restrictions on the predicted. The logit link function is utilized to transform the outcome in a way that constrains the range of predicted values to be between 0 and 1 and the outcome is then linear in the log odds.

Raudenbush and Bryk describe a process of building the model up from level 1 while testing carefully for potential specification problems as new predictors enter the model. They advocate this model building strategy over the more conventional inclusion of all conceptualized relationships because of limited variation at any level and the substantial need for data as the number of predictors increase. I utilize a version of this approach, particularly to test the marginal improvements in the model as regressors are

added at each level of analysis to the model. However, in an effort to demonstrate the fully conceptualized model, non-significant relationships remain in the model and are reported.[11]

Model fit will be evaluated in several ways. I begin by considering the fully unconditional models (FUM) and the partitioning of variance components, which allows for a consideration of how much variation on a given outcome is attributable to each level in the model. The FUM provides two important diagnoses. First, it approximates variance components at each level of analysis, which provides a baseline for model improvement. Second, the FUM also produces a χ^2 test, indicating whether the variance component at a given level is significantly different than zero, meaning there is sufficient variation to be modeled. As the model is built a χ^2 test is utilized to assess whether the change in deviance from the previous model to the next provides a significant improvement in model fit. A significant finding indicates that the regressors introduced to the analysis substantially improve the fit of the model.

Hierarchical Linear Modeling has been frequently utilized in two level analyses of students nested within schools at the K-12 level (Chaney et al., 1997; Lee & Bryk, 1989; Lee, Croninger, & Smith, 1997b; Teitelbaum, 2003), and it is becoming more readily utilized in higher education to study college access and enrollment (Musoba, 2004b; Perna & Titus, 2004b). Bryk and Raudenbush (1988) utilize a three level model to look at school effects on student achievement, where test scores at two time points are nested within students who are nested within schools. Currently, none have looked at high

[11] Finally I will employ common approaches to assessing the tenability of underlying assumptions, including evaluations of distributions, residual plots (homogeneity of variance and residuals plotted with predicted values), and assessments of the influence of outliers.

school student course-taking as a three level model utilizing HLM while considering the influence of state policy on student outcomes.

Variables in the Model

This section includes brief descriptions of the constructs in the study and how they are operationalized in the data. Table A-1 (Appendix) also provides a listing of those constructs and the variables utilized in the analysis.

Outcomes. In this study, high school preparation is operationalized in two ways: (1) whether students complete high school in four years and if so, (2) the number of courses they complete in the core academic subjects of math, science, English, and social studies. Graduation requirements are designed to influence the mix of courses completed by students while in school, assuming that most students are capable of a more rigorous curriculum. Equally important is whether students are likely to finish high school. The high school graduation requirement and exit exam policies are not intended to influence high school graduation, but it is possible that either policy could negatively influence the probability a student will complete high school – which is an equally important consideration for students to attend college.

- High school completion**.** In this analysis, high school completion is a simple dichotomous outcome reflecting whether a student completes high school in four years, including the summer following expected graduation or not. The ELS item used to construct this outcome is actually quite complex. There are 17 possible outcomes identified on a student transcript. For the purpose of this analysis, high school completers include all students that graduated early, graduated on time, graduated the summer after anticipated, or graduated but with no graduation date

provided. This group of completers is compared to all other groups, including students still enrolled, drop outs, transfers, and incarcerated students. Two groups of students that were not included as completers are GED recipients and students receiving a special education designation. For GED recipients, they have opted out of the curriculum required by the policy and as such have elected a path that is much more difficult in terms of college access. Similarly, students with the special education designation follow an individualized education plan (IEP) which exempts them from many of the same curricular requirements, which also makes college access difficult to achieve.[12] Students with missing data were dropped from the analysis.

- Course taking patterns. Prior research has focused on math course-taking both in terms of the numbers of courses taken and the highest level of course (Lee, Croninger, & Smith, 1997; St. John, 2006). In this study I utilize the sum of all courses[13] taken in the core academic subjects of math, science, English, and social studies because state policies address each of these domains. This analysis treats the course-taking variable as a continuous outcome even though it could also be thought of as a count outcome, which would require a different set of parametric assumptions and structural form. The number of courses a student completes in the core academic subjects is constructed as a sum of the number of courses taken in four subject areas. Typically count variable outcomes would also have a limited number of values, but in this case where the outcome is a sum of count variables there is much greater variability. Equally, because there is considerable

[12] A sensitivity analysis is conducted in Chapter 4 to assess how these two decisions affect the analysis.
[13] Measured in Carnegie units where one unit is equivalent to approximately one hour of instruction per day, five days a week for the duration of the school year.

variation in terms of the course areas in which students complete coursework, the distribution on this outcome variable is essentially normal, with a range from 1 to 28, a mean of 14, and a slight left skew (more values above the mean).[14]

State-level Independent Variables

The primary focus of this investigation is state policy and the state is level 3 in the hierarchical framework. These state-level variables owing to St. John and colleagues (St. John, 2004; St. John, Chung et al., 2004; St. John, Chung, Musoba, & Simmons, 2006; St. John & Musoba, 2006), are derived from publicly available data. This study utilizes five state-level variables across the two models, with a particular focus on high school graduation requirement policies and mandatory exit exams – the two policies designed to influence academic preparation. I include a measure of the average funding per student in K-12 education and two measures approximating college cost – public four-year in-state tuition and need-based aid awarded per full-time equivalent student. Each of those variables is discussed below.

- High school graduation requirements. In prior research examining the relationship between high school graduation requirements and student outcomes (including course taking, high school completion, and student achievement), the focus has been on math (Lee et al.., 1997; St. John, 2004) or math and science (Teitelbaum,2003). The research by Clune and White (1992) was unique because it utilized a time series design to examine the relationship between the adoption of rigorous state requirements and the number of courses students completed across the core academic subjects as well as the vocational and technical courses. The

[14] The distribution of this outcome variable is considered in Chapter 4 and a histogram suggests that it is essentially normally distributed.

current study utilizes a four level categorical variable to characterize high school graduation requirements: (1) local control states, (2) states adopting a standard less than the New Basics, (3) States that adopted the New Basics standard (identified in *A Nation at Risk* as 4 English, 3 math, 3 science, and 3 social studies courses), and (4) states that adopt a college preparatory curriculum (which includes clearer expectations regarding the rigor of the courses completed, like Algebra or Geometry or a lab science course).[15]

- Exit exam requirements. St. John (2006) introduces this as a dichotomous indicator of whether or not the state has adopted a state exit exam as a condition for high school graduation. This policy has potentially important implications for high school graduation in particular. Exit exams are intended to insure students have learned what is minimally expected of them while in school, but it may also serve as a barrier for students that have not received adequate preparation.[16] The Center for Education Policy (2004) has conducted a thorough review of the literature on exit exams and finds the evidence is mixed with respect to whether mandatory exit exams influence high school completion.
- K-12 funding per FTE. The amount of money spent per student has been a particularly contentious issue since the Coleman report (Coleman, 1969). Some contend money does not matter (C. E. Finn & Walberg, 1994), but the evidence is mixed (Burtless, 1996). Hanushek (2006) claims that investing in schools will not make a difference unless incentive structures change. Musoba (2004) found that

[15] A more complete description of the coding for the high school graduation requirement policy variable is included in the appendix.
[16] A complete description of the sources of data and the coding for this variable are available in the appendix.

K-12 funding at the state level was positively related to individual level SAT scores. It is clear from the existing research on the influence of school funding on student outcomes has not yet been settled. St. John and colleagues have extracted state averages for K-12 funding per full-time equivalent student and those data are used for the analysis.[17]

- Average in-state tuition at a four-year institution. The cost of college is an important factor determining whether low income students will attend college (Advisory Committee on Student Financial Aid, 2002; Fitzgerald, 2004). In this study, I test whether college cost is related to student outcomes that position students to attend postsecondary education. System alignment theory suggests that students are not well informed of the true costs of college (Kirst & Venezia, 2004; Conley 2005). In this analysis, I treat both tuition and need aid as signals to students regarding the cost of college. As such, both variables are lagged by two years (data for 2002) essentially reflecting the signals students would receive during their sophomore year in high school. St. John has utilized this measure exploring student's financial access to college (St. John, Chung, Musoba, & Simmons, 2004) and has found that the cost of college is negatively related to high school completion. The cost of a four year institution for in-state students is particularly important because policy is moving the high school curriculum more toward a four-year standard.
- Need Based Grant Aid. Tuition is not the only signal states send to students regarding the cost of college. Low-income students are the most sensitive to price

[17] Level of funding per student is best considered at the school level, but the data are not available by school.

and are more likely to select out of the college going pool, but sufficient need-based aid programs may also signal to students that college is an option, and, as such they should prepare themselves to attend. In the St. John et al. (2004) study, tuition was negatively related to high school completion, but among completers, need-based aid was positively associated with whether or not completers attended colleges. The key is that both tuition and aid send signals to students regarding the cost of college, which in turn, may influence students to prepare themselves. These two variables together, test whether college cost signals are related to whether students prepare for college in terms of the number of courses completed in the core subject.

School-level Independent Variables

School level influences on high school outcomes have been a primary focus of the existing literature and are included here as controls. Schools are both influenced by state policy and in turn, influence student outcomes so they constitute a critical link in the high school preparation puzzle. This analysis focuses on the structure of schools at level 2 and not on the academic organization of the schools.[18] This is an important distinction. Schooling reflects the nature of the education students receive in the classroom. The school structure on the other hand, reflects the characteristics of the schools themselves. Seldom is state education policy designed or even intended to influence the nature of

[18] This distinction is discussed earlier in the limitations section. The structure refers to the structural features of the schools including student/teacher ratios, percent minority, percent free or reduced lunch, urbanicity, and the size of the school found in the Common Core of Data (CCD). It does not include measures for the courses offered by the school or the academic concentrations of the students which are elements of the academic organization of schools as described by Lee, Croninger, and Smith (1997).

schooling. Instead, policy makers assume that if the structure is right, schooling will improve.

- Size of school. State policies have changed the nature of the high school curriculum and recent reform initiatives like those undertaken by the Bill and Melinda Gates Foundation have emphasized smaller high schools. Lee and Smith (2001) have found for example, that the optimal size for a high school in terms of academic achievement, is approximately 600-900 students, meaning that both very small and very large schools are negatively related to achievement. In this study I use the measure of total enrollment reported through the administrative survey of ELS. Consistent with the work of Lee et al., the size of the school is not normally distributed so a log transformation is employed.[19]
- Student teacher ratio. There is an important debate in the K-12 literature regarding class size and its impact on student achievement. At the heart of the class size debate is the public investment in education. Fundamentally, the student to teacher ratio is a matter of funding and the research on school funding is far from settled. As discussed earlier, Hanushek (2006) finds that public investment in education does not lead to consistent improvement in student achievement. However, the Tennessee class size experiment suggests that reducing class size from 24 to 15 in early grades is beneficial both in terms improved performance and some modest improvements in terms of closing gaps by race (Mishel & Rothstein, 2002). The Common Core of Data does not include data on the

[19] The Lee and Smith article suggests a different coding scheme for school size because of the curvilinear relationship between school size and achievement. However, in this sample, there are relatively few schools that fall in the range and even fewer on the low end of the range, making it difficult to develop reliable estimates. This is a limitation of the variable in the analysis.

average funding per student at the school level, but the student teacher ratio is one way to consider variation by funding. School budgets are driven to a high degree by personnel expenses and lower student teacher ratios suggest higher levels of funding per student.

- School Urbanicity. A good deal of research has been done examining the role of the high school in urban settings (Anyon, 1997; Cibulka, Reed, Wong, & Politics of Education Association, 1992; Herrington & Orland, 1992; Kozol, 1991; Mirel, 1999; Tierney & Hagedorn, 2002). Suburban districts have largely adopted the comprehensive high school model, but it operates very differently in both rural and urban contexts. In rural communities, there are frequently too few students to effectively differentiate the curriculum to meet the needs and interests of all students. In urban settings, districts largely adopted strategies of differentiating curriculum by building rather than by tracks or concentrations within buildings. As such, this is an important context to consider.
- Percent minority students in school.[20] Race remains an important and politically divisive issue in US education (N. A. Alexander, 2002; Jencks & Phillips, 1998; Kozol, 1991; D. A. Lewis & Nakagawa, 1995). Despite enormous efforts to eliminate de jure segregation in schools leading up to and subsequent to *Brown v. Board*, schools have remained largely segregated by race. Recently, districts have moved away from established desegregation plans. Percent minority in the school is included to consider how segregation at the school level influences student level outcomes.

[20] The percent minority includes the total number of under-represented (African American, Hispanic, and Native American Indian) students divided by the total number of students enrolled in the school. The variable is included from the Common Core of Data (CCD).

- Percent of students receiving free or reduced lunch. Similar to race, socio-economic status is a socially stratifying characteristic, which operates at both the individual and the school levels. St. John (2006) examines the role of poverty as a state level characteristic and finds a negative relationship with college participation. One of the school level characteristics included in ELS is a measure of the percent of students who qualify for the federal lunch free or reduced programs. This variable serves as a proxy for the level of poverty in a school.

Individual-level Independent Variables

No matter how important state policy or school structures are in terms of student outcomes as detailed in the literature review, prior research has reinforced that the largest portion of explainable variation is observed at the student level. These student characteristics are well-documented in the research on student outcomes and they serve as controls in this study.

- Socio-economic Status. Income reflects a families' ability to pay for college where parent's education may influence student's ability to navigate the college preparation, application, and enrollment processes. NCES has created a composite variable for SES that includes income, parent's education, and occupation in part to deal with challenges of multi-collinearity. In an effort to maintain a parsimonious model and to test random effects (discussed below) I utilize the NCES composite variable for SES as a continuous regressor.
- Race/ethnicity. As mentioned above and discussed in the literature review, race remains an important and contentious issue. Some studies attempt to explain away the influence of race by suggesting that when students of color complete a more

rigorous curriculum in high school, they succeed in terms of college enrollment at similar rates as their White peers (Berkner & Chavez, 1997; Horn & Carroll, 1997). This of course, neglects the fact that far fewer students of color are prepared for college if and when they complete high school. Initially, White and Asian students will serve as the referent group with comparisons to Black, Hispanic, and Other.

- Prior achievement. Student achievement is an important sorting mechanism that affects the sorts of opportunities available to students in high school. Students who enter high school with higher test scores and who have already taken Algebra I (Smith, 1996) are more likely to finish high school and take more demanding courses. In this study I use student-level scores on a math achievement test as a covariate because students' decisions to enroll in future courses are influenced by their perceived ability to do more advanced work. This control allows for the consideration of whether student course taking decisions influence future outcomes, independent of prior achievement.
- Sex. For many years, sex was a concern because women were systematically discriminated against throughout the educational system. It remains a concern today, but the picture is a bit more complex. Young girls tend to do as well or better than boys in school in terms of high school completion, the courses they take, and the likelihood they will attend college. In this study, I compare male students to female students with a dichotomous variable.

Course Taking Model

In this study, I examine the relationships between state-level policies and two student level outcomes – high school completion and student course taking – which reflect measures critical to student's access to college. I begin by describing the three level-model for the number of courses students complete in the core academic subjects. Sequentially, this model will be reported in Chapter 5 after the high school completion model, however, the linear model provides a simpler illustration of an HLM analysis. The high school completion model will be discussed in the next section, but with a less detailed explication of equations. I describe the models beginning with the course taking outcome because it is continuous and allows for the more familiar linearity assumptions.

The analyses follow a similar structural form in terms of explanatory variables, with only the outcomes and samples changing. The high school completion model described in the next section utilizes a generalized hierarchical model to better reflect the underlying structural form associated with a dichotomous outcome. For each analysis, the sample is different. The high school completion model is applied to the full sample of public school students where the course taking model applies only to those public school students that have completed high school within four years. Each analysis begins with the fully unconditional model to assess how variation in the outcome measure is allocated across the individual, school, and state levels. For the purposes of the study, I provide equations used to estimate student course taking to illustrate the full three-level model.

The Fully unconditional model. The fully unconditional model (FUM) for high school course taking is formally described as

Student Level

$$Y\ (COURSES)_{ijk} = \pi_{0jk} + e_{ijk} \quad (1)$$

where

$Y\ (COURSES)_{ijk}$ = the number of courses taken by student *i* in school *j*, in state *k* while in high school.

π_{0jk} = the mean number of courses taken by all students in school *j* in state *k*

e_{ijk} = the random effect attributed to the student or the amount of deviation of child *ijk* from the school mean

School Level

$$\pi_{0jk} = \beta_{00k} + r_{0jk} \quad (2)$$

where

β_{00k} = the mean number of courses taken by students in the core academic subjects in state *k*

r_{0jk} = the random effect attributed to the school, or the amount of deviation of school *jk* from the state mean

State Level

$$\beta_{00k} = \gamma_{000} + u_{00k} \quad (3)$$

where

γ_{000} = the grand mean, or the mean number of courses taken by all public school students in all states
u_{00k} = the random effect attributable to the state, or the deviation of school *k* from the grand mean

The fully unconditional model (FUM) represents how variation in an outcome measure is distributed across the three levels under investigation. Raudenbush and Bryk (2002) suggest that the FUM be considered prior to adding predictors to the model to assess the partitioning of variance at the three levels investigated in this analysis. To calculate the percent of variation attributable to each level, the amount of variation at

each level is divided by the total variation (sum of $\sigma^2 + \tau_\pi + \tau_\beta$). For example, the proportion of variance attributable to level 3 (state) is equivalent to $\tau_\beta /(\sigma^2 + \tau_\pi + \tau_\beta)$.

Conditioned three level fixed model. The simplest version of the three level model is to assume that the effects of predictor variables at each level are fixed, meaning the effects are not expected to vary between level 2 schools and level 3 states. Like the conventional Ordinary Least Squares (OLS) analysis, HLM relies upon a similar set of assumptions – linear relationship between the outcome and independent variables, normal distribution of the error terms with a mean of 0 and some measure of variance, homogeneous variation of the residuals, the independence of cases at each level and of predictors with the corresponding level-specific error terms. Similarly, HLM models can be evaluated by the degree to which the model improves prediction and as such, explains variation in the outcome. In HLM, researchers can consider the amount of variance explained at each level of analysis. In this study, variance exists at 3 levels and the amount of variance explained is then a function of the predictors included in the model at a given level.

Raudenbush and Bryk (2002) also warn that specification assumptions apply at each level, where misspecification at one level may bias estimates at another level may influence standard error estimates and inferential statistics. HLM models are particularly sensitive to specification and every care must be taken to minimize the potential bias of misspecification. Error terms associated with prediction of the intercepts at each level of analysis (e_{ijk}, r_{0jk}, and u_{00k}) represent the only random effects in the simple fixed effects version of the models, assuming a normal distribution of the error terms with a mean of 0. Below are the equations for the conditioned model at all three levels.

Level 1 – Individual students

$$Y\ (COURSES)_{ijk} = \pi_{0jk} + \pi_{1jk}\ (SES)_{1jk} + \pi_{2jk}\ (SEX)_{2jk} + \pi_{3jk}\ (RACE)_{3jk} + \pi_{4jk}\ (ACHIEVE)_{4jk} + e_{ijk} \quad (4)$$

Level 2 – Schools

$$\pi_{0jk} = \beta_{00k} + \beta_{01k}\ (SIZE)_{jk} + \beta_{02k}\ (TEACHRATIO)_{jk} + \beta_{03k}\ (MINORITY)_{jk} + \beta_{04k}\ (LUNCH)_{jk} + \beta_{05k}\ (URBANICITY)_{jk} + r_{0jk} \quad (5)$$

Level 3 – States

$$\beta_{00k} = \gamma_{000} + \gamma_{001}\ (COURSE)_{k} + \gamma_{002}\ (EXAM)_{k} + \gamma_{003}\ (NEEDAID)_{k} + \gamma_{004}(TUITION)_{k} + \gamma_{005}\ (K12FUND)_{k} + u_{00k} \quad (6)$$

This set of equations focuses on estimating multilevel fixed effects. In these models, student level predictors are utilized to examine variation at the student level, school level predictors are used to explore the student level intercept (mean courses taken in school *j* and state *k*), and state level predictors are employed to consider variation in the school level intercept (mean courses taken in state *k*). The three equations can be combined into one by algebraic substitution. The equation for the mixed model is then:

$$Y\ (COURSES)_{ijk} = \gamma_{000} + \gamma_{001}\ (COURSE)_{k} + \gamma_{002}\ (EXAM)_{k} + \gamma_{003}\ (NEEDAID)_{k} + \gamma_{004}(TUITION)_{k} + \gamma_{005}\ (FUND)_{k} + \beta_{01k}\ (SIZE)_{jk} + \beta_{02k}\ (TEACHRATIO)_{jk} + \beta_{03k}\ (MINORITY)_{jk} + \beta_{04k}\ (LUNCH)_{jk} + \beta_{05k}\ (URBANICITY)_{jk} + \pi_{1jk}\ (SES)_{1jk} + \pi_{2jk}\ (SEX)_{2jk} + \pi_{3jk}\ (RACE)_{3jk} + \pi_{5jk}\ (ACHIEVE)_{5jk} + u_{00k} + r_{0jk} + e_{ijk} \quad (7)$$

When the level 2 and level 3 equations are substituted into the level 1 equation it becomes evident that students individual course taking is a function of some set of

personal characteristics, a set of factors operating at the school level, and a state level policy context.

Course taking model with random effects. Equation 7 indicates that the effects of sex, race, income or prior achievement are the same for all students across schools and states. Similarly, the models assume that student teacher ratio, school size, percent minority, percent free lunch, and urbanicity all exert the same effects regardless of the state. In HLM it is possible to allow relationships to vary across either level 2 (schools) or level 3 (states). In this case, researchers can test whether state policy might operate differently across schools depending upon the characteristics of those schools. Similarly, researchers can test whether student level characteristics vary depending upon the school or state contexts.

In the fixed effects models, the value of the student outcome for individual *i* in school *j*, nested within state *k* depends on the intercept for school *j* within state *k,* intercept (π_{0jk}), a set of student level predictors, and a residual (e_{ijk}) associated with the student. At level 2, the school specific intercept (π_{0jk}) depends on the state specific intercept (β_{00k}), a set of level 2 school characteristics, and a random effect (r_{0jk}) associated with the *j*th school within state *k*. And the state specific intercept (β_{00k}) is a function of the grand mean (γ_{000}), a set of state policies, and a random effect (u_{00k}) associated with the state. All of the independent variables introduced at each level of the analysis reflect hypothesized relationships between the variable and the outcome and are expected to exert the same influence across schools and states. However, in HLM these relationships can be treated as randomly varying, meaning that family SES may have

differential effects across schools or that the percent minority in a school may have different effects depending upon the state policy context.

In order to test these more complex relationships, HLM allows slopes or relationships at one level to be treated as outcomes at subsequent levels. Much like the intercepts as outcomes approach utilized above, slopes can be modeled where the variation in the slopes depends upon an intercept; and then a random effect may also be introduced and tested. In this study, I test random effects for the relationship between the state high school graduation policy and five slopes: individual student SES and race (African American and Hispanic) effects at level 1 and both the percent minority and percent free lunch effects at level 2. The equations for these three random effects are as follows:

$$\pi_{1jk} = \beta_{10k} \text{ at level 2 and } \beta_{10k} = \gamma_{100} + u_{10k} \quad (8)$$

where

π_{1jk} is the slope of the relationship between SES and the number of courses taken

β_{10k} is the intercept of the slopes or the average SES effect within states

γ_{100} is the grand mean of SES effects

u_{10k} is the random effect associated with the level 3 prediction of the variation in SES effects across schools

In this case, I have assumed that SES effects do not vary at the school level but they do at the state level.[21] Equation 8 then provides an unconditional model or a random coefficients regression model for the explanation of variation in the slope of the relationship between SES and course taking between states. The same equation can be written to test random effects associated with the relationship between racial groups and

[21] Random effects were tested at level 2 and were not significant.

student course taking. The null hypothesis is that the variation in the slopes across level 2 units is 0 and the alternative hypothesis suggests the variance is significantly different than zero. If the random effects associated with the slope of SES at level 1 are significant, then I will test to see if the high school graduation requirement policy explains a portion of that variation. Like the fixed effects model, in HLM3 deviance statistics can be utilized (when the outcome is linear) to assess whether the addition of independent variables to the slopes as outcomes models improves the overall explanatory power of the model. In addition to the random effects tested for SES, four additional random effects are introduced into the analysis, all of which examine the equitable distribution of outcomes – race (both Black and Hispanic) between states at level 1 and percent minority and percent free and reduced lunch effects between states at level 2. These random effects reflect what Raudenbush and Bryk (2002) and Lee, Croninger, and Smith (1997) refer to as equity outcomes, meaning that the variation in these slopes reflect inequitable distributions in outcomes and efforts to improve equity should reduce these differences.

Equation 9 provides an example testing a level 2 random effect associated with the relationship between the percent minority enrolled in a school and the number of courses completed in the core subjects.

$$\beta_{03k} = \gamma_{030} + u_{03k} \quad (9)$$

where

β_{03k} is slope of the relationship between the percent minority enrolled in a school and the number of courses in the core subjects

γ_{030} is the grand mean of the percent minority effects

u_{03k} is the random effect associated with the level 3 prediction of the variation in percent minority effects in schools across states

Like SES, I begin with the random coefficients regression models as null models to test whether the random effects associated with each of the slope coefficients is significantly different than 0. Assuming the variation is significant in both the percent minority and percent free lunch models, I will add the state graduation requirement policy testing whether the states adopting a college preparatory standard effect the equitable distribution of course taking among schools within states. The equations above are structurally similar for high school completion except that the outcome is dichotomous, requiring a Generalized Hierarchical Linear Model (GHLM) (Luke, 2004) and a log link function where the parameters are linear in the logit.[22]

Centering Decisions

An important set of decisions in HLM revolve around the method for centering independent variables. According to West, Welch, and Galecki (2007, p. 49) "centering covariates at specific values has the effect of changing the intercept in the model, so that it represents the expected value of the dependent variable at a specific value of the covariate, rather than when the covariate is equal to 0." Hofmann and Gavin (1998, p. 627) draw a distinction between grand and group mean centering indicating that "grand mean centering yields an intercept equal to the expected value of Y_{ijk} for an individual with an average level of X_{ijk} (full sample)…where group mean centering yields and intercept equal to the expected value of Y_{ijk} for an individual whose value on X_{ijk} is equal to their groups mean."

[22] It is also possible to substitute the slopes as outcomes equations into the larger intercepts as outcomes equation (Equation 7). Doing so will provide more familiar interaction terms, multiplying a predictor at level 3 by predictors at either level 1 or 2.

Hofmann and Gavin (1998) further describe four separate paradigms for choosing centering options – incremental, mediational, moderational, and separate. The incremental approach treats level 2 and level 3 variables as main effects predicting level 1 outcomes and suggests that the group level characteristics have an effect over and above the effects of independent variables at level 1. In this case, grand mean centering effectively controls for level 1 variables in the analysis. The mediational paradigm assumes that a variable at a higher level only influences the outcome indirectly through another predictor. The moderational paradigm assumes that the effect of an independent variable on the outcome is contingent upon the value of another independent variable. In this approach, researchers model variance in the slopes across groups.

The final paradigm suggests that separate models exist at each level where the level 1 model examines variation within groups and level 2 models variation between groups. In this case, group mean centering is the appropriate to provide within and between group partitioning. In this analysis, the centering decisions reflect a combination of the first and third paradigms discussed above. From an incremental perspective, I am primarily interested in the direct effects of state policy controlling for individual and school level characteristics. In this case, grand mean centering is the appropriate option and I have grand mean centered all continuous predictors at level 3 in the intercepts as outcomes models. Dichotomous variables are meaningful when X_{ijk} =0 so they have not been centered. From a moderational perspective and given that I am also interested in whether state policy mediates school effects, I have group mean centered level 1 regressors, meaning that each student is scaled according to the mean in their school. The influence of policy on that slope reflects whether or not state predictors affect the

equitable distribution of outcomes within schools. Additionally, I examine state level slopes as outcomes, suggesting that differences in state policy may influence the random variation associated with level 2 predictors within states (continuous variables at level 2 are group mean centered). The continuous predictors in the slopes as outcomes models are grand mean centered where the dichotomous predictors remain uncentered. When predictors are added to the slopes as outcomes models for the school slopes, coefficients can be interpreted as effects on the equitable distribution of the outcome under investigation within a given school. Predictors in the state slopes models reflect effects associated with the equitable distribution of outcomes within states.

Centering decisions are important relative to the interpretation of findings in the analysis. Choosing to group mean center level 1 and level 2 regressors allows for a consideration of how policy predicts variation within schools (among individual characteristics) and variation within states depending upon characteristics of the schools. It is also possible to choose grand mean centering for all continuous variables, which scales them to the overall means for all students. Grand mean centering of SES at level 1, for example, would change the interpretation from comparing students within schools to comparing them relative to all students. The differences can be important. One can imagine that a student above the SES mean in a low income school may be middle or low SES relative to the population of high school students across the nation. In future analyses it will be worth exploring these alternative centering options.

The High School Completion Model

The high school completion model differs from the high school course taking model because the outcome is dichotomous, indicating whether students completed high

school by the summer following their expected graduation date. Because the outcome is dichotomous, it requires a different set of distributional assumptions than the linear model described above. The equation for high school completion is similar to the course taking model (see Equation 7), in terms of its specification, but is expressed as a logit function where the probability a student will complete high school follows a logistic distribution. The binary outcome in HGLM is a special case where at level 1 the sampling model is linear, the predicted values are normally distributed with an expected value μ, and constant variance σ^2; the link function transforms predicted values to constrain the analysis to the 0/1 interval; and the structural model is linear in the link function – in this case in the logit, where data can be returned either as odds or as probabilities (Raudenbush & Bryk, 2002). The mixed model where all three separate equations corresponding to the individual, school and state levels are combined algebraically in Equation 11 as

$$Y(HSCOMP)_{ijk} = \ln (\gamma_{000} + \gamma_{001} (COURSE)_k + \gamma_{002} (EXAM)_k + \gamma_{003} (FUND)_k + u_{00k} + \beta_{01k} (SIZE)_{jk} + \beta_{02k} (TEACHRATIO)_{jk} + \beta_{03k} (MINORITY)_{jk} + \beta_{04k} (LUNCH)_{jk} + \beta_{05k} (URBANICITY)_{jk} + r_{0jk} + \pi_{1jk} (SES)_{1jk} + \pi_{2jk} (SEX)_{2jk} + \pi_{3jk} (RACE)_{3jk} + \pi_{5jk} (ACHIEVE)_{5jk} + e_{ijk}) \quad (11)$$

Random effects for high school completion. In the high school completion model, I also add the same random effects to the analysis, testing whether the state high school graduation requirement policy affects the gaps in the probability of completing high school by race and by class. Stated differently, does the policy minimize the difference in the probability of high school completion between students from low and high SES backgrounds and, similarly, does it minimize the difference between the percent of

students completing high school in low and high minority and low and high free lunch schools? These questions can be addressed once random effects are included for the slopes of the relationships identified above.

Combined, the two sets of analyses – high school course taking and high school completion – provide a thorough consideration of important state policies and their influence on student outcomes that matter most to the college admissions process – the courses students take, achievement test scores, and high school completion – while accounting for the influences of school characteristics.

Chapter 4

High School Completion

This chapter presents findings on the multi-level influences associated with the probability that public school students will complete high school within four years. Descriptive analysis help contextualize the study while also presenting an important national picture. Data are provided for all states, as well as nationally representative samples of schools and students. As a result, it is possible to view a snapshot of the educational landscape for the graduating class of 2004. Next I consider the potential implications for one of the limitations in this study – small samples in nine states and what that means for distribution with respect to the policies under investigation. After examining the cross tabulations of explanatory variables by high school completion status, I present separate tables for each level of the analysis, built from the first level and providing unconditional random effects for subsequent levels. The final model provides the full array of fixed and random effects and provides a detailed analysis of the influences of fixed factors in both intercepts and slopes as outcomes models. High school completion is a dichotomous outcome, so logistic regression is utilized for the analysis and odds ratios are reported as a more intuitive alternative to the coefficients, which are linear in the logit, but are not units that are meaningful to a general audience including policy makers.

State Policy Environment

States have made important policy decisions regarding student's opportunities for college access. Two policies in particular, are intended to influence how well students are academically prepared for life, work, and college after high school: state graduation requirements and mandatory exit exams. K-12 funding is an important policy issue and in a number of states is shifting to the state through funding equalization strategies. It would have been better to consider K-12 funding at the school level, but the data were not available in ELS. In order to test the possible relationships between student outcomes and the signals students receive about their opportunities for college, two cost variables – average tuition at public four-year institutions and the ratio of need-based aid to tuition – are included.[23] Kirst and others (2004) argue that students over-estimate the cost of college, where tuition reflects the sticker price and need-based aid is intended to capture programs designed to offset cost among less economically advantaged students. Table 1 provides descriptive statistics for the characteristics of states included at level 3 of the analyses for both course taking and high school completion.

For the graduating class of 2004, eight states had maintained local/district control over what courses students were required to complete by the time they finished high school, where 10 states had adopted a college preparatory curriculum, effectively attempting to constrain the high school curriculum for all schools and for all students. By 2004, 40% of states had adopted a mandatory exit exam requirement. Cut values for both average K-12 funding per student and public university tuition were established utilizing quartiles on each measure relative to the percentage of students to which those amounts

[23] College cost is not included in the high school completion model

applied. For tuition in particular, this means that 9 states accounted for 25% of students for which the lowest quartile tuition applied. Need-based aid per FTE (not included in Table 4.1) ranged from 0 to $886 with a mean of $95 and a standard deviation of $172. Three states provided no need-based aid to students in 2002. School size is negatively skewed so a log transformation was included in the analysis for course taking.

Table 4.1
State Characteristics for Graduation Requirements, Exit Exams, K-12 Funding and College Cost

State Policy	(N=51)
High School Graduation Requirements	
Local	8
Less than NB	19
New Basics	14
College	10
Mandatory Exit Exam Required	
No	31
Yes	20
K-12 Funding	
Less than $4,300	16
$4,300 to $5,450	19
Higher than $5,450	16
Tuition at public four-year institutions	
Less than $2,650	9
$2,650 to $5,200	32
Higher than $5,200	10

In order to conduct a three level analysis, HLM requires a sufficient amount of data at each level. While all 50 states and the District of Columbia have data available at the state level, when I narrow the analytic sample to all public school students, the number of level 2 and level 1 units available in each state declines. Table 4.2 provides frequencies for the number of cases in each state. The bottom nine states (which includes Washington DC) all drop below 50 level 1 cases, which may also reflect as few as two high schools.

The first ten states are the largest states in terms of the number of cases included in the analysis where the nine states (including DC) below the line contain insufficient data at either level 2 or level 1 in the final analysis. Dropping units at a given level for lack of data is not an uncommon problem in HLM, but it is important to consider in this case, which states have been dropped from the analysis in an effort to minimize or at very least understand the potential bias introduced by dropping the smallest states. The three policy variables measured continuously are less problematic but high school graduation requirements and the presence of a mandatory exit exam could influence the findings depending on their policies.

Table 4.2
Public School Students by State, Education Longitudinal Study (ELS: 2002-04)

State	# of public students
California	1528
Texas	871
Florida	515
Illinois	508
Georgia	465
New York	465
Ohio	464
Pennsylvania	448
Minnesota	390
New Jersey	388
Idaho	45
Rhode Island	44
Delaware	43
Nebraska	43
New Hampshire	28
Vermont	22
Wyoming	20
District of Columbia	15
Alaska	14

In terms of graduation requirement policies, none of the nine dropped states have adopted the college preparatory standard, four (Delaware, Vermont, Wyoming, and DC) have adopted the New Basics standard, four (Alaska, Idaho, New Hampshire, and Rhode Island) adhere to a state requirement less than the New Basics, and Nebraska is the only local control state dropped from the analysis. The distribution of missing states on the high school graduation requirement policy is fairly representative of all states given that the largest numbers of states adopt either the New Basics standard (14) or something less (20). The mandatory exit exam is slightly more problematic. Of the nine states dropped from the analyses, only one is a mandatory exit exam state (Alaska). The other 8 are all part of the 31 states that have not adopted a mandatory exam for completion. This needs to be considered when interpreting the final analyses.

School Characteristics

In the initial sample, 16,373 students attend 752 high schools, representative of both public and private schools in the nation. However, only public schools provide school level data. These school characteristics are linked to the ELS data from the Common Core of Data (CCD), a mandatory reporting tool for all public schools in the nation. There is no comparable source of data for private schools. According to Table 4.3, 573 public schools comprise the full sample of schools from which transcripts are collected.

Table 4.3
Public School Characteristics for Schools Included in ELS 2002-04

School Characteristics	(N=573)	
School Size		
Smaller than 800 (low quartile)	143	25%
800-2000 (middle 50th)	305	53%
Greater than 2000 (highest quartile)	123	21%
Student Teacher Ratio		
15 students or less	159	28%
Between 15 and 21 students	285	50%
More than 21 students	108	19%
Missing	21	4%
School Locale		
Urban	160	28%
Rural	128	22%
Suburban	285	50%
Percent Minority in School		
Less than 31%	296	52%
Higher than 31%	264	46%
Percent Qualified Free or Reduced Lunch		
Less than 19%	254	44%
Higher than 19%	248	43%

The data reported above are weighted by the school weight calculated for the base year [BYSCHWT], reflecting the school they attended at the time the study was initiated.

The school weight allows for the data to be representative of the entire population of high schools in 2001-02. For descriptive purposes, all of these variables are reported in categorical terms. However, the four continuous variables are utilized as such in the models to maximize the variation on each measure. In terms of school locale, urban and rural schools are compared to suburban schools. School size is reported here in actual terms, but for the purposes of the multilevel models, school size has been transformed using a log transformation to account for the fact that the distribution is not normal.

Individual Characteristics

Table 4.4 provides a descriptive overview for the sample of students attending public schools. Individual characteristics are weighted by F1TRSCWT divided by the mean of the weight to create a relative weight. The relative weight adjusts for the unequal probability a student is selected for the study and it returns the sample size to the actual number of cases available in the analysis. Approximately 78.4% of all public school students complete high school in four years or less. The weighted sample also indicates that more males are enrolled in public schools than females.

Table 4.4
Public School Student Characteristics for High School Completion Model

Individual Level Variables	(N=11,700)	Percent
High School Completion		
Did not complete in four years	2,523	21.6
Completed in four years	9,177	78.4
Sex		
Female	5,782	49.4
Male	5,918	50.6
Race/Ethnicity		
Black	1,765	15.1
Hispanic	2,011	17.2
Asian	464	4.0
White	6,837	58.4
Other	623	5.3
Parents Socio-Economic Status Composite		
Lowest Quartile	3,058	26.1
Middle 50%	6,008	51.4
Highest Quartile	2,634	22.5
Prior Achievement		
Lowest Quartile	2,896	24.8
Middle 50%	5,691	48.6
Highest Quartile	2,783	23.8

The preceding tables provide simple descriptive statistics for all predictors at each level of analysis. Table A-4.5 (Appendix) combines state, school and student level characteristics and provides cross-tabulations of predictors by high school completion, effectively providing a snapshot of anticipated relationships between the predictor variables and high school completion. At the state level two relationships are interesting to note. First, students attending school in local control states are more likely to finish high school within 4 years (82.6%) than students in states adopting any form of state level requirements. Second, and contrary to the anticipated relationship, students attending public schools in states with mandatory exit exams complete high school with greater frequency than non-mandate states. Finally, the state level data suggest that average school funding may be positively related to high school completion as states that average more than $5,450 per student had more than 80% of students finishing high school in four years, whereas 77.6% complete in four years at schools with less than $4,300.

The school level characteristics in Table A-4.5 show that both small school size and lower student teacher ratios exhibit large differences by completion. Students in smaller schools and those attending schools with smaller student to teacher ratios complete high school more frequently than students in large schools and students in schools with larger student to teacher ratios. Similarly, fewer urban school students complete high school than their rural or suburban counterparts; a greater proportion of students in schools with low proportions of minority students finish high school in four years; schools with lower percentages of free and reduced lunch students graduate more students in four years than high free lunch schools.

At the individual level, lower percentages of men finish high school than women. White and Asian students complete high school at higher rates than African American, and Hispanic students. Additionally high socio-economic status students complete high school at higher rates than low-SES students and those with high levels of prior achievement in math finish high school in greater proportions than students who scored lower on the achievement test. The differences identified above indicate relationships to observe in the HLM regression analysis.

Multi-Level Model: High School Completion

High school completion in this analysis is dichotomous, where all students completing the high school diploma within four years are compared with students that had not finished high school. The outcome is not continuous, requiring a more generalized version HLM (HGLM), where a logit link function is utilized. Parameter estimates are linear in the logit and can be transformed in a number of ways to reflect more intuitive results including the odds of high school completion and the probability a student will complete, given the characteristics included in the model.

One of the advantages of utilizing multi-level modeling techniques is that analysis begins by assessing how variance is partitioned among the various levels in the analysis. The decomposition of variance by level in Table 4.6 demonstrates that approximately 32% of variance in high school completion occurs at level 1 (individual), more than 37% occurs at level 2 (school), and nearly 30% of the variance is attributable to state factors (level 3). The amount of variance at each level is one way to evaluate whether or not each level of the analysis contributes to the explanatory power of the model, but it is not the only measure.

Table 4.6
Fully Unconditional Model for High School Completion in ELS: 2002-04

Fixed Effect	Coef.	SE	t-Ratio
Average school mean	1.92	0.211	9.14

Random Effect	Variance Component	df	χ^2	p Value
Students (level 1), e_{ijk}	0.855			
Schools (level 2), r_{0jk}	0.991	451	1797.1	0.000
States (level 3), u_{00k}	0.779	42	263.69	0.000
Variance Decomposition (Percentage by Level)				
Level 1	32.5			
Level 2	37.8			
Level 3	29.7			

The fully unconditioned model (FUM), which includes intercepts and an error term only, provides two additional diagnostic measures. The first is a measure of reliability at each level of analysis. Reliability, according to Raudenbush and Bryk (2002), is a ratio of the parameter variance over the sum of the parameter variance and the error variance. According to Hofmann (1997) reliability can be interpreted as the amount of systematic variance in the parameter across groups (i.e., the variance that is available to be modeled by between group variables). In this analysis, reliabilities at both level 2 (school) and level 3 (state) are 0.712 and 0.743 respectively. Low reliabilities of 0.1 or less suggest that the random effect should be constrained to zero (Raudenbush, Byk, Congdon, and Fotiu, 2003). Second, the FUM provides a likelihood ratio χ^2 test indicating whether the variance component is significantly different than 0. The FUM for high school completion indicates the variance components at levels 1 and 2 are

significant at the $p<0.001$ level (χ^2 =1797, df =451) and the same is true at the state level (χ^2 =263.69, df = 42). The three measures reported here show the variation at each level is significantly different than 0 and that modeling variation in high school completion at 3 levels fits the data.

The initial variance components provide a baseline of comparison for the conditioned models. In a three level model, there are essentially three R^2 measures calculated as the difference between the initial variance component of the FUM and the conditioned model divided by the initial variance. Commonly, studies utilizing HLM report the Intra-Class Correlation (ICC) which is a measure of variation between units in a given class. The ICC for the state level is the proportion of variance between states, which is reported above as 29.7% (0.297). The ICC for schools in the context of a 3 level model is the proportion of the variation associated with both levels 2 and 3 (67.5% or 0.675) because the between school variation is also influenced by the fact that all schools within the same state share certain commonalities.

Table 4.7 conditions the model at level 1 and includes random effects at level 3 as hypothesized in the conceptual framework (Figure 2.1). An initial analysis at level 1 is consistent with the earlier descriptive analysis and with prior research. Level 1 explanatory variables are all significant and operate in expected directions, demonstrating that prior achievement and socio-economic status are both positively related to completion, Black and Hispanic students are less likely to complete high school than White and Asian students, and Males are less likely to complete than Females. The only non-significant relationship is found between those students classified as other race/ethnicity relative to White and Asian students.

Table 4.7
Three Level High School Completion Model Conditional at Level 1

Fixed Effect			Coef.	SE	t-Ratio	Sig.
Level 1 Individual						
Avg. school mean π_{000}			2.27	0.211	10.64	***
Prior Achievement π_{100}			0.052	0.006	8.242	***
SES π_{200}			0.434	0.056	7.713	***
African American π_{300}			-0.713	0.192	-3.712	***
Hispanic π_{400}			-0.686	0.161	-4.288	***
Other Race π_{500}			-0.39	0.216	-1.826	~
Male π_{600}			-0.239	0.074	-3.206	***
Random Effect	Reliability	Variance Component	df	χ^2	p Value	Sig.
Students (level 1), e_{ijk}		0.837				
Schools (level 2), r_{0jk}		0.971	437	1695.7	0.001	***
States (level 3), u_{00k}	0.842	0.905	32	229.18	0.001	***
SES u_{20k}		0.033	32	43.74	0.082	~
African American u_{30k}	0.449	0.430	32	68.38	0.001	***
Hispanic u_{40k}	0.273	0.222	32	53.78	0.008	*

~ ($p<0.1$), * ($p<0.05$), ** ($p<0.01$), ***($p<0.001$)

The second portion of the table indicates whether school level slopes vary and it suggests that the effects of race vary randomly. Stated differently, the effects of race within a given school differ depending upon the state context within which schools operate. To illustrate, consider that the level 1 model predicts an intercept and slopes for each regressor included in the analysis. The slopes as outcomes approach shows that the slopes of each relationship can be conceptualized as varying randomly around some

coefficient and that variation may be modeled in subsequent analyses if sufficient variability is detected when the random effect is introduced. Introducing random effects at level 3 for these school level slopes provides a FUM for the slopes as outcomes models and the final analysis will include predictors for variation in these slopes. Finally, it is possible to examine how much Level 1 variation in the outcome is attributable to the explanatory variables included in the model. The variance component remaining at level 1 after regressors are added to the analysis is 0.834, meaning that level 1 predictors account for approximately 2.5% of the level 1 variance.[24]

Table A-4.8 provides results for high school completion modeled at levels 1 and 2 with random effects included at level 3. Table 4.8 also adds two dimensions to the analysis. First, it conditions the model at level 2 for the school structure, considering student teacher ratio, urbanicity of the school, the percent minority and free or reduced lunch, and the size of the school. Second, this model is unconditional at level 3 only and includes random effects for the equity relationships approximated by the slopes for percent minority and percent free or reduced lunch. At the individual level, the results are similar to Table 4.7. African American and Hispanic students are different than White and Asian students, in terms of completion after structural characteristics of the school are added to the analysis. Similarly, male students are less likely to complete high school than their female counterparts. Both SES and prior achievement are positively related to high school completion.

Three additional findings are of particular importance in this analysis. First, a comparison of variance components from the FUM to this model demonstrates that more than 43% of the variance at level 2 is explained in this model (the reduction of the initial

[24] The intermediate analysis at level 1 without random effects was run but not included in the text.

variance component from 0.971 to 0.538) by a combination of fixed effects and the introduction of random effects for state slopes. Second, two school level factors are significant predictors in this analysis. Student teacher ratio is marginally significant and negative, indicating that as the ratio increases (more students per teacher) the probability a student will complete high school declines, holding other variables constant. Similarly, as the percent minority in a school increases, the likelihood a student will complete high school is reduced.

Table A-4.9 provides a complete summary of the high school completion model conditioned at all three levels and including explanatory variables for the slopes as outcomes as well. The model provides a number of important findings relative to this study. First, it shows that students in local control states are more likely to complete high school than those in states that adopted the New Basics course requirements for graduation. Second, students residing in mandatory exit exam states are less likely to finish high school in four years than non-exam states. Third, the variance component remaining after level 3 explanatory variables are included in the analysis suggests the model explains a substantial portion of the level 3 variation in high school completion. The FUM for high school completion estimated an initial level 3 variance component of 0.927 (or slightly less than a third of the total variance) after conditioning levels 1 and 2. The remaining variance reported above is 0.533, meaning that the combination of state graduation requirement policies, exit exam requirements, K-12 funding and the random effects associated with school demographics account more than 42% of the state level variation in high school completion. The remaining variance component is significant,

which similarly suggests other state level factors may contribute to the probability students complete high school in 4 years.

Table 4.10 below provides a summary of the percentage of variation explained at each level in the analysis by comparing the variance component estimates in the final model with the FUM toward the beginning of the chapter.

Table 4.10
Percent Variation Explained by Level, High School Completion Model

	Initial Variance[25]	% Variation by Level	Final Variance	Δ Variance	% Variance Explained
Level 1	0.855	32.5	0.834	0.021	2.5%
Level 2	0.974	37.8	0.538	0.433	43%
Level 3	0.927	29.7	0.533	0.394	42.5%

Contrary to earlier studies that minimized the role of state policy on whether students complete high school, this table finds that almost 30% of variance is attributable to variation between states. At the same time, more than 42% of the level 3 variance is explained by state policy variables included in the analysis. These are important findings that suggest the state can and in some cases does play an important role in whether or not students complete high school. In an effort to streamline the results for the final high school completion model, I will discuss the findings in three broad sections – the presence of random effects associated with school and state slopes, fixed effects

[25] The initial variance at each level is defined as the variance component associated with the most recent version of the model where no regressors at that level are included in the analysis. At level 1, the FUM has no predictors at any level and no random effects. At level 2, the FUM includes all regressors at level 1 and the random effects associated with level 1 slopes. At level 3, the FUM includes all regressors at levels 1 and 2 and random effects for within school and within state slopes. The initial variance components are used to determine the partitioning of variance, but because the variance components may change as random effects are introduced, it is necessary to use the most recently calculated variance component to assess how much variation is attributable to the corresponding independent variables.

attributable to explaining variance in the intercepts, and fixed effects associated with slopes as outcomes. In the concluding chapter I will discuss what these findings may mean collectively and also in the context of what is learned by examining the number of courses students complete in the core subjects.

Random Effects, Slopes as Outcomes

Equity is an important consideration for any set of policies intended to improve student outcomes in school, but it is less frequently captured in analyses. Lee et al.. (1997) found that when schools elected to constrain the curriculum to the core academic subjects, the differences by SES did not change in terms of achievement, meaning that constraining the curriculum did not place low SES students at a greater disadvantage to high SES students, relative to schools with unconstrained curricula. In this analysis, I scale the policy up to the level of the state and consider whether it has unintended consequences for completion. In order to test these equity outcomes, I introduce random effects into the model. Race and class continue to be the primary dimensions by which to judge the equitable distribution of outcomes and as such are the relationships where random effects are tested in the analysis. I include five random effects in the model, the first three of which test whether the relationships between an individuals' race/ethnicity, class, and high school completion vary randomly by state. Only the relationship between being an African American student and high school completion appeared to vary randomly by school. Random effects for state slopes were included for both the percent minority enrolled in school and the percent of students qualifying for free or reduced lunch, and both were significant, meaning the effects of the percent minority or the percent free lunch enrolled in a school differ by state.

In this analysis, I treat the slopes of the relationships identified above as randomly varying, meaning that there is a unique coefficient for either students or schools in each state where the distribution of those slopes is normal, with some mean and constant variance. The variance components for each random effect tested in Table A-4.8 reflect a measure of the total variation to be explained in the slopes and those in Table A-4.9 reflect the remaining variance after explanatory variables are added to the equations for the slopes. The percentage improvement reflects the amount of variation explained when independent variables are included. In all three cases and despite the fact that several explanatory variables are significant in the model, adding local control or exit exam requirements to the models for slopes as outcomes do not appear to reduce the total variation appreciably as measured by the variance component. This finding suggests that factors which are significant in the intercepts as outcomes analysis may explain very little variation in the slopes.

Fixed Effects, Intercepts as Outcomes

Perhaps the simplest way to interpret the findings of this analysis is to look at the model in ways similar to a single level Binary Regression Model (BRM). The fixed effects of the explanatory variables on high school completion are reported in Table A-4.9, and their coefficients and t-ratios give a sense of the magnitude and direction of the relationships. However, the coefficients are linear in the logit and as such are not interpretable as conventional OLS coefficients. Instead, Table A-4.11 reports the odds ratios associated with the fixed effects of independent variables at each of the three levels related specifically to the dichotomous outcome for high school completion.

The odds ratios represent the probability an event will occur divided by one minus that probability and are calculated by exponentiating the coefficients. When the probability of occurrence is 0.5, the odds ratio is equal to 1; a higher probability results in an odds ratio greater than 1 and a smaller probability results in an odds ratio between 0 and 1. According to Table A-4.11, the odds a male student will complete high school in four years is 21% less than females, holding all other variables at their means. DesJardins (2001) recommends for ease of interpretation, that odds ratios less than one are less intuitive and as such, it may be helpful to report the inverse of the odds ratio. In this case, the odds female students will complete high school are 26% greater than for men holding all else constant. The odds ratio reported for prior achievement suggests a 5% increase in the odds a student will complete high school in four years for a one point increase above the mean on the math achievement test in 10^{th} grade. By extension, 10 points above the mean equates with a 50% greater odds of completing high school.

Socio-economic status is reported in standardized terms, meaning a standard deviation increase in a students' SES increases their odds of completing high school by almost 34%. Hispanic students are considerably less likely than White and Asian students to finish high school. Their odds of completing high school are 41% less than White and Asian students, holding other factors at their means. At the state policy level, the odds of students completing high school in Local Control states is nearly double those in New Basics requirement states (controlling for other factors), which demonstrates that keeping control of the school curriculum at the local level may improve the chances students will complete high school. Students living in mandatory exam states may be at a comparative disadvantage in terms of completion. The odds that a student residing in a

non-mandatory exam state will complete high school in four years is 60% greater than for students in mandatory exam states. Finally, at the school level, students in schools with a higher than average student to teacher ratio are less likely to finish high school in four years than in other schools. Overall, the analysis suggests that low income males attending school in New Basics states may be the group least likely to finish high school in four years. As the student to teacher ratio increases, their odds of completion drops even more. Conversely, female students in local control states and with fewer minority students enrolled represent the group with the highest probability of completing high school.

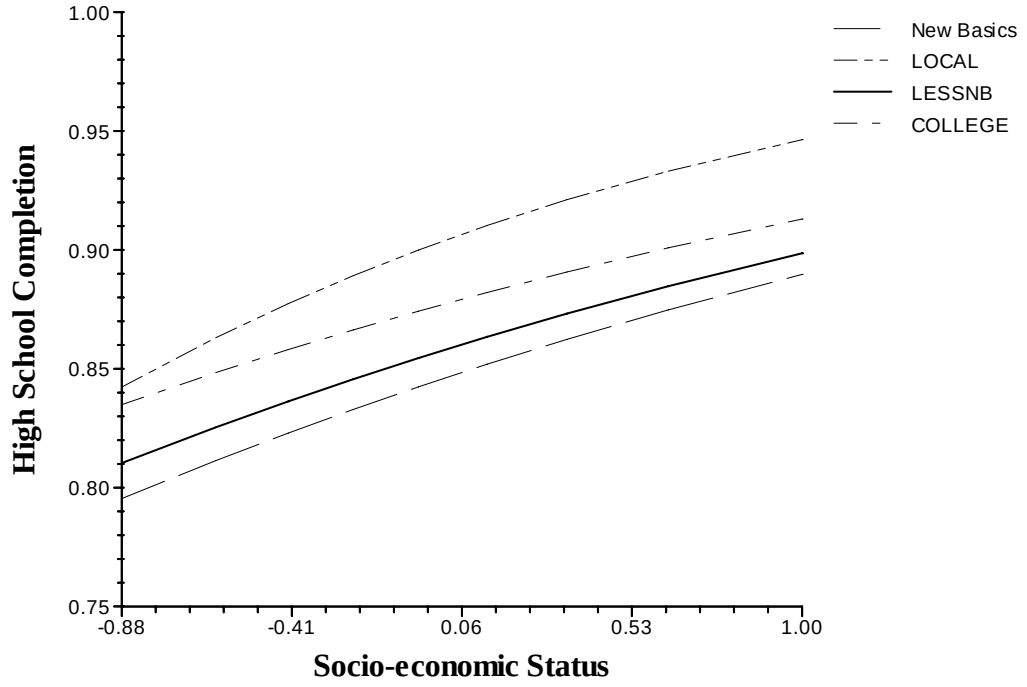
Fixed Effects, Slopes as Outcomes

In addition to considering whether relationships vary randomly by state, it is important to consider whether any of that variation can be modeled in a way that suggests what state factors might influence the equitable distribution of student outcomes. Simply put, are the gaps between racial groups and across class affected by state policies? Where random effects exist, independent variables are added to test whether that variation can be explained by factors added to the slopes as outcomes models. The improvement can be reported as a percentage of variation explained because it is effectively measuring a reduction in the variance component associated with that random effect.

There are two relationships of importance with respect to the slopes as outcomes analysis and the results are illuminating. The relationship between SES and high school completion is positive meaning that higher SES students are more likely to complete high school than lower income students. The interaction of local control by SES is also positive suggesting that the slope of the relationship increases in local control states

relative to New Basics requirement states. Figure 4.1 provides an illustration and the four lines represent high school completion by SES in each of the four graduation policy environments – college preparatory, local control, New Basics, and less than New Basics (listed in order from top to bottom according to the y-intercept).

Figure 4.1
Probability of High School Completion by SES and Graduation Requirement Policy



The graph shows a couple of important findings in this analysis. First, the intercepts for completion by state graduation requirements are fairly close together suggesting the probability of low SES students completing high school varies from approximately 0.79 in New Basics states (the lowest line on the graph) to 0.85 in local control states (the highest line on the graph). In most cases, the slopes appear to be consistent, meaning no difference by state graduation requirement policy. However, the

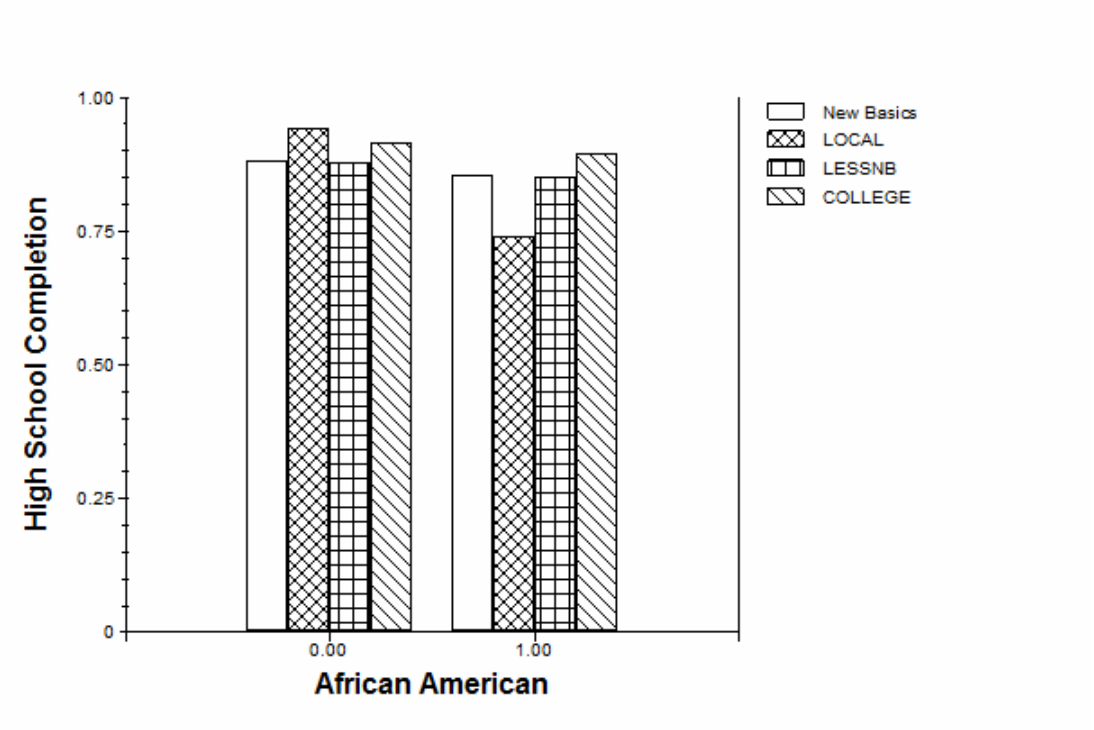
figure demonstrates that SES functions differently in local control states.[26] The probability of high school completion among low SES students (intercepts) in local control states is similar to college preparatory states; however, the slope increases in local control states as SES increases while it appears to level out in college preparatory states. From an equity perspective, maintaining local control may have a modest effect of widening the gap in the probability of high school completion between low income and high SES students in a given state. The fact that the probability of high school completion is less equitably distributed in local control states is interesting in light of the fact that the overall probability of completion in those states is higher than all others (see Table 4.9). This may mean that while all students in local control states are more likely to complete high school, the differences between low income and high income students is greater than in states that have set some level of high school graduation requirements for all students.

The second relationship is equally interesting and operates in a similar direction. From the descriptive analysis, fewer African American students complete high school than their White or Asian counterparts, however, as other factors are controlled, the relationship is not significant. Even so, one can imagine that each state exhibits a different relationship between race and completing high school, and the random effects for African American students suggest that the amount of variation in these slopes is significant. Figure 4.2 shows that living in a local control state is a significant and negative predictor, meaning African American students are less likely to complete high

[26] The graph in Figure 4.1 also suggests a difference between Local Control and College Preparatory policies, but that contrast was not tested in the analysis.

school than their White and Asian peers in local control states – that same relationship does not exist in other state contexts.

Figure 4.2
Probability of High School Completion by Race/Ethnicity and State Graduation Requirement Policy

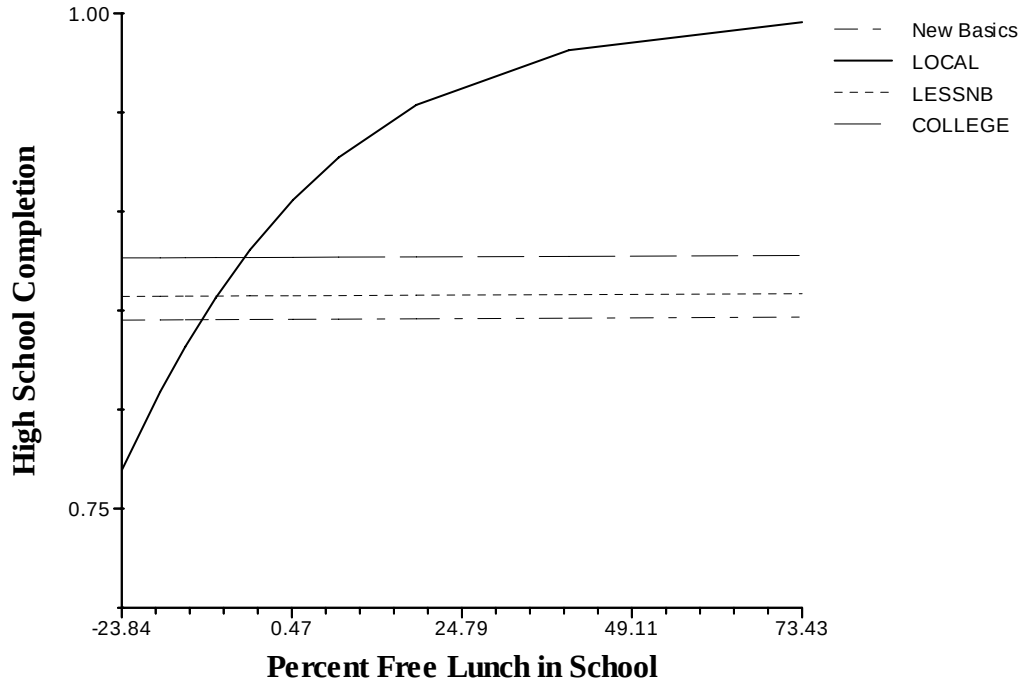


The graph above shows very clearly that while the probability of completion is almost identical for African American and White/Asian students in most state policy environments, there is a considerable gap in Local Control states. Assuming the average slope is 0 because the coefficient is not significant, living in a local control state yields a reduced likelihood of high school completion for African American students relative to White and Asian students as compared to New Basics standard states. The importance of the relationship suggests that while there may be no significant differences by race in terms of the overall probability of completing high school, the probability of completion declines for African American students in local control states, which suggests an equity problem similar to the one discussed relative to SES.

In both cases, it is important to examine the fixed effects of local control on the overall probabilities of completing high school and the separate effects of local control on the slopes as outcomes analyses. First, it is important to be clear that students in local control states overall, are more likely to complete high school. That is an important, positive finding, which is consistent with prior research in this area. Second, while the gaps may be greater by racial group or by SES, local control may still have a positive effect on those groups relative to other state policy contexts; it might simply have a stronger effect on high SES than low SES and on White and Asian students relative to African American Students. One way to examine this complex finding would be to run separate analyses for the groups. Unfortunately, given the importance of the number of cases in three level HLM models, there are not enough cases to produce reliable sub group estimates, with the possible exception of White students.

The findings regarding state policy and its influence on the probability of completing high school is instructive but it may mask as much as it reveals. Two relationships are instructive. Figure 4.3 provides a graphical depiction of the relationship between the percent free or reduced lunch in a school and the probability of high school completion by state graduation requirement policy. The lines represent the probability of high school completion by the percent free or reduced lunch eligible students in a school (scaled to the state mean) and along the y-axis they are listed in order from the lowest intercept to the highest – local control, less than New Basics, New Basics, and college preparatory.

Figure 4.3
Probability of High School Completion by Percent Free Lunch and State Graduation Requirement Policy



According to the analysis reported in Table A-4.9, the effects of the percent free lunch varies randomly by school, but the graduation requirement policy was not a significant predictor of that variation. However, Figure 4.3 suggests that the percent free lunch in a school may matter in Local Control states in ways that are not detected in the analysis (the upward sloping line in Figure 4.3). The graph shows that students attending schools where the percent free lunch is much lower than the mean of schools in a given state are less likely to finish high school than students attending similar schools in other states. As the percentage increases above the mean of schools in a state, the likelihood of completing high school in four years exceeds the probabilities in other states. More

research is necessary to understand the implications of this non-finding relative to the graphical depiction. A similarly challenging non-finding is illustrated in Figure 4.4.

Figure 4.4
Probability of High School Completion by Percent Free Lunch and Mandatory Exit Exam Policy

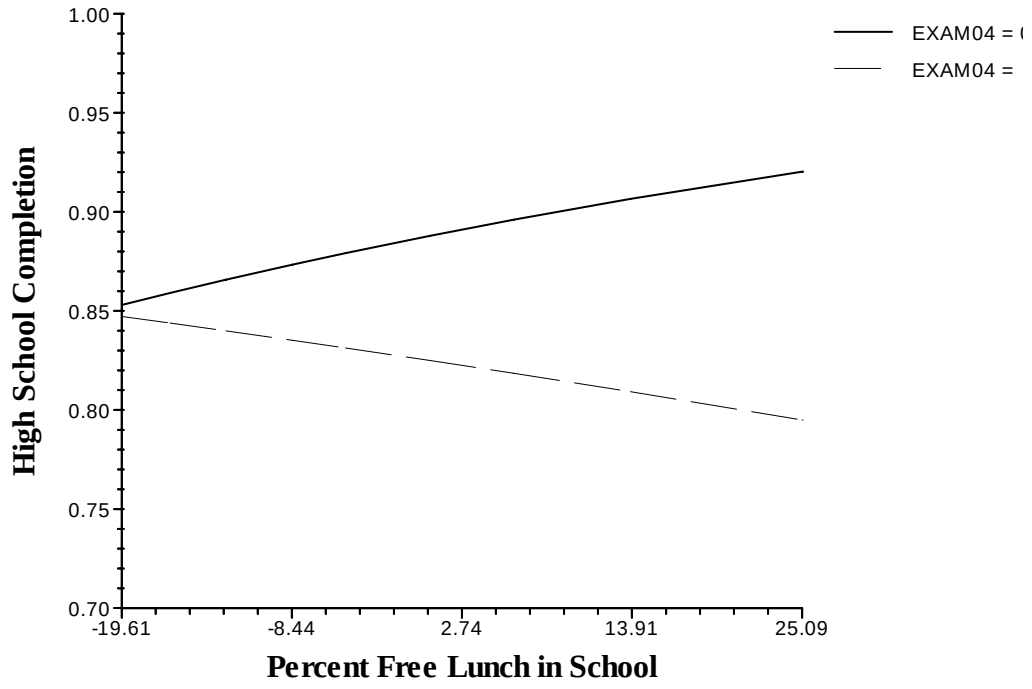
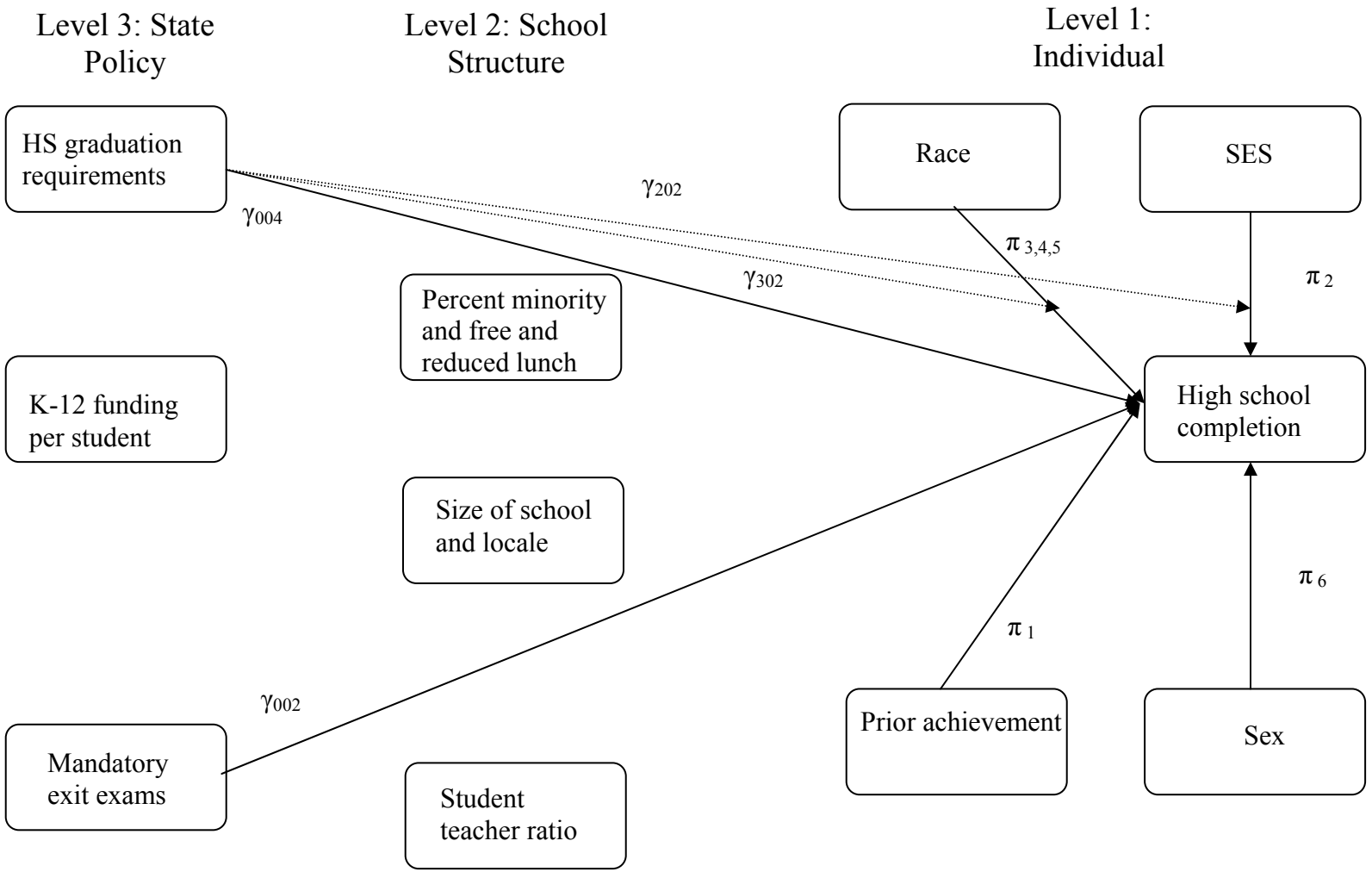


Figure 4.4 shows the relationship identified between the presence of a mandatory exit exam and high school completion. The exit exam was not a significant predictor in the slopes as outcomes model for free or reduced lunch but the graph suggests that in states where a mandatory exit exam is present, a negative relationship exists between the percent free lunch and the probability of students completing high school and the opposite is true in non-exit exam states. Both of these non-findings are important to consider more fully and suggest that the relationships may be more complex than the statistical analyses may indicate.

Figure 4.5 provides a visual depiction of the significant relationships observed in the final high school completion model. As summarized earlier, the solid arrows indicate a direct fixed effect associated with the relationship between the predictor and high school completion. The dotted arrows reflect significant direct effects predicting the slopes of relationships at level 1.

Figure 4.5
Final Framework Identifying Significant Relationships, High School Completion Model



Chapter 5

Course Taking Among High School Completers

The second set of analyses examines the relationship between the number of courses students complete in the core academic subjects and the explanatory variables presented in Figure 2.2. Course taking is conditional upon completing high school because students that do not finish high school will, by definition, complete fewer courses. The analyses in this chapter focus only on public school students in ELS that completed high school in a manner consistent with the definition utilized for chapter 4 – any student that had completed a high school diploma by the summer following their fourth year in school.[27] For that reason, the results are generalizable only to this subset of high school students. It should be recognized that by limiting the sample to high school completers, the analyses does not suggest that the policies do not influence the course taking patterns of non-high school completers. However, it is anticipated that the policy influence for this group will be picked up in the prior set of analyses for high school completion. Table 5.1 provides a description of the sample of students weighted to be representative of the public high school seniors in 2004.

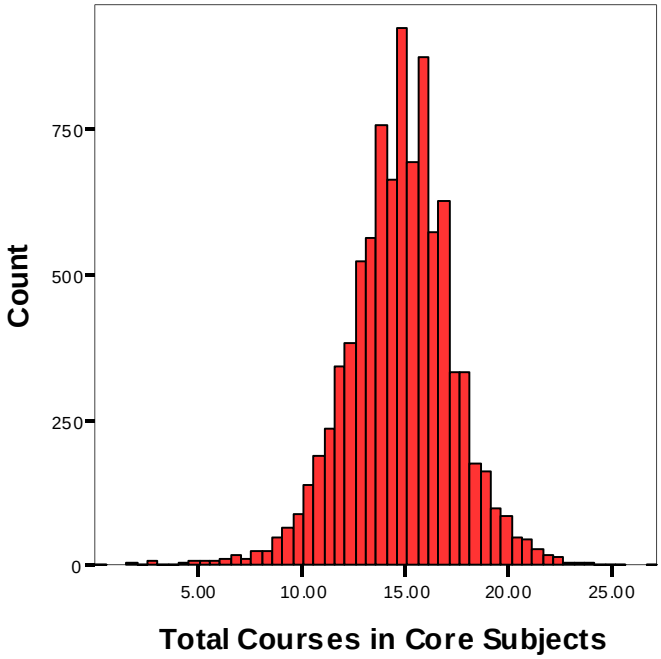
[27] See the methodology in Chapter 2 for more details regarding how high school completion was defined.

Table 5.1
Descriptive Statistics for All Public School Completers, Course Taking Model

Individual Level Variables	(N=9,177)	Percent
Core Academic Course Taking		
Less than 12 credits	930	10.1
12 to 16 credits	4,866	53.0
More than 16 credits	3,381	36.9
Sex		
Female	4,720	51.4
Male	4,458	48.6
Race/Ethnicity		
Black	1,222	13.3
Hispanic	1,365	14.9
Asian	386	4.2
White	5,739	62.5
Other	466	5.1
Parents Socio-Economic Status Composite		
Lowest Quartile	2,087	22.7
Middle 50%	4,755	51.8
Highest Quartile	2,335	25.4
Prior Achievement		
Lowest Quartile	1,841	20.1
Middle 50%	4,587	50.0
Highest Quartile	2,556	27.8
Missing	194	2.1

Table 5.1 demonstrates that 10% of public high school graduates complete fewer than 12 courses in the core academic subjects – math, science, social studies, and English. The cut scores were selected as the closest whole number of courses to the 25th and 75th percentiles for the entire sample of students, so the distribution reflected in the cross-tabulation is not indicative of the distribution on the continuous outcome. Figure 5.1 is a histogram of the distribution of courses completed in the core subjects for all public high school completers only. As discussed in chapter 3, the outcome is essentially normal with a range from 0 to 27.5 and a mean of 14.87. Consistent with the prior set of analyses demonstrating that men are less likely to finish high school in four years, the sample for public school completers has a higher proportion of women (51% to 48%).

Figure 5.1
Distribution of Course Taking in the Core Subjects



The cross-tabulations in Table A-5.2 provide a picture of the relationship among the explanatory variables at each of the three levels of analysis and the number of courses students complete in the core academic subjects. The table shows that a much larger percentage of students complete 16 or more courses in the core subjects in states with either New Basics or College Preparatory high school graduation requirement standards relative to Less than New Basics and local control states. The lowest percentage of students completing 16 or more credits was found in states with graduation requirements set somewhere less than the New Basics standard. Local control states were interesting because while a much larger percentage of students completed fewer than 12 credits, they also had nearly 40% of their students completing more than 16 courses in the core subjects – substantially higher than states with the Less than New Basics Standard. In terms of state policy, it also appears that public high school completers in mandatory exit exam states earned fewer credits in the core subjects relative to their non-exit exam state peers.

At the school level, the descriptive analysis indicates that school size may matter, particularly for smaller schools. A higher percentage of students attending schools of 800 students or less completed 16 or more credits in the core subjects than those in mid-sized schools. Large schools (over 2000) graduated fewer students with 12 credits or less in the core subjects than mid-sized schools. Similarly, very few students attending schools with student to teacher ratios below 15:1 completed 12 or fewer courses in the core subjects. Conversely, a greater percentage of students in low student/teacher ratios schools took 16 or more courses than students in higher ratio schools. Simply put, students appear to complete more courses in the core subjects as the student teacher ratio

declines. Rural schools had a higher percentage of students completing 16 or more credits than either suburban or urban schools and the differences by percent minority and percent free or reduced lunch were negligible. In terms of individual differences, women completed more core courses on average than men; in terms of race/ethnicity, Asian American students lead the way, with White and Black students demonstrating similar patterns and Hispanic students completing fewer courses in the core subjects. Increases in both SES and prior achievement show increased course taking in the core academic subjects.

Table 5.3 presents the fully unconditional model (FUM) for course taking among public high school completers, provides a baseline for comparing conditioned models, and demonstrates that the majority of variance is attributable to level 1 at nearly 74% and 8.7% of the variance can be explained at the state level. The ICC for between state variance is 0.087 or the proportion of variation at level 3 and the ICC for between school variation is 0.26 or the proportion of the total variation at levels 2 and 3 combined. The deviance reported in the lower portion of the table, combined with the number of parameters provides the basis for calculating a likelihood ratio χ^2 test identifying whether the reduction in deviance is significantly different than 0, suggesting that the revised model has a significantly improved fit relative to the prior model.

Table 5.3
Fully Unconditional Model for High School Completion in ELS: 2002-04

Fixed Effect	Coef.	SE	t-Ratio
Average school mean	14.79	0.142	103.87

Random Effect	Variance Component	df	χ^2	p Value
Students (level 1), e_{ijk}	4.06			
Schools (level 2), r_{0jk}	0.946	441	1978.75	0.000
States (level 3), u_{00k}	0.481	42	214.69	0.000

Variance Decomposition (Percentage by Level)			
Level 1	73.9	Deviance	32953.04
Level 2	17.2	Parameters	4
Level 3	8.7		

The random effects at levels 2 and 3 demonstrate that there is significant variation to be explained at the school and state levels. When the likelihood ratio χ^2 test is not significant, the random effects are not significantly different than 0 and as such, there would be no variance to explain at that level. Knowing the random effects for level 2 and 3 are significant, the variance components serve as approximations for initial variance and subsequent improvements serve as R^2 measures for the respective levels. Table 5.4 extends the analysis by conditioning the model at level 1 and adding random effects for the slopes associated with race and class. Because race and class in this analysis are centered around the group means (schools), slopes reflect within school differences, and subsequent modeling of slopes as outcomes reflects how policy effects the equitable distribution of courses within schools.

Table 5.4
Three Level High School Course Taking Model Conditional at Level 1

Fixed Effect			Coef.	SE	t-Ratio	Sig.
Level 1 Individual						
Average school mean π_{000}			15.08	0.158	95.08	***
Prior Achievement π_{100}			0.073	0.005	13.75	***
SES π_{200}			0.220	0.091	2.44	**
African American π_{300}			0.058	0.193	0.301	
Hispanic π_{400}			-0.465	0.448	-1.038	
Other Race π_{500}			-0.132	0.173	-0.758	
Male π_{600}			-0.484	0.067	-7.248	***
Random Effect	Reliability	Var. Comp	Df	χ^2	p Value	Sig.
Students (level 1), e_{ijk}		3.42				
Schools (level 2), r_{0jk}		1.005	416	2135.17	0.001	***
States (level 3), u_{00k}	0.807	0.569	31	166.87	0.001	***
SES u_{20k}	0.724	0.155	31	118.23	0.001	***
African American u_{30k}	0.519	0.398	31	66.55	0.001	***
Hispanic u_{40k}	0.733	2.150	31	99.77	0.001	***
			Deviance		31,883.89	
			Δ Deviance		1,069.14	***
			Parameters		19	

~ (p<0.1), * (p<0.05), ** (p<0.01), ***(p<0.001)

In Table 5.4, the model is conditional at level 1 and remains unconditional at levels 2 and 3. The random effects for race and class provide a baseline of comparison for the conditioned versions of the model. Random effects have been added to test whether the influences of race and class vary within schools. The level 1 model is a

significant improvement over the null model with a change in deviance of 1,069 (19 parameters, $p<0.001$) and those four explanatory variables account for approximately 15.8% of the variation in the level 1 intercept (comparing the student level variance component in Table 5.3 to the remaining portion in Table 5.4). Results indicate that the slopes for race and SES by course taking within schools vary randomly by states and the variance components provide an initial comparison for conditional models. All three random effects associated with the equity relationships are significant, suggesting that state level policies and characteristics may influence the equitable distribution of course taking in the core subjects by SES and race/ethnicity within schools.

The fixed effects coefficients indicate that among all public high school completers, the average number of credits earned in the core academic subjects is 15.27. Male students complete nearly one half course less than female students. Students that score 10 points higher than the mean on the math achievement test complete nearly 75% of an additional course more than students at the school mean.[28] Similarly, a standard deviation increase in a students' composite SES relates to an additional 0.206 courses more completed in the core subjects above the school mean.[29] The descriptive analysis suggest that Hispanic students may complete fewer courses than other students, but after controlling for sex, SES and prior achievement in the multi-level model, the differences are no longer significant. However, there appears to be a more important story to

[28] The coefficient for student achievement is 0.073, meaning that a one-point increase on the math achievement test above the school mean results in 0.073 more courses in the core subjects. A 10-point increase above the mean results in students completing on average 0.73 or about ¾ more core courses than a student at the mean of achievement.

[29] SES is standardized meaning that a standard deviation increase in SES above the mean is related to taking 0.206 more core courses than students from families with mean SES.

consider when the effects of race and SES are allowed to vary randomly by state, which will be explored in greater detail in the final step of the model.

The next step in the analysis conditions the model at level 2 with existing level 1 controls in place and introduces random effects at level 3 associated with the equity relationships for school characteristics – free or reduced lunch and percent minority. The deviance statistic testing whether conditioning the model at level 2 provides an improvement over the previous model indicates that the improvement is significantly different than 0. Similarly, a comparison of school level variance components in Tables 5.4 and Table A-5.5 indicates that conditions imposed at level 2 explain approximately 15.1% of the level 2 variance.

Introducing level 2 predictors into the analysis provides a significant improvement to the model, but in relative terms reflects a far less substantial change in deviance than was captured in the level 1 analysis. Table A-5.5 also illustrates that all five equity slopes vary randomly between states (the random effect associated with percent free lunch is only marginally significant). For example, the relationship between the percent of minorities enrolled in school and the average number of core courses completed by students in school *j* varies by state *k*. None of the school characteristics were significant predictors of the number of core courses taken in this analysis.

Table A-5.6 summarizes the final, fully conditioned model at all three levels, including fixed effects tested in the slopes as outcomes analyses. Tables 5.3 through A-5.6 provide a complete summary analysis of the relationships between the courses students complete in high school and the range of factors introduced at each level. The models are nested and as such, the results build from one table to the next, where Table

5.3 provides the null model for Table 5.4, which is in turn, the null model for Table A-5.5 and so on. There are two ways to compare models from one level to the next. The first is to assess the change in deviance with a likelihood ratio χ^2 test. Comparing the change in deviance from Table A-5.5 where level 3 is unconditional and Table A-5.6 which is fully conditioned shows that a change in deviance of 25.67 with 58 parameters is significant at the $p<0.01$ level.

Table A-5.5 indicates a state level variance component of 0.741 and in the final model, the remaining variance to be explained at level 3 is 0.288, meaning that the level 3 factors added to the model reduce the variance at the state level by nearly 73%. Both of these measures suggest that the addition of level 3 variables improve the model. Similar to Chapter 4 and in an effort to streamline the results for course taking among public high school completers, I will discuss the findings in three broad sections – random effects, fixed effects attributable to explaining variance in the intercepts, and fixed effects associated with slopes as outcomes.

Random Effects, Slopes as Outcomes

In this analysis, I have introduced random effects, testing whether the school slopes for race, SES, percent minority, and percent free or reduced lunch vary randomly by state. Table A-5.5 demonstrates that 4 of 5 relationships were significant ($p<0.001$) and the final relationship (percent free or reduced lunch) was marginally significant ($p<0.06$). All five random effects were maintained as proxies for equity and three state level policies were included as fixed effects explaining variation in the slopes of the identified relationships – the college preparatory graduation requirements, tuition, and the

need-based aid per FTE student. The results are reported in Table A-5.6 and discussed in greater detail below.

Similar to the intercepts as outcomes model, the random effects associated with the unconditional model serve as a baseline for comparison and the change in the variance components associated with the addition of explanatory variables suggests how much of the variation in the slopes is attributable to the state policies identified above. Table 5.7 summarizes the changes associated with the final conditional model.

Table 5.7
Percent Variation Explained by Level, High School Course Taking Model

	Initial Variance	Final Variance	Δ Variance	% Variance Explained
Free Lunch	0.001	0.0006	0.0004	40.0%
Percent Minority	0.0008	0.0001	0.0007	87.5%
Socio-economic Status	0.157	0.136	0.035	22.3%
African American	0.485	0.430	0.171	37.3%
Hispanic	2.136	1.43	0.617	28.8%

In all five cases, the analysis suggests that a substantial amount of variation in the slopes is associated with state policies regarding high school graduation requirements, public university tuition levels, and the relative amount of need-based aid available in a given state. It is also clear that individual level factors share a greater proportion of variance, consistent with the random variation in the intercepts discussed earlier. In this analysis, nearly 75% of the variation is attributable to the individual level. Two measures approximate socio-economic status (SES at level 1 and Percent Free or Reduced Lunch at level 2) and state policy appears to explain a substantial amount of variation in the slopes for each (22.3% at level 1 and 40% at level 2). Similarly with respect to race/ethnicity, state policy explains between 28.8% (Hispanic) and 37.3% (African American) of the

variation in the slopes. More than 85% of the variation in the slope for percent minority and the number of courses completed in the core subjects is explained by state policy as well. The final model also shows that even with the variation already explained, the remaining variance components continue to be significant suggesting there remain state level characteristics that may influence the number of courses students complete in the core academic subjects.

Fixed Effects, Intercepts as Outcomes

At level 1, the relationships remain essentially the same as reported in the earlier stages of the analysis. Simply, high SES female students, particularly those scoring higher on the math achievement test in 10th grade, complete the highest number of courses in the core academic subjects among those that complete high school. Chapter 4 also showed that the same group has among the highest probability of completing high school. These differences are real and need to be considered in greater detail. Hispanic students complete a half a course less on average, than their White and Asian peers. At level 2, students attending rural schools enjoy a modest advantage over suburban schools, controlling for other factors, where rural students complete as much at ¼ of a core academic course more than other students. This may be a function of the fact that rural schools frequently are not as large and as such must make choices to limit the curriculum offerings in order to maintain its cost.

The most important set of findings for this analysis pertain to the state level policies included as explanatory variables. The state level analysis for the number of courses completed in the core subjects provides a direct test of the constrained curriculum hypothesis as it is applied at the state level. For the sample of all public high school

completers, the effects of both Local Control and Less than New Basics high school graduation requirement policy were negative and significantly different than the New Basics standard advocated as part of *A Nation at Risk*. The College Preparatory standard was approaching significance but is not significantly different than the New Basics standard. Students in both the local control states and states adopting something less than the New Basics standard complete a full course less than New Basics students, holding all other factors constant.

Fixed Effects, Slopes as Outcomes

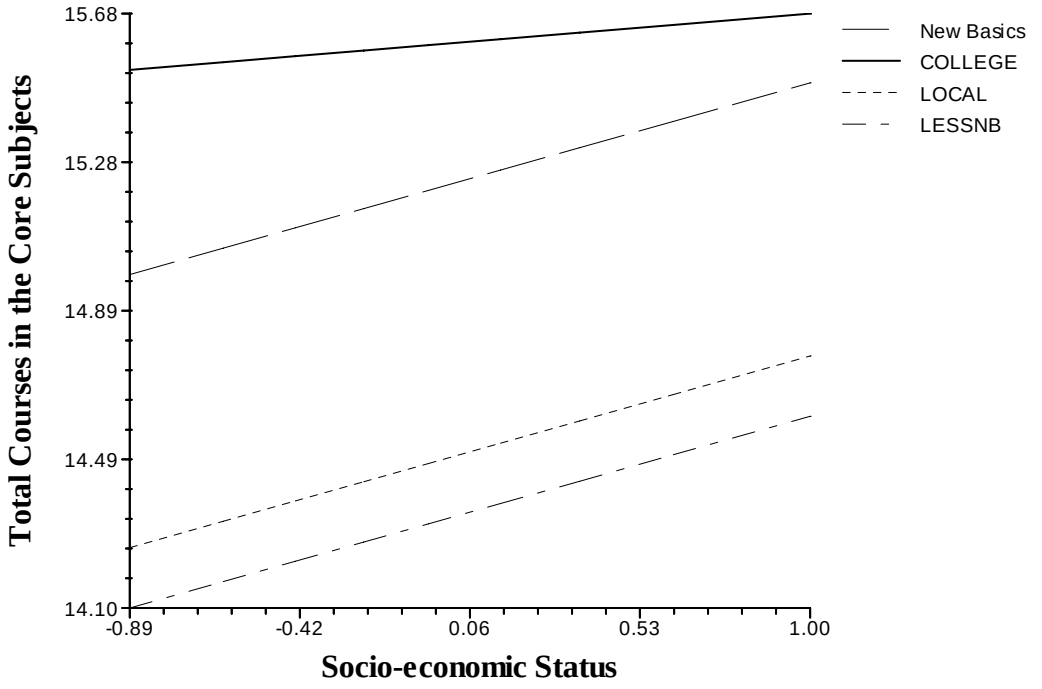
In addition to considering whether relationships vary randomly between schools (level 1 predictors) or between states (level 2 predictors), it is important to consider whether overall, student outcomes are affected by state policy, but it is equally important to know whether these policies influence the equitable distribution of those outcomes and modeling the variation in slopes provides an opportunity to consider whether equity has been impacted. Similar to chapter 4 where the slope of the equity related relationships were modeled with state policies as explanatory variables, the same has been done here. Consistent with the analysis in Chapter 4, level 1 continuous predictors have been group mean centered, meaning that individual values are scaled according to their respective school means, and level 2 continuous predictors have been group mean centered relative to the means within their respective states. These centering options allow for a consideration of whether state policy influences the equitable distribution of courses taken within schools by race and class or within states by percent minority enrollment and percent free or reduced lunch.

The analysis includes two measures which approximate the influence of social class on course taking – SES at the individual level and percent free or reduced lunch at the school level. The findings here are mixed. None of the three policies (graduation requirement policy, tuition, or need aid as a proportion of cost) affect the relationship between SES and the number of core courses completed by public high school graduates. From an equity perspective then, adopting a college preparatory standard does not affect the equitable distribution of courses completed, meaning the gaps between low and high income students is similar whether they are in a college prep state or a local control state relative to a New Basics state; a finding which is consistent with Lee, Croninger, and Smith (1997). Public tuition and the presence of need aid as proxies for the signals sent to students about the cost of college are also not related to the relationships between SES and course taking meaning that similar gaps in course taking exist whether the state has high or low tuition or whether they maintain a strong commitment to need aid or contribute very little to it. However, Figure 5.2 suggests that further investigation may be warranted.

First, the graph clearly demonstrates the differences described in the intercepts as outcomes model showing that there are differences in the mean number of courses completed depending upon the graduation requirement policy in the state. The College Preparatory standard has the highest intercept at nearly 15.5 courses per student, followed by the New Basics standard (referent), Local Control, and Less than New Basics (the order in which they appear on the graph from the highest y-intercept to the lowest). This graph also suggest that while the College Preparatory slope was not significantly different from the New Basics, it is suggestive that the differences between mid-SES students and

high-SES students in College Preparatory states is smaller than other state policy contexts.

Figure 5.2
High School Course Taking by SES and State Graduation Requirement Policy, Public School Completers



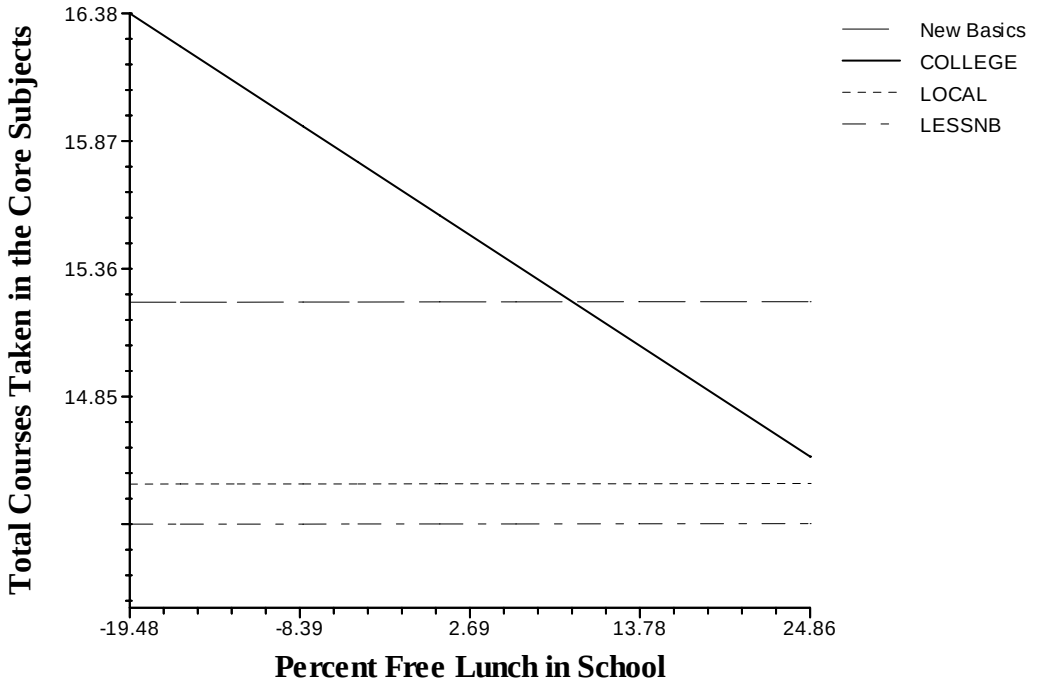
The findings are slightly different for the percentage of students qualifying for free or reduced lunch. In this case, the adoption of a college preparatory standard for high school graduation is negatively related to the slope for percent free lunch. In this analysis, the percent free lunch is not associated with the intercept, meaning there is no relationship between the percent of low income students in a school and the number of core courses they complete – effectively a mean slope of 0. Figure 5.3 provides an illustration of the relationships between state graduation requirements and the percent free lunch slope. Note that the intercepts differ in the same ways described in Figure 5.2

and that the slopes for New Basics, Local Control, and Less than New Basics all appear to be zero, meaning there is no difference in course taking by percent free lunch in those states.[30]

The negative association between the college prep standard and the free lunch slope suggests that states that adopt a college preparatory standard demonstrate a negative relationship between percent free lunch and course taking relative to non-college prep states that demonstrate no relationship. In equity terms, there appear to little difference between students attending school in local or less than New Basics states. Students in New Basics states complete more courses than students in the other two states contexts, but all three demonstrate similar slopes by percent free or reduced lunch. Students in college preparatory states appear to complete significantly more courses in the core subjects on average, but as the percentage of students qualifying for free or reduced lunch increases, the number of courses students complete declines considerably This is interesting given that the effects of SES at the local level appeared to be moderated by the college preparatory policy; SES at the school level may actually exacerbate differences within states.

[30] The Less than New Basics line is not discernable on the graph because it overlaps the x-axis.

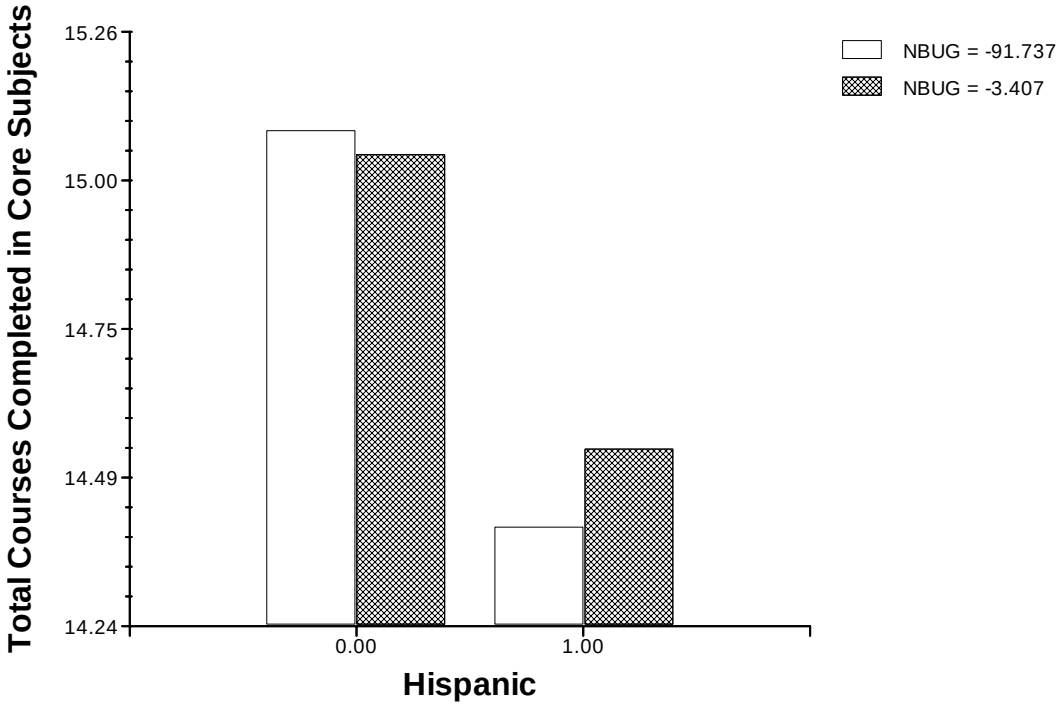
Figure 5.3
High School Course Taking by Percent Free Lunch and State Graduation Requirement Policy, Public School Completers



Race is also an important consideration relative to equity and the descriptive analyses presented earlier underscore that point. In terms of the effects of state policy on the relationships between race and course taking, the results are mixed. At the individual level, I consider African American students and Hispanic students separately at level 1, recognizing their experiences in American schooling may differ for a number of reasons, some of which may be addressed at the state policy level. For African American students, none of the three policies were associated with the slopes, suggesting they did nothing to improve or detract from the equitable distribution of the number of courses completed by public school graduates. Hispanic students, however, appear to be

influenced by college cost. Figure 5.4 illustrates the interaction between tuition and identifying as Hispanic.[31]

Figure 5.4
Hispanic Course Taking by Need-Based Aid, Public School Completers

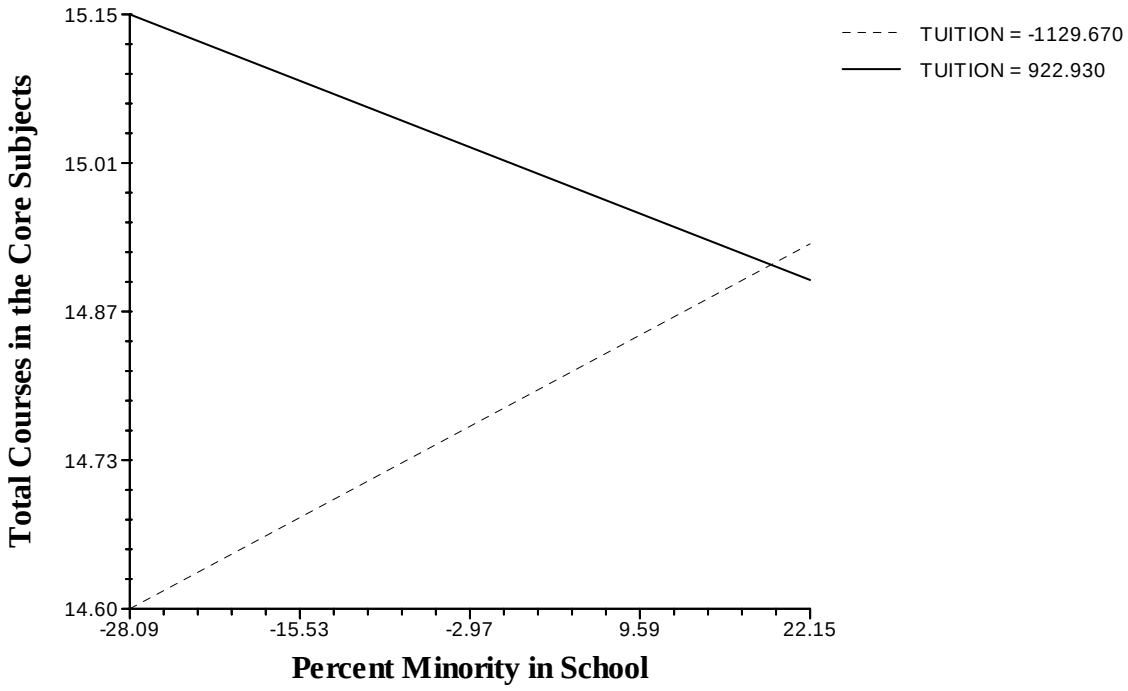


According to Table A-5.6, the slopes for Hispanic students within schools were not influenced by the graduation requirement policies, but the difference in slopes was related to the availability of need-based aid (when need-based aid is measured at the 25th and 75th percentiles). Hispanic students differ marginally from White and Asian students in terms of the average number of courses completed in the core subjected when other factors were controlled – consistent with the findings discussed in the intercepts as outcomes section above. Need-based aid was positively related to the slope for Hispanic

[31] NBUG is equivalent to Need-Based Undergraduate Aid and it is scaled according to the mean for all students. The mean is skewed because California has the highest number of students in the sample and it offers the highest amount of need-based aid to students.

students indicating that as need-based aid rises in a given state, Hispanic students complete more courses in the core subjects. Need-based aid is centered around the grand mean, suggesting that Hispanic students in high need aid states will complete more courses in the core subjects, holding other factors constant, effectively improving equity. However, as Figure 5.4 also suggests, even in high need aid states, Hispanic students complete fewer of the core courses, controlling for other factors. The policy may moderate some of the differences for Hispanic students, but the gaps remain significant. The percent minority slope tells a slightly different story as Figure 5.5 illustrates.[32]

Figure 5.5
Course Taking Percent Minority Enrollment and State Tuition, Public School Completers



Initially, percent minority in a school is not significantly related to the number of courses students complete in the core subjects for schools near the state mean – 0 on the

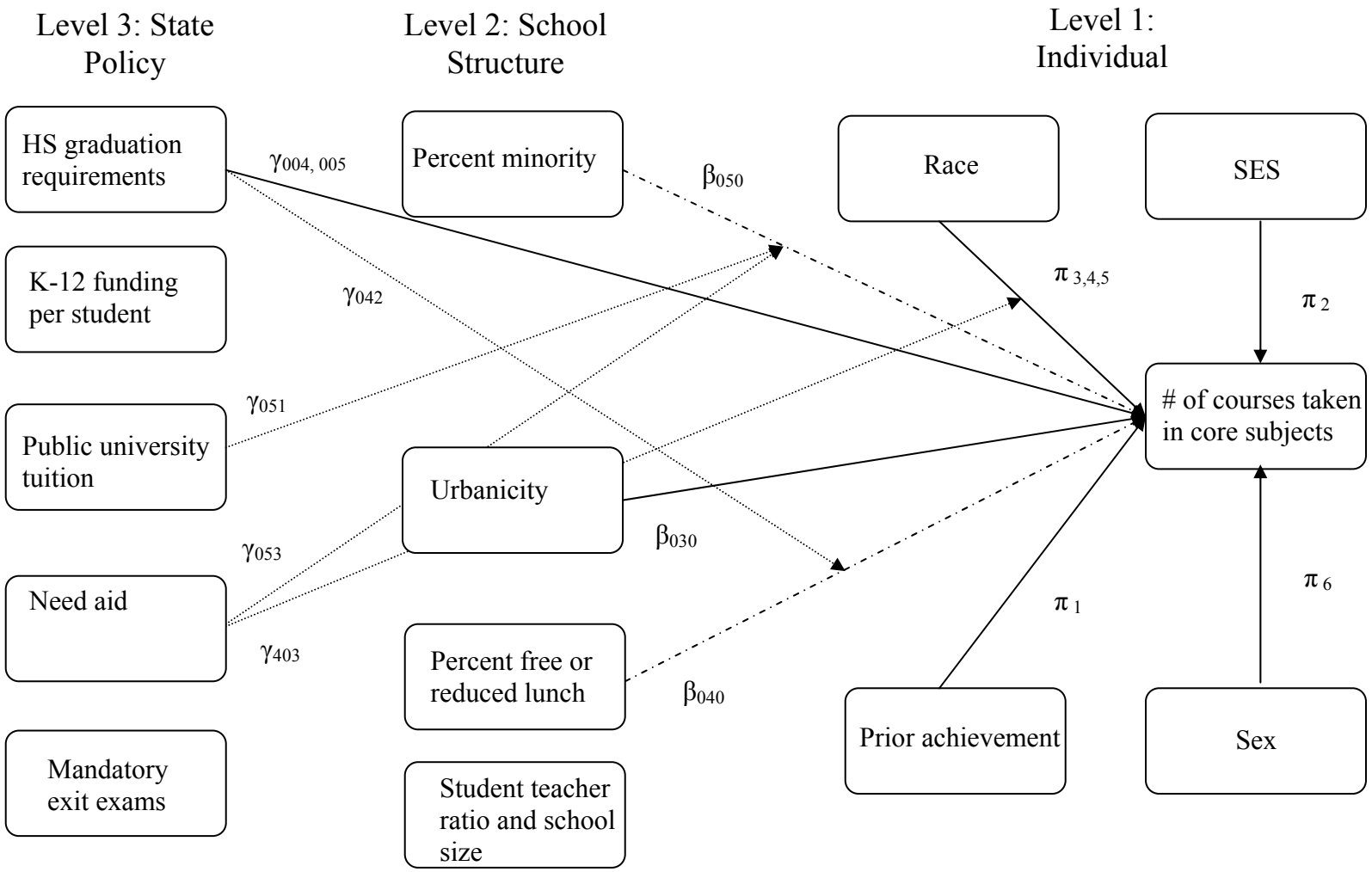
[32] Tuition is reported in Figure 5.5 as the average cost above or below the mean corresponding to the 25th and the 75th percentiles.

x-axis which is near the intersection of the two lines in Figure 5.5. However, the slopes vary randomly with a mean of 0 and low tuition (and the availability of need-based aid not pictured in this graph) is positively related to the slope. Given that need-based aid is grand mean centered, when tuition is equal to the mean, the percent minority has no effect on the number of courses students complete. However, as tuition rises the slope decreases. A negative slope means that as the percent minority enrolled in a school increases, the number of courses completed in the core subjects declines in high tuition states. In practical terms, students attending highly segregated minority schools in states like Michigan, where tuition is high, complete fewer courses on average, than students in mostly White schools, irrespective of the graduation requirement policy. Conversely, in low tuition states, the percent minority slope increases, meaning that students in high minority concentration schools complete more courses than the school mean. The graph for the presence of need-based aid demonstrates an identical set of relationships where the presence of high need aid per student appears to have a positive influence on student course taking in high minority enrollment schools.

These findings are important to view with a bit of caution. In this study, I hypothesized tuition and need aid as two signals to students regarding their ability to afford college. This finding provides evidence to suggest that there is a relationship between the cost of college and how well high school completers prepare for college through the courses they take. It may indicate that in relative terms, high need aid may mediate some of the gap between students in low and high minority concentration schools.

Figure 5.6 provides a schematic depiction of the significant relationships in the high school course taking model. Solid arrows indicate significant direct effects and each is labeled with the corresponding Greek letters from Table A-5.6. Dotted arrows indicate fixed effects in the slopes as outcomes models and dashed arrows indicate non-significant relationships that were included because the random effects were significant and state level predictors were significant in the slopes as outcomes models.

Figure 5.6
Final Framework Identifying Signifcant Relationships, Student Course Taking in the Core Academic Subjects



Chapter 6

Conclusion and Implications

This study addresses one central question – does state policy influence individual educational outcomes pertinent to college access? In an effort to operationalize this question, I posed two sub-questions, one for each outcome under investigation: high school completion and the number of courses completed in the core subjects. Those questions are as follows:

1. Are graduation requirements policies, exit exams, and K-12 funding related to students' completion of high school among public school students?
2. For those that finish high school, are graduation requirements, exit exams, K-12 funding, average public tuition, and need-based aid related to how well students prepare for college as measured by the number of courses completed in the core academic subjects?

In this chapter, I review the methodological approach utilized in the study, summarize the findings relative to each question, and explore implications for researchers and policy makers. The study focuses on the relationship between graduation policies and the courses students complete, but it is essential to begin by examining the relationship between the policy and high school completion – if students do not complete high school, their pathway to college is considerably more difficult.

High schools have been designed to move students through to the completion of a diploma. Some of that can be traced to the early 20th century and movements to curb child labor and to keep kids off the streets. It is also an artifact of a comprehensive high school intended to be all things to all students. For much of the 20th century, the high school diploma was the standard credential for gaining entry into the workforce. High school was either a place to prepare for the world of work or it was going to prepare students for the rigors of college. Lee, Croninger, and Smith (1997) do not address the question of high school completion because their sample is limited to high school graduates. Teitelbaum (2003) suggests that the question has been settled in prior research and increasing high school requirements does not affect high school completion. St. John and Musoba (2006) found there was a relationship between math course requirements and high school completion so clearly the question has not yet been settled. This study shows that the state context is very important relative to high school completion and that more rigorous graduation requirements are negatively related to the probability of completing high school in four years.

This study next examines the relationship between state graduation requirement policies and the number of courses completed in those subjects among high school completers, effectively extending the constraint curriculum hypothesis (Lee et al., 1997) in two ways: (1) by adding the state level to the analysis and (2) by examining the intermediate outcome of the number of courses students complete in the core academic subjects of math, science, social studies, and English. Frequently, research in this area focuses on the relationship between graduation requirement policies and student

achievement but the policy is designed to influence the number of courses students complete and then, by extension, their achievement in those subjects.

Methods

This study makes four important methodological contributions to our understanding of the relationship between state policies and student outcomes. First, I utilize 3-level hierarchical linear modeling (HLM), which provides a robust approach for conducting multi-level analyses on data with complex sampling designs. HLM allows researchers to account for the fact that in much of the education research conducted today, individuals are never truly independent because they are organized into classes and schools and those schools operate in common state policy contexts. Single level models assume independence and as such have a tendency to overestimate findings of significance at upper levels (level 2 and 3 in this analysis) due to artificially low standard errors (SE) associated with those variables. HLM accounts for this problem and allows for more reliable parameter estimates.

Perhaps more important however, is that HLM also allows for researchers to consider how much variation is attributable to each level of analysis, which can provide some sense of the size of the effects. The fully unconditional model described earlier in the text, provides a method by which to assess what proportion of variation is attributable to each level of the analysis. In the high school completion model, nearly a third of the variance is at the state level; in terms of course taking, state level variation accounts for slightly less than 9% of the total variance. This is an important distinction because a significant finding in course taking model may account for more variation at level 3 but comparatively less overall variation than the same policy in the high school completion

model because of the differences in the amount of variation found at the state level of each analysis.

Lee et al. (1997), and others (Hoffer, 1997; Chaney, Burgdorf, and Atash, 1997; Hoffer, 1997; Tietelbaum, 2003; Musoba, 2004) have all employed HLM to explore the relationships between practices to constrain the academic curriculum and student outcomes. Each of these studies examines student outcomes from a two level perspective where students are nested within schools, with the exception of Musoba (2004) who looked at SAT scores for students nested within states. In this study I extend this prior work by conceptualizing the problem at three levels – students nested within schools, which are nested within states.

Second, I reconsider the relationship between state policy and high school completion. St. John and Musoba (2006) make an important contribution by examining the relationships between state policies and outcomes aggregated at the state level. They utilize fixed effects models for state data at multiple time points to demonstrate that state policies have an important influence on state level outcomes, including high school completion. Those findings coupled with the fact that the education reform policy context has changed considerably in ten years suggests that the question of whether state policy can influence high school completion may not yet be settled.

Third, I return to the early work of Clune and White (1992) and bring course taking back into the conversation as an outcome of state policy. Chaney, Burgdorf, and Atash (1997) emphasize that the conceptual linkage between state graduation requirements and student achievement is mediated by the courses students take in high school. Stated differently, graduation requirements influence the number of courses

students complete in the core subjects, which then influences their achievement as measured by test scores.

It is important to test this intermediate linkage for two reasons. First, much of the research mentioned above was conducted during the mid-1990s (except the state level study by St. John and Musoba (2006)) and since that time, state education policies have changed in important ways, including more rigorous high school graduation requirements. Second, course taking is the actual lever graduation requirement policies are designed to influence. If students do not complete more courses in the core subjects when the requirements are increased, then the relationship between policy and achievement will either be limited or it will reflect some other characteristic of states.

Fourth, I employ the slopes as outcomes approach utilized by Lee, Croninger, and Smith (1997) to examine whether state policies affect the relationships between race, class, and student outcomes. By examining the variation in slopes for race and class within schools, it is possible to consider if state policies influence the equitable distribution of outcomes. Lee et al. (1997) found that constraining the curriculum at the school level improves achievement and did not increase the gap by SES for achievement on the National Assessment of Educational Progress (NAEP). Similarly, Musoba (2004) found no significant relationships in the slopes as outcomes models examining the relationship between the highest math course taken and SAT test scores. In this study, I found that graduation requirement policies and college cost indicators were predictive in several slopes as outcomes models (as summarized below) meaning that the relationships varied by state and that variation could, in part, be explained by the policies considered in the analyses.

This study focuses on high school graduation requirement policies and it makes an important contribution to our understanding of both student outcomes and the opportunities and limitations of state policy by scaling up the constrained curriculum hypothesis to the state level. Lee et al. (1997) showed that when schools constrain their curriculum to the core academic subjects, students' achievement is higher. Their study examined the problem from a two level perspective – students nested within schools – which may be suggestive to policy makers that states could do the same and achieve similar outcomes, but as mentioned in chapter 3, the belief may be a function of the ecologic fallacy that what occurs at the school should necessarily generalize to state policy. The summary analyses of the impact of state policies on student level education outcomes is presented in two parts, reflecting the two sub-questions indicated above and overall, the findings suggest that constraints at the state may operate in expected ways, but with some unanticipated consequences in terms of the equitable distribution of those outcomes.

Findings on High School Completion

Are graduation requirements policies, exit exams, and K-12 funding related to students' completion of high school? The simple answer is yes, certain state policies are related to high school completion, and those will be discussed in a moment. In the first analysis (chapter 4), I examined high school completion among public school students at three levels: individual, school, and state. The analyses indicated that there are interesting differences at the individual level, particularly by race, sex, SES and prior achievement, as summarized in chapter 4, that warrant some mention, in addition to state level policy. Higher income students and those that enter high school with stronger

preparation measured by test scores are more likely to finish high school in four years. The differences between men and women reflect a more recent trend showing that girls are more likely to finish high school than boys, holding other factors constant. This study was not intended to focus on differences by sex, but the differences are problematic suggesting young boys are falling behind their female peers.

On the issue of race, Black and Hispanic students are less likely to complete high school in four years than White and Asian students. The statistical differences disappear when state level influences are considered, but it should not suggest that the differences are not important; rather it means that some combination of school and state level factors explain that difference. At the school level, both the percent minority enrolled in the school and student to teacher ratios were significant at the school level, which may suggest that segregation of school or the inequitable funding of schools is where the challenge exists.

At the state policy level, there are five important findings to highlight. The first demonstrates that states matter a great deal in terms of high school completion. State differences account for nearly a third of the variation in the probability of completing high school and school funding, state graduation requirement and exit exam policies account for more than 40% of that variation. By comparison, demographic characteristics (sex, SES, race, and prior achievement) accounted for slightly more than 2.5% of the differences between students. In addition to these findings, the following policy relevant outcomes are worth highlighting:

Effects of race and SES differ by state. Consistent with existing literature on student educational outcomes, the findings on high school completion show that high

SES students are more likely to complete high school than the average SES student. Hispanic students are less likely to finish high school than their White and Asian peers. The probability of completion for African American students does not appear to differ from White and Asian students overall, but a gap does exist in local control states, where African American students are less likely to complete high school and their White and Asian peers.

The effects of schools vary randomly within states by race and SES. The only significant school level factor in the high school completion is the ratio of students to teachers in a school. The more surprising finding is that by adding random effects associated with the percent minority and the percent free and reduced lunch, the level 2 model reduces the variance component by more than 50%. Simply put, the random effects associated with differences in school enrollment are important and state policies do not explain why. The fully conditional model indicates that exit exams and local control at the state level do not explain any of the variation in these state slopes. So while it is important to know that this variation is related to the variation across states, this study does not shed any light on what state factors contribute to the differences. If the effects of aggregate race and SES vary, future studies may be able to explore what state characteristics and policies may mediate these effects.

Local control improves high school completion. High school graduation requirement policies are the primary focus of this study and there are differences in the probabilities students will complete high school, depending upon whether students reside in a local control state or not. Living in a local control state nearly doubles the odds a student will complete high school in four years, relative to states adopting a New Basics

standard. The converse then is also true – the odds for completing high school among New Basics students are half of those for students in local control states. This is a particularly important finding relative to Teitelbaum's (2003) claim that the issue had been decided and that high school completion was no longer a concern with respect to graduation requirement policies. This has to be understood in the context of the fact that more than 78% of 10th grade students complete high school within four years of the time they began ninth grade. It is also not a particularly surprising finding. Intuitively, local schools will find ways to ensure that students complete high school in four years. The question I examine in chapter 5 is whether those students are as well prepared academically, in terms of the number of courses they complete in the core academic subjects as students in states with more rigorous graduation requirement policies.

Mandatory exit exams reduce odds of high school completion. Students living in states with mandated exit exams are less likely than students in other states to complete high school on time. The existing research on the influence of exit exams is mixed. Bishop (2002) strongly advocates exit exams and demonstrates a relationship between test scores and mandatory exams. Hanushek and Raymond (2003) found that there is a positive relationship between achievement and mandatory exit exams but only when there are consequences associated. In their analysis, they also suggest that the policy may widen the gaps between Black and White students. And Musoba (2004) did not find the presence of an exit exam significant in her analysis of state level factors influencing college admissions test scores. The findings in this study suggest that exit exams may be a barrier to high school completion and that more work should be done to understand the relationship.

Gaps by race and SES exist in local control states. SES is positively related to high school completion for all students. However, adding random effects for SES reveals that the effects of SES vary by school. Table A-4.9 shows that gaps by SES are greater in local control states relative to New Basics states. The local control coefficient is positively related to the SES slope, and that slope is already significant and positive. Overall, African American students are not significantly different than White or Asian students, but it appears these relationships may differ by state. Adding random effects to the slopes as outcome model for African American students reveals that the variation in the slopes is significant. Figure 4.2 demonstrates clearly that the gap between African American and non-African American students is substantial. The result is no difference between African American and White students in New Basics states but a negative relationship or a larger gap between Black and White students in local control states. As discussed in chapter 4 this may mean that local control states have a positive effect on all students but less of an effect for African American students. Or more troubling, as Figure 4.2 suggests, African American students are least likely to complete high school in local control states. Both findings suggest that local control may widen gaps by race and SES and those gaps should be explored further. Collectively, the effects of maintaining local control are positive overall in terms of high school completion, but those findings are tempered by the larger gaps by income and race in those states. These challenges related to equity are revealing because in the absence of utilizing HLM, it would not have been possible to examine these equity issues in the same models, which would have resulted in a simple positive finding for local control. This new set of findings

complicates the picture and reminds researchers and policy makers that the effects of these policies are complex and multi-faceted.

Findings on Course Taking

One of the first findings of importance in the course taking model is that state factors make an important contribution to understanding student course taking. Where state level factors accounted for nearly 30% of the variation in the probability a student would complete high school, analysis in chapter 5 illustrates that the percentage is slightly less than 9% in the course taking analysis.[33] This is not surprising given that the course taking analysis eliminates some of the variation by considering only those students that complete high school in four years. The initial variance component at level 3 accounts for 8.7% of the total variance. Of that nearly 9%, state policies included in the model account for about 61% of the variation. In the course taking model, state policy explains a larger proportion of state level variation but a smaller proportion of the total variation than in the high school completion model – because state variation is nearly a third of the total variation in the completion analysis and it is less than 10% in the course taking analysis. Simply, the effects sizes for state policy in the course taking analysis are smaller because there is less variation to explain at the state level as a percentage of the total variation. To place this second set of analyses in context, 75% of the variation in course taking among high school completers occurs at the individual level.

In the same vein, schools do not play nearly as large a role in this analysis as would have been anticipated. Raudenbush and Bryk (2002) indicate that schools will account for 10-30% of the variance so 17% is slightly low. The second related finding is

[33] Consistent with the high school completion model, the χ^2 likelihood ratio test indicates that the proportion of variance at level 3 is significant.

that school structure accounts for only 15.8% of the level 2 (school) variation, which was not surprising, given one of the more important limitations of this study. I have not attempted to account for the academic organization of schools, which Lee et al. (1997) characterize as how the school is organized to provide the curriculum to students. Two measures lacking in this analysis are what courses the schools offer and how much variation there is in the range of courses students take in a given subject. The former was simply not available where the latter was impractical to develop. Lee et al. (1997) developed this variability measure for math, where in this study I broaden the scope to include all courses in the four core academic areas: English, math, social studies, and science. In future analyses it would be important to add measures for teaching to the conceptualization of the academic organization. In this study, I considered the percent teaching out of field and the percent with Masters degrees but the variation on these measures was negligible and missing data prevented their inclusion in the models. In addition, the following seven findings are important to summarize:

High school graduates complete more than 15 courses in the core subjects on average. It is important to keep this analysis in its appropriate context. This study is cross sectional and as such, emphasizes group differences at a particular moment in time. It does not account for how things have changed over many years. NCES (Planty, Provasnik, & Daniel, 2007) shows that in 1982 and the High School and Beyond study, high school completers earned on average 12.1 Carnegie units in the four core subjects (English, math, social studies, and science) where today's average graduate completes 3 additional courses in the same subjects. And contrary to Clune and White's (1992) finding, students may be taking fewer courses in the vocational areas now than in 1982.

So while the differences are important, the fact that students earn 15 credits (which is nearly 1 course per subject for each of the four years) is important.

Individual level factors account for very little of the total variation at level 1 and race is not significant. The purpose of this study was to examine the relationship between state policies and individual outcomes, net of other factors. However, it is important to note that the level 1 model including simple demographic characteristics of students and a control for prior achievement only accounts for 16% of the variance component at level 1. The effect size is comparatively larger than factors at the school or state level because nearly 75% of the total variation occurs at the individual level, but there remains much more to explain than is addressed in the model. One of the trade-offs of conducting a three level model is that complexity at one level may be sacrificed for the addition of multiple levels to the framework. For example, researchers might examine social and cultural capital (Lareau, 1987), student aspirations (Musoba, 2004), or even the role of technology in the context of student outcomes in school. In addition to the desire to maintain a parsimonious model, each of these constructs pose unique challenges, particularly in terms of endogeneity, where exogenous predictors of the outcomes under investigation are also related to endogenous characteristics like student aspirations and alternative forms of capital. For example, adding student aspirations for college to a model exploring student course taking may explain a good deal of variation in the outcome, but the variable itself is related to other predictors in the analysis. Including it in the model may effectively mask effects associated with other variables in the analysis and provide biased parameter estimates as a result. Those issues are too difficult to disentangle in the context of a three level model.

The Effects of School Level Aggregate Race and SES vary within States. In the methods section I note a number of limitations in this study and certainly the school level leaves a good deal yet to explore. The first limitation was the lack of school data for private high schools. It is possible that state policy informs who attends private schools, but this study is not able to explore this relationship. Similarly, the presence of guidance counseling in the school is an important policy consideration at level 2, particularly from a system alignment perspective, but missing data prevented the use of this construct in the analysis. It was important however, to include structural characteristics of schools because a number of them relate directly to the equitable distribution of opportunity. Local property taxes remain a foundation for K-12 funding so the proportion of students qualifying for the federal lunch program remains an important equity consideration because it begins to approximate the collective "wealth" of the community within which the school operates. High schools in the US are highly segregated by race and class (Kozol, 2005) and as such, states attempt to compensate for inequalities with state level policy. Funding equalization strategies like proposal A in Michigan (where the cost burden was shifted substantially from local property taxes to state sales tax) provide illustrations for this sort of compensation. A corollary exists on the higher education side where location-based targeted intervention strategies have evolved in states that eliminated affirmative action. The Longhorn Opportunity Scholars program in Texas, for example, provides university scholarship resources to specifically targeted communities that have not previously sent students to UT-Austin (University of Texas - Austin, 2007).

The only fixed effect at the school level directly related to course taking was whether a student attended school in a rural area, which increased the number of courses

students completed in the core subjects on average. However, adding random effects for the state slopes as outcomes models (percent minority and percent free lunch) improved the fit of the model and accounted for a total of 15% of the level 2 variance. The simple finding is that the effects of school level race and SES vary by state, but like the high school completion model, state policies do not shed light on why these effects differ.

High school graduation requirement policies increase course taking in the core subjects. Students living in New Basics states complete as much as a full course more in the core subjects than students in either Local Control states or those adopting some standard Less than the New Basics. The College Preparatory standard is not significant in the analysis and the finding may not be surprising; the more rigorous standard reflects a more demanding content, but the number of courses alone does not capture level of rigor. It is also possible that the more rigorous college prep standards may not have been in place long enough to have a noticeable effect in a national study. However, as the graphical representation in Figure 5.2 suggests, the difference may not be statistically significant, but a relationship may exist that requires further study. One might expect that students taking more courses in the core subjects will take the advanced courses in the more linear sequences, but this is not necessarily the case at all. Future analyses should build upon this study by capturing differences by the level of rigor completed in those same subjects and the amount of time a graduation requirement policy has been in place.

African American students are not significantly different from White or Asian students in terms of course taking, but Hispanic students appear to demonstrate differences. On average, Hispanic students complete half a course less than the average student within their schools. Hispanic students are making up a growing proportion of

the school going population, particularly in the South, West, and larger states and it is important to address these differences. The slopes as outcomes findings discussed below may provide some insight, particularly with respect to the relationship between college cost and course taking among Hispanic students.

Random effects tell an important story with respect to the equitable distribution of outcomes. All five equity relationships tested in the model are significant meaning that race and class operate differently within schools or across states. This finding in and of itself suggests that more work should be done to understand the unique state contexts within which race and class operate in education. At the same time, in few cases were college cost or graduation requirements predictive of the differences by state. There were however, three exceptions. While Hispanic students complete fewer courses than White and Asian students, controlling for other factors, it appears that in high need-based aid states that difference may almost entirely disappear. When need aid is a full standard deviation higher than the national average, Hispanic students will complete just under half a course more than the same students in average aid states. The result is that need-based aid may have an equalizing effect among Hispanic students that does not seem to operate for other groups.

The percentage of free and reduced lunch students in a school is not predictive of the number of courses students will complete in the core subjects, but in states with a college preparatory standard, the slope becomes negative suggesting that as participation in the free lunch program goes up, the number of courses taken declines. The interaction of graduation requirements and racial composition suggests a potential consequence of rigorous state requirements for all students. The policy may in effect widen the gaps

across schools in terms of their relative SES. The percent minority enrolled in a school is not related to the number of courses students complete in English, math, social studies, and science, but the availability of need-based aid at the state level is a significant predictor of the variation in the percent minority slope. Stated differently as the availability of need-based aid moderates the effects of minority enrollment, meaning the gaps decrease. This may provide an indication that need-aid exhibits a positive effect on course taking in terms of equity.

Implications

With respect to state education reform policies, there may not be one best choice of policy or combination of policies. The combined analyses between chapters 4 and 5 demonstrate for example, that local control states positively influence completion, but for students that graduate, the same policy may not move them toward taking as many courses in the core subjects as students in states with graduation requirement policies. Exit exams on the other hand exert a negative effect on completion and appear to make no difference in terms of the numbers of courses graduates complete. From that perspective, it may not seem worthwhile to adopt the exam requirement, at least from a college access perspective. The investment in need-based aid appears to be the one state policy that can equalize outcomes, where the others either hold stable existing gaps or actually increase the gaps. From a K-16 alignment perspective, such a policy may send exactly the sort of signal that tells students that they should prepare at a higher level because they will be able to afford college. The evidence in this study does not support this as a definitive conclusion, but it is worthy of investigation in future studies.

Also from a K-16 perspective, the role of prior achievement should not be overlooked. I include the variable as a control in this analysis, but it suggests that students' outcomes in high school depend in part upon where they began. As a consequence, it is necessary to move beyond the high school to college transition when attempting to address the alignment of K-12 and higher education. K-16 education has become a euphemism for stronger integration and alignment of elementary and secondary schools with higher education as well as a new set of expectations that all students will require some form of postsecondary education to effectively participate in a fast-changing global economy. There are compelling calls for this new vision for higher education, particularly among policy makers. It does not require a dramatic leap for legislators and educators to see that there is a disconnect between what schools require for a high school diploma and what colleges expect students to know and be able to do at the postsecondary level. Nor does it take an efficiency expert to demonstrate how many students complete remedial courses after successfully completing high school or how many tests are conducted between the completion of courses and mandatory exit exams to college admissions exams and subject placement tests. The same is true with respect to what students know about going to college. Messages up and down the pipeline may be unclear and at times inconsistent, resulting in overestimates of cost and underestimates of academic expectations.

While the primary purpose of this study was to extend testing of the constrained curriculum hypothesis to state policy from a system alignment perspective, it is important to reflect upon what the data suggest with regard to the broader set of theories framing this study. From a status attainment perspective – and consistent with much of the school

effects literature which assumes schools play an important role in terms of improving collective student outcomes – constraining the curriculum at the state level appears to increase course taking for high school completers, but that improvement may come at the expense of some students failing to make it over the higher bar. The finding that students today complete over 15 credits in the core subjects (versus 12 in 1982) also suggests that over time, schools have been able to increase requirements in the core subjects and have more students complete them. Course taking is an intermediate outcome of sorts because it provides the critical link between the state policy and student achievement (as measured by test scores) so it is important to recognize that taking more courses alone does not improve student preparation. Future analyses should look at the level of rigor in core subjects disaggregated by state policy context.

Human capital theory provides a link between student choices and behaviors at the individual level and system alignment at the state level and they should be considered as such. The relationships between policy variables at level 3 and student outcomes at level 1 suggest that the policy may have the intended effect. However, it is not conclusive from this analysis if it is the signal the policy sends to the student that makes a difference or if the impact of the policy is mediated through changes in the academic organization of the school. This is a question that requires future research as well. If the policies demonstrated no relationship – particularly the graduation requirements, tuition, and availability of need-based aid – then it would be suggestive that students' individual choices would not have been influenced by the policy. However, the fact that these policies were significant is not enough to suggest that the signal the policy represents is

what influenced whether students completed high school or more to the point, took more courses in the core subjects.

It may be the case that this study provides as much evidence in support of social reproduction theory as any other, to the extent that gaps by race and SES persist. Prior studies testing social reproduction focus on tracking of students within schools and the evidence is compelling that students in vocational and general tracks perform less well in terms of achievement, high school completion, and course taking.[34] Oakes (1994) clearly demonstrates that the experiences of students differ considerably by the track within which they take their courses in terms of content, pedagogy, and expectations. In this study gaps by income and race remain consistent. In some cases, policies are related to improvements in the probability of completing high school or the average number of courses they complete, but for the most part gaps by race and income remain unaffected by policy. Only graduation requirement policies for socio-economic status and need-based aid among Hispanic students suggest that state policy can overcome or even mitigate the existing racial and class inequalities. The remaining relationships are either inconclusive, meaning they do not exacerbate inequality, or they actually increase gaps. Optimistically, the presence of mandatory exit exams does not appear to have any effect (plus or minus) on the relationships between school structural characteristics (percent minority and percent free lunch) and high school completion; nor does it appear to influence school slopes for race and SES. But more to the point, it does not narrow the gaps either, which in a No Child Left Behind educational environment should be one of the important goals. Conversely, it may be expecting too much to suggest that state policy can moderate educational gaps, particularly when schools and individuals play

[34] See chapter 2 for a review of the relevant literature in this area.

such important roles. From this perspective, any improvement is a positive development and suggests that state policy may be a part of a larger solution.

In the case where adoption of the College Preparatory standard appears to be negatively related to the free or reduced lunch slope in the course taking model, evidence supporting the notion that schools serve to reproduce existing inequality by class is strong. The finding suggests that students attending less economically advantaged schools (free or reduced lunch) may take fewer courses on average in the core subjects than their peers at more advantaged schools. It also suggests that a College Preparatory standard may have an indirect effect on poorer students mediated through lower income schools. From a social reproduction perspective then, local control and exit exam requirements remain a cause for concern – and while there are benefits to state graduation requirements both in terms of completion and course taking, it appears that low income schools may find it challenging to improve student course taking.

High school graduation policies and exit exams in particular reflect efforts to shift the responsibility for student success to the state, which is a dramatic shift away from our roots of local control for education. K-12 funding remains in many states, an issue of local taxation, but increasingly states are assuming responsibility in this domain as well. Funding equalization strategies are shifting the cost of providing K-12 education away from local property tax to some form of state revenue. Funding equalization should have the effect of aligning K-12 institutions by providing a common base of support to offer a common set of curricular expectations that will in turn, lead to improved student outcomes for all. However, it is not yet clear how well those funding equalization initiatives have worked and in what ways they may have influenced student outcomes.

Meanwhile, funding for higher education is hopelessly misaligned in terms of the range of tuition and fees charged at community colleges versus public universities and private liberal arts colleges. Add to that the proliferation of for-profit and on-line providers and the complex set of funding mechanisms. In postsecondary education states and local governments contribute a substantial portion of funding for students attending public universities and community colleges. The signals with respect to cost may be both confusing and mixed, but the evidence in this study is not compelling to address whether cost is problematic from a system alignment perspective. From a college access perspective, both high school completion and the strength of the curriculum completed in high school are important determinants of whether a student will attend college and if so, what opportunities are at their disposal. The American system of higher education is unique in that failure to earn a high school diploma does not preclude anyone from making their way to college, but the path becomes considerably more difficult. Students that fail to complete high school find themselves at an important disadvantage in terms of going to college. Among those that finish high school, the courses they complete matter both in terms of the admissions process and admissions test scores as well as where they place in English, math and even foreign language. Less frequently discussed are the implications for choice of discipline. Students do not typically shift into math and science curricula if they had not received sufficient training in those subjects while in high school. This is an important problem articulated in the recent report by the National Academy of Sciences (2007) entitled, "Rising Above the Gathering Storm." From an efficiency perspective, there are simply not enough science and high technology competent students in fields ranging from the biological and physical sciences to

computer information and engineering. This study does not address the issue of academic disciplines and postsecondary options, but the questions clearly follow the sequence of linkages from the number of courses students complete to their achievement test scores to their opportunities in college. All of these are ripe for future consideration and the Education Longitudinal Study may be a useful place to begin.

Conclusion

It is time to return to the basic question, "Do these state policies influence college access?" First, it is important to recognize that this is a cross-sectional study so it is not possible to draw causal inferences from this analysis alone. However, it is suggestive that high school graduation requirement policies, tuition, and the presence of need-based aid are all related to student outcomes anticipating college access. An important question to ask relative to high school graduation policies is whether the policies influenced the outcomes or if the outcome influenced the adoption of the policy. Consider for a moment which states remain committed to local control - CO, IA, MA, MI, MN, NE, ND, and PA. With the exception of Michigan and Pennsylvania and perhaps Massachusetts, these states are smaller, largely White, and demonstrate higher than average outcomes in terms of the percent of adults with a college degree, average income and a host of state characteristics that might suggest easier access to college. Michigan is a state that at the time of the study was a Local Control state but in that same year elected to adopt a very rigorous state high school graduation requirement policy aligned with 4-year college access. Today they would fall into the College Preparatory category with perhaps the most demanding curriculum across the nation. They chose to adopt this policy because they were concerned about student achievement and college access. So, states have been

making a decision that instead of completing more students, they need to focus on how well students are prepared for college or work when they leave. It may take several years and a number of added changes before it is possible to assess if Michigan made a good decision in terms of student outcomes.

If this analysis has something to say for Michigan, it is this. Higher state standards for graduation reduce the probability that students will complete high school in four years, but for those that complete, the policy is likely to have a positive impact on the number of courses they complete in the core subjects. There are compelling reasons to expect more out of the high school experience for many students and it may better prepare them to enter into and then succeed in college. But at the same time, Michigan policy makers (and other College Preparatory states as well) and schools will have to pay greater attention to keeping students on the path and preventing them from falling through the cracks.

A second challenge that must be addressed is that while the policies are significant in this analysis, the outcome itself is limited to a simple count of courses in the core subjects. It does not consider the level of rigor of those courses. For that reason, it is possible that the policies that demonstrate significance in this model may not substantially change how much students learn as a result; Clune and White (1992) found this in their study and the same may be true here. Future analyses should consider whether these policies influence rigor and by extension learning as approximated by achievement scores. It is also important to consider how schools either adopt or adapt to the policy. Some schools will embrace the change and in fact, many schools choose to adopt more rigorous standards than the state policy requires. Ramping up to provide the

same high quality in those districts will not pose the same challenge as it will in the districts where student outcomes are poor and the curriculum may be less demanding – another important finding of Clune and White's (1992) work 15 years ago. In Michigan, districts have already made some changes that reflect adaptations not consistent with the spirit of the policy, including trimesters and the creation of watered down versions of existing courses like conceptual physics. If more data were available to operationalize the academic organization of schools, it would be possible to get at whether students attend schools that either adopt the policy or adapt in ways meet the technical requirements, but may not lead to substantially improved outcomes for students. Another possible source of variation in the degree to which policy influences student outcomes is the political reality within which policies are made. Case in point – the newly adopted requirements in Michigan appear to be the most rigorous in the nation, but simultaneously, the Superintendent of Public Instruction assures schools and teachers the standards can be achieved by infusing relevant content in the Career and Technical Education courses. This may or may not be true, but it clearly sends a different more complex signal to students about what is expected of them to finish high school.

Ironically, constraining the curriculum at the state level may actually have the impact of differentiating the school curriculum even further as schools make every effort to utilize the courses and personnel they have to meet the new standards. In Michigan for example, existing courses are being reconfigured to meet the content standards undergirding the increased graduation requirements, and a number are being added to provide the new content to a group of students that would otherwise not take the courses.

In the end, this study suggests that while requiring a more rigorous high school curriculum may be beneficial, particularly for the vast majority of public school students that complete high school in four years, the evidence does suggest that fewer students in those states will complete high school. One possible factor to consider is the amount of time the policy has been in place, given that it takes time for an entire system to adjust to the new set of expectations placed upon students. The study also suggests that while local control may allow states to complete a greater proportion of its high school students, the unintended consequence may be greater differences by race and class. If that gap is a consequence of substantially higher proportions for the advantaged groups, then the key is to find ways to bring others to the same level and standard. For example, if African American students are less likely to complete high school than their White peers in local control states, then those states must target their strategies to improve opportunities for this group of students. In a day and age when college participation is becoming an expectation for a substantial proportion of the high school age population, it is important that all students leave high school with as many options open to them as possible.

The analysis also suggests, as it did in Lee et al.'s study, that high school graduation requirements did not exert a negative influence on the equitable distribution of course taking by race or class – at least within schools. The only exception appears to exist in high poverty schools, where as the percent free and reduced lunch increases, the average number of courses completed in the core subjects decreases. This is a complex relationship that requires further exploration to understand how and why graduation requirement policies might be related to the socio-economic status of the school. It may

be the case, for example, the high free lunch schools began with the lowest requirements and may take the longest to adjust to the new expectations. It should not be forgotten that local control may exacerbate gaps in completion, which by extension, influences course taking in terms of the percentages of all students completing more courses in the core subjects.

In the end, state context matters and there may be room for policy makers to influence student educational outcomes. With respect to high school completion in particular, state context matters but the graduation requirement policies and exit exam requirements are only a small part of the equation. Graduation requirements appear to increase course taking with some trade-offs in terms of equity among high school completers, but the policy may be problematic in terms of putting diplomas in the hands of students. And finally, college cost may play a role in terms of preparation for Hispanic students and those attending high minority schools, which is interesting, but it creates more questions than answers. Alignment theory suggests that cost is one of the important signals sent to students and the lack of finding would suggest that misalignment is a problem. In this analysis, it may be that alignment is a problem and the measures do not capture what they are intended to reflect. More qualitative data are necessary to examine this set of relationships more fully.

This analysis does not have any direct bearing on college access per se, but the outcomes addressed here all affect the opportunities students have before them once high school is completed. Future analyses should consider whether taking more courses is related to improved achievement and ultimately if more students attend college, do so at four year institutions, and pursue fields that require rigorous high school preparation. All

of these questions were beyond the scope of this study, but the results open the door to a new set of inquiries that can begin to illuminate more fully the implications, challenges and realities of attempting to assume a K-16 perspective in US education.

Appendix

Table A-3.1
Variables in the High School Completion and Course Taking Models

Variables	Description	Coding
Outcomes		
High School Completion	Completed school (or equivalent) by the time transcripts were collected compared to all other groups	0 = not complete or still enrolled 1 = completed high school or equivalency
High school course-taking	Total number of courses in math, science, English, and social studies taken by high school completers	Continuous
Independent Variables		
State Level Variables		
High School Graduation Requirements	Four level variable including both the number of courses and the rigor of those courses	Categorical
Exit Exam Requirements	State requires passing a test for high school completion	Dichotomous
Average Tuition Cost	The average cost of attending a public four-year college in 2002	Continuous
Need Grant Aid	Average need-based aid per FTE student	Log transformed
K-12 Funding FTE	The amount spent per student on instructional expenditures	Continuous
School Level Variables		
Size of School	Total number of students enrolled in school	Log transformed
Student Teacher Ratio	Percent of full time teachers teaching out of field	Continuous
Percent minority	Percentage of under-represented minorities (Black and Hispanic)	Continuous
Percent Free and Reduced Lunch	Percentage of students in the school that qualify for free or reduced lunch	Continuous
Urbanicity	Where the school is located, suburban is referent for urban and rural	Design set
Individual Level Variables		
Race/Ethnicity	White and Asian compared with Black, Hispanic, and Other	Design Set
Sex	Male Compared with Female	Dichotomous

Parents Income	Income will be considered in terms of quartiles where low income and high income will be compared to the middle 50th	Design Set
Parents Education	Parents Income will be coded with "less than a college education" and "four year degree or above" compared with "some college and less than a four year degree"	Design Set
Prior Achievement	Test scores in math and reading on the ELS administered test	Continuous

Table A-4.5
Comparison of State, School, and Student Characteristics by High School Completion

	High School Completion	
	No (%)	Yes (%)
State Policy		
High School Graduation Requirements		
Local	17.4	82.6
Less than NB	22.6	77.4
New Basics	21.0	79.0
College	23.1	76.9
Mandatory Exit Exam Required		
Yes	20.7	79.3
No	22.6	77.4
K-12 Funding		
Less than $4,300	22.4	77.6
$4,300 to $5,450	22.0	78.0
Higher than $5,450	19.9	80.1
School Characteristics		
School Size		
Smaller than 800 (low quartile)	19.5	80.5
800-2000 (middle 50th)	20.4	79.6
Greater than 2000 (highest quartile)	26.1	73.9
Missing	36.3	63.7
Student Teacher Ratio		
15 or fewer students	17.5	82.5
15 to 21 students	22.1	77.9
Greater than 21 students	26.3	73.7
School Location		
Urban	27.0	73.0
Suburban	18.6	81.4
Rural	21.8	78.2
Percent Minority in School		
Less than 31%	16.2	83.8
Higher than 31%	28.0	72.0
Missing	23.0	77.0
Percent Qualified Free or Reduced Lunch		
Less than 19%	16.5	83.5
Higher than 19%	28.0	72.0
Missing	20.9	79.1

Individual Level Variables		
Race/Ethnicity		
Black	29.5	70.5
Hispanic	30.8	69.2
Asian	16.7	83.3
White	15.6	84.4
Other	24.7	75.3
Sex		
Female	17.6	82.4
Male	24.4	75.6
Missing	27.9	72.1
Parents Socio-Economic Status Composite		
Lowest Quartile	30.6	69.4
Middle 50th	19.6	80.4
Highest Quartile	10.7	89.3
Prior Achievement		
Lowest Quartile	36.5	63.5
Middle 50th	19.4	80.6
Highest Quartile	8.2	91.8
Missing	41.1	58.9

Table A-4.8
Three Level High School Completion Model Conditional at Levels 1 and 2

Fixed Effect	Coef.	SE	t-Ratio	Sig.
Level 1 Individual				
Average school mean π_{000}	2.26	.177	12.73	***
Prior Achievement π_{100}	0.054	0.005	9.58	***
Socio-economic Status π_{200}	0.462	0.054	8.45	***
African American π_{300}	-0.397	0.188	-2.11	*
Hispanic π_{400}	-0.534	0.149	-3.56	***
Other Race π_{500}	-0.295	0.235	-1.26	
Male π_{600}	-0.245	0.076	-3.23	***
Level 2 School				
Student Teacher Ratio β_{010}	-0.029	0.016	-1.75	~
Urban β_{020}	-0.170	0.107	-1.58	
Rural β_{030}	0.039	0.169	0.23	
Free Lunch β_{040}	0.008	0.014	0.58	
Percent Minority β_{050}	-0.018	0.008	-2.18	*
School Size β_{060}	0.152	0.127	1.19	

Random Effect	Reliability	Var. Comp.	df	χ^2	p Value	Sig.
Students (level 1), e_{ijk}		0.838				
Schools (level 2), r_{0jk}	0.549	0.538	369	1089.1	0.001	***
States (level 3), u_{00k}	0.332	0.657	31	164.42	0.001	***
African American u_{30k}	0.425	0.301	31	53.24	0.001	***
Hispanic u_{40k}	0.276	0.162	31	44.37	0.042	*
% Minority in School	0.541	0.001	31	89.26	0.001	***
% Free Lunch in School	0.661	0.004	31	158.54	0.001	***

~ ($p<0.1$), * ($p<0.05$), ** ($p<0.01$), ***($p<0.001$)

Table A-4.9
Final Three Level High School Completion Model

Fixed Effect	Coef.	SE	t-Ratio	Sig
Level 1 Individual				
Average school mean π_{000}	2.19	0.273	8.04	***
Prior Achievement π_{100}	0.055	0.005	9.69	***
SES π_{200}	0.421	0.095	4.41	***
Exit Exam γ_{201}	-0.057	0.111	-0.91	
Local Control γ_{202}	0.242	0.124	1.69	~
African American π_{300}	0.011	0.244	0.05	
Exit Exam γ_{301}	-0.257	0.283	-0.91	
Local Control γ_{302}	-1.23	0.623	-1.98	*
Hispanic π_{400}	-0.623	0.145	-1.92	*
Exit Exam γ_{401}	0.294	0.364	0.81	
Local Control γ_{402}	-0.084	0.624	-0.12	
Other Race π_{500}	-0.294	0.234	-1.21	
Male π_{600}	-0.242	0.075	3.19	***
Level 2 School				
Student Teacher Ratio β_{010}	-0.023	0.017	-1.39	
Urban β_{020}	-0.112	0.114	-0.97	
Rural β_{030}	-0.051	0.171	-0.29	
Free Lunch β_{040}	0.015	0.024	0.61	
Exit Exam γ_{041}	-0.017	0.028	-0.62	
Local Control γ_{042}	0.043	0.037	1.16	
Percent Minority β_{050}	-0.008	0.013	-0.64	
Exit Exam γ_{051}	0.001	0.012	0.06	
Local Control γ_{052}	-0.028	0.020	-1.34	
Size β_{060}	0.022	0.137	0.44	
Level 3 State				
K-12 Funding ($1000's) γ_{001}	-0.032	0.067	0.48	
Exit Exam γ_{002}	-0.535	0.269	-1.98	*
Local Control γ_{004}	0.725	0.452	1.62	~
Less than New Basics γ_{005}	-0.074	0.256	0.29	
College Prep γ_{006}	0.260	0.250	1.04	

Random Effect						
	Reliability	Var. Comp.	df	χ^2	p Value	Sig.
Students (level 1), e_{ijk}		0.839				
Schools (level 2), r_{0jk}	0.543	0.526	366	982.15	0.001	***
States (level 3), u_{00k}	0.259	0.533	26	169.87	0.091	***
Free Lunch u_{04k}	0.677	0.004	29	169.87	0.001	***
Percent Minority u_{05k}	0.54	0.001	29	90.42	0.001	***
African American γ_{300}	0.443	0.143	29	48.36	0.002	**

~ ($p<0.1$), * ($p<0.05$), ** ($p<0.01$), ***($p<0.001$)

Table A-4.11
Odds Ratios for Three Level High School Completion Model

	OR	Sig.
Level 1 Individual		
Prior Achievement	1.056	***
Socio-economic Status	1.524	***
African American	1.045	
Hispanic	0.536	~
Other Race	0.751	
Male	0.784	***
Level 2 School		
Student Teacher Ratio	0.974	
Urban	0.903	
Rural	0.992	
Free Lunch	1.015	
Percent Minority	0.991	
Size	1.06	
Level 3 State		
K-12 Funding ($1000's)	0.999	
Exit Exam	0.582	*
Local Control	2.064	~
Less than New Basics	1.077	
College Prep	1.297	

Table A-5.2
Comparison of State, School, and Student Characteristics by High School Course Taking in the Core Academic Subjects

	Credits in Core Courses		
	12 or fewer	12 to 16	16 or more
State Policy			
High School Graduation Requirements			
Local	13.4	46.9	39.8
Less than NB	16.2	60.8	23.0
New Basics	4.4	49.3	46.3
College	5.0	49.4	45.6
Mandatory Exit Exam Required			
Yes	12.6	57.4	30.0
No	6.9	47.4	45.7
K-12 Funding			
Less than $4,300	8.7	47.9	43.4
$4,300 to $5,450	11.8	59.1	29.2
Higher than $5,450	8.5	47.0	44.6
Tuition at public four-year institutions			
Less than $2,650	10.1	56.5	33.4
$2,650 to $5,200	10.4	53.2	36.3
Higher than $5,200	9.6	49.2	41.2
School Characteristics			
School Size			
Smaller than 800 (low quartile)	8.4	53.9	37.7
800-2000 (middle 50th)	11.0	51.4	37.6
Greater than 2000 (highest quartile)	9.8	56.4	33.8
Missing	18.8	12.5	68.8
Student Teacher Ratio			
15 or fewer students	4.2	53.5	42.4
15 to 21 students	10.5	55.2	34.3
Greater than 21 students	10.5	64.0	25.6
School Location			
Urban	10.2	54.9	34.9
Suburban	11.5	52.5	36.0
Rural	6.6	52.1	41.4
Percent Minority in School			
Less than 31%	10.5	52.6	36.9
Higher than 31%	9.6	53.6	36.8

Missing	10.6	53.1	36.3
Percent Qualified Free or Reduced Lunch			
Less than 19%	9.2	50.9	39.8
Higher than 19%	9.0	54.3	36.7
Missing	16.3	57.2	26.5
Individual Level Variables			
Race/Ethnicity			
Black	9.4	52.3	38.3
Hispanic	12.2	58.4	29.4
Asian	7.5	45.2	47.3
White	9.8	52.2	38.0
Other	12.0	56.1	31.9
Sex			
Female	8.6	52.6	38.8
Male	11.8	53.4	34.8
Missing	10.1	53.0	36.8
Parents Socio-Economic Status Composite			
Lowest Quartile	13.5	56.0	30.5
Middle 50th	10.4	54.2	35.4
Highest Quartile	6.7	47.9	45.4
Prior Achievement			
Lowest Quartile	16.9	60.1	23.0
Middle 50th	9.4	56.1	34.5
Highest Quartile	5.4	44.0	50.6
Missing	25.8	32.0	42.3

Table A-5.5
Three Level Course Taking Model Conditioned at Levels 1 and 2

Fixed Effect			Coef.	SE	t-Ratio	Sig.
Level 1 Individual						
Average school mean π_{000}			15.08	0.224	67.02	***
Prior Achievement π_{100}			0.074	0.005	13.92	***
SES π_{200}			0.223	0.093	2.41	*
African American π_{300}			0.105	0.207	0.51	
Hispanic π_{400}			-0.332	0.469	-0.71	
Other Race π_{500}			-0.125	0.171	-0.74	
Male π_{600}			-0.484	0.067	-7.20	***
Level 2 School						
Student Teacher Ratio β_{010}			0.001	0.020	0.03	
Urban β_{020}			-0.065	0.232	-0.03	
Rural β_{030}			0.260	0.169	1.53	
Free Lunch β_{040}			-0.012	0.012	-0.93	
Percent Minority β_{050}			0.007	0.007	0.975	
Size β_{060}			0.022	0.140	0.163	
Random Effect	Reliability	Variance Component	df	χ^2	p Value	Sig.
Students (level 1), e_{ijk}		3.41				
Schools (level 2), r_{0jk}	0.76	0.872	351	1660.44	0.001	***
States (level 3), u_{00k}	0.702	0.741	29	137.71	0.001	***
% Minority u_{04}	0.492	0.001	29	38.41	0.091	~
% Free Lunch u_{05}	0.389	0.001	29	45.41	0.022	*
SES u_{02}	0.76	0.164	29	117.40	0.001	***
African American u_{03}	0.547	0.520	29	64.30	0.001	***
Hispanic u_{40k}	0.774	2.369	29	89.33	0.001	***
			Deviance		31,826.73	
			Δ Deviance		57.15	***
			Parameters		36	

~ ($p<0.1$), * ($p<0.05$), ** ($p<0.01$), ***($p<0.001$)

Table A-5.6
Final Three Level Course Taking Model for Public School Completers

Fixed Effect	Coef.	SE	t-Ratio	Sig.
Level 1 Individual				
Average school mean π_{000}	15.42	0.244	62.71	***
Prior Achievement π_{100}	0.073	0.003	26.91	***
SES π_{200}	0.270	0.087	3.07	***
Tuition γ_{201}	0.075	0.067	1.06	
College Prep γ_{202}	-0.190	0.186	-1.03	
Need Aid γ_{203}	0.012	0.031	0.38	
African American π_{300}	0.004	0.216	0.02	
Tuition γ_{301}	0.124	0.134	0.92	
College Prep γ_{302}	0.028	0.356	0.08	
Need Aid γ_{303}	0.049	0.085	0.57	
Hispanic π_{400}	-0.535	0.313	-1.71	~
Tuition γ_{401}	0.052	0.227	0.23	
College Prep γ_{402}	-0.801	0.640	-1.24	
Need Aid γ_{403}	0.353	0.140	2.52	*
Other Race π_{500}	-0.124	0.102	-1.22	
Male π_{600}	-0.486	0.044	10.98	***
Level 2 School				
Student Teacher Ratio γ_{010}	-0.017	0.018	-0.97	
Urban β_{020}	-0.026	0.181	-0.15	
Rural β_{030}	0.288	0.133	2.15	*
Free Lunch γ_{040}	0.001	0.009	0.005	
Tuition γ_{041}	0.002	0.006	0.43	
College Prep γ_{042}	-0.040	0.017	-2.34	*
Need Aid γ_{043}	-0.004	0.003	-0.36	
Percent Minority β_{050}	-0.002	0.005	0.34	
Tuition γ_{051}	-0.006	0.003	-1.87	~
College Prep γ_{052}	0.011	0.008	1.30	
Need Aid γ_{053}	0.004	0.002	2.03	*
Size β_{060}	0.059	0.097	-0.611	

Level 3 State						
K-12 Funding ($1000's) γ_{001}			0.159	0.098	1.63	
Exit Exam γ_{002}			0.142	0.204	0.69	
Public Tuition γ_{003}			0.081	0.103	0.84	
Local Control γ_{004}			-0.727	0.278	-2.60	**
Less than New Basics γ_{005}			-0.888	0.260	-3.41	***
College Prep γ_{006}			0.483	0.314	1.54	
Need Aid γ_{007}			-0.015	0.048	-0.32	
Random Effect						
	Reliability	Var. Comp.	df	χ^2	p Value	Sig.
Students (level 1), e_{ijk}		3.41				
Schools (level 2), r_{0jk}	0.757	0.852	351	1733.7	0.001	***
States (level 3), u_{00k}	0.573	0.288	22	51.74	0.001	***
Free Lunch u_{04k}	0.372	0.0006	26	36.22	0.046	*
Percent Minority u_{05k}	0.29	0.0001	26	35.96	0.268	
SES u_{20k}	0.719	0.136	26	103.59	0.001	***
African American γ_{300}	0.461	0.430	26	64.89	0.002	***
Hispanic u_{40k}	0.732	1.43	26	62.99	0.001	***
			Deviance		31,772.9	**
			Δ Deviance		25.67	*
			Parameters		58	

~ (p<0.1), * (p<0.05), ** (p<0.01), ***(p<0.001)

High School Graduation Requirements

For this study, high school graduation requirement policies are derived and verified through three separate sources. First, the Education Commission of the States (ECS) has compiled a web-based resource to catalogue all current and future state graduation requirements as they are reported in state statute. The data were gathered through the end of 2005 for existing policies and has been updated with subsequent and future changes. I begin with this resource because it relies upon state statute to define the parameters of each state policy. The assumption is that all policies gathered in 2005 were applicable to the graduating class of 2004. In order to verify this assumption, I consider two additional sources of information. The first is the biannual report for the Council of Chief State School Officers (2004). This report reflects self-reported graduation requirement policies for the state CCSSO. Second, in cases where there is a discrepancy between the two sources, state web sites have been consulted.

The categories described below and utilized for this analysis are derived from specific policy considerations. Perhaps the most notable curricular recommendation was issued out of *A Nation at Risk* (1983), which called for the New Basics for all high school students. Fourteen states (including Washington DC) adopted the full set of recommendations and an additional 10 adopted an even more rigorous standard, calling for specific levels of rigor in math and science. The college preparatory standard begins with the New Basics and adds the rigor dimension meaning that in addition to specifying the number of courses students were required to complete in the core academic subjects, it articulates a minimum level of course content. Math and science are easiest to codify because of the sequential nature of the course work but these policies frequently include

course content for social studies and in some cases may specify literature or composition in English. The National Commission on Educational Excellence (1983) had also suggested as an addendum to the New Basics that states recommend two years of a single foreign language for college-bound students. By 2004, no state had adopted a language requirement so it is not included in the college preparatory curriculum below.

College Preparatory Curriculum – A number of states have made the new basics curriculum more rigorous by specifically articulating rigor in math (e.g. Algebra I, Geometry, Algebra II) and science (e.g. either a physical and a biological science or at least one laboratory course). Qualifying states include AL, AR, FL, GA, KY, MD, TN, TX, VA, WV.

New Basics Curriculum – According to *A Nation at Risk* the New Basics curriculum was defined as 4 English, 3 math, 3 science, 3 social studies, ½ unit computer science. For the purposes here, only the four core subjects are considered. The following states require the same number of courses and do not specify both math and science courses (as described above). States meeting this standard include DE, DC[35], HI, LA[36], MS[37], NJ, NM[38], NY[39], NC[40], OH, OK[41], SC, VT, WY.

Less than New Basics – A greater number of states have adopted minimum graduation requirements but have not gone as far as the New Basics recommendations.

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[35] DC requires one science course with a lab but the elementary algebra course does not meet the Algebra I standard for inclusion at the college preparatory level.
[36] LA requires the New Basics curriculum and specifies Algebra I and a biology course, but no specification on a physical science course.
[37] MS does not specify a physical science course as part of its New Basics requirement.
[38] NM is categorized as New Basics despite requiring only 2 science courses. The requirements include at least one lab science course and a minimum of Algebra I in math.
[39] NY requires all of the New Basics and at least one lab course in science but establishes no minimum requirement for math.
[40] NC differentiates diploma options, so the state is categorized by the least demanding option.
[41] OK same as LA.

Typically, these states require only 2 math and/or science courses and in some cases only 3 English courses. States with some requirements set below the New Basics standard include AK, AZ, CA[42], CT[43], ID[44], IL, IN[45], KS, ME, MT, MO, NV, NH, OR, RI, SD, UT[46], WA, WI.

Local Control – A number of states have elected not to impose course requirements for high school graduation, effectively leaving those decisions to local education authorities (LEA). Those states include CO, IA, MA, MI, MN, NE, ND[47], PA. It is important to recognize that several of these states, including Michigan and Iowa, have recently adopted state graduation requirements.

In this study, states with the New Basics standard serve as the reference group to which the other three are compared. It is important to note that these policies provide a snapshot for a particular year and for a specific cross-section of students nationally. These policies have changed frequently in the past 15 years. In 2007, 27 states (AR, DE, DC, FL, HI, ID, IL, IN, IA, KS, KY, LA, ME, MI, MN, MS, NJ, NM, OH, OK, OR, RI, SD, TN, TX, UT, WV) have adopted more rigorous standards – two of which are local control states in the context of this study. If nothing else, the fact that so many policies are changing in the next 10 years demonstrates the importance of exploring the relationship between these policies and student course-taking patterns, achievement scores, and high school graduation status.

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[42] CA is unique because while it requires fewer courses in all of the core subject areas than the New Basics require, they specify Algebra I and biological and physical science courses.
[43] CT falls short of the New Basics requirements by 1 science course
[44] ID requires one science course with a lab requirement, but required only 2 math and 2 science courses.
[45] IN requires
[46] UT has high math requirement of Algebra I and Geometry, but requires fewer courses in math and science and no lab course.
[47] ND sets no specific course requirements, but it does establish a minimum number of total units to graduate high school at 21.

Exit Exam Requirements

The source of data for mandatory exit exams is derived from a report conducted by the Center for Education Policy (2004). According to CEP a state is designated as having an exit exam requirement if passing the state exam is a condition for students to successfully complete high school. As of 2004, 20 states had adopted a mandatory exit exam and six others had policies under development. The following states are identified as having adopted a mandatory exit exam for the graduating class of 2004: AL, AK, FL, GA, IN, LA, MD, MA, MN, MS, NV, NJ, NM, NY, NC, OH, SC, TN, TX, VA. All 20 states are coded as having mandatory exit exams applying to the cohort of students under investigation in this analysis.

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